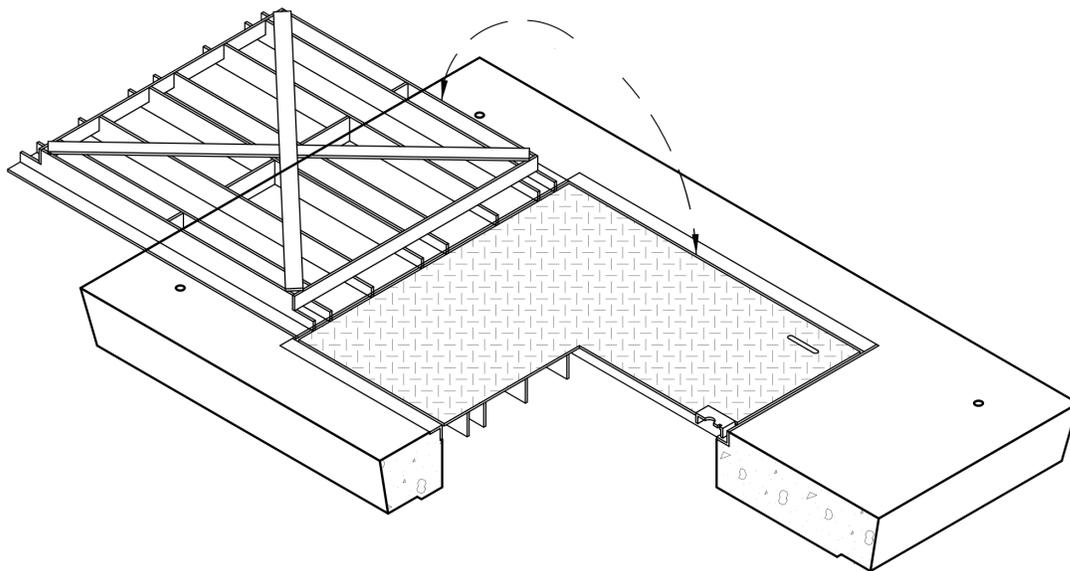


# Material Standards

December 2015



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Seattle City Light

# Material Standards

Volume 1 of 2

December 2015

Welcome to your 2015 edition of the Material Standards.

Seattle City Light construction, design, and material standards, as well as our stock catalog, define the utility's best practices. Compliance with standards is mandatory for all City Light employees and contractors. Your cooperation in this compliance is essential to our shared success.

A handwritten signature in black ink that reads "Phil West". The signature is written in a cursive, flowing style.

**Phil West**, Customer Services and Energy Delivery Officer

**Seattle City Light  
Material Standards 2015**

Published by the Seattle City Light Standards Org

Prepared by Laura Vanderpool and Jamie Eby

Seattle, Washington  
December 2015

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The Standards org runs four committees: Looped Radial, Network, Grounding, and Streetlight. If you have a standards-related question or problem, please bring it to the attention of the Chair or Clerk.

Be aware that security requires those without keycard rights to obtain a pass on the 32nd floor to reach City Light offices and meeting rooms.

**Looped Radial**

The Looped Radial Standards Committee discusses and solves problems related to design, construction methods, and material used to construct and maintain our overhead and underground distribution systems.

Date: Second Tuesday of each month

Time: 9:00 a.m. to 11:30 a.m.

Location: Confirm with the Standards org

Chair: John Shipek, (206) 684-3950

Clerk: Quan Wang, (206) 386-1785

**Network**

The Network Standards Committee discusses and solves problems related to design, construction methods, and material used to construct and maintain our network distribution systems.

Date: Third Tuesday of each month

Time: 9:00 a.m. to 11:00 a.m.

Location: Confirm with the Standards org

Chair: Brett Hanson, (206) 684-3726

**Grounding**

The Grounding Standards Committee discusses and solves problems related to design, construction methods, and material used to construct and maintain our grounding system.

Date: Third Tuesday of each month

Time: 10:00 a.m. to 11:30 a.m.

Location: Confirm with the Standards org

Chair: Brett Hanson, (206) 684-3726

**Streetlight**

The Streetlight Standards Committee discusses and solves problems related to design, construction methods, and material used to construct and maintain our streetlight system.

Date: Second Wednesday of each month

Time: 10:00 a.m. to 12:00 p.m.

Location: Confirm with the Standards org

Chair: Yaochiem Chao, (206) 684-3076

**Online Access**

*Internal*

Employees can access all City Light standards at <http://sclweb/engstds/> (“The Red Page”).

*External*

The public can access all standards, except design standards, at <http://www.seattle.gov/light/engineerstd/> (“The Blue Page”)

**Recent Revisions**

New standards and revisions are published regularly on both the internal and external sites. Be sure to check there for the most recent version of any standard.

You can also view a chronological list of recent revisions at <http://sclweb/engstds/revDate.aspx>.

**Corrections and Additions**

To submit corrections or additions to City Light standards, please see SCL 0010.07, “How to Mark Up and Submit a Standard for Revision.”

**Book Distribution**

*Print*

We provide printed books to internal users who place advance orders. A limited supply of printed books will be available for those who missed the order deadline.

*Digital*

We publish digital versions of all Standards books on the internal City Light Standards page (“The Red Page”) at <http://sclweb/engstds>.

Important: We update standards and stock catalog pages throughout the year. As a result, print and digital books might not reflect the most recent revisions. Visit The Red Page to view the latest revision of a standard or stock catalog entry.

## Head Protection Systems



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### 1. Scope

This standard covers the requirements for head protection systems, more commonly known as hard hats and hard hat accessories. This standard applies to the Seattle City Light (SCL) stock numbers cited in Section 12.

The requirements for arc flash protection and face shields are outside the scope of this standard. See SCL 4013.31 for arc flash protection accessories.

---

### 2. Application

A head protection system is a hard hat shell and an internal suspension manufactured by the same company and designed to work together. A head protection system:

- Reduces the force of an impact.
- Guards against penetration.
- May provide protection from electric shock.

The hard hat shell comes in a partial brim "cap" or a full brim style. The suspension uses either a dihedral (pinlock) or ratcheting adjustment system to ensure proper fit.

---

Standards Coordinator  
Bob Kephart



Standards Supervisor  
John Shippek



Unit Director  
Darnell Cola



Hard hat accessories include:

- Replacement suspensions
- Brow pads
- Ear muffs
- Chin straps
- Winter liners

Hard hat shells shall only be used with suspensions that are manufactured by the same company.

---

### 3. Industry Standards

Head protection systems shall meet the requirements of the following industry standard:

**ANSI/ISEA Z89.1-2014**; American National Standard for Industrial Head Protection

Color designations shall be consistent with the **Pantone Matching System (PMS)**; the standardized color reproduction numbering system of the Pantone Corporation

---

### 4. Requirements

Head protection systems shall meet the standard Type I, Class E performance requirements as defined in ANSI/ISEA Z89.1.

Testing requirements are covered in section 9.

---

### 5. Materials

Hard hat shells shall be fabricated from water resistant, fire resistant, acid resistant, non-conducting, High-Density Polyethylene (HDPE) plastic #2.

Suspensions shall be of the fixed crown type with adjustable woven nylon straps and adjustable built-in nape strap.

Suspensions shall provide a suitable fit to the head and the hard hat shall be free from bounce.

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### 6. Shell Color

Hard hat shells shall be furnished in the following colors:

- Yellow (PMS 109C)
  - White (PMS white)
- 

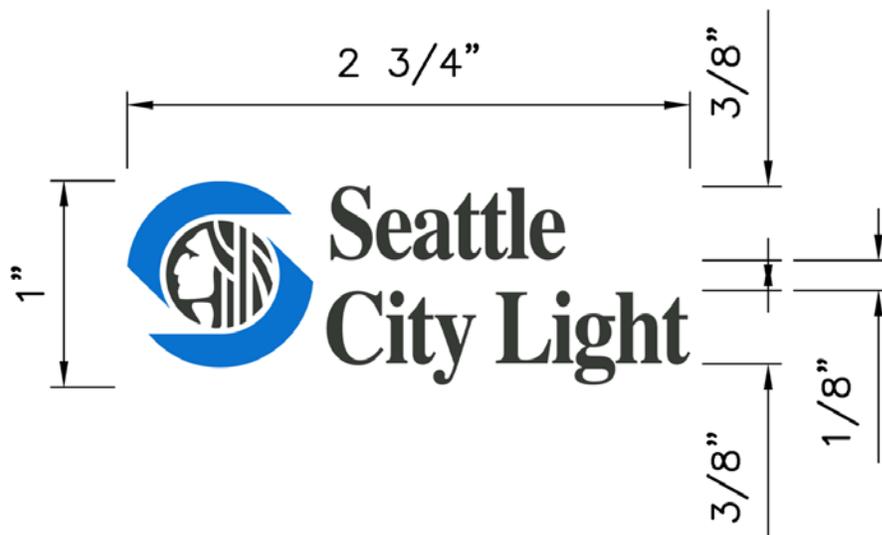
### 7. Logo Color

The SCL logo shall be in accordance with the Seattle City Light Branding Guidelines. The two-color, two-line Chief Seattle logo shall be printed on the front of each hat in the following colors: SCL Blue (PMS 285) and Dark Gray (PMS 447) as designated in Figure 7a. Dimensions of logo shall be as shown in Figure 7b.

**Figure 7a. Chief Seattle Logo Color Scheme**



**Figure 7b. Chief Seattle Logo Dimensions**



## 8. Marking

Head protection systems shall be marked according to the requirements of ANSI/ISEA Z89.1 and shall include:

- Name or identification mark of the manufacturer
- Date of manufacture
- ANSI/ISEA Z89.1 designation
- Applicable Type and Class designations followed by applicable optional criteria markings
- Appropriate head size range

## 9. Testing

Tables 9a and 9b summarize the testing requirements of ANSI/ISEA Z89.1.

**Table 9a. Preconditioning for Force and Penetration Testing**

Preconditioning	Duration, min (hours)	Requirements
120°F ± 3.6°F	2	Tested within 30 seconds of preconditioning
0°F ± 3.6°F	2	Tested within 30 seconds of preconditioning
Submersion in fresh tap water maintained at 73.4°F ± 5.4°F	2	Tested following a maximum drain time of 30 seconds and within 90 seconds of preconditioning

**Table 9b. Test Performance Requirements**

Test Name	Description	Requirements	ANSI Z89.1 Section No.
Flammability	Application of a calibrated horizontal test flame from a Bunsen burner with a 0.4-in bore for 5 seconds +1, -0.	No flame shall be visible 5 seconds after removal of test flame.	10.1 7.1.1
Force Transmission	An approved impactor of 8 lb ± 0.1 lb shall be dropped from a height that yields an impactor velocity of 18 ft/s ± 0.16 ft/s.	Shall not transmit a force greater than 1000 lbf. For each preconditioning, the maximum transmitted force of individual test samples shall be averaged. The averaged values shall not exceed 850 lbf.	10.2 7.1.2
Apex Penetration	An approved penetrator shall be dropped from a height that yields an impact velocity of 23 ft/s ± 0.3 ft/s	An approved penetrator shall not make contact with the top of the test headform.	10.3 7.1.3
Electrical Insulation Current Leakage	With the helmet filled and submerged in fresh tap water, a voltage shall be applied and increased to 20,000 Vac (rms) and held for not less than three minutes at which time the current leakage shall be recorded.	Leakage current shall not exceed 9 mA.	10.7.4.2 7.1.4.3
Electrical Insulation Burn-through	After the current leakage test, the test sample shall be tested for burn-through by further increasing the voltage to 30,000 Vac (rms) at a rate of 1000 volts per second and then immediately reducing the voltage to 0.	The test sample shall not burn through.	10.7.4.2 7.1.4.3

## 10. Packaging

Head protection systems and accessories shall be packaged to prevent damage during shipping, handling, and inside storage.

Shipping containers shall be legibly marked with the SCL purchase order number.

## 11. Issuance

EA

## 12. Approved Manufacturers

Stock No.	Description	Manufacturer	Catalog No.
110022	Hard hat, full brim, yellow	E.D. Bullard	C33YLR
110112	Hard hat, full brim, white	"	C33WHR
110020	Hard hat, partial brim cap style, yellow	"	C30YLR
110021	Hard hat, partial brim cap style, white	"	C30WHR
110182	Suspension, pinlock For Bullard hard hat stock numbers 110020, 110021, 110022, and 110112	"	RS6PC
110183	Suspension, ratcheting For Bullard hard hat stock numbers 110020, 110021, 110022, and 110112	"	RS6RC
110180	Chin strap, elastic For Bullard hard hat stock numbers 110020, 110021, 110022, and 110112	"	ES42
110190	Brow pad, Polartec For Bullard hard hat stock numbers 110020, 110021, 110022, and 110112	"	RBP-Cool
110076	Ear muffs, one pair For stock numbers 110020 and 110021	Bilsom Safety	T1H204-1011601
110136	Winter liner, dielectric	North	WL4
110137	Winter liner, dielectric neck and face shield	North	WL12FP
012590	Reflective vinyl hard hat adhesive strips, white 1 in x 4 in	Safety Flag Co.	6801W

## 13. References

**SCL Brand Guidelines**; February 2015

**SCL Material Standard 4013.31**; "Arc Flash Protection Accessories"

## 14. Sources

**Colloff, Hilary**; SCL Marketing Development Coordinator and branding subject matter expert for 4006.30 (hilary.colloff@seattle.gov)

**E. D. Bullard Company**; www.bullard.com

**Kephart, Bob**; SCL Associate Electrical Engineer and originator of 4006.30 (bob.kephart@seattle.gov)

**Mine Safety Appliances**; us.msasafety.com

**SCL Material Standard 7639.0** (canceled); "Hats, Safety Electrical Workers"

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist and subject matter expert for 4006.30 (kathy.tilley@seattle.gov)

**WAC 296-800-160**; Personal Protective Equipment (PPE), Core Rules; State of Washington Administrative Code; 2015

## Safety Glasses



### 1. Scope

This standard covers the requirements for polycarbonate safety spectacles, more commonly known as safety glasses.

This standard applies to the Seattle City Light stock numbers listed in Section 9.

The requirements for goggles and face shields are outside the scope of this standard.

### 2. Application

Safety glasses of the type specified in this standard are used to minimize or prevent eye injuries from impact and/or solar glare. Some models provide protection from electrical arc flash; some are available with reader prescriptions.

**CAUTION:** Foam eyewear does not meet ASTM F-1506 standard performance specifications for flame resistant and arc-rated material. Foam-lined safety glasses shall not be used when the possibility of arc flash exposure exists.

Select lenses based on your specific application. Refer to Table 2.

**Table 2. Attributes and Applications**

Lens	Application
Clear	Best for hazy or overcast conditions or for indoor applications which require impact protection.
Gray	Reduces glare and bright light in outdoor applications. Provides good color recognition while decreasing visible brightness.
Smoke	Commonly used for outdoor applications in bright light with excessive glare.
Amber	Good for indoor or outdoor applications in low light situations where contrast is important.
Blue mirror	Reduces glare and bright light for outdoor applications.
Chrome mirror	Reduces glare and bright light for outdoor applications.
Foam lined	Best for work in dusty, muddy water spray environments. Keeps out fine particulates.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



Two sizes of polarized clip-on, flip-up lenses are available from the storeroom (Stock Nos. 110238 and 110239). Clip-on lenses do not provide impact protection and are not compatible with most of the safety glasses cited in this standard.

Safety glasses of the type specified in this standard are not intended to provide protection from welding radiation, blood borne pathogens, chemical vapors, X-rays, microwaves, or lasers. Other limitations may also apply.

Glasses that do not have the Z87.1+ marking should be discarded.

Hinge to hinge width values cited in Section 9 are comparative estimates to aid individual selection and fitting.

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### 3. Industry Standards

Safety glasses shall meet the requirements of the following industry standard:

**ANSI Z87.1-2003** - Occupational and Educational Personal Eye and Face Protection Devices

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### 4. Requirements

Safety glasses shall be high impact class, as defined in ANSI Z87.1, Section 7.1.

Safety glasses shall be designed with integral side protection or furnished with separate side-shields installed.

Safety glasses lenses shall be scratch- and impact-resistant.

Safety glasses lenses shall block more than 99.9 percent of UV-A and UV-B light.

---

### 5. Marking

Safety glasses shall be marked according to the requirements of ANSI Z87.1, Section 7.10 and Annex G.

Glasses shall be marked with Z87.1+. This indicates that the glasses meet the ANSI high impact criteria rating.

---

### 6. Testing

Safety glasses test data that establishes compliance with the requirements of ANSI Z87.1 and this standard shall be provided upon request.

---

### 7. Packaging

Safety glasses shall be individually boxed or bagged in plastic and legibly marked or tagged with the following information:

- Manufacturer's name
- Manufacturer's catalog number
- Product description

Each shipping container shall be marked with:

- Seattle City Light's purchase order number
  - Seattle City Light's stock number
- 

### 8. Issuance

PR

## 9. Approved Manufacturers

---

<b>Stock No.</b>	<b>110283</b>
Lens Color	Clear
Relaxed Hinge to Hinge Width, mm	140
Prescription	None
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	3000354



---

<b>Stock No.</b>	<b>110284</b>
Lens Color	Gray
Relaxed Hinge to Hinge Width, mm	140
Prescription	None
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	25688



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<b>Stock No.</b>	<b>110285</b>
Lens Color	Amber
Relaxed Hinge to Hinge Width, mm	140
Prescription	None
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	25659



<b>Stock No.</b>	<b>110287</b>
Lens Color	Smoke, mirror
Relaxed Hinge to Hinge Width, mm	140
Prescription	None
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	25688



<b>Stock No.</b>	<b>110072</b>
Lens Color	Clear
Relaxed Hinge to Hinge Width, mm	141
Prescription	None
Adjustable Length Spatula	No
Apply Over Glasses	Yes
Foam Lined	No
Manufacturer	Radians Crossfire
Model	OG-3
Catalog Number	3114



<b>Stock No.</b>	<b>110301</b>
Lens Color	Shiny pearl gray
Relaxed Hinge to Hinge Width, mm	141
Prescription	None
Adjustable Length Spatula	No
Apply Over Glasses	Yes
Foam Lined	No
Manufacturer	Radians Crossfire
Model	OG-3
Catalog Number	3116



<b>Stock No.</b>	<b>110230</b>
Lens Color	Blue, mirror
Relaxed Hinge to Hinge Width, mm	132
Prescription	None
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Radians
Model	Techna Bobcat
Catalog Number	380-B



<b>Stock No.</b>	<b>012265</b>
Lens Color	Clear
Relaxed Hinge to Hinge Width (mm)	140
Prescription	+1.5
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	28621



<b>Stock No.</b>	<b>012266</b>
Lens Color	Clear
Relaxed Hinge to Hinge Width (mm)	140
Prescription	+2.0
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	22516



<b>Stock No.</b>	<b>012493</b>
Lens Color	Smoke
Relaxed Hinge to Hinge Width, mm	140
Prescription	+1.5
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	22516



<b>Stock No.</b>	<b>012494</b>
Lens Color	Smoke
Relaxed Hinge to Hinge Width, mm	140
Prescription	+2.0
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Jackson Safety
Model	Nemesis
Catalog Number	22518



<b>Stock No.</b>	<b>013825</b>
Lens Color	Amber
Relaxed Hinge to Hinge Width (mm)	140
Prescription	+1.5
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Uvex
Model	Genesis
Catalog Number	S3766



<b>Stock No.</b>	<b>013826</b>
Lens Color	Amber
Relaxed Hinge to Hinge Width (mm)	140
Prescription	+2.0
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Uvex
Model	Genesis
Catalog Number	S3767



<b>Stock No.</b>	<b>013640</b>
Lens Color	Yellow
Relaxed Hinge to Hinge Width (mm)	129
Prescription	No
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radians
Model	Crossfire MP7
Catalog Number	24422AF



<b>Stock No.</b>	<b>013641</b>
Lens Color	Polarized Blue/Green
Relaxed Hinge to Hinge Width (mm)	138
Prescription	No
Adjustable Length Spatula	Yes
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radians
Model	Crossfire MP7
Catalog Number	24426



<b>Stock No.</b>	<b>013642</b>
Lens Color	Clear, Anti-Fog
Relaxed Hinge to Hinge Width, mm	129
Prescription	No
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radian
Model	Crossfire MP7
Catalog Number	2444AF



<b>Stock No.</b>	<b>013644</b>
Lens Color	Smoke, Anti-Fog
Relaxed Hinge to Hinge Width, mm	129
Prescription	No
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radians
Model	Crossfire MP7
Catalog Number	2461AF



<b>Stock No.:</b>	<b>013645</b>
Lens Color:	Clear, Anti-Fog
Relaxed Hinge to Hinge Width (mm):	147
Prescription:	None
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radians
Model	Journeyman
Catalog Number	2834AF



<b>Stock No.</b>	<b>013646</b>
Lens Color	Dark smoke, anti-fog
Relaxed Hinge to Hinge Width (mm)	147
Prescription	No
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	Yes
Manufacturer	Radians
Model	Journeyman
Catalog Number	2861AF



<b>Stock No.</b>	<b>012955</b>
Lens Color	Clear
Relaxed Hinge to Hinge Width (mm)	128
Prescription	None
Adjustable Length Spatula	No
Apply Over Glasses	No
Foam Lined	No
Manufacturer	Radians
Model	Prestige
Catalog Number	PR1-10 clear



## 10. Sources

**ASTM F-1506**; Standard Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards, ASTM International, West Conshohocken, PA, 2010

**Palmer, Tom**; Safety and Health Specialist and subject matter expert for 4008.10 (tom.palmer@seattle.gov)

**Tilley, Kathy**; Electrical Engineering Support Specialist and subject matter expert for 4008.10 (kathy.tilley@seattle.gov)

**Shipek, John**; SCL Standards Supervisor, originator and subject matter expert for 4008.10 (john.shipek@seattle.gov)

**WAC 296-800-16050**, "Personal Protective Equipment," Washington Administrative Code; Washington State

**SECONDARY FR PROTECTION COVERALLS**



**1. Scope**

This material standard covers the requirements for secondary FR (flame resistant) protection coveralls related to personal arc flash protection.

This material standard applies to the following Seattle City Light Stock Numbers:

Coverall with Attached Sock Boots	Coverall	Size
013209	013219	Small (S)
013210	013220	Medium (M)
013211	013221	Large (L)
013212	013222	Extra-large (XL)
013213	013223	Double extra-large (2X)
013214	013224	Triple extra-large (3X)
013215	013225	Four extra-large (4X)
013216	013226	Five extra-large (5X)
013217	013227	Six extra-large (6X)
013218	013228	Seven extra-large (7X)

Arc flash suits and accessories are outside the scope of this standard.

**2. Application**

Secondary FR (flame resistant) protection coveralls are worn over primary FR clothing to resist nuisance contamination from solids and non-toxic liquids.

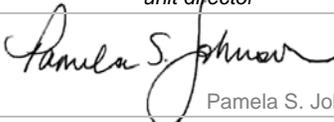
Secondary FR protection coveralls do not provide protection from hazardous chemical exposures or provide additional FR protection.

Secondary FR protection coveralls are considered single use garments.

Attached sock boots are designed to be worn inside protective outer footwear.

DuPont offers a variety of specialty fabrics for a variety of applications: Tyvek® for dry particulate hazards; Tychem® for liquid and gas chemical hazards (this material standard); Nomex® for thermal hazards; and Kevlar® for cut and abrasion protection plus ballistic protection for law enforcement and military applications.

Arc flash suits and accessories are covered in Material Standards 4013.29 and 4013.31 respectively.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

Secondary FR Protection Coveralls

standard number: **4013.25**

superseding: new  
 effective date: March 25, 2011  
 page: 2 of 2

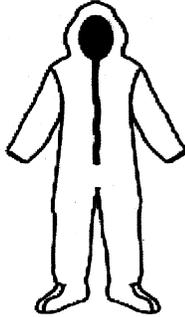
**3. Attributes**

**3.1 Coverall with attached sock boots**

**Description:** Temprow® fabric coverall, standard fit attached hood, serged seams, elastic wrist, attached sock boots, elastic ankle, and front zipper closure

**Color:** blue

**Fabric Weight:** 2.4 oz/yd<sup>2</sup>

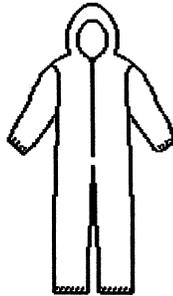


**3.2 Coverall**

**Description:** Temprow® fabric coverall, standard fit attached hood, serged seams, elastic wrist, elastic ankle, and front zipper closure.

**Color:** blue

**Fabric Weight:** 2.4 oz/yd<sup>2</sup>



**4. Packaging**

Secondary FR protection coveralls shall be packaged to prevent damage during shipping, handling, and storage.

Secondary FR protection coveralls shall be packaged 25 per case.

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**5. Issuance**

Stock Unit: EA

**6. Approved Manufacturers**

**6.1 Coverall with attached sock boots**

Stock Number	Size	DuPont Catalog Numbers
013209	S small	TM122SBUSM002500
013210	M medium	TM122SBUMD002500
013211	L large	TM122SBULG002500
013212	XL extra-large	TM122SBUXL002500
013213	2X double extra-large	TM122SBU2X002500
013214	3X triple extra-large	TM122SBU3X002500
013215	4X four extra-large	TM122SBU4X002500
013216	5X five extra-large	TM122SBU5X002500
013217	6X six extra-large	TM122SBU6X002500
013218	7X seven extra-large	TM122SBU7X002500

**6.2 Coverall**

Stock Number	Size	DuPont Catalog Numbers
013219	S small	TM127SBUSM002500
013220	M medium	TM127SBUMD002500
013221	L large	TM127SBULG002500
013222	XL extra-large	TM127SBUXL002500
013223	2X double extra-large	TM127SBU2X002500
013224	3X triple extra-large	TM127SBU3X002500
013225	4X four extra-large	TM127SBU4X002500
013226	5X five extra-large	TM127SBU5X002500
013227	6X six extra-large	TM127SBU6X002500
013228	7X seven extra-large	TM127SBU7X002500

**7. References**

**Number DPP 500 P**, "Arc Flash Electrical Safety"; *Draft* Version 1.4; City Light, Department Policy & Procedure (DPP); City of Seattle; *Draft* date January 24, 2011

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 4013.25 (john.shipek@seattle.gov)

[www.dupont.com](http://www.dupont.com)

[www.dupontcatalog.com/personal protection](http://www.dupontcatalog.com/personal protection)

**ARC FLASH SUITS**



**1. Scope**

This material standard covers the requirements for bright orange, arc flash suits.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Size
013229	Medium (M)
013230	Large (L)
013231	Extra-large (XL)
013232	Double extra-large (2X)
013233	Triple extra-large (3X)
013234	Four extra-large (4X)
013235	Five extra-large (5X)

Accessories worn with arc flash suits are outside the scope of this standard.

**2. Application**

Arc flash suits (with special accessories) are worn to protect employees from known arc flash hazards and

maintain state and federal compliance. Arc flash suits also offer protect against liquid chemical splash.

Employees must be trained prior to using arc flash suits and accessories. Contact Seattle City Light Safety & Health for details.

Detailed application and procedural information may be found in Seattle City Light, Department Policy & Procedure (DPP) **Number DPP 500 P**, Arc Flash Electrical Safety, *Draft*. Up to the time this DPP becomes final, Contact Seattle City Light Safety & Health for a copy of the latest draft.

Arc flash suits are considered reusable.

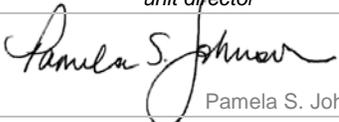
Arc flash protection accessories are covered in Material Standard 4013.31.

**3. Industry Standard**

Arc flash suits shall meet the applicable requirements of the industry standards cited in DuPont Personal Protection, Technical Data Package, DuPont Tychem ThermoPro Garments, TP198T, TP199T, **K-23401** 03/10.

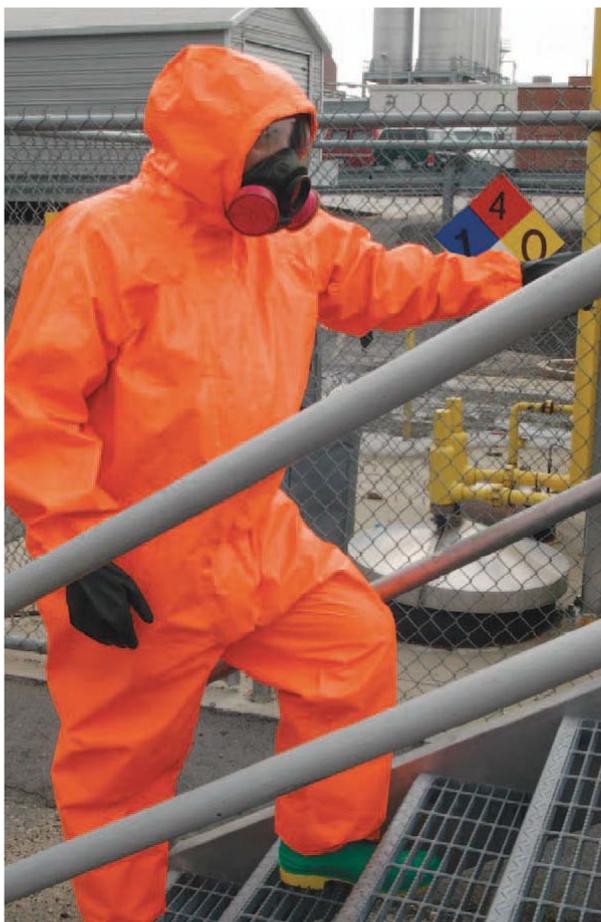
**4. Attributes**

**Color:** Bright orange

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

4. Attributes, continued

# DuPont Personal Protection



This information packet may not be removed except by the end user

K-23401 03/10

## Technical Data Package

**DuPont™ Tychem®  
ThermoPro Garments**

**TP198T, TP199T**

**Compliant with  
Requirements of  
NFPA 1992,  
2005 Edition  
&  
NFPA 2112,  
2007 Edition**

Consult the Tychem® User Manual  
for additional Instructions on Use



*The miracles of science™*

**4. Attributes, continued****Technical Data Package****Tychem<sup>®</sup> ThermoPro**

**Compliant with  
NFPA 1992, 2005 Edition  
NFPA 2112, 2007 Edition**

**Consult the Tychem<sup>®</sup> User Manual for Instructions on Use  
and the DuPont<sup>™</sup> Tychem<sup>®</sup> Accessories List**

**Model TP198T**—hooded coverall; respirator fit; draw string hood; elastic wrist; hemmed ankles; front zipper; double storm flap, fastened by flame resistant treated polyamide hook-and-loop material, high contrast orange or low visibility gray.

**Model TP199T**—hooded coverall; respirator fit; draw string hood; elastic wrist; attached socks; boot-top cover; front zipper; double storm flap fastened by flame resistant treated polyamide hook-and-loop material, high contrast orange or low visibility gray.

This garment is acceptable under OSHA 29 CFR 1910.269, *Occupational Safety and Health Standards for Electric Power Generation, Transmission, and Distribution*. For electric arc hazard exposures, wear the proper arc rated garment system as dictated by an electric arc hazard analysis. The arc rating of this garment is 15.2 cal/cm<sup>2</sup> E<sub>bt</sub>.

**WARNING:** This garment is inherently flame-resistant and is intended to provide liquid chemical splash protection and to minimize burn injury during short term and emergency exposure to flame or electric arc. The wearer should try to remove themselves as quickly as possible from the area where the fire or electric arc has occurred to minimize burn injury. Do not use for protection against continuous thermal loads, molten metal splash, hot liquids, or steam. Do not wear for structural or proximity fire fighting.

**CAUTION:**

- Discard the garment if it has been damaged, altered or contaminated.
- Do not wear garments containing flammable or meltable fabrics over this garment.
- For fire and arc hazard situations, undergarments made with flame resistant fibers such as Nomex<sup>®</sup> or non-melting fibers such as cotton, silk, wool, or rayon should be worn.
- Garment should be loose fitting and provide adequate mobility for the intended use.
- All closures must be fully secured and sleeves and pant legs must extend to fully cover wrists and ankles.

**4. Attributes, continued**

Tychem<sup>®</sup> ThermoPro garments are constructed of a proprietary fabric developed by DuPont for this application. There are no replaceable components on these garments. There are no other options available on these garments. Separate user-supplied respiratory protection, additional eye and face protection as needed, gloves, boots, and head protection should be worn with this garment. These garments are not an ensemble, encapsulating or non-encapsulating, as defined by NFPA 1992. These garments do not include visor or gloves. Both models must be worn with separate, user-supplied boots. Model TP199T has chemically resistant socks attached to the garment, but these socks do not provide physical protection to the foot. Model TP198T does not provide chemical barrier or physical footwear protection.

Garments are available in sizes Medium (M), Large (L), Extra Large (XL), Double Extra Large (2X), Triple Extra Large (3X), Four Extra Large (4X) and Five Extra Large (5X). See sizing chart in the Tychem<sup>®</sup> User Manual selection criteria based on height and weight. The sizing chart assumes normal work clothing worn underneath. An MSA V-Gard<sup>®</sup> helmet was utilized during the testing for compliance with the requirements of NFPA 1992. The Tychem<sup>®</sup> ThermoPro garment closures consist of a 32 inch zipper (28 inch in size medium) with metal teeth set in a web of NOMEX<sup>®</sup> fabric. The closure is covered by two storm flaps made of garment material. The outer storm flap is fastened with hook-and-loop material made from flame resistant treated polyamide. The hood draw string is made from NOMEX<sup>®</sup> and KEVLAR<sup>®</sup> fiber. The garments seams are sewn with thread made of NOMEX<sup>®</sup> fibers. The seams are sealed with hot-air-welded tape.

**Performance Requirements of NFPA 2112, *Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire, 2007 Edition***

Section	Description	Requirement	Tychem <sup>®</sup> ThermoPro
7.1.1	Contact TPP	> 3.0 cal/cm <sup>2</sup>	17 cal/cm <sup>2</sup>
	Spaced TPP	> 6.0 cal/cm <sup>2</sup>	20 cal/cm <sup>2</sup>
7.1.2	Vertical Flammability Char Length	< 4 in.	0.65 in. MD 1.87 in. CD
	Vertical Flammability Afterflame	< 2 sec.	0 sec. MD 0 sec. CD
	Melt and Drip	No observed melt drip during vertical flame test	No observed melt or drip
7.1.3	Thermal Shrinkage MD/CD	< 10%	8.3%/8.3%
7.1.4	Component Heat Resistance, 500° F	No drip	No drip
		No melt	No melt
		No ignition	No ignition
		No separation	No separation
7.1.5	Manikin Flash Fire Test	< 50% predicted body burn	14 %
7.2	Thread Heat Resistance, 500° F	No melting	No melting
7.3	Hardware Heat Resistance, 500° F	No drip	No drip
		No melt	No melt
		No ignition	No ignition
		No separation	No separation
7.4	Label Legible after Conditioning	Legible	Legible

**4. Attributes, continued****Design and Performance Requirement of NFPA 1992, Standard on Liquid-Splash Protective Ensembles and Clothing for Hazardous Materials Emergencies, 2005 Edition****Chapter 6 – Design Requirements**

Section	Requirements	Tychem® ThermoPro
<b>6.1 Protective Garment Elements and Items Design Requirements</b>		
6.1.1	Liquid splash-protective garments shall be designed and configured to protect the wearer's torso, arms, and legs.	Compliant
6.1.2	Where used, booties shall be designed as an extension of the garment leg and shall cover the entire foot and ankle.	Compliant
6.1.3	Liquid splash-protective garments shall be offered in at least four unique and different sizes.	Compliant
6.1.4	All external fittings shall be free of rough spots, burrs, or sharp edges that could tear primary materials.	Compliant
<b>6.2 Protective Glove Elements and Items Design Requirements</b>		Not Applicable
<b>6.3 Protective Footwear Elements and Items Design Requirements</b>		Not Applicable
<b>6.4 Non-encapsulating Ensemble Design Requirements</b>		Not applicable
<b>6.5 Encapsulating Ensemble Design Requirements</b>		Not applicable
<b>6.6 Optional Chemical Flash Fire Protection Design Requirements</b>		Not applicable

**Chapter 7 – Performance Requirements**

Section	Description	Requirement	Tychem® ThermoPro
<b>7.1 Protective Garment Elements and Items</b>			
7.1.1	Liquid-tight Integrity (note: the hood to respirator seal and sleeve to glove seals)	No observed leakage inside the garment and on the indicator garment	No observed leakage
7.1.2	Simulated work activities	Complete all tasks in 15 minutes	Compliant
	Liquid-tight Integrity after garment is exercised (note: the hood to respirator seal and sleeve to glove seals)	No observed leakage inside the garment and on the indicator garment after exercise	No observed leakage
	Garment Closure Performance	Closure remains closed during simulated work	Compliant
7.1.2.1	Accommodates head protection during simulated work activities	Use ANSI Z89.1 compliant head protection	Compliant
7.1.2.2	Visor optical Clarity	Visual acuity >20/35	Not applicable- no visor
7.1.2.3	Protective flap over closure	Flap remains	Compliant

**4. Attributes, continued**

		closed during simulated work	
7.1.3	Garment material resist penetration by acetone, acetonitrile, ethyl acetate, hexane, 50% sodium hydroxide, 93.1% sulfuric acid, tetrahydrofuran	No observed penetration after 1 hour per ASTM F 903, Method Procedure C	No observed penetration
7.1.4	Garment material burst strength	> 135N	697 N
7.1.5	Garment material puncture propagation tear	> 25 N MD & CD	386 N MD 383 N CD
7.1.6	Garment material cold flex at – 13° F and 60° angular deflection	< 0.68 N-m MD & CD	0.020 N-m MD 0.021 n-m CD
<b>7.1.7</b>	<b>Garment Visor Requirements</b>		Not applicable
<b>7.1.8</b>	<b>Garment Seam Requirements</b>		
7.1.8.1	Garment seams resist penetration by 100% isopropanol and 93.1% sulfuric acid	No observed penetration after 1 hour per ASTM F 903, Method Procedure C	No observed penetration
7.1.8.2	Garment seam strength	> 67N/50mm	178 N/ 50 mm
<b>7.1.9 Garment Closure Assembly Requirements</b>			
7.1.9.1	Closure Penetration if no protective flap by 100% isopropanol and 93.1% sulfuric acid	No observed penetration after 1 hour per ASTM F 903, Method Procedure C	No Applicable – closure protective flap present
7.1.9.2	Closure Strength	> 67N/50mm	88 N/50 mm
<b>7.2 Protective Glove Element Performance Requirements</b>			Not applicable
<b>7.3 Protective Footwear Element Performance Requirements</b>			Not applicable
<b>7.4 Non-encapsulating Protective Ensemble Performance Requirements</b>			Not applicable
<b>7.5 Encapsulating Protective Ensemble Performance Requirements</b>			Not applicable
<b>7.6 Optional Chemical Flash Fire Escape Protective Performance Requirements</b>			Not applicable

**Product safety information available upon request.** This information corresponds to our current knowledge on this subject. It is offered solely to provide possible suggestions for your determination. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. It is the user's responsibility to determine the level of risk and the proper protective equipment needed for the user's particular purpose. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, DUPONT MAKES NO WARRANTIES AND ASSUMES NO LIABILITY IN CONNECTION WITH ANY USE OF THIS INFORMATION. Nothing in this publication is to be considered as a license to operate in or a recommendation to infringe any trademark or patent rights.

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**MATERIAL STANDARD**

Arc Flash Suits

standard number: **4013.29**

superseding: new  
 effective date: March 23, 2011  
 page: 7 of 7

**5. Tests and Test Reports**

Arc flash suit test data that establishes compliance with the requirements of this material standard shall be provided upon request.

**6. Packaging**

Arc flash suits shall be packaged to prevent damage during shipping, handling, and storage.

Arc flash suits shall be packaged 2 per case.

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Issuance**

Stock Unit: EA

**8. Approved Manufacturer**

Stock Number	Size	DuPont Catalog Numbers
013229	Medium (M)	TP199TORMD000200
013230	Large (L)	TP199TORLG000200
013231	Extra-large (XL)	TP199TORXL000200
013232	Double extra-large (2X)	TP199TOR2X000200
013233	Triple extra-large (3X)	TP199TOR3X000200
013234	Four extra-large (4X)	TP199TOR4X000200
013235	Five extra-large (5X)	TP199TOR5X000200

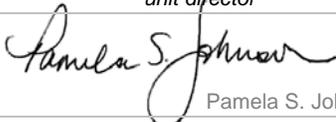
**9. References**

**Number DPP 500 P**, "Arc Flash Electrical Safety"; *Draft* Version 1.4; City Light, Department Policy & Procedure (DPP); City of Seattle; *Draft* date January 24, 2011

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 4013.29 (john.shipek@seattle.gov)

**www.dupont.com**

**www.dupontcatalog.com/personal protection**

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pamela S. Johnson

**ARC FLASH PROTECTION ACCESSORIES**



**1. Scope**

This material standard covers the requirements for garment accessories related to personal arc flash protection.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Description
013236	Carbon Kevlar® Balaclava
013237	Medium energy arc goggle
013238	Face shield

Arc flash suits are outside the scope of this standard.

**2. Application**

Arc flash garment accessories are worn with arc flash suits to protect employees from known arc flash hazards and maintain state and federal compliance.

Balaclavas (sock hoods), Stock Number 013236, are intended to be used in conjunction with arc flash goggle, Stock Number 013237, to result in a system that offers an Arc Thermal Performance Value (ATPV) of 27 cal/cm<sup>2</sup> (ASTM 2178 test method).

Employees must be trained prior to using arc flash suits and accessories. Contact Seattle City Light Safety & Health for details.

Detailed application and procedural information may be found in Seattle City Light, Department Policy & Procedure (DPP) **Number DPP 500 P**, Arc Flash Electrical Safety, *Draft*. Up to the time this DPP becomes final, Contact Seattle City Light Safety & Health for a copy of the latest draft.

Arc flash accessories are considered reusable.

Arc flash suits are covered in Material Standard 4013.29.

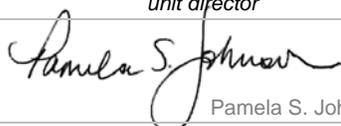
**3. Industry Standards**

Arc flash accessories shall meet the applicable requirements of the following industry standards:

**ANSI Z87.1** (2003) Practice for Occupational and Educational Eye and Face Protection

**ASTM F2178** (2008) - Standard Test Method for Determining the Arc Rating and Standard Specification for Eye or Face Protective Products

**NFPA 70E** (2009) Standard for Electrical Safety in the Workplace

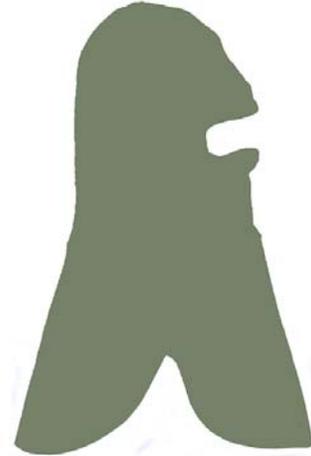
standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

**4. Attributes**

**4.1 Carbon Kevlar® Balaclava (sock hood)**

**Stock Number:** 013236

**Description:** 6 ounce, double layer balaclava made from knit material of Carbon Kevlar® fiber is designed with a slightly longer bib, for additional arc protection, as well as a contoured eyehole that can be worn over or under the nose for maximum comfort, without compromising safety.



**4.2 Medium Energy Arc Goggle**

**Stock Number:** 013237

**Description:** Medium energy arc goggle

**Lens:** Optically correct dual layer lens. Outer polycarbonate lens is hard coated and the inner propionate lens is anti-fog treated. Tested to the requirements of ASTM F2178

**Strap:** Silicone strap is comfortable and easily adjustable with gloves

**Frame:** Frame manufactured from silicone and fits over most prescription safety and sun protective spectacles. Outer blue bezel designed with protective nose shield.

**Color:** Black frame with blue bezel

**ATPV Rating:** Designed to meet the performance specifications of NFPA 70E-2004 @ 38 Cal/Cm<sup>2</sup> and ANSI Z87.1. Tested under ASTM F2178.

**Helmet and Accessory Compatibility:** Cap style and full brim safety helmets

**Weight:** 7.23 oz



**4.3 Face Shield**

**Stock Number:** 013238

**Description:** ArcShield kit for full brim helmets. Includes Nano Particle Arc Shield, permanently attached chin protector, mounting bracket and instructions.

**Material:** Plastic/chemical alloy

**Color:** Light green

**Arc Thermal Performance Value (ATPV):** 27 cal/cm<sup>2</sup> (NFPA 70E-2004; ANSI Z87.1-Special Application)

**Weight:** 13 oz

**Compatibility:** Designed to fit full brim helmets by Bullard®, MSA®, Jackson®, North®, ERB®, and American Allsafe®



**MATERIAL STANDARD**

Arc Flash Protection Accessories

standard number: **4013.31**

superseding: new  
 effective date: March 25, 2011  
 page: 3 of 3

**5. Tests and Test Reports**

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

**6. Packaging**

Arc flash accessories shall be packaged to prevent damage during shipping, handling, and storage.

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Issuance**

Stock Unit: EA

**8. Approved Manufacturers**

Stock Number	Description	Manufactures and Catalog Numbers	
		National Safety Apparel, Inc.	Paulson Mfg. Corp.
013236	Carbon Kevlar® Balaclava	H62RK	-
013237	Medium Energy Arc Goggle	-	Model 510-ARC-SN 38
013238	Face shield	-	Model ARC-S <sup>2</sup> K3-12, Part No. 2130084

**9. References**

**2010 Arc Flash Catalog**; Revision 6; Paulson Manufacturing

**Number DPP 500 P**, "Arc Flash Electrical Safety"; *Draft* Version 1.4; City Light, Department Policy & Procedure (DPP); City of Seattle; *Draft* date January 24, 2011

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 4013.31 (john.shipek@seattle.gov)

[www.nsamfg.com](http://www.nsamfg.com)

[www.paulsonmfg.com](http://www.paulsonmfg.com)

**HIGH-VISIBILITY, FLAME RESISTANT, SAFETY VESTS,  
 STANDARD-WEIGHT**



Stock No.  
110225  
large

**1. Scope**

This material standard covers the requirements for standard-weight, high-visibility, flame resistant, safety vests.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Size
110223	small
110224	medium
110225	large
110226	x-large
110227	2x-large
010700	3x-large
010701	4x-large

The requirements for *light-weight*, high-visibility, flame resistant safety vests are found in Material Standard 4015.15.

**2. Application**

Safety vests are intended to provide conspicuity to the user in hazardous situations under any light conditions by day and under illumination by vehicle headlights in the dark.

Safety vests are designed and manufactured with flame resistant textile so as to, at the minimum, not contribute

to the injuries of an electrical worker exposed to a momentary electric arc and related thermal hazard. Safety vests have an arc thermal performance value (ATPV) rating of 5.5 cal/cm<sup>2</sup> and are intended to be layered over other flame resistant personal protective equipment (PPE). Safety vests alone shall not be expected to offer protection against momentary electric arcs.

Light-weight, safety vests, specified in Material Standard 4015.15, serve the same need as standard-weight, safety vests, except that they offer the wearer a more comfortable option in warmer weather.

**3. Industry Standards**

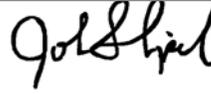
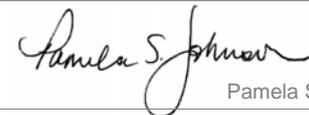
Safety vests shall meet the requirements of the following industry standards:

**ANSI/ISEA 107-2004** - American National Standard for High-Visibility Safety Apparel and Headwear

**ASTM D 6413-08** - Standard Test Method for Flame Resistance of Textiles (Vertical Test)

**ASTM F 1506-08** - Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards

**NFPA (Fire) 1971** - Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2007 Edition

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

High-Visibility, Flame Resistant, Safety Vests, Standard-Weight

standard number: **4015.10**

superseding: new  
 effective date: June 19, 2009  
 page: 2 of 3

**4. Requirements**

**4.1 General**

Safety vest minimum areas of visible material shall meet the requirements of ANSI/ISEA 107, Table 1, as clarified below:

Performance class	2
Photometric performance level	2

Garment design shall follow ANSI/ISEA 107, Appendix C - Examples of Garment Designs, Figure C-6, Vest Pattern 3 and figure 4.1.

figure 4.1



**4.2 Fabric**

Fabric shall meet the requirements of ASTM F 1506 as clarified below:

Type	100% modacrylic
Color	orange
Weight, nominal	5.5 oz/yd <sup>2</sup>
Arc Thermal Performance Value (ATPV)	5.5 cal/cm <sup>2</sup>

**4.3 Binding (edging)**

Binding shall meet the requirements of ASTM F 1506 as clarified below:

Type	100% modacrylic
Color	orange
Weight, nominal	5.5 oz/yd <sup>2</sup>
Arc Thermal Performance Value (ATPV)	5.5 cal/cm <sup>2</sup>

**4.4 Retroreflective Tape**

Retroreflective tape shall be placed according to ANSI/ISEA 107, Appendix C - Examples of Garment Designs, Figure C-6, Vest Pattern 3, with the following clarification: horizontal stripe shall be 2 inches off the bottom of the vest.

figure 4.4, Vest Pattern 3 (Performance Class 2), ANSI/ISEA 107-2004



Retroreflective tape shall be:

Type	Avery Dennison reflective material
Color	yellow
Width	2 in

**4.5 Front Closure**

Front closure shall be flame resistant according to the requirements of ASTM D 6413 or NFPA 1971.

Front closure shall be:

Type	Flame resistant, black, hook and loop, Velcro® or approved equal
Width	1 in
Length	11 in

**4.6 Pockets**

Safety vests shall have pockets as clarified below:

Inside front	one on each side, 7-1/2 in x 9-1/2 in
Inside breast:	one upper right side, 5 in x 5 in

**4.7 Laundering**

Safety vests shall be able to withstand a minimum of 5 washing cycles before losing their ability to meet the requirements of this Material Standard.

**MATERIAL STANDARD**

High-Visibility, Flame Resistant, Safety Vests, Standard-Weight

**4. Requirements**, continued

**4.8 Logo**

Safety vests shall be furnished with the Seattle City Light, Chief Seattle logo as depicted in figures 4.8a and 4.8b. The logo shall be located over the left breast and shall be placed so as to allow separation of approximately 1/4-inch from the binding tape on fabric front opening and from the retroreflective tape.

figure 4.8a, Chief Seattle Logo, actual size



**Seattle  
 City Light**

figure 4.8b, Chief Seattle Logo, dimensions



**5. Marking**

Safety vests shall be marked according to the requirements of ANSI/ISEA 107, Sections 10 and 11, where this information includes, but is not limited to:

- Manufacturer's name or symbol
- Product type, commercial name, or code
- Size
- ANSI/ISEA 107-(year)
- Performance Class
- Photometric Performance Level
- Washing or cleaning instructions

**6. Testing**

Safety vest test data and/or apparel certification that establishes compliance with the requirements of ANSI/ISEA 107, ASTM D 6413 (or NFPA 1971), ASTM F 1506, and this material standard shall be provided upon request.

**7. Packaging**

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**8. Issuance**

EA

**9. Approved Manufacturer**

Stock Number	Size	Chest Range, in	Minimum Length, in	M.L. Kishigo
110223	small	38-40	27	1119D-SM
110224	medium	42-44	27	1119D-MED
110225	large	46-48	27	1119D-LG
110226	x-large	50-52	27	1119D-XLG
110227	2x-large	54-56	27	1119D-XXLG
010700	3x-large	58-60	28	1119D-3XLG
010701	4x-large	62-64	28	1119D-4XLG

**10. References**

**Code of Federal Regulations Title 23 (Highways)**

**Part 634:** "Use of High-Visibility Apparel When Working on Federal-Aid Highways;" US Federal Highway Administration, DOT; 2006

**Nelson, Dawn;** SCL subject matter expert for SCL Material Standard 4015.10 (dawn.nelson@seattle.gov)

**Shipek, John;** SCL Standards Engineer, subject matter expert and originator of SCL Material Standard 4015.10 (john.shipek@seattle.gov)

**WAC 296-800-160,** Personal Protective Equipment (PPE), Core Rules; State of Washington Administrative Code; 2009

**HIGH-VISIBILITY, FLAME RESISTANT, SAFETY VESTS,  
LIGHT-WEIGHT**



**1. Scope**

This material light covers the requirements for light-weight, high-visibility, flame resistant, safety vests.

This material light applies to the following Seattle City Light Stock Numbers:

Stock Number	Size
012963	medium
012964	large
012965	x-large
012966	2x-large
012967	3x-large
012968	4x-large

The requirements for *standard-weight*, high-visibility, flame resistant safety vests are found in Material Standard 4015.10.

**2. Application**

Safety vests are intended to provide conspicuity to the user in hazardous situations under any light conditions by day and under illumination by vehicle headlights in the dark.

Safety vests are designed and manufactured with flame resistant textile so as to, at the minimum, not contribute to the injuries of an electrical worker exposed to a momentary electric arc and related thermal hazard.

Safety vests have an arc thermal performance value (ATPV) rating of 5.0 cal/cm<sup>2</sup> and are intended to be layered over other flame resistant personal protective equipment (PPE). Safety vests alone shall not be expected to offer protection against momentary electric arcs.

Standard-weight, safety vests, specified in Material Standard 4015.10, serve the same need as light-weight, safety vests, except that they offer the wearer a more durable option in cooler weather.

**3. Industry Standards**

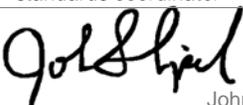
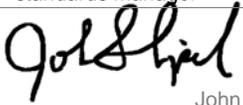
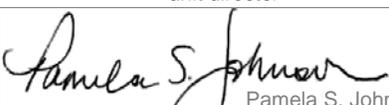
Safety vests shall meet the requirements of the following industry standards:

**ANSI/ISEA 107-2004** - American National Standard for High-Visibility Safety Apparel and Headwear

**ASTM D 6413-08** - Standard Test Method for Flame Resistance of Textiles (Vertical Test)

**ASTM F 1506-08** - Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards

**NFPA (Fire) 1971** - Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2007 Edition

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

High-Visibility, Flame Resistant, Safety Vests, Light-Weight

standard number: **4015.15**

superseding: June 19, 2009

effective date: July 3, 2009

page: 2 of 3

**4. Requirements**

**4.1 General**

Safety vest minimum areas of visible material shall meet the requirements of ANSI/ISEA 107, Table 1, as clarified below:

Performance class	2
Photometric performance level	2

Garment design shall follow ANSI/ISEA 107, Appendix C - Examples of Garment Designs, Figure C-6, Vest Pattern 3 and figure 4.1.

figure 4.1



**4.2 Fabric**

Fabric shall meet the requirements of ASTM F 1506 as clarified below:

Type	100% modacrylic
Color	lime
Weight, nominal	5.0 oz/yd <sup>2</sup>
Arc Thermal Performance Value (ATPV)	5.0 cal/cm <sup>2</sup>

**4.3 Binding (edging)**

Binding shall meet the requirements of ASTM F 1506 as clarified below:

Type	100% modacrylic
Color	lime
Weight, nominal	5.0 oz/yd <sup>2</sup>
Arc Thermal Performance Value (ATPV)	5.0 cal/cm <sup>2</sup>

**4.4 Retroreflective Tape**

Retroreflective tape shall be placed according to ANSI/ISEA 107, Appendix C - Examples of Garment Designs, Figure C-6, Vest Pattern 3, with the following clarification: horizontal stripe shall be 2 inches off the bottom of the vest.

figure 4.4, Vest Pattern 3 (Performance Class 2), ANSI/ISEA 107-2004



Retroreflective tape shall be:

Type	Avery Dennison reflective material
Color	orange
Width	2 in

**4.5 Front Closure**

Front closure shall be flame resistant according to the requirements of ASTM D 6413 or NFPA 1971.

Front closure shall be:

Type	Flame resistant, black, hook and loop, Velcro® or approved equal
Width	1 in
Length	11 in

**4.6 Pockets**

Safety vests shall have pockets as clarified below:

Inside breast: one upper right side, 5 in x 5 in

**4.7 Laundering**

Safety vests shall be able to withstand a minimum of 5 washing cycles before losing their ability to meet the requirements of this Material Standard.

**MATERIAL STANDARD**

High-Visibility, Flame Resistant, Safety Vests, Light-Weight

**4. Requirements**, continued

**4.8 Logo**

Safety vests shall be furnished with the Seattle City Light, Chief Seattle logo as depicted in figures 4.8a and 4.8b. The logo shall be located over the left breast and shall be placed so as to allow separation of approximately 1/4-inch from the binding tape on fabric front opening and from the retroreflective tape.

**figure 4.8a**, Chief Seattle Logo, actual size



**Seattle  
City Light**

**figure 4.8b**, Chief Seattle Logo, dimensions



**5. Marking**

Safety vests shall be marked according to the requirements of ANSI/ISEA 107, Sections 10 and 11, where this information includes, but is not limited to:

- Manufacturer's name or symbol
- Product type, commercial name, or code
- Size
- ANSI/ISEA 107-(year)
- Performance Class
- Photometric Performance Level
- Washing or cleaning instructions

**6. Testing**

Safety vest test data and/or apparel certification that establishes compliance with the requirements of ANSI/ISEA 107, ASTM D 6413 (or NFPA 1971), ASTM F 1506, and this material standard shall be provided upon request.

**7. Packaging**

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**8. Issuance**

EA

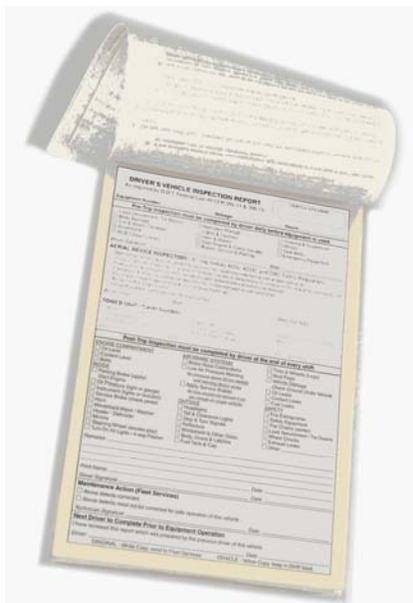
**9. Approved Manufacturer**

Stock Number	Size	Chest Range, in	Minimum Length, in	M.L. Kishigo
012963	medium	42-44	27	319-FM1119-MED
012964	large	46-48	27	319-FM1119-LG
012965	x-large	50-52	27	319-FM1119-XLG
012966	2x-large	54-56	27	319-FM1119-XXLG
012967	3x-large	58-60	28	319-FM1119-3XLG
012968	4x-large	62-64	28	319-FM1119-4XLG

**10. References**

- Code of Federal Regulations Title 23 (Highways) Part 634:** "Use of High-Visibility Apparel When Working on Federal-Aid Highways;" US Federal Highway Administration, DOT; 2006
- Nelson, Dawn;** SCL subject matter expert for SCL Material Standard 4015.15 (dawn.nelson@seattle.gov)
- Shipek, John;** SCL Standards Engineer, subject matter expert and originator of SCL Material Standard 4015.15 (john.shipek@seattle.gov)
- WAC 296-800-160,** Personal Protective Equipment (PPE), Core Rules; State of Washington Administrative Code; 2009

**DRIVER VEHICLE INSPECTION REPORT (DVIR) BOOKS**



**1. Scope**

This standard covers the requirements for Driver Vehicle Inspection Report (DVIR) books, also known as Daily Driver Inspection Report books.

This material standard applies to Seattle City Light Stock Number 013343.

Inspections of aerial devices mounted to the vehicle's chassis are outside the scope of this standard.

**2. Application**

Driver Vehicle Inspection Report books are used by all Seattle City Light commercial vehicle drivers.

At the beginning of each driving shift, the driver shall complete a Driver Vehicle Inspection Report that covers all the items in the pre-trip inspection for Commercial Driver's License (CDL) Units and Towed Units.

Additional instructions are printed on the cover and inside each book.

Documenting daily vehicle inspections are a requirement of D.O.T. Federal Law 49 CFR 396.11 & 396.13.

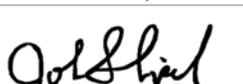
For more information, contact your supervisor or City Light's Safety Unit.

**3. Requirements**

The front cover of each book shall be printed with the characters "**013343 (mm-yy)**", where *mm-yy* represents the date the proof was approved. Subsequent printings should utilize the same date, unless the proof was changed and re-approved.

A proof shall be approved by City Light prior to the first printing. If mutually agreed upon between buyer and seller and if there are no changes, subsequent printings do not require a proof be re-approved.

Dimensions, nominal, in	5-1/2 x 8-1/2
Format	2-ply, carbonless
Construction	Front cover
	Insert
	Pages
	Half-wrap
	Chipboard

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**Material Standard**

Driver Vehicle Inspection Report (DVIR) Books

**3. Requirements, continued**

Ply 1	White NCR paper with black ink on front
	No printing on back
	Perforations at bound edge
Ply 2	Canary NCR paper with black ink on front
	No printing on back
	No perforations
Custom insert	White paper with black ink on front
	No printing on back
	No perforations
Custom half-wrap	White tag
	Outside back prints black
	Balance blank

**4. Packaging**

Report books shall be packaged to prevent damage during shipping, handling, and storage.

Report books shall be packaged 100 per box.

Each shipping container (box) shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**5. Issuance**

Stock Unit: EA

**6. Approved Manufacturer**

Stock Number	Manufacturer	Order Description
013343	Willamette Traffic Bureau, LLC	Custom Driver's Vehicle Inspection Report (1CPBD)

**7. References**

**Davis, Kevin;** Safety & Health Specialist and subject matter expert for Material Standard 4019.85

**D.O.T.;** Federal Law 49 CFR 396.11 & 396.13

**Lozier, Diane;** Willamette Traffic Bureau sales agent and subject matter expert for Material Standard 4019.85

**Shipek, John;** SCL Standards Engineer, subject matter expert, and originator of Material Standard 4019.85 (john.shipek@seattle.gov)

**Willamette Traffic Bureau, LLC;**  
[www.wtbtraffic.com](http://www.wtbtraffic.com)



**Overhead-Type, Single-Phase, Natural Ester Fluid,  
 Distribution Transformers**



**1. Scope**

This standard details the manufacturer requirements for single-phase, pole-mounted transformers from 25 kVA to 250 kVA.

This standard applies to the following Seattle City Light (SCL) 25 564GrdY/14 760 single-phase Y transformer stock numbers:

kVA	120/240	138.5/277	240/480	2400	1385/2400	Parallel-connected "cut-straight" secondary 120/240 cut 120
25	355122	355622	–	–	–	355822
50	355132	355632	355332	355932	–	355832
75	355134	355634	355334	355934	–	355834
100	355136	355636	355336	355936	–	355836
167	355142	355642	–	355942	359942	355842
250	–	–	–	355948	359948	–

**2. Application**

This class of transformers is typically used to serve homes and small businesses. As of this publication, these units are the most common transformer type installed annually in the SCL distribution system.

Standards Coordinator  
 Brett Hanson

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

### 3. Industry Standards

Transformers shall meet the applicable requirements of the following industry standards:

**DOE 10 CFR, Part 431**; “Energy Efficiency Program for Certain Commercial and Industrial Equipment”; Department of Energy

**IEEE C57.12.00-2010**; “Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers”

**IEEE C57.12.20-2011**; “Standard for Overhead-Type Distribution Transformers, 500 kVA and Smaller”

**IEEE C57.12.90-2010**; “Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers”

**IEEE C57.147-2008**; “Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers”

**RCW 19.29.010, Rule 5 - 2011**; Revised Code of Washington, Rules for Test Tag

**NEMA TR 1-1993 (R2000)**; “Transformers, Regulators, and Reactors”

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### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light purchase order (PO)
  2. City of Seattle General Terms and Conditions
  3. This standard
  4. Other industry standards.
- 

### 5. Ratings

#### 5.1 Kilovolt-Ampere Ratings

Kilovolt-ampere ratings shall be 25, 50, 75, 100, 167, 250 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings are continuous and are based on not exceeding a 65 °C average winding temperature rise.

The temperature rise of the insulating oil shall not exceed 65 °C when measured near the top of the tank.

#### 5.2 Voltage Ratings

Voltage ratings shall be as specified on the purchase order or as follows:

- 25 564GrdY/14 760 - 120/240 V
- 25 564GrdY/14 760 - 240/480 V
- 25 564GrdY/14 760 - 133/266 V
- 25 564GrdY/14 760 - 138.5/277 V
- 25 564GrdY/14 760 - 1385/2400Y V
- 25 564GrdY/14 760 - 2400/4160Y V

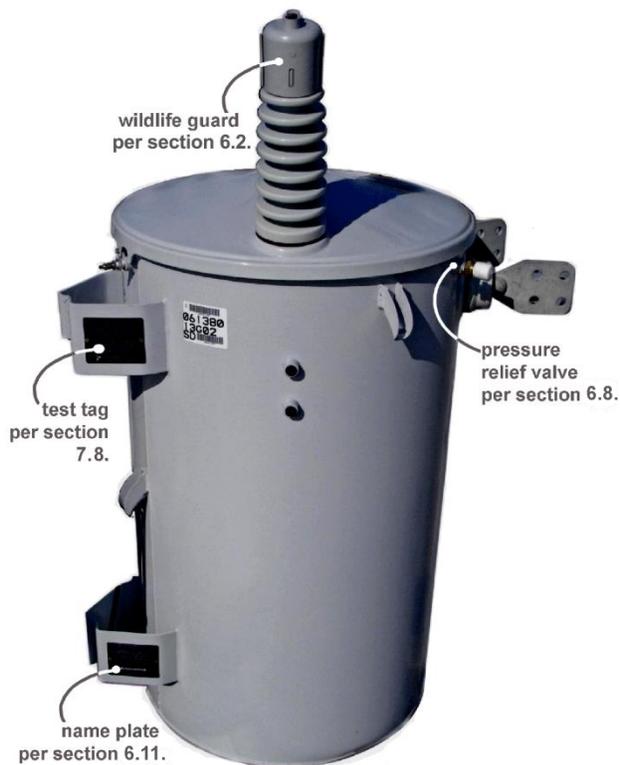
## 6. Construction

### 6.1 General

Transformers shall be according to the requirements of IEEE C57.12.20 with the following clarifications and Figure 6.1, below.

Polarity shall be subtractive.

**Figure 6.1. Transformer showing location of the wildlife guard, pressure relief valve, test tag, and nameplate**



### 6.2 High-Voltage Bushing

High-voltage bushing shall have a BIL of 125 kV with a creepage distance of 17 inches. Bushing shall be mounted per IEEE C57.12.20, Figure 8.

High-voltage terminal shall be supplied with a side-mounted handwheel type wildlife guard sized to fit each transformer securely.

Wildlife guard shell and handwheel shall be the appropriate model from the Central Moloney 703803 series.

### 6.3 Low-Voltage Bushings

Low-voltage bushings shall have a minimum BIL of 30 kV.

#### 6.4 Low-Voltage Terminals

Terminals shall be constructed per IEEE C57.12.20, Section 7.1.2 with the following clarifications:

- Transformers with secondary voltages of 120/240, 240/480, 133/266, 138.5/277, sized 100kVA or larger shall have Spade H terminals per IEEE C57.12.20, Table 9 and Figure 5b.
- Transformers with secondary voltages of 1385/2400 or 2400/4160 shall have insulated hand wheel type terminals.
- Parallel-connected “cut straight” transformers shall be supplied with only X1 and X2 terminals connected per C57.12.20, Figure 6. X3 terminal shall be covered with heat-shrink tubing.

#### 6.5 Accessories

Accessory equipment shall be provided per IEEE C57.12.20, Section 7.2 and located as shown in Figure 8.

#### 6.6 Liquid Level Marking

Liquid level marking shall be provided per IEEE C57.12.20, Section 7.2.3.

#### 6.7 Lifting Lugs

Lifting lugs shall be provided per IEEE C57.12.20, Section 7.2.4.

#### 6.8 Pressure Relief Valve

A pressure relief valve shall be provided per SCL 4503.10 and IEEE C57.12.20, Section 7.2.5.1 with the following clarifications.

**Figure 6.8. Pressure Relief Valve**



##### 6.8.1. Indicator

The pressure relief valve shall include an orange or red indicator that becomes visible only after the valve has vented.

##### 6.8.2. Cap and pull ring

The valve shall be covered by a cap with a pull ring that separates from the assembly during venting, revealing the orange or red indicator and hanging down from the valve via a chain or strap.

##### 6.8.3. Sealant

Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

#### 6.8.4. Approved models

The pressure relief valve shall meet the requirements of SCL 4503.10.

#### 6.8.5. Location

The valve shall be installed in segment 1 or the half of segment 2 or 4 nearest to segment 1 as defined in IEEE C57.12.20, Figure 1. See Figure 6.1 of this standard.

#### 6.9 Enclosure Integrity

The completely assembled transformer enclosure shall comply with IEEE C57.12.20, Section 7.2.6.

#### 6.10 Polarity, Terminal Markings, and Angular Displacement

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.20, Section 7.3.

Primary terminals, secondary terminals and ground lugs shall be marked with minimum 1-in tall letters.

#### 6.11 Nameplate

Nameplate shall be according to the requirements of IEEE C57.12.20, Section 7.3.4 with the following clarifications:

- Class shall be KNAN.
- Approximate total weight in pounds shall be indicated for all transformer sizes.
- Gallons of insulating fluid shall be indicated.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

##### Figure 6.11. Nameplate, PCB statement



#### 6.12 kVA Rating

The kVA rating shall be provided on the tank per IEEE C57.12.20, Section 7.3.5 in numerals approximately 2.5 inches high. Numerals may be applied by stenciling or by any other permanent means.

#### 6.13 Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cooper Envirottemp FR3. Each transformer shall have a 5-in diameter minimum label indicating fluid brand.

#### 6.14 Tank

##### 6.14.1. Covers and Handholes

Cover shall comply with IEEE C57.12.20, Section 7.5.1.

##### 6.14.2. Support Lugs

Support lugs shall comply with IEEE C57.12.20, Section 7.5.2. Support lugs shall be secured to the tank with fillet welds on all edges.

### 6.14.3. Tank Finish

Tank finish shall comply with IEEE C57.12.20, Section 7.5.3 with the following clarifications. When measured with a magnetic thickness gauge, the paint thickness shall be the following.

- Cover- 8 mils thick, minimum
- Tank- 3 mils thick, minimum

### 6.14.4. Tank Grounding

Tank grounding provision, tank grounding connector, low-voltage grounding connection, low-voltage grounding provision, and static cover bond shall comply with IEEE C57.12.20, Section 7.5.4.

The low-voltage grounding provision shall be a solderless connector that will accommodate conductor size Number 8 AWG solid to Number 2 AWG stranded and will match the tank grounding provision.

All grounding provisions shall be treated with an oxide-inhibiting compound.

The tank ground shall be located at the intersection of segments 3 and 4 as defined in IEEE C57.12.20, Figure 1.

## 6.15 Weight

Each unit, including all accessories and fluid, shall not exceed 2,500 lb.

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## 7. Tests

### 7.1 General

Except as specified in Dielectric Tests, all applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

### 7.2 Dielectric Tests

Dielectric tests shall be performed as specified in IEEE C57.12.20, Section 6.2 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00.

### 7.3 Tank Design Tests

Tests shall be performed as specified in IEEE C57.12.20, Section 9.

### 7.4 Short Circuit Tests

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12.

### 7.5 Audible Sound Levels

Audible sound levels for each unit shall be according to the requirements of NEMA TR-1, Section 0.05. Tests shall be performed per IEEE C57.12.90, Section 13.

### 7.6 Radio Influence Voltage Test

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03.

### 7.7 Documentation

Tests reports demonstrating conformance to all tests completed shall be submitted in a single Adobe Acrobat PDF file.

All documentation shall be in English and use customary inch-pound units.

## 7.8 Test Tag

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit. Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE." Tag shall indicate the date on which the test was made, and the name of the person who performed the test.

**Figure 7.8. Test Tag**



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## 8. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that would affect the transformer's understood or published capabilities.

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## 9. Shipping and Handling

Each transformer shall be supplied on its own pallet.

### 9.1 Pallet Material

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

### 9.2 Support

Pallet supplied shall accommodate lifting by both forklifts and pallet jacks:

- Pallet shall be minimum 4 in tall.
- The most central pallet stringer shall be centered and a maximum of 7 in wide.
- The bottom of each pallet shall be open or have 8-in openings. See Figure 9.2.

**Figure 9.2. Pallets**



### 9.3 Orientation

Transformer shall be centered on pallet and banded to pallet via its lifting lugs. Transformer shall be oriented on the pallet with secondary terminals perpendicular to the forklift entrance to prevent accessories (secondary terminals, support lugs, etc.) from coming into contact with pallet moving equipment. See Figure 9.3. If accessories are near edge of pallet, enclose them with protective devices to prevent damage.

**Figure 9.3. Orientation**



### 9.4 Arrival Condition

Transformers shall be delivered on enclosed trucks.

Transformers shall be received by Seattle City Light in clean condition.

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## 10. Seattle City Light Processes

### 10.1 Bid Process

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

### 10.2 Loss Factors

Load and no-load loss measurements shall be performed and corrected to 85°C and 20°C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

#### 10.2.1. Load Loss

Load losses shall be assessed at \$2.60 per watt.

#### 10.2.2. **No-load Loss**

No-load “core” losses shall be assessed at \$5.90 per watt.

#### 10.2.3. **Loss Assessment**

Total Price (\$) = Bid Price + Loss Total

Loss Total = Load Loss + No-load Loss

Load Loss = Losses (Watts) x \$2.60

No-load Loss = Losses (Watts) x \$5.90

The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Tolerances will be allowed in accordance with IEEE C57.12.90, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.

### 10.3 **Bid Completion**

Upon completion of the bidding process, the successful bidder shall submit in a single Adobe Acrobat PDF file the following:

- Transformer dimensions
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment.
- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.7. Format test data using numbering system shown in IEEE C57.12.00, Section 8.7.

### 10.4 **Inspection and Electrical Testing**

Upon delivery, 100% of the transformers will be inspected for physical defects and conformance to this standard.

A minimum of 10% of the transformers will be tested electrically for Radio Influence Voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), Losses and a small battery of other tests.

If any transformers fail, the manufacturer will be notified and an additional 10% will be tested.

If more transformers fail, the manufacturer will be contacted and given the option to return the lot, test 100% of the lot, or return the lot except the units that passed during initial testing.

### 10.5 **Guarantee**

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

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## 11. **Issuance**

Stock Unit: EA

## 12. Approved Manufacturers

<b>Manufacturer</b>	<b>Location</b>
ABB	Athens, Georgia
Central Moloney	Pine Bluff, Arkansas
Cooper Power	Nacogdoches, Texas
Howard Industries	Laurel, Mississippi

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## 13. References

**SCL Material Standard 4503.10**; "Valve, Transformer Pressure Relief"

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## 14. Sources

**Hanson, Brett**; SCL Standards Engineer; subject matter expert and originator of 4150.00 (brett.hanson@seattle.gov)

**SCL Material Standard 0025.1** (canceled); "Distribution Transformer, Single-Phase, Pole-Type, Natural Ester Fluid"

**SCL Material Standard 2940.1**; "Valve, Transformer Pressure Relief" (renumbered to 4503.10 in October 2015)

**PAD MOUNTED, SINGLE-PHASE, NATURAL ESTER FLUID  
 DISTRIBUTION TRANSFORMERS**



**1. Scope**

This standard details the manufacturer requirements for single-phase, pad mounted transformers from 25 kVA to 167 kVA and as listed in Table 1.

**Table 1**, 25 564GrdY/14 760 – 240/120, Single-Phase, Pad Mounted (PM)-Transformers by Stock Number

kVA	Stock No
25	373122
50	373132
75	373134
100	373136
167	373142

**2. Application**

This class of transformers is installed on concrete pads and is used to serve homes and small businesses in the rare cases that overhead or submersible transformers are unworkable. As of this publication, these units make up less than one percent of the transformers installed annually in the Seattle City Light distribution system.

**3. Industry Standards**

Transformers shall meet the applicable requirements of the following industry standards:

**ANSI C57.12.25-1990**; “American National Standard for Transformers-Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors; High Voltage, 34 500 GrdY/ 19 920 Volts and Below; Low Voltage, 240/120 Volts; 167 kVA and Smaller -Requirements”

**DOE 10 CFR Part 431**; “Energy Efficiency Program for Certain Commercial and Industrial Equipment”; Department of Energy

**IEEE 386-2006**; “IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V”

**IEEE C57.12.00-2010**; “Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers”

**IEEE C57.12.28-2005**; IEEE Standard for Pad-Mounted Equipment – Enclosure Integrity

**IEEE C57.12.70-2000**; “IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers”

Standards Coordinator  
 Laura Vanderpool

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 John Shipek

Unit Director  
 Darnell Cola

**Material Standard**

**3. Industry Standards, continued**

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.147-2008**; "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers"

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

**RCW 19.29.010, Rule 5 -2011**; *Revised Code of Washington, Rules for Test Tag*

**4. Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. City of Seattle General Terms and Conditions
3. This material standard
4. Other industry standards

**5. Ratings**

**5.1 Kilovolt-Ampere Ratings**

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.25, Section 3.1 and be 25, 50, 75, 100, 167 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings shall be continuous and based on not exceeding a 55 °C average winding temperature rise.

The transformers shall have a temperature rise insulation system of 65 °C.

**5.2 Voltage Ratings**

Voltage ratings shall be as follows, or as specified on the purchase order:

25 564 GrdY/14 760 -  
 240/120 Volts

**6. Construction**

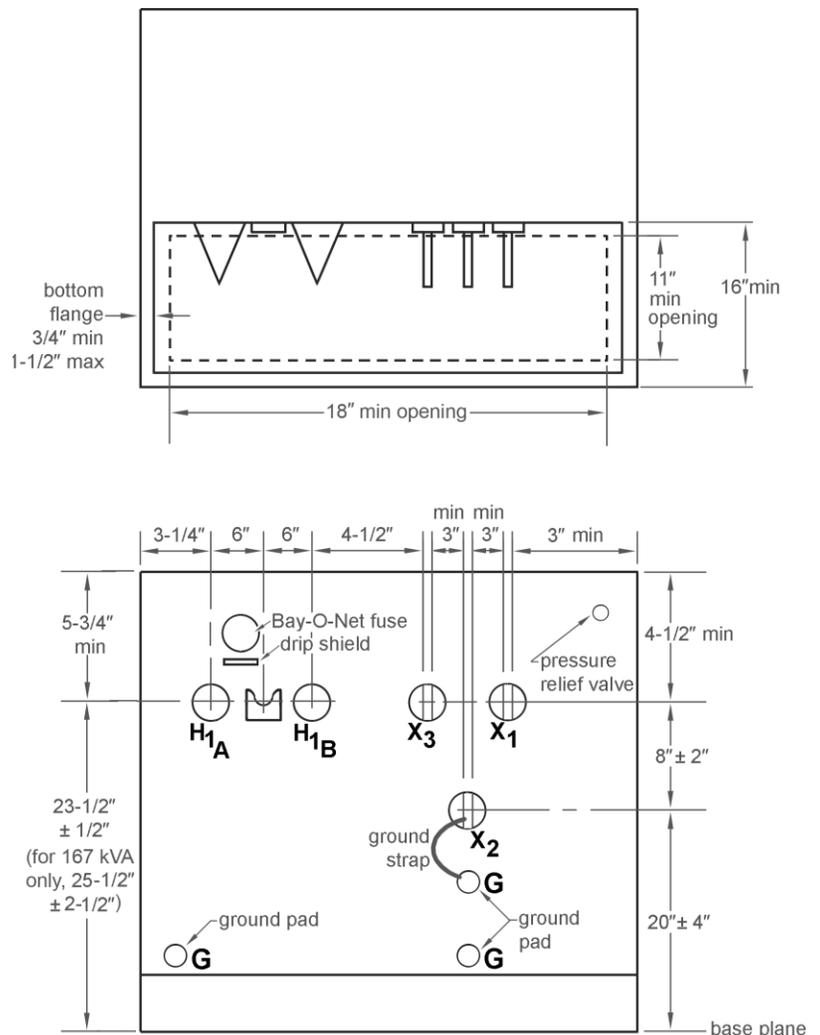
**6.1 General**

Transformers shall be according to the requirements of Figure 6.1 (below) and IEEE C57.12.25 Type 1 arrangement with the following clarifications.

The BIL shall be 125kV per IEEE C57.12.25, Section 4.1.

Polarity shall be subtractive.

**Figure 6.1**, Transformer showing location of the terminals and accessories, based on IEEE C57.12.25 Figure 1 (a).



**Material Standard**

Pad-Mounted, Single-Phase, Natural Ester Fluid Distribution Transformers

**6. Construction, continued**

**6.2 High-Voltage Bushing Wells**

Two 200 amp high-voltage bushing wells shall be supplied and constructed per IEEE 386, Figure 3 and IEEE C57.12.25 Section 6.2.3. Wells shall include a parking stand and be one of the models listed below:

Central Moloney 70191855

Cooper Power:  
 Well 2638372CO2R and  
 Clamp 2606823A04

Each bushing well will be supplied with bail tabs that are compatible with Cooper and Elastimold deadbreak hold down bail assemblies. A tight-fitting dust cap shall be fixed in place with wire run between the bail tabs.

**6.3 Low-Voltage Terminals**

Terminals shall be constructed per IEEE C57.12.25, Section 6.2.5.

Transformers shall be supplied with three low-voltage spades constructed per IEEE C57.12.25 Figure 4(a).

Transformers shall be supplied with a ground pad near the low-voltage neutral and connected via a removable ground strap per IEEE C57.12.25 Section 6.2.6.

**6.4 Overcurrent Protection**

Overcurrent protection shall be a Bay-O-Net fuse assembly installed and furnished with a dual sensing fuse as listed below. Isolation links shall not be installed because each transformer is protected upstream by a backup current limiting fuse. A drip shield shall be provided on each unit.

**Bay-O-Net Fuse Assembly**

Cooper Power Systems 4000361C99MC

**Dual-sensing Bay-O-Net Fuse**

Transformer, kVA	Cooper Power Systems Catalog No	amps
25	4000358C05	8
50	4000358C08	15
75	4000358C08	15
100	4000358C08	15
167	4000358C10	25

**6.5 Liquid Level Marking**

Liquid level indication shall be provided per IEEE C57.12.25, Section 6.5.2.

**6.6 Lifting Provisions**

Lifting provisions shall be provided per IEEE C57.12.25, Section 6.1.6.

**6.7 Pressure Relief Valve**

A pressure relief valve shall be provided per SCL 4503.10 and IEEE C57.12.20, Section 7.2.5.1 with the following clarifications:

**Figure 6.7, Pressure relief valve**



**6.7a Indicator**

The pressure relief valve shall include an orange or red indicator that becomes visible only after the valve has vented.

**6.7b Cap and pull ring**

The valve shall be covered by a cap with a pull ring. The cap will separate from the assembly during venting, revealing the orange or red indicator and hang down from the valve via a chain or strap.

**6.7c Sealant**

Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

**6.7d Approved models**

The pressure relief valve shall be BETA 1712K-4 series, VIAT 302-030-01 series, or equal with approval prior to bid and listed for use with the included transformer fluid.

**6.7e Location**

The valve shall be installed in the low-voltage portion of the terminating compartment as defined in IEEE C57.12.25 Section 6.5.2 and in Figure 6.1.

**Material Standard**

Pad-Mounted, Single-Phase, Natural Ester Fluid Distribution Transformers

**6. Construction, continued****6.8 Enclosure Integrity**

The completely assembled transformer enclosure shall comply with IEEE C57.12.28.

Terminal compartment shall be accessed by a single lift-up hood, secured by a captive penta head bolt.

**6.9 Polarity, Terminal Markings, and Angular Displacement**

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.25, Section 6.2.

Primary terminals, secondary terminals, and ground lugs shall be marked with minimum 1-inch tall letters.

**6.10 Nameplate**

Nameplate shall be according to the requirements of IEEE C57.12.25, Section 6.4 with the following clarifications:

- Class shall be KNAN.
- BIL shall be 125 kV
- Total weight in pounds shall be indicated for each individual transformer.
- Volume in gallons of insulating fluid shall be indicated.
- Manufacturer name and part number of the Bay-o-net fuse assembly shall be indicated.
- Tank design pressures shall be listed to comply with Section 6.13d.
- Manufacturer name and part number of the dual sensing fuse shall be indicated.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

Figure 6.10, Nameplate, PCB statement

**CONTAINS LESS THAN 1PPM PCB  
AT TIME OF MANUFACTURE**

**6.11 kVA Rating**

The kVA rating shall be provided on the tank in numerals approximately 2.5 inches high. These numerals may be applied by stenciling or by any other permanent means.

**6.12 Fluid**

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cooper Envirotemp FR3. Each transformer shall have a minimum 5-inch diameter label indicating fluid brand.

**6.13 Tank**

Tank shall meet all the integrity requirements of IEEE C57.12.25, Section 6.6.

**6.13a Cover**

Cover shall comply with IEEE C57.12.28.

**6.13b Tank finish**

Tank finish shall comply with IEEE C57.12.28, Section 5. The tank finish color shall be Semi Gloss Dark Green Munsell Notation 7GY 3.29/1.5.

**6.13c Tank grounding**

Tank grounding provision shall comply with IEEE C57.12.25, Section 6.6.4 and will accommodate #8 solid through #2 stranded copper wire.

**6.13d Strength**

Tank will be designed to withstand negative and positive 7 psig per IEEE C57.12.25 Section 6.6.1.

**7 Tests****7.1 General**

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

**7.2 Dielectric Tests**

Dielectric tests shall be performed as specified in IEEE C57.12.25, Section 5.2 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

**7.3 Tank and Enclosure Tests**

Tests shall be performed as specified in IEEE C57.12.25, Section 6.6.1 and IEEE C57.12.28.

**Material Standard****7 Tests, continued****7.4 Short Circuit Tests**

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12.

**7.5 Audible Sound Levels**

Audible sound levels for each unit shall be according to the requirements of NEMA TR-1, Section 0.05. Tests shall be performed per IEEE C57.12.90, Section 13.

**7.6 Radio Influence Voltage Test**

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03.

**7.7 Load and No-Load Tests**

Load and no-load loss measurements shall be performed at 85 degrees C and 20 degrees C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

**7.8 Documentation**

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

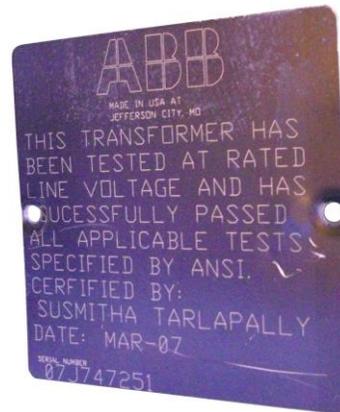
**7.9 Test Tag**

A legible weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- transformer serial number
- date on which the test was performed
- name of the person who performed the test.

**Figure 7.9, Test tag, example****8. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the transformer's understood or published capabilities.

**9. Shipping and Handling**

Each transformer shall be supplied on its own pallet.

**9.1 Pallet Material**

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

**9.2 Support**

Pallet shall be 4 inches high to accommodate lifting by both forklifts and pallet jacks.

The most central pallet stringer shall be centered and a maximum of 7 inches wide to insure picking by pallet jacks.

**9.3 Orientation**

Transformer shall be centered on pallet and secured via its pad attachments.

Transformer shall be oriented on the pallet to prevent transformer enclosure from coming into contact with pallet moving equipment or otherwise shall be enclosed by protective devices to prevent damage.

**9.4 Arrival Condition**

Transformers shall be delivered on enclosed trucks.

Transformers shall be received by Seattle City Light in clean condition.

**Material Standard**

Pad-Mounted, Single-Phase, Natural Ester Fluid Distribution Transformers

**10. Seattle City Light Processes****10.1 Bid Process**

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

**10.2 Loss Factors**

Load and no-load loss measurements shall be performed at 85°C and 20°C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

**10.2a Load Loss**

Load losses shall be assessed at \$2.60 per watt.

**10.2b No-load Loss**

No-load "core" losses shall be assessed at \$5.90 per watt.

**10.2c Loss Assessment**

Total Price (\$) = Bid Price + Loss Total

Loss Total = Load Loss + No-load Loss

Load Loss = Losses (Watts) x \$2.60

No-load Loss = Losses (Watts) x \$5.90

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Tolerances will be allowed in accordance with IEEE C57.12.90, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.

**10.3 Bid Completion**

Upon completion of the bidding process, the successful bidder shall submit in a single electronic file the following:

- Transformer dimensions and spare parts list
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment.
- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.6. Format test data using numbering system shown in IEEE C57.12.00, Section 8.6.

**10.4 Inspection and Electrical Testing**

Upon delivery, the transformers will be inspected for physical defects and conformance to this standard.

The transformers will be tested electrically for Radio Influence Voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), losses and a small battery of other tests.

If any transformer fails, the manufacturer will be contacted and given the option to take back the lot or take back the lot except the units that passed during initial testing.

**10.5 Guarantee**

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

**11. Issuance**

Stock Unit: EA

**12. Approved Manufacturers and Factories**

ABB	Jefferson City, Missouri
Carte International	Winnipeg, Manitoba, Canada
Cooper Power	Nacogdoches, Texas

## Material Standard

Pad-Mounted, Single-Phase, Natural Ester Fluid Distribution Transformers

Standard Number: **4220.00**

Superseding: April 4, 2012  
Effective Date: October 28, 2015  
Page: 7 of 7

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### 13. References

**Hanson, Brett**; SCL Standards Engineer, subject matter expert for 4220.00 (brett.hanson@seattle.gov)

**SCL 0028.1**; "Distribution Transformer, Single-Phase, Padmount Type 25 through 167 kVA" (canceled); Material Standard

**SCL Material Standard 4503.10** (renumbered from 2940.1); "Pad-Mounted, Single-Phase, Natural Ester Fluid Distribution Transformers"

## Pad Mounted, Three-Phase, Natural Ester Fluid Distribution Transformers



### 1. Scope

This standard details the manufacturer requirements for three-phase, pad mounted transformers from 150 kVA to 2500 kVA as listed in Table 1.

**Table 1. Three-Phase, Pad Mounted (PM) Transformers by Stock Number**

kVA	High Voltage	Low Voltage		Fuses	Taps
		208Y/120	480Y/277		
150	25 564GrdY/14 760	374840	374440	3	-
225	"	374846	374446	3	-
300	"	374850	374450	3	-
500	"	374860	374460	3	-
750	26 400GrdY/15 242	374866	374466	-	5
1000	"	374872	374472	-	5
1500	"	-	374476	-	5
2000	"	-	374478	-	5
2500	"	-	374480	-	5

### 2. Application

This class of transformers is installed on concrete pads and is used to serve large businesses when either overhead or submersible transformers are impractical or the customer requires more than 500 kVA of capacity. As of this publication, these units make up less than ten percent of the transformers installed annually in the Seattle City Light (SCL) distribution system.

### 3. Industry Standards

Transformers shall meet the applicable requirements of the following industry standards:

**IEEE C57.12.34-2009**; "IEEE Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5MVA and Smaller; High Voltage 34.5 kV Nominal system Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below"

**DOE 10 CFR Part 431**; "Energy Efficiency Program for Certain Commercial and Industrial Equipment"; Department of Energy

**IEEE 386-2006**; "IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V"

Standards Coordinator  
 Brett Hanson

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

### 3. Industry Standards, continued

**IEEE C57.12.00-2010**; "Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.12.28-2005**; IEEE Standard for Pad-Mounted Equipment – Enclosure Integrity

**IEEE C57.12.70-2000**; "IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers"

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.147-2008**; "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers"

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

**RCW 19.29.010, Rule 5 -2011**; *Revised Code of Washington*, Rules for Test Tag

### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. City of Seattle General Terms and Conditions
3. This material standard
4. Other industry standards

### 5. Ratings

#### 5.1 Kilovolt-Ampere Ratings

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.34, Section 4.1 and be 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings shall be continuous and based on not exceeding a 55 °C average winding temperature rise.

The transformers shall have a temperature rise insulation system of 65 °C.

#### 5.2 Voltage Ratings

Voltage ratings shall be as follows, or as specified on the purchase order:

- 25 564 GrdY/14 760 – 208Y/120 Volts or
- 25 564 GrdY/14 760 – 480Y/277 Volts or
- 26 400 GrdY/15 242 – 208Y/120 Volts or
- 26 400 GrdY/15 242 – 480Y/277 Volts

### 6. Construction

#### 6.1 General

Transformers shall be according to the requirements of Figure 6 and Table 6 of this document.

Transformers shall comply with IEEE C57.12.34 Figure 8 (a), Figure 12, and Figure 13A for radial-feed transformers with high-voltage connectors, to include the following clarifications:

BIL shall be 125 kV per IEEE C57.12.34, Section 6.

Polarity shall be subtractive.

Transformers shall be constructed with either a 5-legged core or a triplex core to mitigate ferroresonant tank heating.

#### 6.2 High-Voltage Bushing Wells

Three 200 amp high-voltage bushing wells shall be supplied and constructed per IEEE 386, Figure 13 and IEEE C57.12.34 Section 8.7.2.3, Figure 13A with bails. Wells shall include a parking stand and be one of the models listed below:

Central Moloney 70191855

Cooper Power WELL 2638372CO2R and  
CLAMP 2606823A04

City Light connects these transformers to 200 amp deadbreak elbows via bushing well inserts.

Each bushing well will be supplied with bail tabs that are compatible with Cooper and Elastimold deadbreak hold down bail assemblies. A tight fitting cap shall be fixed in place with wire run between the bail tabs.

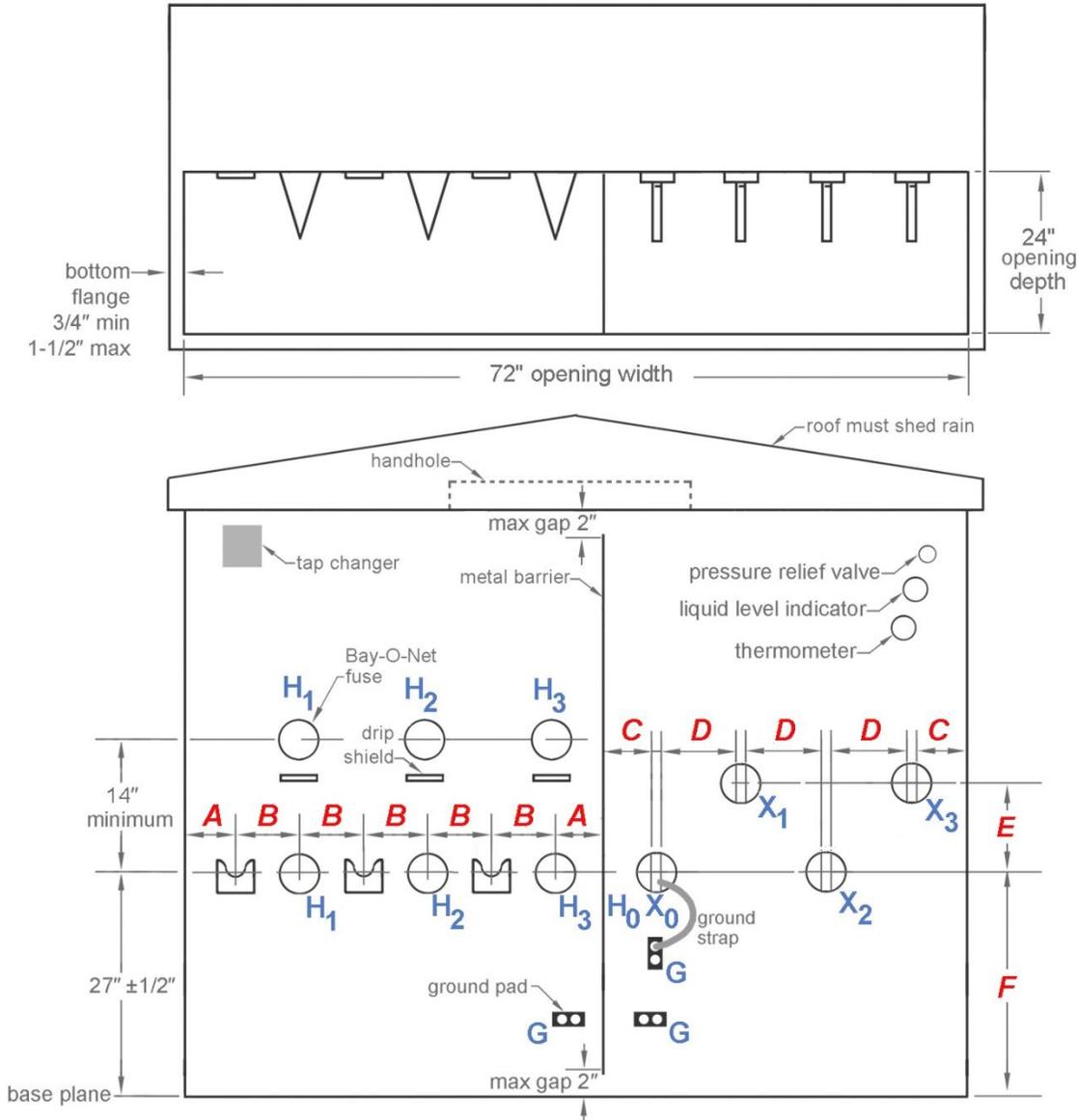
#### 6.3 Low-Voltage Terminals

Terminals shall be constructed per IEEE C57.12.34, Section 8.7.3 with the following clarifications:

- Transformers shall be supplied with four low-voltage spades constructed per IEEE C57.12.34 Figure 8(a) and Figure 15A. Neutral terminal shall be labeled HoXo.
- Transformers shall be supplied with an additional ground pad near the low-voltage neutral terminal to match the ground pads required in Section 6.13c of this document. HoXo terminal shall be connected to this ground pad via a removable strap per IEEE C57.12.34 Section 8.7.4.1.
- Transformers shall be provided with an HoXo switch to disconnect the primary neutral from the secondary neutral to allow for testing. HoXo switch shall be hand operable without tools and accessible only from within the handhole. HoXo switch can be submerged no more than 6 inches below the insulating fluid.

**6. Construction, continued**

**Figure 6. Transformer showing location of the terminals and accessories, based on IEEE C57.12.34 Figure 12, Figure 8, and Figure 13A.**



**Table 6, Transformer Requirements**

kVA	150	225	300	500	750	1000	1500	2000	2500
<b>A</b> , in, min	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
<b>B</b> , in, min, ± 1/4 in	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
<b>C</b> , in, min	4	4	4	4	4	4	4	4	4
<b>D</b> , in, ± 1/4 in	5	6	6	6	6	6	6	6	6
<b>E</b> , in, ± 1/4 in	6	8	8	8	8	8	8	8	8
<b>F</b> , in, ± 1/4 in	27	31	31	31	46	46	46	46	46
208Y/120 terminal holes	4	4	4	6	10	10	-	-	-
480Y/277 terminal holes	4	4	4	4	6	6	6	10	10
W x D, ft, max	6.5 x 7	6.5 x 7	6.5 x 7	6.5 x 7	7 x 9	7 x 9	7 x 9	7 x 9	7 x 9

**6. Construction, continued**

**6.4 Taps**

For transformers rated 750 kVA or more, a full-capacity de-energized tap changer shall be supplied and located per Figure 6 of this document. Taps shall comply with C57.12.34 Section 4.3 except the nominal voltage shall be 26 400 volts and there will be one tap above and three below. Tap voltages shall be 27060, 26400, 25740, 25080, and 24420. Units shall be shipped on the 25740 volt tap.

**6.5 Overcurrent Protection**

For transformers rated 500 kVA or less overcurrent protection shall be a Bay-O-Net fuse assembly installed and furnished with a dual sensing fuse as listed below. Isolation links shall not be installed because each transformer is protected upstream by a backup current limiting fuse. A drip shield shall be provided on each unit.

**Bay-O-Net Fuse Assembly**

Cooper Power Systems 4000361C99MC

**Dual-sensing Bay-O-Net Fuse**

Transformer, kVA	Cooper Power Systems Catalog No	amps
112.5	4000358C05	8
150	4000358C08	15
225	4000358C08	15
300	4000358C08	15
500	4000358C10	25

**6.6 Liquid Level Marking**

Liquid level indication shall be provided per IEEE C57.12.34, Section 8.10.2.

For transformers rated 750 kVA or more, provide a liquid level gauge and temperature gauge in the low-voltage compartment. Liquid level gauge shall include an indication of the correct liquid level at 25 °C. Temperature gauge shall be a resettable dial-type thermometer with needles indicating the current top of oil temperature and the highest temperature recorded since last reset.

**6.7 Lifting Provisions**

Lifting provisions shall be provided per IEEE C57.12.34, Section 8.6.

**6.8 Pressure Relief Valve**

A pressure relief valve shall be provided per SCL 4503.10 and IEEE C57.12.34, Section 8.9.2 with the following clarifications:

**6.8a Indicator**

The pressure relief valve shall include an orange or red indicator that becomes visible only after the valve has vented.

**Figure 6.8. Pressure Relief Valve**



**6.8b Cap and Pull Ring**

The valve shall be covered by a cap with a pull ring. The cap will separate from the assembly during venting, revealing the orange or red indicator and hang down from the valve via a chain or strap.

**6.8c Sealant**

Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

**6.8d Approved Models**

The pressure relief valve shall be listed for use with the included transformer fluid and be one of the models listed in SCL 4503.10.

**6.8e Location**

The valve shall be installed in the low-voltage portion of the terminating compartment as shown in Figure 6.

## 6. Construction, continued

### 6.9 Enclosure Integrity

The completely assembled transformer enclosure shall comply with IEEE C57.12.28.

Terminal compartment shall be constructed per IEEE C57.12.34 Sections 8.1, 8.2, 8.3, 8.4, and 8.5.

Enclosure roof shall shed rain and prevent collection of water.

### 6.10 Polarity, Terminal Markings, and Angular Displacement

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.34, Section 8.7.

Primary terminals, secondary terminals, and ground lugs shall be marked with minimum 1-inch tall letters.

### 6.11 Nameplate

#### Figure 6.11. Nameplate, PCB Statement

CONTAINS LESS THAN 1PPM PCB  
AT TIME OF MANUFACTURE

Nameplate shall be according to the requirements of IEEE C57.12.34, Section 8.8 and IEEE C57.12.00, Section 5.12 (Nameplate C for all kVA ratings) with the following clarifications:

- Class shall be KNAN.
- BIL shall be 125 kV.
- Tested impedance shall be listed.
- Tested X/R ratio shall be listed.
- Total weight in pounds shall be indicated for each individual transformer.
- Volume in gallons of insulating fluid shall be indicated.
- Manufacturer name and part number of the Bay-o-net fuse assembly shall be indicated.
- Manufacturer name and part number of the dual sensing fuse shall be indicated.
- Tank design pressures shall be listed to comply with Section 6.13d of this document.

- HoXo switch shall be shown in the phasor diagram.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

### 6.12 Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cooper Envirotemp FR3. Each transformer shall have a minimum 5-inch diameter label indicating fluid brand.

### 6.13 Tank

Tank shall meet all the integrity requirements of IEEE C57.12.34, Section 8.10.

#### 6.13a Cover

Cover shall comply with IEEE C57.12.28.

Cover shall be welded to the tank.

#### 6.13b Tank Finish

Tank finish shall comply with IEEE C57.12.28, Section 5. The tank finish color shall be Semi Gloss Dark Green Munsell Notation 7GY 3.29/1.5.

#### 6.13c Tank Grounding

Tank grounding provision shall comply with IEEE C57.12.34, Section 8.11 and will accommodate #8 solid through #2 stranded copper wire.

#### Figure 6.13c. Ground Pad



## 6. Construction, continued

### 6.13 Tank, continued

#### 6.13d Strength

Tank will be designed to withstand negative and positive 7 psig per IEEE C57.12.34 Section 8.10.1.

#### 6.13e Handhole

Tank shall include a handhole to access internal components for testing. The handhole shall have a cover that can be unbolted from within the terminal compartments to prevent unauthorized access. The handhole shall have a minimum opening of 121 square inches and will provide access to the HoXo switch. The gasket shall be one-piece material.

#### 6.13f Drain Valve

A one-inch globe-type drain valve shall be installed, including a 3/8-inch sampling device and a plug. The valve shall be installed on a pipe nipple welded to the tank in the primary section of the terminal compartment.

Figure 6.13f. Drain valve



## 7 Tests

### 7.1 General

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

### 7.2 Dielectric Tests

Dielectric tests shall be performed as specified in IEEE C57.12.34, Section 7.2 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

### 7.3 Tank and Enclosure Tests

Tests shall be performed as specified in IEEE C57.12.34, Section 8.10.1 and IEEE C57.12.28.

### 7.4 Short Circuit Tests

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12.

### 7.5 Audible Sound Levels

Audible sound levels for each unit shall be according to the requirements of NEMA TR-1, Section 0.05. Tests shall be performed per IEEE C57.12.90, Section 13.

### 7.6 Radio Influence Voltage Test

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03.

### 7.7 Load and No-Load Tests

Load and no-load loss measurements shall be performed at 85 degrees C and 20 degrees C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

### 7.8 Documentation

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

### 7.9 Test Tag

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- Transformer serial number
- Date on which the test was performed
- Name of the person who performed the test.

Figure 7.9. Test Tag, Example



## 8. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the transformer's understood or published capabilities.

## 9. Shipping and Handling

Each transformer shall be supplied on its own pallet.

### 9.1 Pallet Material

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

### 9.2 Support

Pallet shall be 4 inches high to accommodate lifting by both forklifts and pallet jacks.

The most central pallet stringer shall be centered and a maximum of 7 inches wide to insure picking by pallet jacks.

### 9.3 Orientation

Transformer shall be centered on pallet and secured via its pad attachments.

Transformer shall be oriented on the pallet to prevent transformer enclosure from coming into contact with pallet moving equipment or otherwise shall be enclosed by protective devices to prevent damage.

### 9.4 Arrival Condition

Transformers shall be delivered on covered or enclosed trucks.

Transformers shall be received by Seattle City Light in clean condition.

## 10. Seattle City Light Processes

### 10.1 Bid Process

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

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Load and no-load loss measurements shall be performed at 85°C and 20°C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

### 10.2a Load Loss

Load losses shall be assessed at \$2.60 per watt.

### 10.2b No-load Loss

No-load "core" losses shall be assessed at \$5.90 per watt.

### 10.2c Loss Assessment

Total Price (\$) = Bid Price + Loss Total

Loss Total = Load Loss + No-load Loss

Load Loss = Losses (Watts) x \$2.60

No-load Loss = Losses (Watts) x \$5.90

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Tolerances will be allowed in accordance with IEEE C57.12.90, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.

## 10.3 Bid Completion

Upon completion of the bidding process, the successful bidder shall submit in a single electronic file the following:

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- Nameplate
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- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.6. Format test data using numbering system shown in IEEE C57.12.00, Section 8.6.

**10. Seattle City Light Processes, continued**

**10.4 Inspection and Electrical Testing**

Upon delivery, the transformers will be inspected for physical defects and conformance to this standard.

The transformers will be tested electrically for Radio Influence Voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), losses and a small battery of other tests.

If any transformer fails, the manufacturer will be contacted and given the option to take back the lot or take back the lot except the units that passed during initial testing.

**10.5 Guarantee**

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

**11. Issuance**

Stock Unit: EA

**12. Approved Manufacturers and Factories**

ABB	Jefferson City Missouri
Carte International	Winnipeg, Manitoba, Canada
Cooper Power	Waukesha, Wisconsin

**13. References**

**SCL Material Standard 4503.10**; "Valve, Transformer Pressure Relief"

**14. Sources**

**Hanson, Brett**; SCL Standards Engineer and subject matter expert for 4240.00 (brett.hanson@seattle.gov)

**SCL Material Standard 0028.3**; "Distribution Transformer, Three-Phase, Padmount Type 75 through 500 kVA, No Taps, Natural Ester Fluid" (canceled)

**SCL Material Standard 0028.5**; "Distribution Transformer, Three-Phase, Padmount Type 750 through 2500 kVA, With Taps, Natural Ester Fluid" (canceled)

**Power Transformer, 3-Phase  
 26400 Grd. Y/15242 - 13800Y/7970**

**1. General**

- 1.1 This specification covers three-phase power transformers for use on a 25,564 Grd.Y/14,760 volts, 60 Hertz distribution system. The transformers are intended for installation above ground on pads.
- 1.2 Transformers supplied under this specification shall meet the requirements of IEEE C57.12.10 - 2010, except as modified herein.
- 1.3 The transformer shall have a buried tertiary winding with a capacity of 35% of the transformer rating with a voltage of the manufacturer's choice.

**2. Rating**

- 2.1 The transformer shall have the following kVA ratings:

Seattle City Light Stock No.	345588	345592	345594
Self-cooled at 55° C	5000	7500	10000
Self-cooled at 65° C	5600	8400	11200
With <b>provisions</b> for additional future cooling fans at 55° C	6250	9375	12500
With <b>provisions</b> for additional future cooling fans at 65° C	7000	10500	14000

- 2.2 The voltage rating shall be 26,400 Grounded Y/15,242-13,800Y/7,970 volts.
- 2.3 The impedance shall be per IEEE C57.12.10, Section 4.6 for 150 kV BIL (6.5%)

**3. Insulation**

- 3.1 The basic impulse insulation level (BIL) design shall be 150 kV for the high-voltage windings and 110 kV BIL for the low-voltage windings. Note: IEEE C57.12.10 designates 150 kV BIL for the 26 kV H.V. windings; however, the bushings will limit testing to 125 kV BIL.
- 3.2 The transformer shall be designed for a 55/65° C rise with provisions for future fans. This shall be stated both on the bid and on the nameplate.

**4. Primary Bushings**

- 4.1 Four 600 ampere primary bushings shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 600 amperes, 125 kV BIL and shall be suitable for operation on a 25,564 Gr.Y/14,760-volt system. **Gasketed bushings are not acceptable.** The bushings shall be labeled H<sub>0</sub>, H<sub>1</sub>, H<sub>2</sub>, or H<sub>3</sub> appropriately adjacent to each bushing. The bushings shall be mounted on a horizontal line a minimum of 9" to 12" apart. The end nut on the bushings inside the tank shall be 24" maximum (arm's length) from the handhole on the cover.

Standards Coordinator  
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Standards Supervisor  
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#### 4. Primary Bushings (Continued)

- 4.2 The bushings shall be Elastimold Apparatus Bushing K650S1 or K650T1. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type and, (b) certified test data are submitted showing that they are interchangeable with Elastimold K655 BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.
- 4.3 Each bushing shall have a cap to prevent the entrance of moisture or contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.
- 4.4 One parking stand (four total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 NC tapped hole, 7/16" (11 mm) deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold K650 SOP standoff plug.

#### 5. Secondary Bushings

- 5.1 Four 600 ampere secondary bushings shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 600 amperes, 125 kV BIL\* and shall be suitable for operation on a 13,800 Grd.Y/7970-volt system. **Gasketed bushings are not acceptable.** The bushings shall be labeled X<sub>0</sub>, X<sub>1</sub>, X<sub>2</sub>, or X<sub>3</sub> appropriately adjacent to each bushing. The bushings shall be mounted on a horizontal line a minimum of 9" apart. The end nut on the bushings inside the tank shall be 24" maximum (arm's length) from the handhole on the cover.
- 5.2 The bushings shall be Elastimold Apparatus Bushing K650S1\* or K650T1\*. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type, and (b) certified test data are submitted showing that they are interchangeable with Elastimold K655 BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.

\* The requirement for 25 kV class bushings is for interchangeability with the majority of Seattle City Light's distribution system equipment.

- 5.3 Each bushing shall have a cap to prevent the entrance of moisture or contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.
- 5.4 One parking stand (four total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 UNC tapped hole 7/16" deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold standoff plug.

#### 6. Tank Ground

- 6.1 Tank grounding provisions shall consist of four (two per end) copper-faced steel pads 2" x 3-1/2" with two 1/2"-13 UNC tapped holes 7/16" deep, 1-3/4" apart on the wall of the transformer near the base per IEEE C57.12.10, Section 5.5. The ground pads shall be mounted in the vertical position 34-1/2" center to center. All tapped holes for ground connections shall be coated with oxide-inhibiting compound.

## 7. Tank, Cover, and Handhole

- 7.1 The tank shall be constructed per IEEE C57.12.10, Section 5.8.
- 7.2 The tank shall be designed for an operating pressure of  $\pm 8$  psig minimum. The transformer shall be tested by the manufacturer as follows:
  - (a) 7 psig negative for 30 seconds. Permanent deformation of the metal shall constitute failure.
  - (b) 7 psig positive for 6 hours per IEEE C57.12.24, Section 8.5.1. Permanent deformation of metal or leaks shall constitute failure. It is strongly suggested talc or chalk powder be applied to all welds, seams, valves and plugs for leak detection. Removal of the powder prior to shipment is not required. It is also suggested the plug in the drain valve be removed during leak testing.
- 7.3 The maximum operating pressure (positive and negative) shall be indicated on the nameplate per IEEE C57.12.10, Section 5.8.1.
- 7.4 The main cover with two handholes, shall be welded per IEEE C57.12.10, Section 5.8.3; one handhole at the primary end and one at the secondary end. The handhole and cover shall also meet the requirements of the latest revision of Seattle City Light Material Standard Supplement Number 0038.nn. The handholes shall have a net opening of 200 to 400 square inches. The handhole cover with a one piece (no dovetail) reusable gasket shall be through-bolted to a raised flange which is welded to the transformer cover. Bolts shall be silicon bronze or stainless steel. If the gaskets are cork and synthetic rubber (BUNA-N) or similar material, they shall be installed without adhesives. The cover shall have means for breaking the seal (seal-breaking bolt or similar). Handholes will be opened for receiving inspection. Gaskets damaged will be replaced by the manufacturer at the manufacturer's expense. It is strongly suggested that the surfaces that mate with the gasket be painted with an epoxy paint allowing adequate cure time before installation of the gasket.
- 7.5 The fluid fill shall consist of a 2" NPT nipple welded in the center of one of the handhole covers complete with a brass pipe cap. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable.
- 7.6 A pressure relief device shall be per IEEE C57.12.10 Section 5.8.1 except it shall be installed in the middle of one of the handhole covers.
- 7.7 The covers and all appurtenances shall be designed to shed water.
- 7.8 Tank finish shall comply with IEEE C57.12.32 and be Light Gray Number 70, Munsell Notation 5BG 7.0/0.4.

## 8. Accessories

The transformers shall be equipped with the following accessories:

- 8.1 Taps. The transformer shall have a full-capacity, de-energized tap changer in the high-voltage windings for 27,100 volts, 26,400 volts, 25,700 volts, 25,000 volts, and 24,340 volts per IEEE C57.12.10, Section 5.1.1.
- 8.2 Liquid-Level Indicator. A magnetic liquid-level indicator shall be per IEEE C57.12.10, Section 5.1.2. The float mechanism shall have a stop that prevents the float from going over the high mark due to fluid sloshing during transit. It is strongly suggested the float mechanism be within arm's length of the handhole as this is a frequent receiving problem.

## 8. Accessories (Continued)

- 8.3 Liquid Temperature Indicator. A dial-type thermometer shall be per IEEE C57.12.10, Section 5.1.3. Unless other provisions are made, the indicator shall have contacts necessary for future fans.
- 8.4 Pressure-Vacuum Gage. A pressure-vacuum gage shall be per IEEE C57.12.10, Section 5.1.5.
- 8.5 Drain and Filter Valves. Drain and filter valves shall be per IEEE C57.12.10, Section 5.1.5 except the valve shall be installed on a pipe nipple welded to the tank. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable. Drain valve shall maintain a minimum of 3 inches of clearance from the base of the unit to prevent breakage during transport.
- 8.6 Lifting, Moving, and Jacking Facilities. Lifting, moving, and jacking facilities shall be per IEEE C57.12.10, Section 5.3, except **additional jacking bosses shall be provided**, one in each corner,  $9" \pm 1/2"$  above the ground, for jacking with hydraulic transformer jacks.
- 8.7 For seismic anchoring systems, the base rails shall be designed to be welded to beams imbedded in the concrete pad. The details of the base rail shall be included on the outline drawing or on a separate drawing. The center of gravity shall be shown on the outline drawing.
- 8.8 Fans and Controls. **Provisions** for future fans and automatic controls, controlled from the top fluid temperature shall be per IEEE C57.12.10, Section 5.9. "Provisions" shall include all necessary equipment, cabinets, wiring and mountings except fans and controller. The fan power will be 120/240V, 1Ø and provided from an external source.

## 9. Short-Circuit Capability

The manufacturer shall submit certified test data proving its design has performed satisfactorily when tested in accordance with IEEE C57.12.90, except "Proof of Satisfactory Performance" shall include compliance with:

- (a) The visual inspection requirements of Section 12.5.1.
- (b) The dielectric tests of Section 12.5.2.
- (c) The wave shape of terminal voltage and current requirements of Section 12.5.3.
- (d) The leaking impedance allowable variations of Section 12.5.4.
- (e) The low-voltage impulse test of Section 12.5.5.
- (f) The excitation current requirements of Section 12.5.6.

In addition, the manufacturer shall supply proof that the design tested is essentially the same design being supplied.

## 10. Losses

Per IEEE C57.12.00 Section 5.9, transformer no-load and load losses shall be corrected to 20°C and 85° C respectively and evaluated for the KNAN design at the rates below:

- (a) No-load losses at \$5.90 per W
- (b) Load losses (windings) at \$2.60 per W

(Total Losses = No-Load Losses + Load Losses)

Losses shall be provided at the 55° C KNAN rating and the 65° C KNAN rating. Losses shall comply with IEEE C57.12.90.

## 11. Nameplate

A stainless steel diagrammatic nameplate shall be affixed to a standoff bracket using stainless steel fasteners. The nameplate standoff bracket shall be welded to the tank end or side wall, approximately 5 feet (1.5 m) above the base. The nameplate shall:

- (a) State all information per IEEE C57.12.00, Nameplate C.
- (b) Include the date (year) of manufacture.
- (c) State the operating pressure as required in IEEE C57.12.10, Section 5.8.1.
- (d) State "Contains less than one ppm PCB at time of manufacture."

## 12. Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cargill Envirotemp FR3 or ABB BIOTEMP. Each transformer shall have a minimum 5-inch diameter label indicating fluid brand.

## 13. Electrical Tests

The minimum following electrical tests shall be made by the manufacturer in accordance with IEEE C57.12.90 and NEMA TR1.

- (a) Resistance.
- (b) Ratio.
- (c) Polarity and phase relation.
- (d) Exciting current at 90 percent, 100 percent, and 110 percent of rated voltage.
- (e) %R, %X, X/R
- (f) No load loss at rated voltage.
- (g) Load loss at the 55° C KNAN rating and at the 65° C KNAN rating.
- (h) Regulation at 100 percent PF and 80 percent PF.
- (i) Temperature rise at 65° C rating.
- (j) Applied potential.
- (k) Induced potential.
- (l) Impulse test.
- (m) R.I.V. test per NEMA TR1-0.03 except test voltage shall be 17.4 kV, L-G for one minute. The R.I.V. level, not to exceed 250 microvolts, shall be recorded and reported.

### 13. Electrical Tests (Continued)

- (n) Average audible sound levels at the KNAN 55°C and 65° C ratings.

### 14. Data to be Submitted with Bid

- 14.1 All bidders shall submit their proposal with the data listed below. They shall submit a description of any changes, additions, or exceptions to the specification they propose, together with reasons for the change. Product evaluation and conformance to standard will be determined on the basis of the information submitted. The drawings and data furnished must be in sufficient detail and clarity to enable making a complete and positive check with the technical provisions of this standard.
  - (a) Outline drawings with overall dimensions.
  - (b) Details of the high- and low-voltage bushings including the manufacturer's name and catalog number.
  - (c) Average load losses, and no-load losses at the KNAN rating corrected to 85° C and 20° C respectively.
  - (d) That the transformer is a 55/65° C rise design.
  - (e) A copy of an instruction book or an outline of all required maintenance
  - (f) Regulation at power factors of 100 percent and 80 percent.
  - (g) Impedance of windings at rated load expressed in percent of rated voltage.
  - (h) Details of tank materials and tank finish.
  - (i) Make, specification, number of gallons, and weight of insulating fluid.
  - (j) Detailed information regarding short-circuit capability. See Section 9 of this standard.
  - (k) State all electrical tests given to the transformers at the factory. Include all tests listed in Section 13 in bid price.
  - (l) Total weight of completely assembled transformer, including insulating fluid.
  - (m) Provide information on each type of transformer insulation material used.
  - (n) Average audible sound level at the KNAN 55° C and 65° C ratings.

## 15. Data to be Supplied by Manufacturer

15.1 As soon as possible after award of contract, but not later than 45 days thereafter, the manufacturer shall furnish for approval three copies of drawings showing all of the basic design details.

Approval of the manufacturer's drawings by the City shall not relieve the manufacturer of any part of its obligation to meet all of the requirements of these specifications nor of the responsibility for the correctness of such drawings, diagrams, and schematics.

15.2 Thirty days prior to delivery, the manufacturer shall furnish:

- (a) Six copies of transformer dimensions with all accessories, showing the center of gravity.
- (b) Six copies of details of the base rails, if not included with the outline drawing. These are required for design of seismic anchoring systems.
- (c) Six copies of transformer nameplate.
- (d) Six copies of an instruction book covering installation.
- (e) Six copies of complete parts list for the above equipment. The list shall include the part numbers for all components necessary for fan operations.

15.3 Six copies of the certified test reports noted in Section 13 shall be furnished attached to the invoice.

## 16. Guarantee and Penalties

16.1 Any transformer failing, due to defective design, material, and/or workmanship, within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle, City Light Department. Any defect in design, material, and/or construction discovered within this period shall be corrected on all transformers furnished on this order at the manufacturer's expense, either by repair or replacement.

16.2 The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal.

$$\text{Total loss value} = \text{no-load loss} \times \$5.90/\text{watt} + \text{load loss} \times \$2.60/\text{watt}.$$

The penalty shall be the difference between the total loss value delivered less the total loss value in the bid proposal. Tolerances will be allowed in accordance with ANSI C57.12.00, Section 9.3, Table 18, except "on a given order" shall mean transformers of a given size and voltage; i.e., one line item.

16.3 Upon delivery, all transformers will be tested and inspected. Transformers that fail to pass the tests will be returned to the manufacturer. The cost of **retesting** transformers that have been returned to the manufacturer for correction of defects will be charged to the manufacturer.

## 17. Approved Manufacturers and Factories

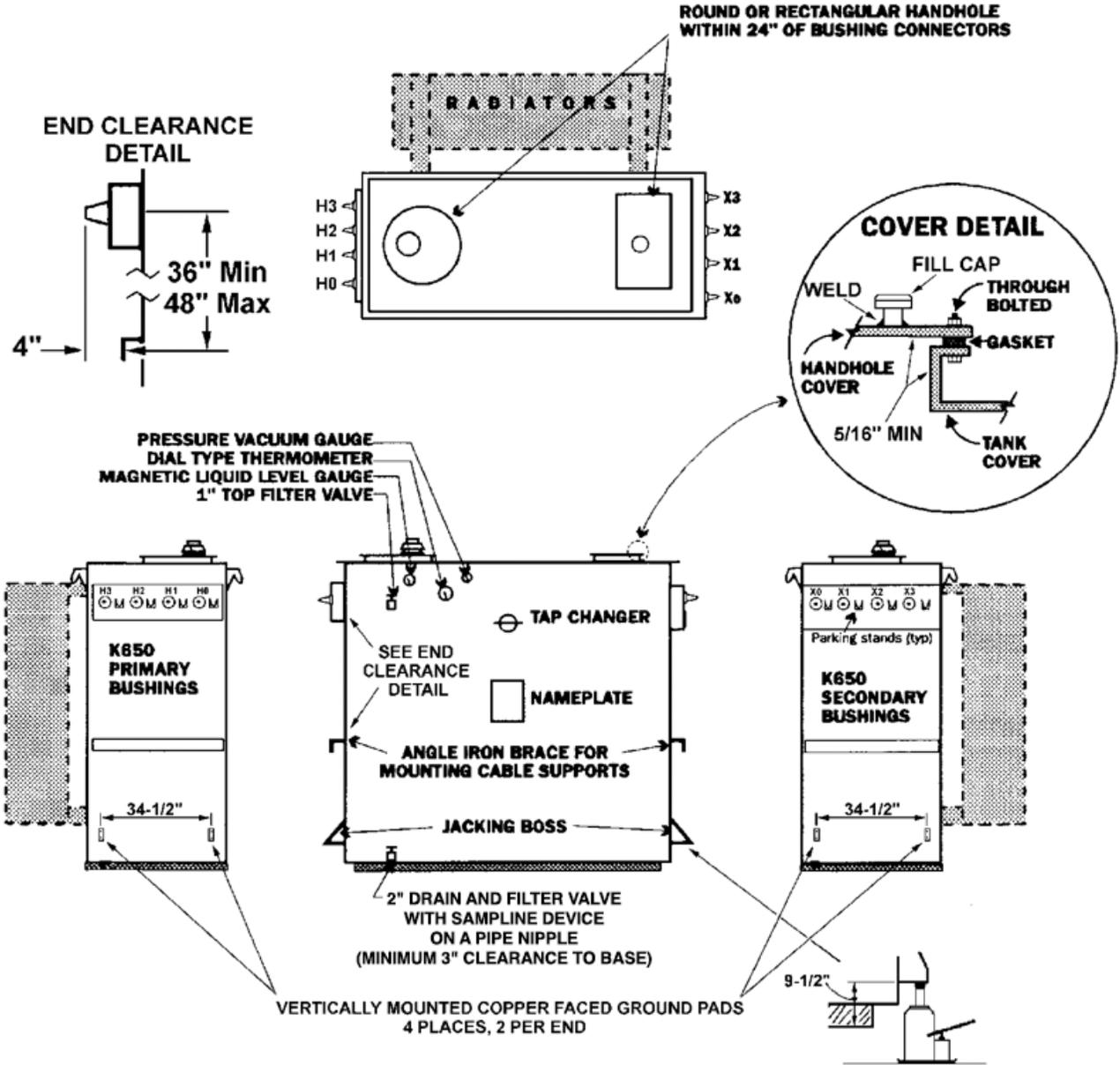
Carte International, Winnipeg, Manitoba, Canada  
ABB, Jefferson City, Missouri

## 18. References

IEEE C57.12.00 - 2010  
IEEE C57.12.10 - 2010  
IEEE C57.12.24 - 2009  
IEEE C57.12.32 - 2008  
IEEE C57.12.40 - 2011  
IEEE C57.12.90 - 2010  
NEMA TR1 – 1993 (R2000)

In October 2015, this standard was renumbered from 0035.5 to 4273.13.

**POWER TRANSFORMER, 3-PHASE**  
**26400 GRD.Y/15242 -13800Y/7970**



**Power Transformer, 3-Phase  
 26400 Grd. Y/15242 – 4160Y/2400**

**1. General**

- 1.1 This specification covers three-phase power transformers for use on a 25564 Grd. Y/14760 volts, 60 Hertz distribution system. The transformers are intended for installation above ground on pads.
- 1.2 Transformers supplied under this specification shall meet the requirements of IEEE C57.12.10-2010 except as modified herein.
- 1.3 The transformer shall have a buried tertiary winding with a capacity of 35% of the transformer rating with a voltage of the manufacturer's choice.

**2. Rating**

- 2.1 The transformer shall have the following kVA ratings:

Seattle City Light Stock No.	345488	345492
Self-cooled at 55° C	5000	7500
Self-cooled at 65° C	5600	8400
With <b>provisions</b> for additional future cooling fans at 55° C	6250	9375
With <b>provisions</b> for additional future cooling fans at 65° C	7000	10500

- 2.2 The voltage rating shall be 26,400 Grounded Y/15,242-4,160Y/2,400 volts.
- 2.3 The impedance shall be per IEEE C57.12.10, Section 4.6 for 150 kV BIL (6.5%)

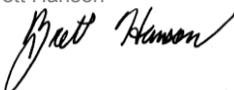
**3. Insulation**

- 3.1 The basic impulse insulation level (BIL) design shall be 150 kV for the high-voltage windings and 75 kV BIL for the low-voltage windings. Note: IEEE C57.12.10 designates 150 kV BIL for the 26-kV H.V. windings, however the bushings will limit testing to 125 kV BIL.
- 3.2 The transformer shall be designed for a 55/65°C rise with provisions for future fans. This shall be stated both on the bid and on the nameplate.

**4. Primary Bushings**

- 4.1 Four 600 ampere primary bushings shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 600 amperes, 125 kV BIL and shall be suitable for operation on a 25,564 Gr. Y/14,760-volt system. **Gasketed bushings are not acceptable.** The bushings shall be labeled H<sub>0</sub>, H<sub>1</sub>, H<sub>2</sub>, or H<sub>3</sub> appropriately adjacent to each bushing. The bushings shall be mounted on a horizontal line a minimum of 9" to 12" apart. The end nut on the bushings inside the tank shall be 24" maximum (arm's length) from the handhole on the cover.

Standards Coordinator  
 Brett Hanson



Standards Supervisor  
 John Shipek



Unit Director  
 Darnell Cola



#### 4. Primary Bushings (Continued)

- 4.2 The bushings shall be Elastimold Apparatus Bushing K650S1 or K650T1. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type, and (b) certified test data are submitted showing that they are interchangeable with Elastimold K655 BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.
- 4.3 Each bushing shall have a cap to prevent the entrance of moisture or contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.
- 4.4 One parking stand (four total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 NC tapped hole, 7/16" (11 mm) deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold K650 SOP standoff plug.

#### 5. Secondary Bushings

- 5.1 Seven 900-ampere secondary bushings (one X<sub>0</sub> and two X<sub>1</sub>, X<sub>2</sub>, and X<sub>3</sub>) shall be **welded** on the end wall of the transformer in approximately the upper one-third of the tank. The bushings shall be rated 900 amperes, 125 kV BIL\* and shall be suitable for operation on a 4160Y/2400-volt system. **Gasketed bushings are not acceptable.** The bushings shall be labeled X<sub>0</sub>, X<sub>1</sub>, X<sub>2</sub>, or X<sub>3</sub> appropriately adjacent to each bushing. The seven bushings shall be mounted in two rows. The top row with 4 bushings X<sub>0</sub>, X<sub>1</sub>, X<sub>2</sub>, or X<sub>3</sub>, 12" apart. The 2nd row, 12" below, X<sub>1</sub>, X<sub>2</sub>, or X<sub>3</sub>, 12" apart, 6" offset from the first row. The end nut on the top bushings inside the tank shall be 24" maximum from the handhole on the cover.
  - \* The requirement for 25-kV class bushings is for interchangeability with the majority of Seattle City Light's distribution system equipment.
- 5.2 The 900 ampere bushings shall be Elastimold Apparatus Bushing K675S1 or K675T1. Other manufacturers' bushings may be acceptable provided (a) they are the welded-in type, and (b) certified test data are submitted showing that they are interchangeable with Elastimold BLR elbow interfaces and electrical ratings. Bushings shall have a 5/8" threaded hole. Bushings with studs installed are not acceptable.
- 5.3 Each bushing shall have a cap to prevent the entrance of moisture of contamination during shipping and storage. The bushings shall be protected against damage during shipping and temporary storage with a wood or metal cover that is securely fastened to the transformer.
- 5.4 One parking stand (seven total) shall be welded on the wall near each bushing, complete with stainless steel or copper-faced steel ground pads with a 1/2"-13 UNC tapped hole 7/16" deep. The threads shall be coated with oxide-inhibiting compound. The parking stand shall accommodate an Elastimold standoff plug.
- 5.5 The following statement shall be stenciled 6" to 24" beneath the low-voltage bushings in 1"-2" letters: "900 amp bushings; use all copper components".

#### 6. Tank Ground

Tank grounding provisions shall consist of four (2 per end) copper-faced steel pads 2" x 3-1/2" with two 1/2"-13 UNC tapped holes 7/16" deep, 1-3/4" apart on the wall of the transformer near the base per IEEE C57.12.10, Section 5.5. The ground pads shall be mounted in the vertical position 34-1/2" center to center. All tapped holes for ground connections shall be coated with oxide-inhibiting compounds.

## 7. Tank, Cover, and Handhole

- 7.1 The tank shall be constructed per IEEE C57.12.10, Section 5.8.
- 7.2 The tank shall be designed for an operating pressure of  $\pm 8$  psig minimum. The transformer shall be tested by the manufacturer as follows:
  - (a) 7 psig negative for 30 seconds. Permanent deformation of the metal shall constitute failure.
  - (b) 7 psig positive for 6 hours per IEEE C57.12.24, Section 8.5.1. Permanent deformation of metal or leaks shall constitute failure. It is strongly suggested talc or chalk powder be applied to all welds, seams, valves and plugs for leak detection. Removal of the powder prior to shipment is not required. It is also suggested the plug in the drain valve be removed during leak testing.
- 7.3 The maximum operating pressure (positive and negative) shall be indicated on the nameplate per IEEE C57.12.10, Section 5.8.1.
- 7.4 The main cover with two handholes, shall be welded per IEEE C57.12.10, Section 5.8.3; one handhole at the primary end and one at the secondary end. The handholes shall have a net opening of 200 to 400 in.<sup>2</sup>. The handhole cover with a one piece (no dovetails) reusable gasket shall be through-bolted to a raised flange which is welded to the transformer cover. Bolts shall be silicon bronze or stainless steel. If the gaskets are cork and synthetic rubber (BUNA-N) or similar material, they shall be installed without adhesives. The cover shall have means for breaking the seal (seal-breaking bolt or similar). Handholes will be opened for receiving inspection. Gaskets damaged will be replaced by the manufacturer at its expense. It is strongly suggested that the surfaces that mate with the gasket be painted with an epoxy paint allowing adequate cure time before installation of the gasket.
- 7.5 The fluid fill shall consist of a 2" NPT nipple welded in the center of one of the handhole covers complete with a brass pipe cap. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable.
- 7.6 A pressure relief device shall be per IEEE C57.12.10 Section 5.8.1 except it shall be installed in the middle of one of the handhole covers.
- 7.7 The covers and all appurtenances shall be designed to shed water.
- 7.8 The transformer finish shall consist of three coats of alkyd enamel to a minimum thickness of 5 mils when measured with a magnetic thickness gage. An undercoat over the regular finish shall be applied to the tank bottom and extend up the sides 12" above the bottom of the base. The undercoat shall be a minimum of 10 mils (reference: IEEE C57.12.40, Section 9.4, Network Transformers).

## 8. Accessories

The transformers shall be equipped with the following accessories:

- 8.1 Taps. The transformer shall have a full-capacity, de-energized tap changer in the high-voltage windings for 27,100 volts, 26,400 volts, 25,700 volts, 25,000 volts, and 24,340 volts per IEEE C57.12.10, Section 5.1.1.
- 8.2 Liquid-Level Indicator. A magnetic liquid-level indicator shall be per IEEE C57.12.10, Section 5.1.2. The float mechanism shall have a stop that prevents the float from going over the high mark due to fluid sloshing during transit. It is strongly suggested the float mechanism be within arm's length of the handhole as this is a frequent receiving problem.
- 8.3 Liquid Temperature Indicator. A dial-type thermometer shall be per IEEE C57.12.10, Section 5.1.3. Unless other provisions are made, the indicator shall have contacts necessary for future fans.

## 8. Accessories (Continued)

- 8.4 Pressure-Vacuum Gage. A pressure vacuum gage shall be per IEEE C57.12.10, Section 5.1.4.
- 8.5 Drain and Filter Valves. Drain and filter valves shall be per IEEE C57.12.10, Section 5.1.5 except the valve shall be installed on a pipe nipple welded to the tank. A liquid thread compound shall be used on the pipe joint. Teflon tape is not acceptable. Drain valve shall maintain a minimum of 3 inches of clearance from the base of the unit to prevent breakage during transport.
- 8.6 Lifting, Moving, and Jacking Facilities. Lifting, moving, and jacking facilities shall be per IEEE C57.12.10, Section 5.3 except **additional jacking bosses shall be provided**, one in each corner, 9" ± 1/2" above the ground, for jacking with hydraulic transformer jacks.
- 8.7 For seismic anchoring systems, the base rails shall be designed to be welded to beams imbedded in the concrete pad. The details of the base rail shall be included on the outline drawing or on a separate drawing. The center of gravity shall be shown on the outline drawing.
- 8.8 Fans and Controls. **Provisions** for future fans and automatic controls, controlled from the top fluid temperature shall be per IEEE C57.12.10, Section 5.9. "Provisions" shall include all necessary equipment, cabinets, wiring and mountings except fans and controller. The fan power will be 120/240V, 1Ø and provided from an external source.

## 9. Short-Circuit Capability

The manufacturer shall submit certified test data proving their design has performed satisfactorily when tested in accordance with IEEE C57.12.90, except "Proof of Satisfactory Performance" shall include compliance with;

- (a) The visual inspection requirements of Section 12.5.1.
- (b) The dielectric tests of Section 12.5.2.
- (c) The wave shape of terminal voltage and current requirements of Section 12.5.3.
- (d) The leakage impedance of allowable variations of Section 12.5.4.
- (e) The low-voltage impulse test of Section 12.5.5.
- (f) The excitation current requirements of Section 12.5.6.

In addition, the manufacturer shall supply proof that the design tested is essentially the same design being supplied.

## 10. Losses

Transformer losses will be evaluated at the full load KNAN rating at 75°C on the following basis:

- (a) Core losses at \$5,900.00 per kW
- (b) Load losses (windings) at \$2,600.00 kW

Total losses = Core Losses + Load Losses

Losses shall be provided at the 55°C KNAN rating and the 65°C KNAN rating.

## 11. Nameplate

A stainless steel diagrammatic nameplate shall be affixed to a standoff bracket with stainless steel fasteners. The nameplate standoff bracket shall be welded to the tank end or side wall, approximately 5' above the base. The nameplate shall:

- (a) State all information per IEEE C57.12.00, nameplate C.
- (b) Include the date (year) of manufacture.
- (c) State "Contains less than one ppm PCB at time of manufacture."
- (d) State the operating pressures as required in IEEE C57.12.00, Section 5.8.1.

## 12. Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cargill Envirotemp FR3 or ABB BIOTEMP. Each transformer shall have a minimum 5-inch diameter label indicating fluid brand.

## 13. Electrical Tests

The minimum following electrical tests shall be made by the manufacturer in accordance with IEEE C57.12.90 and/or NEMA TR1.

- (a) Resistance.
- (b) Ratio.
- (c) Polarity and phase relation.
- (d) Exciting current at 90 percent, 100 percent, and 110 percent of rated voltage.
- (e) %R, %X, X/R
- (f) No load loss at rated voltage.
- (g) Load loss at the 55°C KNAN rating and at the 65°C KNAN rating.
- (h) Regulation at 100 percent PF and 80 percent PF.
- (i) Temperature rise at 65°C rating.
- (j) Applied potential.
- (k) Induced potential.
- (l) Impulse test.
- (m) R.I.V. test per NEMA TR1-0.03 except test voltage shall be 17.4 kV, L-G, for one minute. The R.I.V. level, not to exceed 250 microvolts, shall be recorded and reported.
- (n) Average audible sound levels at the KNAN 55°C and KNAN 65°C ratings.

#### 14. Data to be Submitted with Bid

Each bidder shall submit with its proposal the data listed below. It shall submit a description of any changes, additions, or exceptions to the specification it proposes, together with reasons for the departure. Product evaluation and conformance to specification will be determined on the basis of information submitted. The drawings and data furnished must be in sufficient detail and clarity to enable making a complete and positive check with the technical provisions of the specification.

- (a) Outline drawings with overall dimensions.
- (b) Details of the high- and low-voltage bushings including the manufacturer's name and catalog number.
- (c) Average load losses and no-load losses at the KNAN rating corrected to 85 C and 20 C respectively.
- (d) That the transformer is a 55/65°C rise design.
- (e) A copy of an instruction book or an outline of all required maintenance.
- (f) Regulation at power factors of 100 percent and 80 percent.
- (g) Impedance of windings at rated load expressed in percent of rated voltage.
- (h) Details of tank materials and tank finish.
- (i) Make, specification, number of gallons, and weight of insulating fluid.
- (j) Detailed information regarding the short-circuit capability. See Section 9 of this standard.
- (k) State all electrical tests given to the transformers at the factory. Include all tests in Section 13 in bid price.
- (l) Total weight of completely assembled transformer, including insulating fluid.
- (m) Provide information on each type of transformer insulation material used.
- (n) Average audible sound level at the KNAN 55 C and KNAN 65 C ratings.

#### 15. Data to be Supplied by Manufacturer

- 15.1 As soon as possible after award of contract, but not later than 45 days thereafter, the manufacturer shall furnish for approval three copies of drawings showing all of the basic design details.

Approval of the manufacturer's drawings by the City shall not relieve the manufacturer of any part of its obligation to meet all of the requirements of these specifications nor of the responsibility for the correctness of such drawings, diagrams, and schematics.

- 15.2 Thirty days prior to delivery, the manufacturer shall furnish:
- (a) Six copies of outline dimensions of transformers with all accessories showing the center of gravity.
  - (b) Six copies of details of the base rails if not included with the outline drawing. These are required for design of seismic anchoring systems.
  - (c) Six copies of transformer nameplate.
  - (d) Six copies of an instruction book covering installation.
  - (e) Six copies of complete parts list for the above equipment. The parts list shall include the part numbers for all components necessary for fan operations.
- 15.3 Six copies of the certified test reports noted in Section 13 shall be furnished attached to the invoice for payment.

## 16. Guarantee and Penalties

- 16.1 Any transformer failing due to defective design, material, and/or workmanship, within two years after being energized or 30 months after delivery, shall be repaired or replaced without cost to the City of Seattle, City Light Department. Any defect in design, material, and/or construction discovered within this period shall be corrected on all transformers furnished on this order at the manufacturer's expense, either by repair or replacement.
- 16.2 The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal.
- Total loss value = no-load loss x \$5.90/watt + load loss x \$2.60/watt.
- The penalty shall be the difference between the total loss value delivered less the total loss value in the bid proposal. Tolerances will be allowed in accordance with IEEE C57.12.00, Section 9.3, Table 18, except "on a given order" shall mean transformers of a given size and voltage; i.e., one line item.
- 16.3 Upon delivery, all transformers will be tested and inspected. Transformers that fail to pass the tests will be returned to the manufacturer. The cost of **retesting** transformers that have been returned to the manufacturer for correction of defects will be charged to the manufacturer.

## 17. Approved Manufacturers and Factories

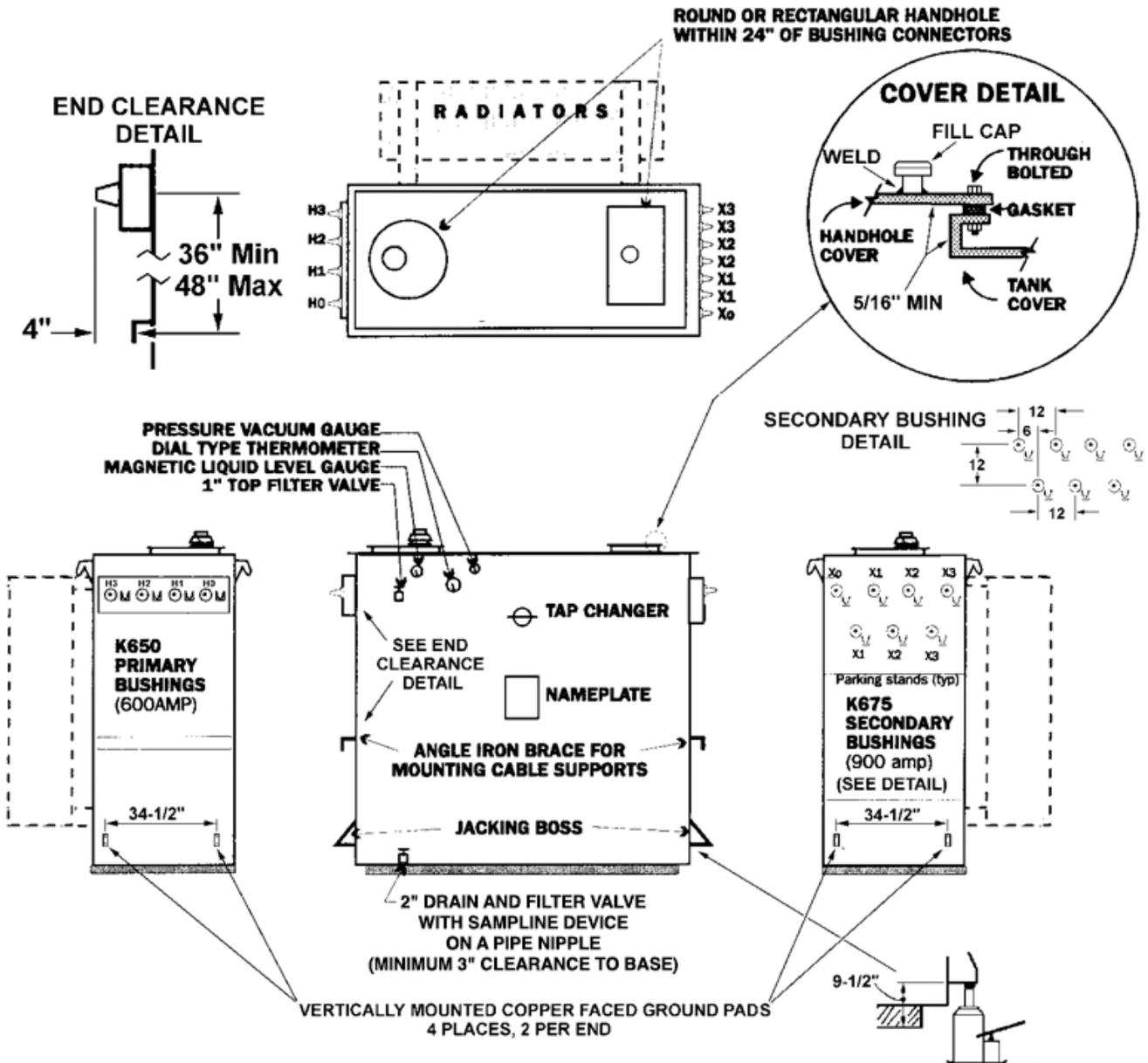
Carte International, Winnipeg, Manitoba, Canada  
ABB, Jefferson City, Missouri

## 18. References

IEEE C57.12.00-2010  
IEEE C57.12.10-2010  
IEEE C57.12.24-2009  
IEEE C57.12.32-2008  
IEEE C57.12.40-2011  
IEEE C57.12.90-2010  
NEMA TR1-1993 (R2000)

In October 2015, this standard was renumbered from 0035.7 to 4273.41.

**Power Transformer, 3-Phase**  
**26400 Grd. Y/15242 – 4160Y/2400**



**Submersible-Type, Single-Phase, Natural Ester Fluid,  
 Distribution Transformers**



**1. Scope**

This standard details the manufacturer requirements for single-phase submersible transformers from 25 kVA to 167 kVA.

This standard applies to the following Seattle City Light (SCL) 25 564GrdY/14 760 single-phase SY transformer stock numbers:

kVA	120/240	138.5/277	240/480	Parallel-connected "cut straight" secondary 120/240 cut 120
25	362122	362622	362322	362822
50	362132	362632	362332	362832
75	362134	362634	362334	362834
100	362136	362636	–	362836
167	362142	362642	–	362842

**2. Application**

This class of transformers is typically installed in underground vaults. They are designed to be submerged continuously and are used to serve homes and small businesses. As of this publication, these units are the second most common transformer type installed annually in the SCL distribution system.

Standards Coordinator  
 Brett Hanson

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

### 3. Industry Standards

Transformers shall meet the applicable requirements of the following industry standards:

**Department of Energy 10 CFR Part 431**; "Energy Efficiency Program for Certain Commercial and Industrial Equipment"

**IEEE C57.12.00-2010**; "Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.12.20-2011**; "Standard for Overhead Distribution Transformers, 500 kVA and Smaller"

**IEEE C57.12.23-2009**; "Standard for Submersible Single-Phase Transformers: 167kVA and Smaller"

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.147-2008**; "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers"

**RCW 19.29.010, Rule 5 -2011**; *Revised Code of Washington*, Rules for Test Tag

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

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### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light purchase order (PO)
  2. City of Seattle General Terms and Conditions
  3. This standard
  4. Other industry standards.
- 

### 5. Ratings

#### 5.1 Kilovolt-Ampere Ratings

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.23, Section 5.2 and be 25, 50, 75, 100, 167 kVA, or as specified on the purchase requisition.

Kilovolt-ampere ratings shall be continuous and based on not exceeding a 55 °C average winding temperature rise.

The transformers shall have a temperature rise insulation system of 65 °C.

#### 5.2 Voltage Ratings

Voltage ratings shall be as follows, or as specified on the purchase requisition:

25 564GrdY/14 760 - 120/240 Volts

25 564GrdY/14 760 - 240/480 Volts

25 564GrdY/14 760 - 133/266 Volts

25 564GrdY/14 760 - 138.5/277 Volts

25 564GrdY/14 760 - 2400 Volts

## 6. Construction

### 6.1 General

Transformers shall be according to the requirements of IEEE C57.12.23 with the following clarifications and Figure 6.1, below:

- The BIL shall be 125kV per IEEE C57.12.23, Section 5.4.
- Polarity shall be subtractive.

**Figure 6.1. Transformer, showing location of the nameplate on the lid, kVA rating and fluid label**



### 6.2 High-Voltage Bushing Well

One of the high-voltage bushing wells listed below and the matching parking stand shall be supplied. Each bushing well shall be supplied with a tight fitting cap fixed in place with wire run between the bail tabs:

- Elastimold K1601PC-T1
- Central Moloney 702233-51.

### 6.3 Low-Voltage Terminals

Terminals shall be constructed per IEEE C57.12.23, Section 7.2.3. All low-voltage terminals shall be threaded stud type to facilitate easier secondary lead or spade replacement. See Figure 6.3.

**Figure 6.3. Threaded low voltage terminal stud**



#### 6.3.1 Low-Voltage Leads for Transformers Rated 75 kVA or Less

Transformers rated 75 kVA or less shall be supplied with 4 low-voltage leads constructed per IEEE C57.12.23, Section 7.2.3.

Low-voltage cable leads shall have a minimum of 14 inches of flexible lead length.

#### 6.3.2 Low-Voltage Spades for Transformers Rated 100 kVA or more

Transformers rated 100 kVA or more shall be supplied with 4 low-voltage spades constructed per IEEE C57.12.23 Figure 2.

Transformers shall be supplied with a jumper connected to the X2 and X3 terminals. See Figure 6.3.2a.

**Figure 6.3.2a. Transformer with jumper connected to X2 and X3 terminals**



Transformers with "cut-straight" parallel-connected secondary terminals shall be supplied with 2 jumpers: one connected to the X1 and X3 terminals and one connected to the X2 and X4 terminals. See Figure 6.3.2b.

**Figure 6.3.2b. Cut straight parallel-connected transformer with jumpers connected to X1 and X3 terminals and X2 and X4 terminals**



### 6.3.3 Transformer Flat-Tinned Copper Braid Jumper

Jumpers can be purchased from Electric Motion Company (part number EMFB800-4-20), or manufactured.

If manufactured, jumpers shall be constructed with 4 20-in lengths of flat-tinned copper braid (Continental Cordage 278, Stock No. 013491). Jumpers shall be connected with 1-3/4 in bolts, 2 washers, a lock washer and nut for each bolt. Hardware shall be silicon bronze. See Figure 6.3.3.

**Figure 6.3.3. Flat-tinned copper braid jumper**



## 6.4 Accessories

Accessory equipment shall be provided per IEEE C57.12.23, Section 7.3 and located as shown in Figure 1 of that document.

## 6.5 Overcurrent Protection

Overcurrent protection shall be a cover-mounted Bay-O-Net assembly furnished with a dual sensing fuse as listed below. Isolation links shall not be installed because each transformer is protected upstream by a backup current limiting fuse.

### Cover-mounted Bay-O-Net fuse assembly:

Cooper Power Systems part no. 40001177B53MC

### Dual sensing Bay-O-Net fuse:

Transformer (kVA)	Cooper Power Systems Part No.	Amps
25	4000358C05	8
50	4000358C08	15
75	4000358C08	15
100	4000358C08	15
167	4000358C10	25

## 6.6 Liquid Level Marking

Liquid level indication shall be provided per IEEE C57.12.23, Section 7.3.

## 6.7 Lifting Lugs

Lifting lugs shall be provided per IEEE C57.12.23, Section 7.6.

## 6.8 Enclosure Integrity

The completely assembled transformer enclosure shall comply with IEEE C57.12.23, Section 7.5.

## 6.9 Polarity, Terminal Markings, and Angular Displacement

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.23, Section 7.2.

Primary terminals, secondary terminals, and ground lugs shall be marked on the lid with minimum one-inch tall letters.

## 6.10 Nameplate

Nameplate shall be according to the requirements of IEEE C57.12.23, Section 7.4 with the following clarifications:

- Tested impedance shall appear on the nameplate.
- Class shall be KNAN.
- Total weight in pounds shall be indicated for each individual transformer.
- Volume in gallons and manufacturer of insulating fluid shall be indicated.
- Total weight in pounds of insulating fluid for each transformer shall be indicated.
- Manufacturer name and part number of the bay-o-net fuse assembly shall be indicated.
- Manufacturer name and part number of the dual sensing fuse shall be indicated.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate, as shown in Figure 6.10.

### Figure 6.10. Nameplate, PCB statement



CONTAINS LESS THAN 1PPM PCB  
AT TIME OF MANUFACTURE.

### 6.11 KVA Rating

The kVA rating shall be marked on the tank and comply with IEEE C57.12.20, Section 7.3.5.

### 6.12 Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cooper Envirotemp FR3. Each transformer shall have a 5-inch diameter minimum label indicating fluid brand.

### 6.13 Tank

Tank shall meet all the integrity requirements of IEEE C57.12.23, Section 7.5.

#### 6.13.1 Covers

Cover shall comply with IEEE C57.12.23, Section 7.6 and be completely welded, with no handholes.

Any cover penetrations that cannot be welded shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

#### 6.13.2 Tank Material and Finish

Tank material and finish shall comply with IEEE C57.12.23, Sections 7.1 and 7.6 and per the table below.

**Table 6.13.2. Tank Material and Finish**

Paint	Tank Material	
	Stabilized Ferritic 409 Stainless Steel	Austenitic 304L Stainless Steel
Coating with Light Gray Number 70 Munsell Notation 5BG 7.0/0.4	Required	Optional
Thickness	3 mil	1 coat

#### 6.13.3 Tank Grounding

Tank grounding provision shall comply with IEEE C57.12.23, Section 7.6.

### 6.14 Dimensions

Each unit including all accessories shall not exceed a maximum height of 58 in.

Each unit including all accessories shall meet the diameter requirements defined in IEEE C57.12.23, Section 7.1 and be capable of being lowered into a 29 in x 29 in square hatch.

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## 7. Tests

### 7.1 General

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

### 7.2 Dielectric Tests

Dielectric tests shall be performed as specified in IEEE C57.12.23, Section 6.2 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

### 7.3 Tank Design Tests

Tests shall be performed as specified in IEEE C57.12.23 Section 6.5.

#### 7.4 Short Circuit Tests

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12.

#### 7.5 Audible Sound Levels

Audible sound levels for each unit shall be according to the requirements of NEMA TR-1, Section 0.05. Tests shall be performed per IEEE C57.12.90, Section 13.

#### 7.6 Radio Influence Voltage Test

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03.

#### 7.7 Load and No-Load Tests

Load and no-load loss measurements shall be performed and corrected to 85°C and 20°C, respectively, according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

#### 7.8 Documentation

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

#### 7.9 Test Tag

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- Transformer serial number
- Date on which the test was performed
- Name of the person who performed the test.

**Figure 7.9. Test tag**



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### 8. Shipping and Handling

Each transformer shall be supplied on its own pallet.

#### 8.1 Pallet Material

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

## 8.2 Support

Pallet supplied shall accommodate lifting by both forklifts and pallet jacks:

- Pallet shall be a minimum of 4 inches tall
- The most central pallet stringer shall be centered and a maximum of 7 inches wide.

The bottom of each pallet shall be open or have 8-in openings. See Figure 8.2.

**Figure 8.2. Pallets**



## 8.3 Orientation

Transformer shall be centered on pallet and banded to pallet via its lifting lugs. Transformer shall be oriented on the pallet with secondary terminals perpendicular to the forklift entrance to prevent accessories (secondary terminals, support lugs, etc.) from coming into contact with pallet moving equipment. See Figure 8.3. If accessories are near edge of pallet, enclose them with protective devices to prevent damage.

**Figure 8.3. Orientation**



## 8.4 Arrival Condition

Transformers shall be delivered on enclosed trucks.

Transformers shall be received by Seattle City Light in clean condition.

## 9. Seattle City Light Processes

### 9.1 Bid Process

Bid process details are available at [www.seattle.gov](http://www.seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

### 9.2 Loss Factors

Load and no-load loss measurements shall be performed per Section 7.7.

#### 9.2.1 Load Loss

Load losses shall be assessed at \$2.60 per watt.

#### 9.2.2 No-load Loss

No-load "core" losses shall be assessed at \$5.90 per watt.

#### 9.2.3 Loss Assessment

Total Price (\$) = Bid Price + Loss Total

Loss Total = Load Loss + No-load Loss

Load Loss = Losses (Watts) x \$2.60

No-load Loss = Losses (Watts) x \$5.90

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Loss penalties will be calculated on the basis of the average tested losses of all transformers of a given SCL stock code built to a given SCL purchase order.

Tolerances will be allowed in accordance with IEEE C57.12.00, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.

### 9.3 Bid Completion

Upon completion of the bidding process, the successful bidder shall submit in a single electronic file the following:

- Transformer dimensions
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment
- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.7. Format test data using numbering system shown in IEEE C57.12.00, Section 8.7.

#### 9.4 Inspection and Electrical Testing

Upon delivery, the transformers will be inspected for physical defects and conformance to this standard.

The transformers will be tested electrically for radio influence voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), losses and a small battery of other tests.

If any transformers fail, the manufacturer will be contacted and given the option to return the lot or return the lot except the units that passed during initial testing.

#### 9.5 Guarantee

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

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#### 10. Approved Manufacturers and Factories

<b>Manufacturer</b>	<b>Factory</b>
Carte International	Winnipeg, Manitoba, Canada
Central Moloney	Pine Bluff, Arkansas, USA
Howard Industries	Laurel, Mississippi, USA

---

#### 11. References

**Hanson, Brett**; SCL Standards Engineer; subject matter expert and originator of 4320.00 (brett.hanson@seattle.gov)

**SCL Material Standard 0026.1** (canceled); "Distribution Transformer, Single-Phase, Subsurface-Type, Natural Ester Fluid"

**SUBMERSIBLE, THREE-PHASE, NATURAL ESTER FLUID  
 DISTRIBUTION TRANSFORMERS**



**1. Scope**

This standard details the manufacturer requirements for three-phase, submersible transformers from 750 kVA to 2500 kVA as listed in Table 1. These units are sometimes called commercial subsurface or commercial subway (CS) transformers.

**Table 1, 26 400GrdY/15 242 Three-Phase, Submersible (CS) Transformers by Stock Number**

kVA	Low Voltage, Standard			Low Voltage, Stainless Steel	
	208Y/120	480Y/277	4160Y/2400	208Y/120	480Y/277
750	364866	364466	364966	365866	365466
1000	364872	364472	364972	365872	365472
1500	-	364476	364976	-	365476
2000	-	364478	364978	-	365478
2500	-	364480	364980	-	-

**2. Application**

This class of transformers is installed in building vaults and below-grade vaults when a customer requires more than 500 kVA of capacity. For dry building vaults, standard units with copper-bearing steel tanks shall be installed. For wet below grade vaults, units with 304L stainless steel tanks shall be installed to prevent corrosion. Prior to the introduction of padmount

three phase transformers, a submersible three phase unit was sometimes installed on a pad and secured with a fence. A submersible unit on a pad is less desirable as it takes up more space, costs more, and is more difficult to secure.

As of this publication, these units represent a small percent of the transformers installed annually in the Seattle City Light distribution system.

**3. Industry Standards**

Transformers shall meet the applicable requirements of the following industry standards:

**IEEE C57.12.24-2009**; "IEEE Standard for Submersible Three-Phase Transformers, 3750 kVA and Smaller; High Voltage 34.500 GrdY/19 920 Volts and Below; Low Voltage, 600Volts and Below"

**DOE 10 CFR Part 431**; "Energy Efficiency Program for Certain Commercial and Industrial Equipment"; Department of Energy

**IEEE 386-2006**; "IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V"

**IEEE C57.12.00-2010**; "Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers"

standards coordinator	standards supervisor	unit director
 Brett Hanson	 John Shipek	 Darnell Cola

**Material Standard**

Submersible, Three-Phase, Natural Ester Fluid Distribution Transformers

standard number: **4350.00**

superseding: June 29, 2012

effective date: February 15, 2013

page: 2 of 8

**3. Industry Standards, continued**

**IEEE C57.12.32-2002**; IEEE Standard for Submersible Equipment – Enclosure Integrity

**IEEE C57.12.70-2000**; "IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers"

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.147-2008**; "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers"

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

**RCW 19.29.010, Rule 5 -2011**; Revised Code of Washington, Rules for Test Tag

**4. Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. City of Seattle General Terms and Conditions
3. This material standard
4. Other industry standards

**5. Ratings****5.1 Kilovolt-Ampere Ratings**

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.24, Section 4.1 and be 750, 1000, 1500, 2000, 2500 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings shall be continuous and based on not exceeding a 55 °C average winding temperature rise.

The transformers shall have a temperature rise insulation system of 65 °C.

**5.2 Voltage Ratings**

Voltage ratings shall be as follows, or as specified on the purchase order:

- 26 400 GrdY/15 242 – 208Y/120 Volts
- 26 400 GrdY/15 242 – 480Y/277 Volts
- 26 400 GrdY/15 242 – 4160Y/2400 Volts

**6. Construction****6.1 General**

Transformers shall be according to the requirements of Figure 6 and Table 6 of this document. Transformers shall comply with IEEE C57.12.24 Figure 2 with the following

clarifications:

- BIL shall be 125 kV per IEEE C57.12.24, Section 5.4.
- Polarity shall be subtractive.
- Transformers shall be constructed with either a 5-legged core or a triplex core to mitigate tank heating.
- Transformers shall be suitable for continuous submerged operation per IEEE C57.12.24 Section 4.2.

**6.2 High-Voltage Bushing Wells**

Three 200 amp high-voltage bushing wells shall be welded to the cover and constructed per IEEE 386, Figure 3 and IEEE C57.12.24 Section 7.2.1. Wells shall include a parking stand and be one of the models listed below:

Central Moloney 702233-51

Elastimold K1601PC-T1

City Light connects these units to 200 amp deadbreak elbows via bushing well inserts.

Each bushing well shall be supplied with bail tabs that are compatible with Cooper and Elastimold deadbreak hold down bail assemblies. A tight-fitting, UV-resistant dust cap shall be fixed in place with wire run between the bail tabs, Polycast International PWCAP-01 or equal.

**6.3 Low-Voltage Terminals**

For transformers with 208Y/120 Volt or 480Y/277 Volt secondaries, terminals shall be constructed per IEEE C57.12.24, Section 7.2.2 with the following clarifications:

- Transformers shall be supplied with four low-voltage spades constructed per IEEE C57.12.24 Figure 4(b) and 4(c). Neutral terminal shall be labeled HoXo.
- Transformers shall have a ground pad near the low-voltage neutral terminal to match the ground pads required in Section 6.13c of this document. HoXo terminal shall be connected to this ground pad via a removable strap per IEEE C57.12.24 Section 7.2.3.
- Transformers shall be provided with an HoXo switch to disconnect the primary neutral from the secondary neutral to allow for testing. HoXo switch shall be hand operable without tools and accessible only from within the handhole.
- HoXo switch operating mechanism shall be submerged no more than 6-inches below the 25°C insulating fluid level.

**Material Standard**

Submersible, Three-Phase, Natural Ester Fluid Distribution Transformers

standard number: **4350.00**

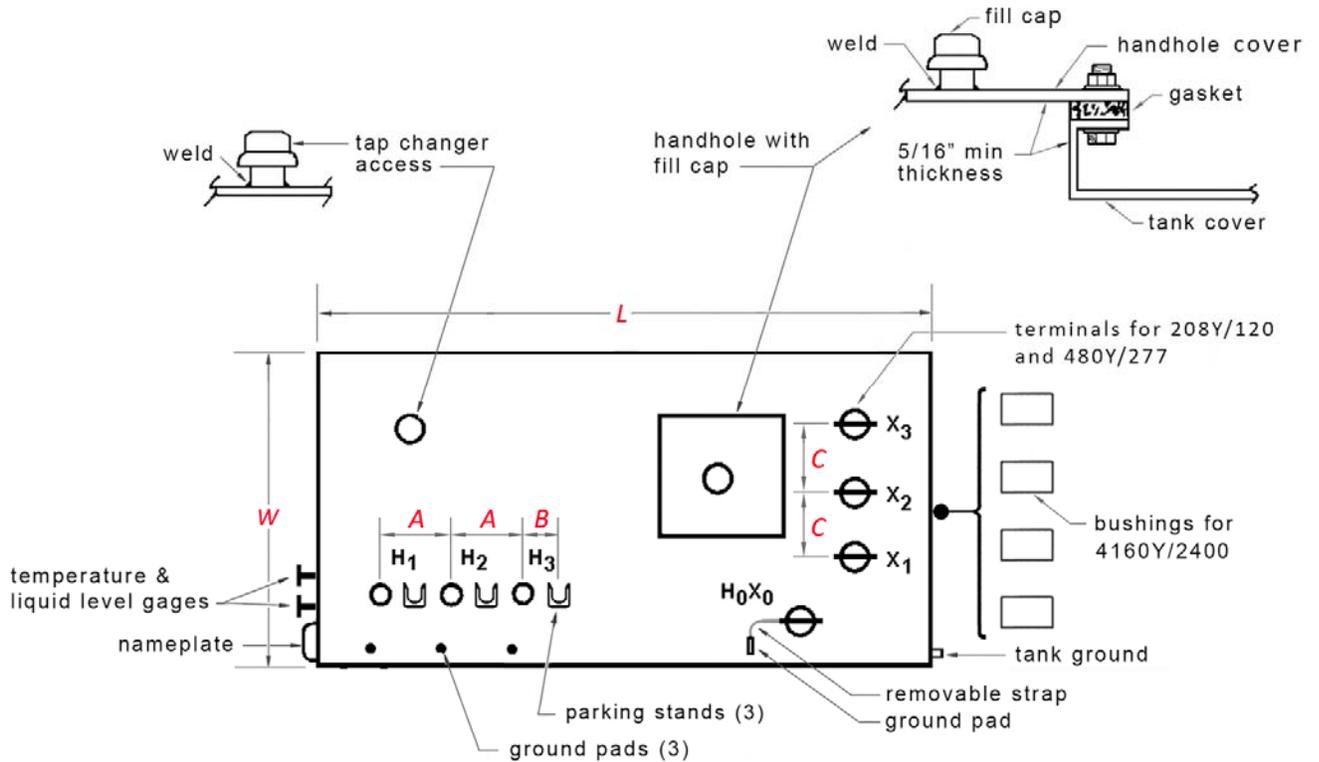
superseding: June 29, 2012

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**6. Construction, continued**

**Figure 6**, Transformer showing location of the terminals and accessories, based on IEEE C57.12.24 Figure 2.



**Table 6**, Transformer Dimensions

	kVA				
	750	1000	1500	2000	2500
<b>A, in, min</b>	14	14	14	14	14
<b>B, in, min</b>	7	7	7	7	7
<b>C, in, min</b>	6	6	6	6	6
<b>Number of holes per terminal</b>					
<b>208Y/120</b>	10	10	-	-	-
<b>480Y/277</b>	6	6	6	10	10
<b>Width (W) x Length (L) x Height from base to highest point (H), in, maximum</b>	42 x 84 x 84	42 x 84 x 84	52 x 96 x 96	56 x 130 x 96	60 x 140 x 108

**Material Standard**

Submersible, Three-Phase, Natural Ester Fluid Distribution Transformers

standard number: **4350.00**

superseding: June 29, 2012

effective date: February 15, 2013

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**6. Construction, continued**

**6.3 Low-Voltage Terminals, continued**

For transformers with 4160Y/2400 secondaries, four low voltage bushings (XoHo, X1, X2 & X3, left to right) shall be located horizontally on the end wall of the transformer, between 5-feet and 7-feet above grade, spaced 5-inches minimum on center, with the following clarifications:

- The secondary lead nut shall be within 24-inches of the handhole cover to insure access by maintenance personnel.
- Bushings shall be welded to the tank. Bushings shall be 600 amp, 125 kV BIL, Elastimold K650S1.
- Transformers shall be supplied with an additional ground pad near the low-voltage neutral terminal to match the ground pads required in Section 6.13c of this document.
- A 1-1/2-inch by 1-1/2-inch angle iron shall be welded to the tank wall 2-feet below the bushings for the purpose of mounting cable support brackets. The angle iron shall have a 9/16-inch hole drilled below each bushing.

**6.4 Taps**

A full-capacity de-energized tap changer shall be supplied and located per Figure 6 of this document. Taps shall comply with C57.12.24 Section 7.3.1 except the nominal voltage shall be 26 400 volts and there will be one tap above and three below. Tap voltages shall be 27060, 26400, 25740, 25080, and 24420. Units shall be shipped on the 25740 volt tap.

Tap changer shall be externally operated via a pipe nipple welded to the cover and a pipe cap located per Figure 6. A 300-series stainless steel tap position indicating plate shall be provided next to the operating mechanism. An unpainted stainless steel, galvanized steel, or copper alloy tap changer wrench shall be provided in a holder, mounted near the tap changer.

**Figure 6.4, Tap Changer**



**6.5 Percent Impedance**

The percent impedance shall be 5.75% per IEEE C57.12.24, Section 5.5.

**6.6 Liquid Level Marking**

Liquid level indication shall be provided per IEEE C57.12.24, Section 7.5.11.

A liquid level gauge and temperature gauge shall be provided near the high voltage bushing wells. Liquid level gauge shall include an indication of the correct liquid level at 25 °C. Temperature gauge shall be a resettable dial-type thermometer with needles indicating the current top of oil temperature and the highest temperature recorded since last reset.

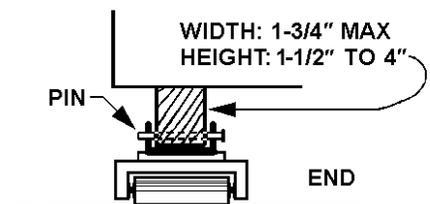
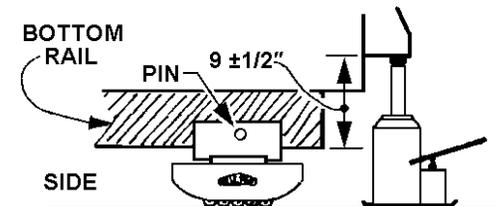
**6.7 Lifting Provisions**

Lifting provisions shall be provided per IEEE C57.12.24, Section 7.5.8.

The lifting lugs shall be arranged such that they can also be used to strap the transformer to a flat bed truck without damaging the coolers or other accessories.

Additional jacking bosses (steps) shall be provided, one in each corner 9" ± 1/2" from the bottom of the unit, for jacking with hydraulic transformer jacks. Moving will be done with Hilman "Cat Tracks". At each rail end (4 locations), a 7/16" diameter hole shall be drilled in the rail, centered 4" from the end and 5/8" from the bottom for the purpose of connecting the Cat Track to the transformer.

**Figure 6.7, Lifting Provisions**



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**6. Construction, continued**

**6.8 Pressure relief**

Pressure relief devices shall not be installed.

**6.9 Enclosure Integrity**

The completely assembled transformer enclosure shall comply with IEEE C57.12.32.

**6.10 Polarity, Terminal Markings, and Angular Displacement**

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.24, Section 7.5.12

Primary terminals, secondary terminals, and ground lugs shall be marked with minimum 1-inch tall letters.

**6.11 Nameplate**

Nameplate shall be according to the requirements of IEEE C57.12.24, Section 7.4 and IEEE C57.12.00, Section 5.12 (Nameplate C for all kVA ratings) with the following clarifications:

- Nameplate shall be 300-series stainless steel and affixed to the transformer with 300-series stainless steel or silicon bronze fasteners.
- Class shall be KNAN.
- BIL shall be 125 kV.
- Impedance shall be listed.
- Tested X/R ratio shall be listed.
- Total weight in pounds shall be indicated for each individual transformer.
- Volume in US gallons of insulating fluid shall be indicated.
- Tank design pressures shall be listed to comply with Section 6.13d of this document.
- Tank material (copper-bearing steel or 304L stainless steel) shall be listed.
- HoXo switch shall be shown in the phasor diagram and schematic.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

**Figure 6.11, Nameplate, PCB statement**



**6.12 Fluid**

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid level marking. Fluid shall be Cooper Envirotamp FR3. Each transformer shall have a minimum 5-inch diameter label indicating fluid brand.

**6.13 Tank**

Tank shall meet all the integrity requirements of IEEE C57.12.24, Section 7.5.

**Table 6.13, Minimum Material Thickness**

Transformer	Thickness, in
Tank wall	0.31
Auxiliary coolers	0.31
Cover	0.5
Tank bottom	0.5

**6.13a Tank material and finish – Standard**

Tank shall comply with IEEE C57.12.24, Section 7.5.1 and Table 6.13 with copper bearing steel tank, base, fittings and attachments. Finish shall meet IEEE C57.12.32 and be black.

**6.13b Tank material and finish – Stainless Steel**

Tank, base, fittings and attachments shall be 304L stainless steel per Table 6.13. If painted, color shall be black. Apply an automotive-type coating over the finish from the bottom of the unit to 12 inches above the base, including on the cooling fins.

**6.13c Tank grounding**

Tank grounding provision shall comply with IEEE C57.12.24, Section 7.5.9 (b) with a one-hole pad next to each high-voltage bushing and a two-hole pad on the wall near the low voltage terminals.

Coat tapped holes with oxide-inhibiting compound and plug.

**Figure 6.13c, Ground Pad**



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**6. Construction, continued****6.13d Strength**

Tank shall be designed to withstand negative and positive 7 psig per IEEE C57.12.24 Section 7.5.2. Each transformer shall be leak tested per IEEE C57.12.24 Section 7.5.2.

**6.13e Handhole**

Tank shall include a handhole to access internal components for testing. The handhole shall have a 5/16-inch minimum thickness 304L stainless steel cover per Table 6.13 of this document. The handhole shall have a minimum opening of 200 to 400 square inches and will provide access to the HoXo switch. Gasket shall be a single piece of material.

Cover shall have means for breaking the seal (seal breaking bolts).

A 1-inch fill plug shall be located in the center of the handhole cover. Plug shall consist of a pipe nipple welded to the cover and furnished with a pipe cap. See Figure 6.

**Figure 6.13e, Handhole****6.13f Drain Valve**

A one-inch globe-type drain valve shall be installed, including a 3/8-inch sampling device and a plug. The valve shall be installed on a pipe nipple welded to the tank.

**Figure 6.13f, Drain valve****6.13g Seismic Anchors**

For seismic anchoring systems, the base rails shall meet IEEE C57.12.24, Section 7.5.7 and be designed to be welded to beams imbedded in the concrete pad or floor. The details of the base rail shall be included on the outline drawing or on a separate drawing. The center of gravity shall be shown on the outline drawing.

**7. Tests****7.1 General**

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

**7.2 Dielectric Tests**

Dielectric tests shall be performed as specified in IEEE C57.12.24, Section 6 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

**7.3 Tank and Enclosure Tests**

Tests shall be performed as specified in IEEE C57.12.24, Section 6. Units shall be tested on a design basis with 7 psig negative for 30 seconds. Units shall be tested on a routine basis with 7 psig positive for 6 hours. Any permanent deformation is a failure and will be rejected.

**7.4 Short Circuit Tests**

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12 on a design basis.

**7.5 Audible Sound Levels**

Audible sound levels for each unit shall be according to the requirements of NEMA TR-1, Section 0.05 and IEEE C57.12.24, Section 7.8. Tests shall be performed per IEEE C57.12.90, Section 13 on a design basis.

**7.6 Radio Influence Voltage Test**

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03.

**7.7 Load and No-Load Tests**

Load and no-load loss measurements shall be corrected to 85 degrees C and 20 degrees C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

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## 7. Tests, continued

### 7.8 Documentation

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

### 7.9 Test Tag

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- transformer serial number
- date on which the test was performed
- name of the person who performed the test.

Figure 7.9, Test tag, example



## 8. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the transformer's understood or published capabilities.

## 9. Shipping and Handling

Each transformer shall be supplied on its own pallet.

### 9.1 Pallet Material

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

### 9.2 Support

Pallet shall be 4 inches high to accommodate lifting by both forklifts and pallet jacks.

The most central pallet stringer shall be centered and a maximum of 7 inches wide to insure picking by pallet jacks.

### 9.3 Orientation

Transformer shall be centered on pallet and secured via its pad attachments.

Transformer shall be oriented on the pallet to prevent transformer enclosure from coming into contact with pallet moving equipment or otherwise shall be enclosed by protective devices to prevent damage.

### 9.4 Arrival Condition

Transformers may be delivered on enclosed, covered, or flatbed trucks. If transformers are delivered on flatbed trucks, they shall be side-loaded. Because Washington State law requires a 10 inch minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

Transformers shall be received by Seattle City Light in clean condition.

## 10. Seattle City Light Process

### 10.1 Bid Process

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

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## 10. Seattle City Light Processes, continued

### 10.2 Loss Factors

Load and no-load loss measurements shall be corrected to 85°C and 20°C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

#### 10.2a Load Loss

Load losses shall be assessed at \$2.60 per watt.

#### 10.2b No-load Loss

No-load “core” losses shall be assessed at \$5.90 per watt.

#### 10.2c Loss Assessment

Total Price (\$) = Bid Price + Loss Total  
Loss Total = Load Loss + No-load Loss  
Load Loss = Losses (Watts) x \$2.60  
No-load Loss = Losses (Watts) x \$5.90

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Tolerances will be allowed in accordance with IEEE C57.12.90, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.10.3

### 10.3 Bid Completion

Upon completion of the bid process, the successful bidder shall submit in a single electronic file the following:

- Transformer dimensions and spare parts list
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment.

Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.6. Format test data using numbering system shown in IEEE C57.12.00, Section 8.6.

### 10.4 Inspection and Electrical Testing

Upon delivery, the transformers will be inspected for physical defects and conformance to this standard.

The transformers will be tested electrically for Radio Influence Voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), losses and a small battery of other tests.

If any transformer fails, the manufacturer will be contacted and given the option to take back the lot or take back the lot except the units that passed during initial testing.

### 10.5 Guarantee

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer’s expense, either by repair or replacement.

## 11. Issuance

**Stock Unit:** EA

## 12. Approved Manufacturers and Factories

Carte International: Winnipeg, Manitoba, Canada

## 13. References

**Hanson, Brett;** SCL Standards Engineer, subject matter expert for 4350.00 (brett.hanson@seattle.gov)

**SCL 0036.4;** “Commercial Underground-Type Transformer Three Phase, Unfused, 26 kV Natural Ester Fluid” (canceled); Material Standard

**NETWORK, THREE-PHASE, MINERAL OIL  
 DISTRIBUTION TRANSFORMERS**



**1. Scope**

This standard details the manufacturer requirements for three-phase, network transformers from 500 kVA to 2500 kVA as listed in Table 1.

**Table 1, Three-Phase, Network (S) Transformers by Stock Number**

kVA	High Voltage	Type	Low Voltage		Taps
			216Y/125	480Y/277	
500	13 750	ΔY	386460	386860	5
750	"	ΔY	386466	386866	5
1000	"	ΔY	-	386872	5
1500	"	ΔY	-	386876	5
2000	"	ΔY	-	386878	5
2500	"	ΔY	-	386880	5
500	26 400	ΔY	389460	389860	5
750	"	ΔY	389466	389866	5
1000	"	ΔY	-	389872	5
1500	"	ΔY	-	389876	5
2000	"	ΔY	-	389878	5
2500	"	ΔY	-	389880	5
500	26 400GrdY/15 242	YY	380560	380160	5
750	"	YY	380566	380166	5
1000	"	YY	380572	380172	5
1500	"	YY	-	380176	5
2000	"	YY	-	380178	5
2500	"	YY	-	380180	5

**2. Application**

This class of transformers is installed in building vaults in network areas. On the primary side cables are connected to a non-loadbreak switch. On the secondary side, the transformer has provisions to support a throat-mounted network protector. As of this publication, these units make up a few percent of the transformers installed annually in the Seattle City Light distribution system.

**3. Industry Standards**

Transformers shall meet the applicable requirements of the following industry standards:

**ASTM D3487-09**; "Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus"

**IEEE C57.12.40-2011**; "IEEE Standard for Secondary Network Transformers, Subway and Vault Types (Liquid Immersed)"

**DOE 10 CFR Part 431**; "Energy Efficiency Program for Certain Commercial and Industrial Equipment"; Department of Energy

**IEEE 386-2006**; "IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V"

**IEEE C57.12.00-2010**; "Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.12.32-2002**; IEEE Standard for Submersible Equipment – Enclosure Integrity

standards coordinator	standards supervisor	unit director
 Brett Hanson	 John Shipek	 Darnell Cola

# Material Standard

Network, Three-Phase, Mineral Oil Distribution Transformers

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### 3. Industry Standards, continued

**IEEE C57.12.70-2000**; "IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers"

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

**RCW 19.29.010, Rule 5 -2011**; Revised Code of Washington, Rules for Test Tag

### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. City of Seattle General Terms and Conditions
3. This material standard
4. Other industry standards

### 5. Ratings

#### 5.1 Kilovolt-Ampere Ratings

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.40, Section 3.1 and be 500, 750, 1000, 1500, 2000, 2500 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings shall be continuous and based on 55°C/ 65° C average winding temperature rise.

The transformers shall have a temperature rise insulation system of 65 °C.

#### 5.2 Voltage Ratings

Voltage ratings shall be as follows, or as specified on the purchase order:

- 13 750 – 216Y/125 Volts or
- 13 750 – 480Y/277 Volts or
- 26 400 – 216Y/125 Volts or
- 26 400 – 480Y/277 Volts or
- 26 400 GrdY/15 242 – 216Y/125 Volts or
- 26 400 GrdY/15 242 – 480Y/277 Volts

### 6. Construction, General

Transformers shall be according to the requirements of Figure 6 and Table 6 of this document.

Transformers shall be suitable for continuous submerged operation and comply with IEEE C57.12.40 Figure 1 with the following clarifications:

BIL shall be 95kV for 13 750V units per IEEE C57.12.40, Section 3.4.

BIL shall be 125kV for 26 400V and 26 400GrdY/15 242V units per IEEE C57.12.40, Section 3.4.

Polarity shall be subtractive.

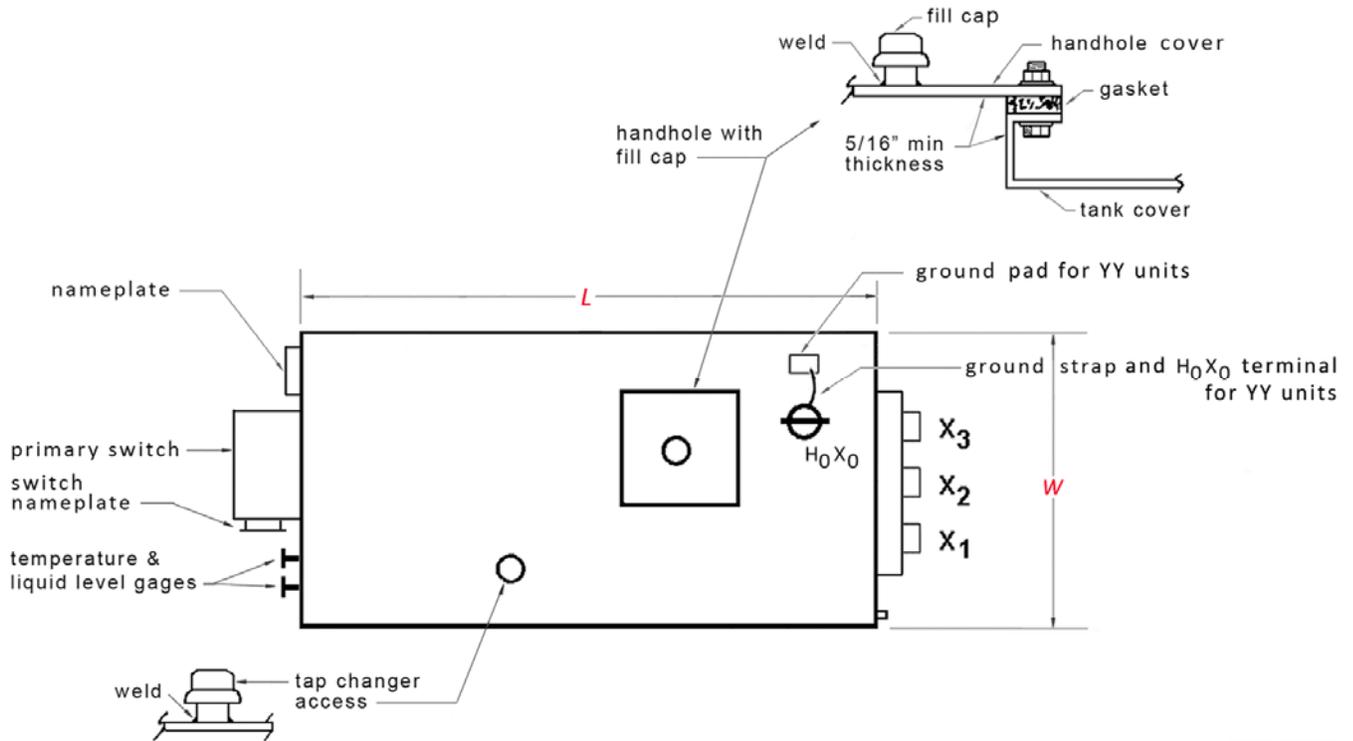
Transformers shall be constructed with either a 5-legged core or a triplex core to mitigate tank heating due to unbalanced loads or faults.

**Material Standard**

Network, Three-Phase, Mineral Oil Distribution Transformers

**6. Construction, continued**

**Figure 6,** Transformer showing location of the terminals and accessories, based on IEEE C57.12.40, Figure 1.



**Table 6, Transformer Dimensions**

	kVA					
	500	750	1000	1500	2000	2500
<b>13 750V W x L x H,</b> inches, max, with "H" being the height from base to highest point	44 x 78 x 70	47 x 84 x 74	52 x 86 x 84	56 x 96 x 86	64 x 105 x 96	70 x 105 x 96
<b>13 750V Throat Centerline Height,</b> inches, max	48	55	57	62	70	75
<b>26 400V W x L x H,</b> inches, max, with "H" being the height from base to highest point	46 x 87 x 70	48 x 93 x 74	55 x 97 x 78	60 x 100 x 86	70 x 115 x 89	75 x 129 x 95
<b>26 400V Throat Centerline Height,</b> inches, max	55	61	60	65	70	75

**Material Standard**

Network, Three-Phase, Mineral Oil Distribution Transformers

standard number: **4370.00**superseding: new  
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page: 4 of 13**7. Primary Bushings and Switch**

The primary bushings and primary switch shall be supplied either in a combined chamber, see Section 7.1 for this preferred construction type or in separate chambers, see Section 7.2. See Section 7.6 for chamber paint requirements.

**7.1 Combined bushing and switch chamber**

Combined bushing and switch chambers must meet all the requirements of Section 7.2 of this document except that duplicate provisions for filling, air testing, liquid level indication, and draining shall not be provided.

Combined chamber viewing window must also permit visual confirmation that primary bushings are in contact with oil.

Primary bushing components shall not be used to support switch contacts. Flexible cables must connect these components.

**Figure 7.1, Bushing and Switch Chamber****7.2 Separate Bushing and switch chambers**

Primary bushing and switch chambers will meet IEEE C57.12.40 Section 6 and 7 and Figures 1 and 2 with the following clarifications:

- Primary bushing and switch chambers shall have a bolted and gasketed cover similar to the handhole cover in Figure 6. Bolts, nuts, and washers shall be

silicon bronze or stainless steel. The gasket will be made from cork and synthetic rubber (Buna-N). Gasket shall be a single piece of material. Cover shall have a means for breaking the seal (seal breaking bolts).

- Primary bushing and switch chambers shall be shipped drained of oil and filled instead with dry air or nitrogen at 2 psig.
- Primary bushing chamber shall have the provisions listed in IEEE C57.12.40 Section 5.5 and Figure 2a to facilitate filling, air testing, liquid level indication, and draining. Plugs shall have brass hex heads. Drain valve plug shall be brass with a 13/16-inch square head.
- Primary cable entrance shall be by bushing per IEEE C57.12.40 Section 7.1.3.
- Switch chamber shall have the provisions listed in IEEE C57.12.40 Section 5.5 to facilitate filling, air testing, liquid level indication, and **draining. Plugs shall have brass hex heads.** Drain valve plug shall be brass with a 13/16-inch square head.
- Switch chamber will include a viewing window sized to provide view to the switch blades in all three positions. Window shall be protected with a metal cover, hinged at the top.
- Primary chamber shall include a cover to protect the bushings during shipment and storage outside.

**7.3 Primary Bushings**

Three 600 amp high-voltage bushings shall be welded to the chamber and supplied with external removable studs. Bushings shall be the following:

Elastimold K650T1

City Light connects these transformers to 600 amp Elastimold K655BSR straight cable housings. Each bushing shall be supplied with a tight-fitting UV resistant dust cap installed for shipment and storage outside.

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page: 5 of 13**7. Primary bushing and switch, continued****7.4 Primary Switch**

The primary switch shall comply with the requirements of IEEE C57.12.40 Section 6 with the following clarifications:

- Switch shall be capable of interrupting magnetizing current per IEEE C57.12.40 Section 6.2.3.2.
- One interlock shall be provided per IEEE C57.12.40 Section 6.2.6.2 to prevent moving the switch from closed to open when the feeder is energized. This will lock when de-energized.
- A second interlock shall be provided per IEEE C57.12.40 Section 6.2.6.2 to prevent moving the switch to the ground position when it is energized.
- Interlock coils shall be rated 125V for 216Y/125V units and 277V for 480Y/277V units. This rating shall be permanent and visible when the cover is removed.

**7.5 Switch Nameplate**

Nameplate shall be stainless steel and affixed to the switch chamber with stainless steel fasteners and state the following in minimum 1/4-inch tall letters:

- CAUTION: NON-LOADBREAK SWITCH
- This switch will interrupt transformer exciting current only. Do not interrupt load current.
- Switch chamber with disconnect and grounding switch.
- Two interlock circuits, single phase.
- Hertz
- Rated Voltage
- Rated Amperes
- Direct current test voltage
- Momentary amperes when closed
- Type of insulating oil

**7.5 Switch Nameplate, continued**

- Switch chamber volume in gallons.
- Serial number
- Switch manufacturer name
- Maintenance manual number

**7.6 Chamber Paint**

The inside face of the chambers including the flange face shall have the following paint system applied:

- Primer consisting of one coat DuPont 824S light gray Corlar epoxy with a DuPont 826S activator.
- Topcoat consisting of two coats of preservative high performance coating tripoxy polyamide 88-580 white or black and a preservative 88-101 clear coat.

**8. Tank Construction****8.1 Low-Voltage Terminals**

Terminals shall be constructed per IEEE C57.12.40, Section 7.3 and Figure 4 with the following clarifications:

- Transformer low-voltage neutral terminal shall be copper and bolted.
- The electric interlock bushing in the low-voltage throat shall be furnished with a 10-32 or 1/4-20 threaded stud.
- Wye-wye transformers shall be provided with an HoXo switch to disconnect the primary neutral from the secondary neutral to allow for testing. HoXo switch shall be hand operable without tools and accessible only from within the handhole. The top of HoXo switch operating mechanism shall be submerged no more than 6-inches below the 25° C insulating fluid level.
- Transformers shall be provided with a cover-mounted HoXo bushing and an additional ground pad nearby to match the ground pad required in Section 6.13c of this document. HoXo terminal shall be sized per Table 10 and connected to the ground pad via a removable strap per IEEE C57.12.40 Section 8.2.

**Material Standard**

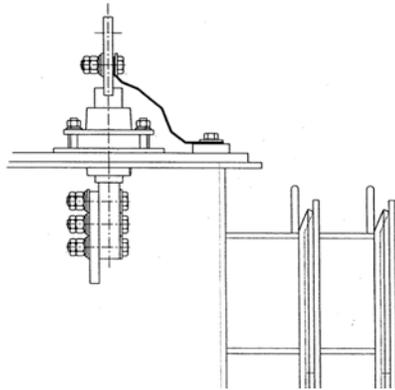
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**8. Tank Construction, continued**

**Figure 8.1, H<sub>0</sub>X<sub>0</sub> Terminal and Ground Pad**



**8.2 Taps**

A full-capacity de-energized tap changer shall be supplied and located per Figure 6 of this document. Taps shall comply with C57.12.40 Section 3.2 and Table 8.2 below.

**Table 8.2, Tap Voltages**

Voltage	Taps
13750ΔY	14438 /14094 /13750 /13406 /13063
26400ΔY	27720 /27060 /26400 /25740 /25080
26400YY	27060 /26400 /25740 /25080 /24420

Tap changer shall be externally operated via a pipe nipple welded to the cover and a pipe cap located per Figure 6. A stainless steel tap position indicating plate shall be provided next to the operating mechanism. An unpainted stainless steel, galvanized steel, or copper alloy tap changer wrench shall be provided in a holder, mounted near the tap changer.

**Figure 8.2, Tap Changer**



**8.3 Percent Impedance**

The percent impedance for these transformers shall be per IEEE C57.12.40, Section 3.5.

**8.4 Liquid Level Marking**

**8.4a Liquid Level Indicator**

Liquid level indicator shall be provided per IEEE C57.12.40, Section 5.5.5.4 with the following clarifications:

- Indicator shall be welded type.
- Indicator shall have non-grounded alarm contacts suitable for interrupting at 0.2 Amp DC inductive or non-inductive load and 2.5 Amp AC inductive or non-inductive load. Contacts shall be insulated for use on a 250V circuit and calibrated for minimum acceptable liquid level.
- 2.5 Amp AC inductive or non-inductive load. Contacts shall be insulated for use on a 250V circuit and calibrated for minimum acceptable liquid level.

**8.4b Thermometer**

Thermometer shall be provided per IEEE C57.12.40, Section 5.7.4.

Indicator shall have nongrounded alarm contacts suitable for interrupting at 0.2 Amp DC inductive or non-inductive load and 2.5 Amp AC inductive or non-inductive load. Contacts shall be insulated for use on a 250V circuit and calibrated for 80 °C.

**8.5 Lifting Provisions**

Lifting lugs shall be of adequate strength and size and arranged to provide for lifting and lowering the complete transformer when filled with oil, including the attached network protector, per ANSI C57.12.40, Section 5.3.4 except that the lifting lugs shall be arranged such that they can also be used to strap the transformer to a flat bed truck without damaging the coolers or other accessories. Moving will be done with Hilman rollers. Each rail end (4 locations), shall have a 7/16-inch diameter hole drilled in the subbase bar, centered 4-inches from the end and 5/8-inch from the bottom for the purpose of connecting

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standard number: **4370.00**

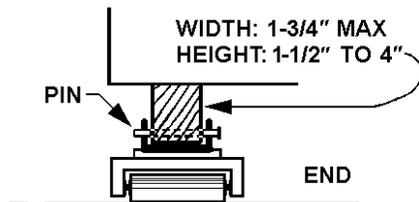
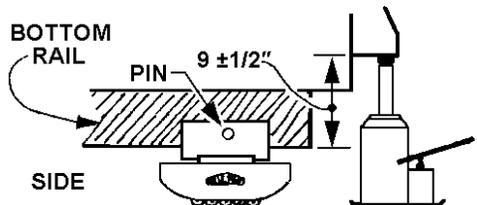
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**8. Tank Construction, continued**

**8.5 Lifting Provisions, continued**

the Cat Track to the transformer. Each end of the subbase bar shall have a 1-1/4-inch by 8-inch area masked from undercoat paint, centered on the hole to prevent paint and Cat Track interference. Subbase bar shall be 1-3/4-inches wide maximum to insure it can fit in the Hilman channel.

**Figure 8.5, Lifting Provisions**



**8.6 Pressure Relief**

Pressure relief devices shall not be installed.

**8.7 Enclosure Integrity**

The completely assembled transformer enclosure shall comply with IEEE C57.12.32. Switch compartment shall be constructed per IEEE C57.12.40 Section 5.3.1.

**8.8 Polarity, Terminal Markings, and Angular Displacement**

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.40, Section 7.4.

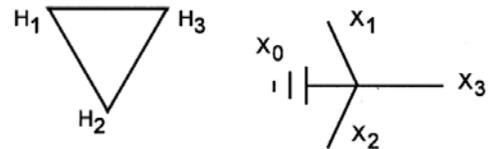
Primary terminals, secondary terminals, and ground pads shall be marked with minimum 1-inch tall letters.

Transformers shall be connected per Figure 8.8.

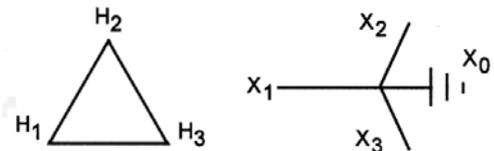
**Figure 8.8, Phase Relationships**

Rated Voltage:

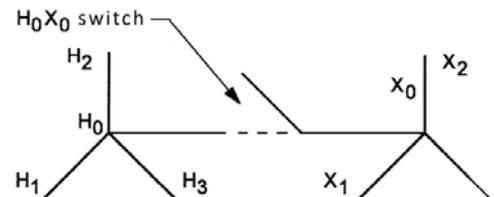
13 750-216Y/125 and 13 750-480Y/277



26 400-216Y/125 and 26 400-480Y/277



26 400Y/15 242-216Y/125 and  
 26 400Y/15 242-240Y/277



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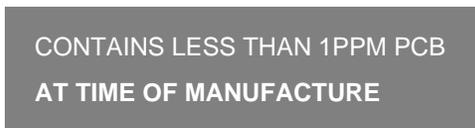
**8. Tank Construction, continued**

**8.9 Nameplate**

Nameplate shall be according to the requirements of IEEE C57.12.40, Section 9 and IEEE C57.12.00, Section 5.12 (Nameplate C for all kVA ratings) with the following clarifications:

- Nameplate shall be 300-series stainless steel and affixed to the transformer with stainless steel or silicon bronze fasteners.
- Class shall be ONAN.
- BIL shall be listed.
- Tested impedance shall be listed.
- Tested X/R ratio shall be listed.
- Total weight in pounds shall be indicated for each individual transformer.
- Volume in US gallons of insulating fluid shall be indicated.
- Tank design pressures shall be listed to comply with Section 8.11d of this document.
- HoXo switch shall be shown in the phasor diagram and schematic.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

**Figure 8.9, Nameplate, PCB statement**



**8.10 Fluid**

Inhibited naphthenic mineral oil complying with ASTM D3487 Type II shall be provided in the transformer up to the liquid level marking.

**8. Tank Construction, continued**

**8.11 Tank**

Tank shall meet the integrity requirements of IEEE C57.12.40, Section 5.3 and IEEE C57.12.32.

**8.11a Tank material**

Tank shall comply with IEEE C57.12.40 Section 5.2.1 and Table 8.11a.

**Table 8.11a, Material Thickness**

Transformer	Thickness, minimum, in
Tank Wall	0.31
Switch housing	0.31
Auxiliary coolers	0.31
Cover	0.5
Tank bottom	0.5

**8.11b Tank finish**

Tank finish shall comply with IEEE C57.12.32 and be black. Finish shall include a minimum of three coats of paint and an automotive-type undercoat that extends up to 12-inches above the base.

**8.11c Tank grounding**

Tank grounding provision shall comply with IEEE C57.12.40, Section 5.7.7 with a pad below the primary bushing compartment and a second pad below the low voltage terminals located to avoid the network protector cabinet. Tapped holes shall be coated with an oxide-inhibiting compound and plugged.

**Figure 8.11c, Ground Pad**



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**8. Tank Construction, continued****8.11d Strength**

Tank shall be designed and tested to withstand negative and positive 7 psig per IEEE C57.12.40 Section 5.3.1.

**8.11e Handhole**

Tank shall include a handhole to access internal components for testing. The handhole shall have a 5/16-inch minimum thickness and be made of 300 series stainless steel. The handhole shall have a minimum opening of 200 to 400 square inches and provide access to the HoXo switch on Wye-wye transformers. Gasket shall be a single piece of cork-rubber material. Cover shall have a means for breaking the seal (seal breaking bolts).

A 1-1/2-inch fill plug shall be located in the center of the handhole cover. Plug shall consist of a pipe nipple welded to the cover and furnished with a pipe cap. See Figure 6.

The inside face of the handhole shall have the following paint system applied:

- Primer consisting of one coat DuPont 824S light gray or black Corlar epoxy with a DuPont 826S activator.
- Topcoat consisting of two coats of preservative high performance coating tripoxy polyamide 88-580 white or black and a preservative 88-101 clear coat.

**Figure 8.11e, Handhole****8.11f Drain valves**

Each drain valve shall be one-inch and include a 13/16-inch brass plug with square head. The valve shall be installed on a pipe nipple welded to the tank. Filter press connections shall not be installed.

Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

**Figure 8.11f, Drain valve****8.11g Air Test Provision**

Tank shall be supplied with an air test provision per IEEE C57.12.40 Section 5.7.2. Plug shall be brass with a hex head.

An additional 1/4-inch opening shall be provided and equipped with a 1/4-inch brass plug with a hex head. This opening shall be located on the tank wall, above the 85°C liquid level, on the primary end above the primary terminal chamber extension.

**8.12 Transformer Anchor Beams**

Transformer shall be supplied with two anchor beams constructed per the Figures 6.14a, 6.14b, and 6.14c with the following clarifications:

- Structural steel shall meet ASTM A-36
- Paint shall match tank paint. See Section 8.11b.

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**8. Tank Construction, continued**

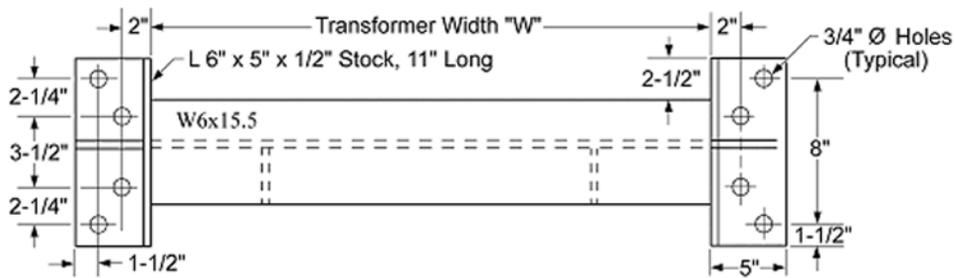
**8.12 Transformer Anchor Beams, continued**

For shipment and storage, the anchor beams shall be securely attached to each transformer tank, in a vertical position to prevent the collection of water and debris. Each end of the anchor beams shall be attached to the transformer via four 5/8-inch x 1-1/2-inch welded-on stud bolts, nuts and washers. The anchor beams shall be positioned and cushioned to prevent damage the transformer finish. See Figure 8.12d.

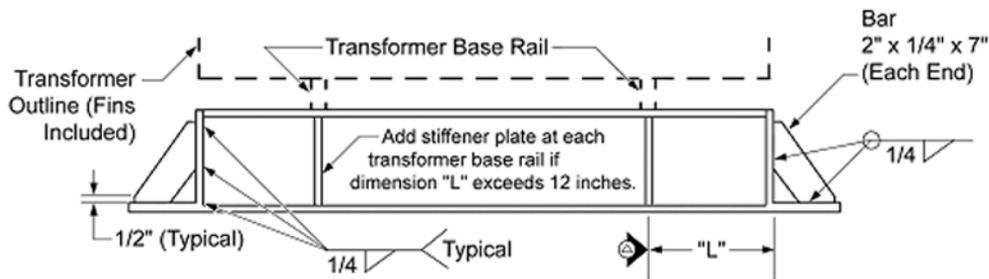
**Figure 8.12d, Transformer Anchor Beams**



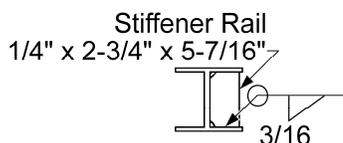
**Figure 8.12a, Beam plan view**



**Figure 8.12b, Beam elevation**



**Figure 8.12c, Stiffener Detail**



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**9. Tests**

**9.1 General**

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

**9.2 Dielectric Tests**

Dielectric tests shall be performed as specified in IEEE C57.12.40, Sections 3.4, 6.2.4, and 6.2.5 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

**9.3 Tank and Enclosure Tests**

Tests shall be performed as specified in IEEE C57.12.40, Section 4 and IEEE C57.12.32. Units shall be tested on a design basis with 7 psig negative for 30 seconds. Units shall be tested on a routine basis with 7 psig for 6 hours. Any permanent deformation is a failure and will be rejected.

**9.4 Short Circuit Tests**

Short circuit tests shall be performed as specified in IEEE C57.12.90, Section 12 on a design basis.

**9.5 Audible Sound Levels**

Audible sound levels for each unit shall be according to the requirements of IEEE C57.12.40 Section 3.6. Tests shall be performed per IEEE C57.12.90, Section 13 on a design basis.

**9.6 Radio Influence Voltage Test**

Radio influence voltage shall be according to the requirements of NEMA TR-1, Section 0.03 and the table below.

**Table 9.6**

H.V. Rating	Test Voltage	Maximum RIV, microvolts
13 750	9.2 kV	250
26 400	17.4 kV	250
26 400Y/15242	17.4 kV	250

**9.7 Load and No-Load Tests**

Load and no-load loss measurements shall be corrected to 85 degrees C and 20 degrees C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

**9.8 Polarization Index**

A Polarization Index test shall be performed on the high voltage windings to confirm moisture level. This consists of comparing a 1000 V megger test at minute one and later at minute ten. The index shall be 1.2 or higher.

**9.9 Documentation**

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

**9.10 Test Tag**

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- transformer serial number
- date on which the test was performed
- name of the person who performed the test.

**Figure 9.10, Test tag, example**



**Material Standard**

Network, Three-Phase, Mineral Oil Distribution Transformers

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page: 12 of 13**10. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the transformer's understood or published capabilities.

**11. Shipping and Handling**

Each transformer shall be supplied on its own pallet.

**11.1 Pallet Material**

Pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

**11.2 Support**

Pallet shall be 4 inches high to accommodate lifting by both forklifts and pallet jacks.

The most central pallet stringer shall be centered and a maximum of 7 inches wide to insure picking by pallet jacks.

**11.3 Orientation**

Transformer shall be centered on pallet and secured via its pad attachments.

Transformer shall be oriented on the pallet to prevent transformer enclosure from coming into contact with pallet moving equipment or otherwise shall be enclosed by protective devices to prevent damage.

**11.4 Arrival Condition**

Transformers may be delivered on enclosed, covered, or flatbed trucks. If transformers are delivered on flatbed trucks, they shall be side-loaded. Because Washington State law requires a 10 inch minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

Transformers shall be received by Seattle City Light in clean condition.

**12. Seattle City Light Process****12.1 Bid Process**

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

**12.2 Loss Factors**

Load and no-load loss measurements shall be corrected to 85°C and 20°C, respectively according to the requirements of IEEE C57.12.00, Section 5.9 and shall comply with IEEE C57.12.90.

**12.2a Load Loss**

Load losses shall be assessed at \$1.30 per watt.

**12.2b No-load Loss**

No-load "core" losses shall be assessed at \$5.90 per watt.

**12.2c Loss Assessment**

Total Price (\$) = Bid Price + Loss Total

Loss Total = Load Loss + No-load Loss

Load Loss = Losses (Watts) x \$1.30

No-load Loss = Losses (Watts) x \$5.90

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Individual transformers that exceed the load loss and no-load loss testing tolerances as stated in IEEE C57.12.90, Section 9.3 may be rejected and returned to the manufacturer.

**12.3 Bid Completion**

Upon completion of the bid process, the successful bidder shall submit in a single electronic file the following:

- Transformer dimensions and spare parts list
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment.
- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.6. Format test data using numbering system shown in IEEE C57.12.00, Section 8.6.

## MATERIAL STANDARD

Network, Three-Phase, Mineral Oil Distribution Transformers

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### 12. Seattle City Light Process, continued

#### 12.4 Inspection and Electrical Testing

Upon delivery, transformers will be inspected for physical defects and conformance to this standard.

Transformers will be tested electrically for Radio Influence, losses and a small battery of other tests.

If any transformer fails, the manufacturer will be contacted and given the option to take back the lot or take back the lot except the units that passed during initial testing.

#### 12.5 Guarantee

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

### 13. Issuance

**Stock Unit:** EA

### 14. Approved Manufacturers and Factories

Carte International	Winnipeg, Manitoba, Canada
Quality Switch Inc.	Newton Falls, Ohio

### 15. References

**Hanson, Brett;** SCL Standards Engineer, subject matter expert for 4370.00  
(brett.hanson@seattle.gov)

**SCL 0038.3;** "Network Transformers – Subway Type 13 kV and 26 kV" (canceled); Material Standard

# MATERIAL STANDARD

## PROTECTOR, SECONDARY NETWORK, TRANSFORMER-MOUNTED, SUBMERSIBLE

### 1. Scope

This specification is for three-phase, submersible, transformer-mounted, network protectors to be installed on a 60-Hertz, 4-wire, solidly grounded neutral, 3-2-1 counterclockwise phase rotation system of 216Y/125 volts or 480Y/277 volts.

### 2. General

- 2.1 The network protectors furnished under this specification shall be complete with circuit breaker, operating mechanism, and auxiliary apparatus. Network protector relays and fuses shall not be supplied with the protectors but will be purchased separately.
- 2.2 The network protectors shall meet or exceed the applicable requirements of IEEE C57.12.44, 1994, except as modified herein.

### 3. Ratings

The ratings shall be as shown below. Protector ratings and voltage will be specified in the requisition.

### 4. Construction

- 4.1 The protectors shall have bushings with copper spades that are NEMA standard drilling with 9/16-inch holes on 1-3/4-inch centers for two-hole connectors. Side-to-side spacing for spades shall be 1-3/4 inches.
- 4.2 The interior of the protector housing shall be painted white.
- 4.3 The submersible enclosure door shall open a minimum of 160 degrees when hinged on either side.

### 5. Special Features

- 5.1 The network protectors shall be wired for counterclockwise phase rotation of 3-2-1.
- 5.2 A nominal 125-volt to neutral (ground) single-phase circuit shall be provided from the transformer side of the breaker for external pilot lights. This 125-volt circuit may also be used for motor, control, or relay circuits as required. The external pilot load will not exceed 100 watts at 125 volts.
- 5.3 Two spark plug insulated bushings shall be installed on the side of the enclosure for the installation of external pilot lights.
- 5.4 Two stages (one "a" and one "b") on the auxiliary switch shall be wired for external pilot light control with a common point of the two stages connected to the 125-volt source (Section 5.2) and the "a" and "b" terminals connected to the spark plug bushings.
- 5.5 One "b" stage on the auxiliary switch will be wired in series between the network side of the breaker and the spark plug bushing in the throat of the transformer by Seattle City Light. The manufacturer shall supply a coil of wire of sufficient length to make this connection. One end of the coil shall be connected to the "b" stage of the auxiliary switch.
- 5.6 All protectors shall have provisions for external trip and lockout circuits, including two normally closed lockout terminals and two normally open trip terminals. Their external connections shall be made through a submersible connector or connectors on the side of the case. The two external contacts for the lockout circuit shall come jumpered outside the case. The protector shall be configured such that, when the trip terminals are externally connected, the protector trips and, when the lockout terminals are externally disconnected, the protector is locked out from closing. The external terminals of the waterproof connector(s) shall be covered by a waterproof junction box with two-3/4 inch threaded taps and plugs, one tap and plug located on the top of the junction box and the other tap and plug on the transformer side of the box. The four trip and lockout terminals shall be labeled.
- 5.7 As described in IEEE C57.12.44 section 10.5.8 (except as noted), the protector enclosure shall be provided with a grounding pad welded to the lower part of the protector side wall on the right side facing the protector door (XO side of transformer). The grounding pad shall be 3/4-inches thick minimum.
- 5.8 The current transformer circuit shall be grounded on all type CM22 and 313NP protectors.
- 5.9 A 1/2" N.P.T. hole shall be provided in the lower part of the protector side wall.
- 5.10 Total network protector weight shall be shown on the nameplate.
- 5.11 Grade 5 or equivalent mounting bolts shall be included with the network protector.

Standards Coordinator  
Laura Vanderpool

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola





# MATERIAL STANDARD

## 6. Wiring Diagrams and Schematics

The wiring diagrams and schematics shall indicate counterclockwise phase rotation of 3-2-1.

## 7. Tests

The protector shall be completely assembled, adjusted, and operationally tested and ready for installation.

## 8. Data to be Supplied by Bidder

Each bidder shall submit with his proposal the data listed below. Product evaluation and conformance with specifications will be determined strictly on the basis of information submitted. The drawings and data furnished must be in sufficient detail and clarity to enable making a complete and positive check with the technical provisions of the specification.

- A. Outline drawings with overall dimensions.
- B. Information concerning details of construction and operation.
- C. Total weight of the unit.
- D. Standard factory tests.
- E. Schematic wiring diagrams.
- F. Proposed changes, additions, or exceptions to this specification and the reasons for the departure.

## 9. Data to be Submitted by the Successful Bidder

The successful bidder shall supply the data listed below. The data shall be delivered to Seattle City Light, attention Material Control, 3613 4th Avenue S., Seattle, Washington 98134-2207.

- A. Three copies of certified reports of all standard factory tests.
- B. Three copies of detailed drawings showing construction and mounting dimensions.
- C. Three copies of complete schematic and connection diagrams.
- D. Three copies of complete maintenance and testing information including instruction books and diagrams.
- E. A parts catalog, together with suggested stock of renewal parts for the number of protectors furnished.

## 10. Guarantee and Penalties

- 10.1 Any protector failing, due to defective design, material, and/or workmanship, within twelve months after being energized or eighteen months after delivery, whichever comes first, shall be replaced or repaired without cost to the City of Seattle City Light Department. Any defect in design, material, and/or construction discovered within this period shall be corrected on all units furnished on this order, at the manufacturer's expense, either by repair or replacement.
- 10.2 Upon delivery, all protectors will be tested and inspected. Protectors that fail to pass the tests will be returned to the manufacturer. The cost of retesting protectors that have been returned to the manufacturer for correction of defects will be charged to the manufacturer.

**Reference specifications:** ANSI C57.12.40 and IEEE C57.12.44.

Stock Number	Protector Rating		Approved Manufacturers	
	Volts	Amps	™Cutler-Hammer	ETI
336205	216Y/125 - 480Y/277	±1875	Order by description	313NP
336207	216Y/125 - 480Y/277	2825	Order by description	313NP
334209	480Y/277	3500	Order by description	313NP

± 1875 ampere protectors shall be equipped with 800/1200/1600:5 multiple rated current transformers.

™ **Cutler-Hammer** Protectors shall be type CMD or CM22 as specified on the purchase order.

**SCL Material Standard 3322.0**; "Secondary Network, Transformer-Mounted, Submersible" (renumbered to 4381.36 in October 2015).

**MODIFIED PROTECTOR, SECONDARY NETWORK  
WALL-MOUNTED, SUBMERSIBLE**

**1. Scope**

This specification is for three-phase, submersible, wall-mounted, network protectors for use as bus tie disconnect switches on a 60-Hertz, 4-wire, solidly grounded neutral 3-2-1 counterclockwise phase rotation system of either 216Y/125 volts or 480Y/277 volts.

**2. General**

- 2.1 The modified protectors shall be complete with circuit breaker, operating mechanism for manual closing, auxiliary apparatus, and provisions for fuses. Removable copper links shall be supplied in place of the fuses.
- 2.2 The modified protectors shall be provided with their normal rated current transformers, the secondaries of which are connected to a terminal block and short-circuited with jumpers. The current transformers will be used for remote monitoring.
- 2.3 The modified protectors shall meet or exceed the applicable requirements of the latest revision of ANSI C57.12.44 except as modified herein.

**3. Ratings**

The ampere ratings shall be as shown below and will be specified in the purchase requisition. Any modified protector shall be able to operate on either 216Y/125-volt or 480Y/277-volt systems by manual operation of an internal selector switch.

**4. Construction**

- 4.1 The modified protectors shall be suitable for wall mounting without the removal of any external housing components.
- 4.2 The modified protectors shall have threaded copper studs supplied for the line and load side. For ratings 1,875 amperes or less, the studs shall be 1½" in diameter, and for over 1,875 amperes the studs shall be 3" in diameter.
- 4.3 The modified protectors shall have removable feet capable of supporting the weight of the protector and providing 9" of clearance between the studs and the floor.
- 4.4 The interior of the modified protector housing shall be painted white.
- 4.5 The housing external ground provisions shall be located on the side near the bottom and shall consist of an unpainted copper, copper-faced steel, or stainless steel pad 2" x 3½" (50 mm x 89 mm) minimum, with two ½"-13 UNC tapped holes at 1¾" on centers and ½" deep threads. The tapped holes shall be filled with an oxide-inhibiting compound. The pad shall be oriented vertically.
- 4.6 A 13/16" diameter mounting hole shall be provided at each corner of the protector. The mounting holes shall be accessible from the front and not covered or blocked by the cable bushings or other appurtenances.

Standards Coordinator  
Laura Vanderpool



Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



**MODIFIED PROTECTOR, SECONDARY NETWORK  
WALL-MOUNTED, SUBMERSIBLE**

**5. Special Features and Requirements**

- 5.1 A nominal 125-volt to neutral (ground) single-phase circuit shall be provided from the line side of the breaker for external pilot lights. This 125-volt circuit may also be used for relay circuits as required. The external pilot load will not exceed 100 watts at 125 volts.
- 5.2 Two spark plug insulated bushings shall be installed on the side of the enclosure for the installation of external pilot lights.
- 5.3 Two stages (one "a" and one "b") on the auxiliary switch shall be wired for external pilot light control with a common point of the two stages connected to the 125-volt source (Section 5.1) and the "a" and "b" terminals connected to the spark plug bushings.
- 5.4 A third stage on the auxiliary switch shall be a "b" contact wired to a terminal block.
- 5.5 All modified protectors shall have provisions for an external trip circuit requiring two external connections. The external connections shall be made through a submersible connector or connectors (spark plugs) on the side of the protector case and shall be enclosed by a waterproof junction box. The top of the junction box shall have a 1/2" NTP threaded hole with a pipe plug installed.
- 5.6 The nameplate shall show the weight of the network protector.

**6. Tests**

The modified protector shall be completely assembled, adjusted, and operationally tested and ready for installation.

**7. Data to be Supplied by Bidders**

Each bidder shall submit with his proposal the data listed below. Product evaluation and conformance with specifications will be determined strictly on the basis of information submitted. The drawings and data furnished shall be in sufficient detail and clarity to enable making a complete and positive comparison with the technical provisions of the specification.

- (a) Outline drawings with overall dimensions
- (b) Information concerning details of construction and operation
- (c) Total weight of the unit
- (d) Standard factory tests
- (e) Schematic wiring diagrams
- (f) Proposed changes, additions, or exceptions to this specification and the reasons for the departure

**8. Data to be Submitted by the Successful Bidder**

The successful bidder shall supply the data listed below. The data shall be delivered to Seattle City Light, attention Network Distribution Engineering, 700 Fifth Avenue, Suite 3100, Seattle, WA 98104-5031.

- (a) Three copies of certified reports of all standard factory tests
- (b) Three copies of detailed drawings showing construction and mounting dimensions
- (c) Three copies of complete schematic and connection diagrams
- (d) Three copies of complete maintenance and testing information, including instruction books and diagrams
- (e) A parts catalog with part numbers, together with a suggested stock of renewal parts for the number of protectors furnished.

**MODIFIED PROTECTOR, SECONDARY NETWORK  
 WALL-MOUNTED, SUBMERSIBLE**

**9. Guarantee and Penalties**

- 9.1 Any modified protector failing, due to defective design, material, and/or workmanship, within twelve months after being energized or eighteen months after delivery, whichever comes first, shall be replaced or repaired without cost to the City of Seattle Light Department. Any defect in design, material, and/or construction discovered within this period shall be corrected on all units furnished on that order, at the manufacturer's expense, either by repair or by replacement.
- 9.2 Upon delivery, all modified protectors will be tested and inspected. Modified protectors that fail to pass the tests will be returned to the manufacturer. The cost of retesting modified protectors that have been returned to the manufacturer for correction of defects will be charged to the manufacturer.

**Reference Specifications:** ANSI C57.12.44, latest revision

Stock Number	Protector Rating		Approved Manufacturers	
	Volts	Amps	Cutler-Hammer Type	Richards
335205	480Y/277 216Y/125	1875	CM-22	313NP Bus Tie
335207	480Y/277 216Y/125	2825	CM-22	313NP Bus Tie
335605*	480Y/277 216Y/120	1875	-	313NP-1875A-TS Dwg.#MN120048
335607*	480Y/277 216Y/120	2825	-	313NP-2825A-TS Dwg.#MN120049 Rev. 1

\* Special top bushings – special project.

**SCL Material Standard 3322.5;** “Modified Protector, Secondary Network, Wall-Mounted, Submersible” (renumbered to 4381.72 in October 2015)

**Submersible-Type, Single-Phase and Three-Phase,  
 Natural Ester Fluid, Specialty Transformers**



**1. Scope**

This standard provides the manufacturer requirements for underground, single-phase specialty transformers and three-phase auto-transformers from 25 kVA to 225 kVA. Seattle City Light (SCL) stock numbers are as listed in Tables 1.1 and 1.2.

**Table 1.1. Single-Phase Specialty Transformers**

kVA	High Voltage		Low Voltage	Taps
	125/216Y	277/480Y		
25	390001	390048	125/250	5
50	390002	390049	125/250	5
75		390050	125/250	5
100	390004	390051	125/250	3
167	390005	390055	125/250	0

**Table 1.2. Three-Phase Auto-Transformers**

kVA	High Voltage		Low Voltage	Taps
	480Y/277			
30	391124		216Y/125	5
45	391130		216Y/125	5
75	391134		216Y/125	5
112.5	391138		216Y/125	5
150	391140		216Y/125	5
225	391146		216Y/125	5

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 Brett Hanson

Standards Supervisor  
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Unit Director  
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## 2. Application

This class of transformers is used in network areas and installed in underground vaults. They are designed to be submerged under water continuously and are used to serve existing homes and small businesses whose services still connect at 125/250 V. It is no longer a standard practice to provide 125/250 V service for new buildings. As of this publication, these units represent a small percentage of the transformers installed annually in the SCL distribution system.

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## 3. Industry Standards

Transformers shall meet the applicable requirements of the following industry standards:

**Department of Energy 10 CFR Part 431**; "Energy Efficiency Program for Certain Commercial and Industrial Equipment"

**IEEE C57.12.00-2010**; "Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.12.20-2011**; "Standard for Overhead Distribution Transformers, 500 kVA and Smaller"

**IEEE C57.12.23-2009**; "Standard for Submersible Single-Phase Transformers: 167 kVA and Smaller"

**IEEE C57.12.24-2009**; "Standard for Submersible Three-Phase Transformers, 3750 kVA and Smaller"

**IEEE C57.12.28-2005**; "Standard for Pad-Mounted Equipment – Enclosure Integrity"

**IEEE C57.12.40-2011**; "IEEE Standard for Secondary Network Transformers, Subway and Vault Types (Liquid Immersed)"

**IEEE C57.12.90-2010**; "Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers"

**IEEE C57.147-2008**; "Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers"

**RCW 19.29.010, Rule 5 -2011**; Revised Code of Washington, Rules for Test Tag

**NEMA TR 1-1993 (R2000)**; "Transformers, Regulators, and Reactors"

There is currently no single industry standard for single-phase isolating transformers and three-phase auto transformers connected to a network.

---

## 4. Guidance in Case of Conflict

Where conflict exists, requirements shall apply in the following order of precedence:

1. Seattle City Light purchase order (PO)
2. City of Seattle General Terms and Conditions
3. This material standard
4. Other industry standards.

## 5. Ratings

### 5.1 Kilovolt-Ampere Ratings

Kilovolt-ampere ratings shall comply with the requirements of IEEE C57.12.23, Section 5.2. They shall be 25, 30, 45, 50, 75, 100, 112.5, 150, 167, or 225 kVA, or as specified on the purchase requisition.

Kilovolt-ampere ratings shall be continuous and based on not exceeding an average winding temperature rise of 55 °C.

The transformers shall have a temperature- rise insulation system of 65 °C.

### 5.2 Voltage Ratings

Voltage ratings shall be as follows or as specified on the purchase requisition.

- 125/216Y - 125/250 Volts
- 277/480Y - 125/250 Volts
- 480Y/277 - 216Y/125 Volts.

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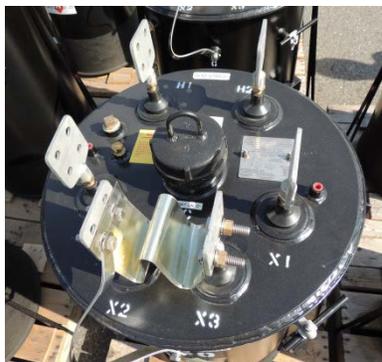
## 6. Construction

### 6.1 General

Transformers shall be constructed according to the requirements of IEEE C57.12.23 and IEEE C57.12.24 with the clarifications below and in Figures 6.1a and 6.1b.

- The BIL shall be 30 kV per IEEE C57.12.00, Table 4.
- Polarity shall be additive.
- Transformers shall be suitable for continuous submerged operation per IEEE C57.12.24 Section 4.2.
- Terminals and accessories shall be located as shown in Figures 6.1a and 6.1b.

**Figure 6.1a. Single-Phase Specialty Transformer Showing Location of the Terminals and Accessories**



**Figure 6.1b. Three-Phase Transformer Showing Location of the Terminals and Accessories**



## 6.2 High-Voltage Terminals

Terminals shall be constructed according to the requirements of IEEE C57.12.23, Section 7.2.3. All terminals shall be threaded stud type to facilitate spade replacement. See Figure 6.2.

**Figure 6.2. Threaded Terminal Stud**



## 6.3 Low-Voltage Terminals

Terminals shall be constructed according to the requirements of IEEE C57.12.23, Section 7.2.3 with the clarifications listed below:

- All terminals shall be threaded stud type to facilitate secondary lead or spade replacement. See Figure 6.2.
- Transformers shall be supplied with four low-voltage spades constructed according to the requirements of IEEE C57.12.23 Figure 2.

## 6.4 Taps

A full-capacity de-energized tap changer shall be supplied and located as shown in Figures 6.1a and 6.1b. Units shall be shipped with the tap changer set to the nominal tap.

Taps shall comply with requirements listed in Table 6.4. (Ideally, a transformer would have five taps in 2.5-percent increments, but because this cannot be consistently achieved in units of this design, the ranges described in this table are allowed.)

**Table 6.4. Taps**

kVA	Stock No.	Allowed Taps		
		Small Step %	Big Step %	Number
25	390001	2.5-3.5	5-7	5
50	390002	2.5-3.5	5-7	5
100	390004		5-6	3
167	390005		4-6	0
25	390048	2.2-3.2	4.5-5.5	5
50	390049	2.2-3.2	4.5-5.5	5
75	390050	2.3-2.8	4.7-5.2	5
100	390051	2.3-2.8	4.5-5.5	5
167	390055		4.5-5.5	3
30	391124	2.3-2.8	4.6-5.1	5
45	391130	2.3-2.8	4.7-5.2	5
75	391134	2.2-3.2	4.7-5.2	5
112.5	391138	2.2-3.2	4.7-5.2	5
150	391140	2.3-2.8	4.5-5.5	5
225	391146	2.3-2.8	4.7-5.2	5

The tap changer shall be accessible through a pipe nipple welded to the cover and enclosed by a pipe cap. A tap position indicating plate shall be provided. A stainless-steel tap changer wrench shall be provided in a holder mounted near the tap changer.

**Figure 6.4. Tap Changer Access and Wrench**



**6.5 Liquid-Level Marking**

Liquid-level indication shall be provided according to the requirements of IEEE C57.12.23, Section 7.3.

**6.6 Lifting Lugs**

Lifting lugs shall be provided according to the requirements of IEEE C57.12.23, Section 7.6.

**6.7 Enclosure Integrity**

The tank shall meet the integrity requirements of IEEE C57.12.40, Section 5.3 and IEEE C57.12.32.

**6.8 Polarity, Terminal Markings, and Angular Displacement**

Polarity, terminal markings, and angular displacement shall be according to the requirements of IEEE C57.12.23, Section 7.2. Primary terminals, secondary terminals, and ground lugs shall be marked on the lid with letters at least one inch tall.

## 6.9 Nameplate

A nameplate shall be provided that meets the requirements of IEEE C57.12.40, Section 9 and IEEE C57.12.00, Section 5.12 (Nameplate C for all kVA ratings) with the following clarifications:

- Nameplate shall be 300-series stainless steel and affixed to the transformer with stainless steel or silicon bronze fasteners.
- Class shall be KNAN.
- BIL shall be listed.
- Impedance shall be listed.
- Tested X/R ratio shall be listed.
- Total weight in pounds shall be indicated for each transformer.
- Volume of insulating fluid shall be indicated in US gallons.
- Vector diagram for three-phase transformers shall be included.
- Tap voltages shall be listed.
- Tank design pressures shall be listed to comply with Section 6.12 of this document.
- The statement "CONTAINS LESS THAN 1PPM PCB AT TIME OF MANUFACTURE." shall appear on the nameplate.

**Figure 6.9.** Nameplate, PCB Statement



## 6.10 KVA Rating

The kVA rating shall be marked on the tank and comply with IEEE C57.12.20, Section 7.3.5.

## 6.11 Fluid

Natural ester insulating fluid complying with IEEE C57.147 shall be provided in the transformer up to the liquid-level marking. Fluid shall be Cooper Envirottemp FR3. Each transformer shall have a minimum five-inch-diameter label indicating the fluid brand.

## 6.12 Tank

The tank shall meet the requirements of IEEE C57.12.40, Section 5.2 and IEEE C57.12.28.

**Tank material:** The tank shall be constructed of 304L stainless steel and comply with the requirements of IEEE C57.12.40 Section 5.2.1 Subway Type.

**Tank finish:** The tank finish shall comply with IEEE C57.12.28 and be black if paint is used.

**Tank grounding:** Single-phase transformer tank grounding shall comply with C57.12.23, Section 7.6 except a total of three ground bosses and connectors shall be provided: two on the tank wall near the primary terminals and one on the tank wall near the secondary terminals. A removable ground strap, sized for the short-circuit rating of the transformer, shall be provided and connected between the neutral terminals and the secondary ground pad. See Figure 6.12a.

**Figure 6.12a. Single-Phase Ground Lug**



The three-phase transformer tank grounding provision shall comply with IEEE C57.12.24, Section 7.5.9 (b) with a two-hole pad near the low-voltage terminals. A removable ground strap, sized for the short-circuit rating of the transformer, shall be provided and connected between the neutral terminals and the secondary ground pad. See Figure 6.12b. Two additional ground bosses and connectors that comply with C57.12.23, Section 7.6, shall be provided: one on the tank wall near the primary terminals and one on the tank wall near the secondary terminals. Unused tapped holes shall be coated with oxide-inhibiting compound and plugged.

**Figure 6.12b. Three-Phase Ground Terminal**



**Strength:** The tank shall be designed to withstand negative and positive 7 psig as specified in IEEE C57.12.24 Section 7.5.2. Each transformer shall be leak tested per IEEE C57.12.24 Section 7.5.2.

## 6.13 Dimensions

Each unit including all accessories shall not exceed a maximum height of 60 inches.

Each unit including all accessories shall be capable of being lowered into both a 28- by 40-inch rectangular hatch and 40-inch-diameter round opening.

---

## 7. Tests

### 7.1 General

All applicable tests shall be performed as specified in IEEE C57.12.00 and in IEEE C57.12.90.

### 7.2 Dielectric Tests

Dielectric tests shall be performed as specified in IEEE C57.12.23, Section 6.2 and IEEE C57.12.90, Section 10. Dielectric test levels shall be in accordance with the levels specified in IEEE C57.12.00, Section 5.10.

### 7.3 Tank Design Tests

Tests shall be performed as specified in IEEE C57.12.23 Section 6.5. Units shall be tested on a design basis with 7 psig negative for 30 seconds. Units shall be tested on a routine basis with 7 psig positive for 6 hours. Any permanent deformation is a failure and will be rejected.

### 7.4 Short-Circuit Tests

Short-circuit tests shall be performed as specified in IEEE C57.12.90, Section 12 on a design basis.

### 7.5 Audible Sound Levels

Audible sound levels for each unit shall meet the requirements of NEMA TR-1, Section 0.05. Tests shall be performed on a design basis according to the requirements of IEEE C57.12.90, Section 13.

### 7.6 Radio Influence Voltage Test

Radio influence voltage shall be tested according to the requirements of NEMA TR-1, Section 0.03.

### 7.7 Load and No-Load Loss Tests

Load and no-load loss measurements shall be corrected to 85 degree C and 20 degree C, respectively, according to the requirements of IEEE C57.12.00, Section 5.9, and shall comply with IEEE C57.12.90.

### 7.8 Documentation

Tests reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch/pound units.

### 7.9 Test Tag

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

The tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

The tag shall indicate:

- Transformer serial number
- Date on which the test was performed
- Name of the person who performed the test.

**Figure 7.9.** Test tag example



## 8. Design Changes

The manufacturer shall inform Seattle City Light in writing of all design changes that could affect the transformer's understood or published capabilities.

---

## 9. Shipping and Handling

Each transformer shall be supplied on its own pallet.

### 9.1 Pallet Material

The pallet and all pallet accessories shall be constructed of unpainted wood and suitable for yard storage through all weather conditions.

### 9.2 Support

Pallet supplied shall accommodate lifting by both forklifts and pallet jacks:

- Pallet shall be minimum 4 inches tall.
- The most central pallet stringer shall be centered and a maximum of 7 inches wide.
- The bottom of each pallet shall be open or have 8-inch openings. See Figure 9.2.

**Figure 9.2. Pallet**



### 9.3 Orientation

The transformer shall be centered on the pallet and banded to the pallet through its lifting lugs. The transformer shall be oriented on the pallet to prevent transformer accessories (secondary terminals, support lugs, etc.) from coming into contact with pallet moving equipment, or the accessories shall be enclosed by protective devices to prevent damage.

### 9.4 Shipping and Arrival Condition

Transformers may be delivered on enclosed or covered flatbed trucks. If transformers are delivered on flatbed trucks, they shall be side-loaded. Because Washington State law requires a 10-inch minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to facilitate offloading.

Transformers shall be received by Seattle City Light in clean condition.

## 10. Seattle City Light Processes

### 10.1 Bid Process

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Bids shall be organized to correspond with the sections of this standard.

Any exceptions taken to the standard shall be summarized in an attached letter with references to the numbers of affected sections in this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

### 10.2 Loss Factors

Load and no-load loss measurements shall be performed according to the requirements of Section 7.7.

**Load Loss:** Load losses shall be assessed at \$2.60 per watt.

**No-load Loss:** No-load "core" losses shall be assessed at \$5.90 per watt.

**Loss Assessment:**

$$\text{Total Price (\$)} = \text{Bid Price} + \text{Loss Total}$$

$$\text{Loss Total} = \text{Load Loss} + \text{No-load Loss}$$

$$\text{Load Loss} = \text{Losses (Watts)} \times \$2.60$$

$$\text{No-load Loss} = \text{Losses (Watts)} \times \$5.90$$

The manufacturer will be assessed a penalty for transformers delivered that exceed the total loss value stated and calculated on the bid proposal. The penalty shall be the difference between the total loss values delivered less the total loss value in the bid proposal.

Loss penalties will be calculated on the basis of the average tested losses of all transformers of a given SCL stock code built to a given SCL purchase order.

Tolerances will be allowed in accordance with IEEE C57.12.00, Section 9.3, except, tolerances shall apply to transformers of a given size and voltage; i.e., one line item. Individual transformers that exceed these tolerances may be rejected and returned to the manufacturer.

### 10.3 Bid Completion

Upon completion of the bidding process, the successful bidder shall submit in a single electronic file the following:

- Transformer dimensions
- Nameplate
- Loss data
- Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment
- Certified test data for each transformer type bid and for every category listed in IEEE C57.12.00, Section 8.7. Format test data using numbering system shown in IEEE C57.12.00, Section 8.7.

#### 10.4 Inspection and Electrical Testing

Upon delivery, the transformers will be inspected for physical defects and conformance to this standard.

The transformers will be tested electrically for radio influence voltage (per NEMA TR-1, Section 7 at 1MHz and 17.4kV, RIV not to exceed 100 microVolts), losses and a small battery of other tests.

If any transformers fail, the manufacturer will be contacted and given the option to return the lot or return the lot except the units that passed during initial testing.

#### 10.5 Guarantee

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, whichever period is shorter, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

---

#### 11. Issuance

Stock Unit: EA

---

#### 12. Approved Manufacturers and Factories

<b>Manufacturer</b>	<b>Factory</b>
Carte International	Winnipeg, Manitoba, Canada

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#### 13. References

**Hanson, Brett**; SCL Standards Engineer; subject matter expert and originator of 4410.00 (brett.hanson@seattle.gov)

**SCL Material Standard 0039.0 (canceled)**; "Specialty Transformer, Liquid-Immersed, Submersible One-Phase and Three-Phase, 25 Through 225 kVA"

**OUTDOOR, SINGLE-PHASE, DRY-TYPE,  
 GENERAL PURPOSE AUTOTRANSFORMERS**



1.3 kVA, Stock No. 391286



3.0 kVA, Stock No. 391285

**1. Scope**

This Material Standard details the manufacturer requirements for 277-120 volt, single-phase, dry-type, general purpose autotransformers up to 10 kVA and applies to the following Seattle City Light Stock Numbers:

Stock No.	kVA
391286	1.3
391285	3.0

**2. Application**

This class of transformers is typically used in vaults and handholes to step down streetlight voltage in order to serve light fixtures and receptacles in those spaces. These units are also installed in select streetlight bases in order to serve seasonal lighting receptacles.

**3. Industry Standards**

Transformers shall meet the applicable requirements of the following industry standards:

**IEEE 259-1999**; "Standard Test Procedure for Evaluation of Systems of Insulation for Dry-Type Specialty and General-Purpose Transformers"

**NEMA ST 20-1992 (R1997)**; "Dry Type Transformers for General Applications"

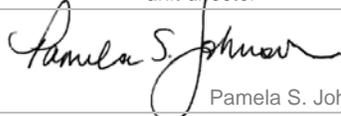
**RCW 19.29.010, Rule 5 -2009**; *Revised Code of Washington*, Rules for Test Tag

**4. Ratings**

**4.1 Kilovolt-Ampere Ratings**

Kilovolt-ampere ratings shall be 1.3 or 3 kVA, or as specified on the purchase order.

Kilovolt-ampere ratings are continuous and are based on not exceeding a 115 °C average winding temperature rise.

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 Devyn Byrnes	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

Outdoor, Single-Phase, Dry-Type, General Purpose Autotransformers

standard number: **4470.00**

superseding: new

effective date: December 3, 2010

page: 2 of 3

**4. Ratings, continued****4.2 Voltage Ratings**

The transformer voltage rating shall be 277-120 Volts, or as specified on the purchase order.

**4.3 Temperature Rise and Insulation System**

1.3 kVA shall have 185° C hottest spot insulation system for 115° C average winding temperature rise as specified in NEMA ST-20, Section 3.9.6.

3.0 kVA units shall have 220° C hottest spot insulation system for 150° C average winding temperature rise as specified in NEMA ST-20, Section 3.9.7.

Stock No.	kVA	Primary/Secondary, Volts	Temp. Rise, °C	Ins. Class, °C	Typical Weight lbs
391286	1.3	277/120	115	185	18
391285	3.0	277/120	150	220	44

**5. Construction****5.1 General**

Transformers shall be according to the requirements of NEMA ST-20.

**5.2 Enclosure Integrity and Finish**

For 1.3 kVA units, no enclosure is required. The transformer shall be designed and constructed to be installed in a cylindrical metal streetlight housing 9 inches long and 6 inches in diameter.

For all other transformers, the enclosure shall be in accordance with NEMA ST-20, Section 3.3.3, Outdoor Construction and in accordance with Section 3.3.2, Corrosion Resistance.

**5.3 Markings**

Transformers shall be marked as specified in NEMA ST-20, section 3.27, Autotransformer.

Terminals shall be marked according to the requirements specified in NEMA ST-20, Section 3.29.

**5.4 Nameplate**

A stainless steel nameplate complete with connection diagram shall be affixed to the outside of the enclosure, using stainless steel fasteners. The nameplate shall state all information in accordance with NEMA ST-20, Section 3.25, Nameplates.

A connection diagram shall be provided on the nameplate as specified in figure 5.4, along with the date of manufacture.

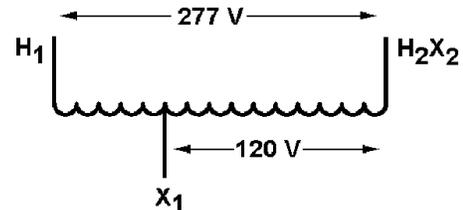


Figure 5.4, Connection Diagram

**5.5 Grounding**

The transformer enclosure shall be provided with a suitable grounding terminal to provide for a full current ground conductor. This terminal shall be plainly labeled "G" or "GRD."

**6. Tests****6.1 General**

Electrical tests shall be made in accordance with the latest revision of NEMA ST-20 and IEEE 259.

**6.2 Routine Tests**

Routine Tests outlined in NEMA ST-20 section 4, table 4-1, shall be conducted on all transformers before being purchased by Seattle City Light to insure that design performance is maintained in production.

**6.3 Design Tests**

Design Tests in accordance with NEMA ST-20, section 4.1.2, shall be conducted on a sufficient number of transformers to demonstrate compliance with NEMA ST-20 and this Standard. These tests need not be repeated unless the design of the transformer has changed.

**6.4 Audible Sound Levels**

Audible sound levels for each unit shall not exceed a maximum of 40dB according to the requirements of NEMA ST-20, section 3.32. Audible Sound Level tests shall be performed as outlined in NEMA ST-20, section 4.2.10.

**6.5 Insulation System Tests**

All Transformer Insulation System Tests shall be conducted in accordance with the latest revision of IEEE 259.

**MATERIAL STANDARD**Outdoor, Single-Phase, Dry-Type, General Purpose  
Autotransformersstandard number: **4470.00**

superseding: new

effective date: December 3, 2010

page: 3 of 3

**6. Tests, continued****6.6 Documentation**

If requested, test reports demonstrating conformance to all tests completed shall be submitted in a single electronic document.

All documentation shall be in English and use customary inch-pound units.

**6.7 Test Tag**

A weatherproof test tag conforming to the requirements of the Revised Code of Washington RCW 19.29.010, Rule 5 shall be firmly attached to each unit.

Tag shall read "THIS TRANSFORMER HAS BEEN SUBJECTED TO AN INSULATION TEST IN ACCORDANCE WITH THE STANDARDIZED RULES OF IEEE/ANSI. THIS TRANSFORMER HAS BEEN TESTED AT RATED LINE VOLTAGE."

Tag shall indicate:

- transformer serial number
- date on which the test was made
- name of the person who performed the test

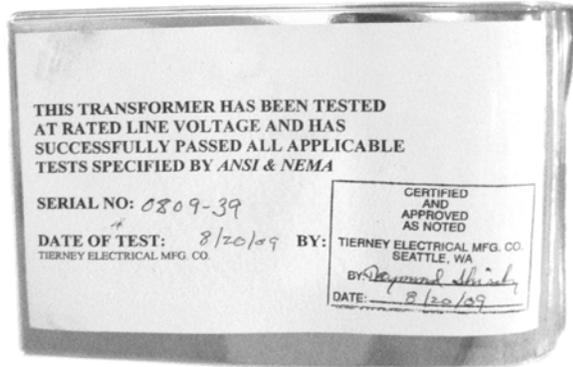


Figure 6.7, test tag

**7. Shipping and Handling**

Transformers shall be received by Seattle City Light in clean condition.

**8. Seattle City Light Processes****8.1 Bid Process**

Bid process details are available at [www.Seattle.gov](http://www.Seattle.gov).

Bid documentation shall be submitted with details demonstrating conformance to this standard. Submittal details shall be listed to correspond with this standard's section formatting.

Any exceptions taken to the standard shall be summarized in an attached letter, complete with section numbering relating to this standard. Requests for approved equal components must be submitted with first bid documents; all subsequent requests will be rejected.

**8.2 Guarantee**

Any transformer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery, shall be repaired or replaced without cost to the City of Seattle. Any defect discovered within this period shall be corrected on all transformers furnished on the order at the manufacturer's expense, either by repair or replacement.

**9. Approved Manufacturer and Factory**

Stock		Tierney Electric, Seattle, WA
No.	kVA	Part/Catalog No
391286	1.3	AC1.3A-5V2H-CCO
391285	3.0	AC103A-5V2F80-SP

**10. References**

**0039.2** (canceled); "Autotransformer, Dry-Type, Outdoor Wall Mount, Single Phase, Through 10 kVA;" Material Standard; SCL

**053100-JS-1A**; "Drawing" (3 kVA) Tierney Electrical Mfg. Co.

**5211-92-NK-1**; "Drawing" (1.3 kVA) Tierney Electrical Mfg. Co.

**Hanson, Brett**; SCL Standards Engineer; subject matter expert and originator of 4470.00; ([brett.hanson@seattle.gov](mailto:brett.hanson@seattle.gov))

**Byrnes, Devyn**; SCL Standards student intern; subject matter expert for 4470.00 ([devyn.byrnes@seattle.gov](mailto:devyn.byrnes@seattle.gov))

## Transformer Insulating Mineral Oil



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### 1. Scope

This standard details the manufacturer requirements for new transformer insulating mineral oil. Seattle City Light purchases naphthenic, ASTM Type II mineral oil with Diteritary Butyl Paracresol (DBPC) added to inhibit oxidation within the transformer.

This standard applies to Stock Number 753100.

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### 2. Application

This oil is used to replace or supplement mineral oil in repaired or maintained distribution transformers. As of this writing, only new Network transformers are purchased with mineral oil. All other transformers are purchased with natural ester insulating fluids like FR3.

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### 3. Industry Standards

Transformer insulating oil shall meet the applicable requirements of the following industry standards:

**ASTM D3487-09** - "Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus;" ASTM

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Darnell Cola



#### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. Seattle City Light General Terms and Conditions
3. Seattle City Light detailed material standard
4. This material standard
5. ICEA publications
6. ASTM publications
7. Other industry standards.

#### 5. Purchase Order Information

Purchase Order will state the following minimum information:

- Oil description
- Seattle City Light material standard number including revision date
- Seattle City Light stock number
- Total order quantity
- Price
- Delivery date
- Quantity per tanker.

#### 6. Attributes

Oil shall be refined to exhibit the following attributes:

<b>Electrical Property</b>	<b>ASTM Standard</b>	<b>Value</b>
Dielectric breakdown- 0.10 inch gap	D877	30kV, minimum
Dielectric breakdown- 1mm gap	D1816	20kV, minimum
Dielectric breakdown- 2mm gap	D1816	35kV, minimum
Liquid power factor- 25 degrees C	D924	0.05%, maximum
Liquid power factor- 100 degrees C	D924	0.3%, maximum
Gassing tendency	D2300	negative
<b>Chemical Properties</b>		
Aniline point	D611	84 degrees C maximum
Corrosive sulfur	D1275	passes
Acid number	D974	0.015 mg KOH/g maximum
Moisture	D1533	25ppm maximum
PCBs	D4059	less than 1ppm maximum
Furanic compounds	D5837	20 ppb maximum
Oxidation inhibitor	D2668 D4768	0.2-0.3% by weight
<b>Physical Properties</b>		
Color	D1500	0.5 maximum
Flash point	D92	145 degrees C minimum
IFT	D971	40 dynes/cm minimum
Pour point	D97	-40 degrees C maximum
Viscosity	D445	11 cSt maximum at 40 degrees C

---

Appearance	D1524	clear and bright
Sludge free life	Doble	80 hours, +/-8 hours
Power factor valued oxidation	Doble	passes
Sludge % at 72 hours	D2440	0.1% maximum
Acid number at 72 hours	D2440	0.3 maximum
Sludge % at 164 hours	D2440	0.2% maximum
Acid number at 164 hours	D2440	0.4 maximum
Rotating vessel	D2112	220 minutes minimum

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## 7. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published attributes.

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## 8. Packaging

Oil tankers shall be filled to prevent contamination during shipping and handling.

Individual tankers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Seattle City Light's Stock Number
- Seattle City Light's Purchase Order Number.

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## 9. Documentation

### 9.1 General

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

### 9.2 Bidder's Data

Bidder shall identify all exceptions to Seattle City Light requirements with reference to the requirement to which exception is taken; indicate if no exceptions taken.

### 9.3 Certified (Production) Test Reports

For each shipment a certified production test report (CTR) shall be emailed to:  
standards.scl@seattle.gov.

Certified production test report shall include:

- A unique certified test report number
- Seattle City Light Purchase Order number
- Manufacturer's name
- Manufacturing plant location
- Basic oil description
- Manufacturer's order number

- Shipping information or serial numbers and shipment volume
- Test values for each shipment that demonstrate compliance with ASTM D3487 and this standard including Section 6 Attributes

Supplier shall provide a certified production test report and follow the product evaluation process per Section 10 of this material standard.

#### 9.4 Plant QA Processes

Upon request, supplier shall provide information describing their plant's quality assurance processes.

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### 10. Product Evaluation

Seattle City Light Quality Assurance and Standards will evaluate the certified production test report for compliance.

Following the internal evaluation, Seattle City Light Material Control will inform the supplier if oil shipment is in compliance, or not.

Upon receipt at Seattle City Light, the oil will be tested for dielectric strength in accordance with the requirements of ASTM D1816.

- Sampling for purposes of inspection and test shall be in accordance with ASTM D 117, latest revision. A composite sample of not less than 5 gallons of oil shall be taken from each lot.
- For purposes of sampling, a lot shall consist of a manufacturer's batch. If the material cannot be identified by batch, a lot shall consist of not more than 10,000 gallons of oil of the same grade offered for delivery at one time.
- Inspection and Tests, as listed in Section 6, shall be conducted in accordance with the applicable ASTM test method.
- The supplier shall ensure that all inspection and tests required by this standard are performed on each batch of insulating oil furnished.
- All inspection and tests shall be the responsibility of the supplier and shall be performed at its expense in a recognized laboratory. These test reports shall be certified by an authorized representative of the laboratory conducting the tests.
- The certified test report shall accompany the packing list.

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### 11. Approved Manufacturers

Any supplier meeting the technical requirements of this document.

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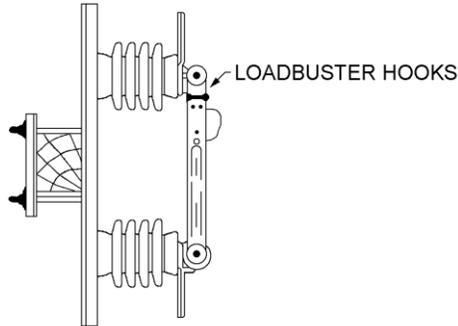
### 12. References

**SCL 7531.0** Insulating Oil – Electrical Napthenic (canceled)

**Half Century Transformer Maintenance**, SD Myers 2010

**Hanson, Brett**; SCL Standards Engineer, originator and subject matter expert for 4487.00 (brett.hanson@seattle.gov)

**Switch, Air Break Disconnect  
 Vertical or Inverted Crossarm Mounting, 26 kV**



**General**

This specification covers single-pole disconnect switches for use on overhead lines of a 15/26 kV distribution system, and shall conform to the applicable requirements of ANSI C37.32, except as modified herein.

**Design Requirements**

The switch shall be designed for crossarm mounting in either vertical or inverted position.

The switch shall be designed with hooks for opening with the S & C Loadbuster tool, and the blade stop shall be adjustable for 90° or 160° in the open position.

The insulator color shall be Sky Gray, ANSI #70.

The terminals shall be NEMA 2-hole pads.

**Packaging**

The switches shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage, and shall be shipped completely assembled with insulators.

**Electrical Specifications**

Minimum Nominal Switch Voltage	25 kV
1.2 x 50 Impulse Withstand	150 kV
Continuous Current Rating	600 amps
Momentary Current Rating	40,000 amps
3-Second Current Rating	25,000 amps

**Stock Unit:** each

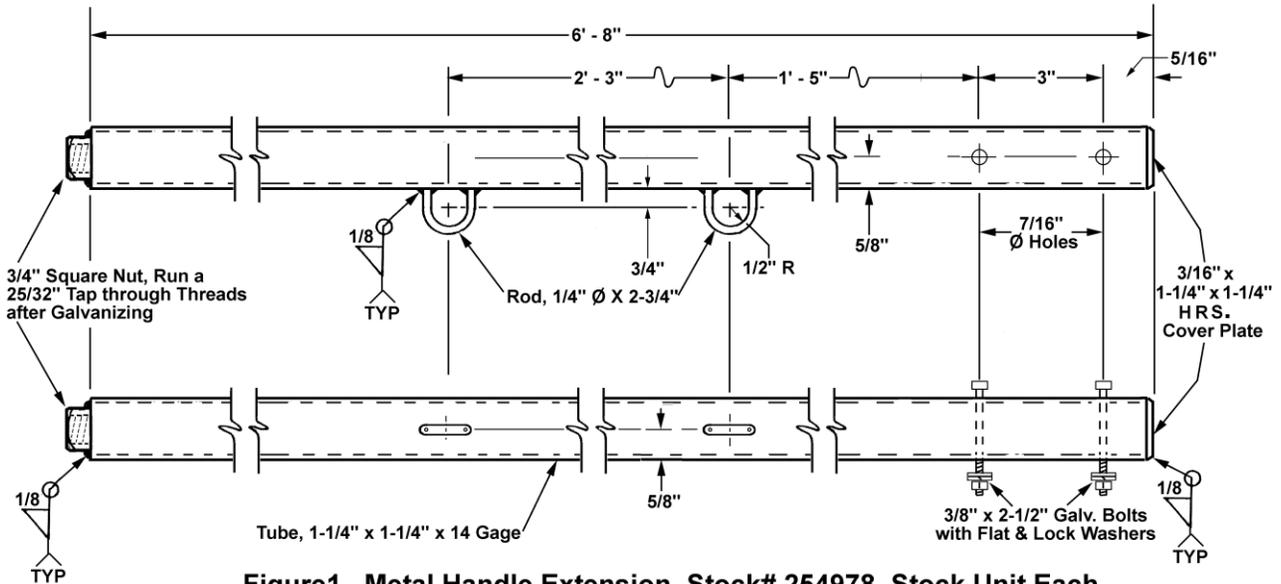
Stock No.	Item	Kearney	Royal
250130	Switch	127725L	19995

Standards Coordinator  
 Laura Vanderpool

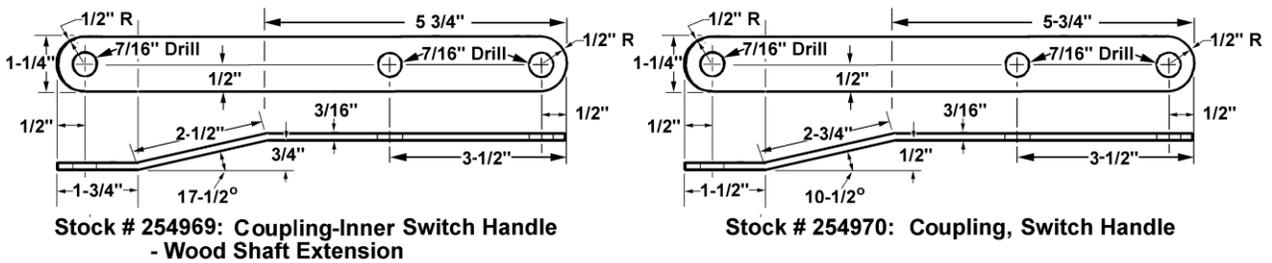
Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

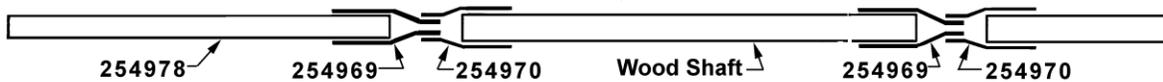
**Handle Extension, 4 and 26 kV Switches**



**Figure 1. Metal Handle Extension. Stock# 254978 Stock Unit Each**



**Figure 2. Extension Couplings. Stock Unit: Pair**



**Figure 3. 4 & 26kV Switch Handle Extension Assembly**

**All metal parts** shall be of the configuration and dimensions shown. They shall be made of steel that conforms to ASTM A36 and shall be free of rough or uneven surfaces and edges. All parts shall be galvanized after fabrication in accordance with ASTM A123.

**Reference Specifications:** ASTM A36 and ASTM A123.

In October 2015, this standard was renumbered from 2549.8 to 4500.35.

Standards Coordinator  
 Laura Vanderpool

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

**OVERHEAD DISTRIBUTION SWITCH, 27 KV, GANG-OPERATED**



**1. Scope**

This material standard covers the requirements for 27 kV, overhead, three-phase, gang-operated, load-break switches and replacement interrupters.

This material standard applies to Seattle City Light Stock Numbers:

Switch Stock No	Interrupter Stock No	Shunt Kit Stock No	Mounting Type	Amps
250150	012119	013279	horizontal	600
250151	012119	013279	riser style	600
250152	012121	013280	horizontal	1200
250153	012121	013280	riser style	1200

**2. Application**

Overhead distribution switches are mounted on wood poles to break or pick up load, loop, and line charging current on Seattle City Light's 26.4 kV, looped radial distribution system.

Horizontally-mounted (upright) switches are used for sectionalizing feeders. Riser style switches are installed on terminal poles.

Inertia switches purchased after March 2011 are provided with interrupter shunts. This feature improves a switch's operability. 600A and 1200A shunt interrupter upgrade kits are available as separate stock items.

**3. Industry Standards**

Overhead distribution switches shall meet the applicable requirements of the following industry standards:

**ASTM A153-2005** Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

**IEEE 1247-2005** – Interrupter Switches for Alternating Current, Rated Above 1000 V

**IEEE C37.32-2002** - High Voltage Switches, Bus Supports, and Accessories Schedules of Preferred Ratings, Construction Guidelines, and Specifications

**IEEE C37.34-1994** - Test Code for High-Voltage Air Switches

**IEEE C37.37-1996** - Loading Guide for AC High-Voltage Air Switches (in Excess of 1000 V)

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Overhead Distribution Switch, 27 kV Gang-Operated

standard number: **4501.50**

superseding: June 8, 2011

effective date: May 30, 2012

page: 2 of 6

**4. Requirements****4.1 General**

Complete switch assembly shall be integrally designed and produced. Manufacturer shall be solely responsible for the performance of the basic switch components as well as the complete integrated assembly.

**4.2 Switch Ratings**

Switches shall be distribution class as defined by IEEE C37.32.

Temperature rise tests shall be performed according to IEEE C37.32.

600 and 1200 A switches shall have the following electrical ratings:

Continuous Current, A, rms	600	1200
Voltage		
Nominal, kV, rms	25	25
Maximum, kV, rms	27	27
Number of phases	3	3
Power frequency, Hz	60	60
Lightning-impulse withstand voltage (BIL), kV, crest	170	170
Short-time (3 s) withstand current, kA, rms symmetrical	25	44
Momentary (10 cycles) withstand current, kA, rms symmetrical	40	70
Allowable continuous current class (ACCC) designation, per IEEE C37.37	DO6	DO6

**4.3 Interrupter Ratings**

Interrupters shall be tested according to IEEE 1247.

Interrupters shall have the following electrical ratings:

Interrupter Style	Expulsion Tube, A, rms	Vacuum Bottle, A, rms
Load current	900 (at 23 kV)	1500
Parallel current	900 (at 5 kV)	1500
Cable charging	26 (at 27 kV)	600
Magnetizing current	2.7 (at 27 kV)	600

**4.4 Construction**

Switch shall be designed for installation on wood poles with pole-top diameters ranging from 8 to 14 inches in diameter.

Switch shall be capable of ice breaking according to the requirements of IEEE C37.34, section 10. Ice thickness for ice tests shall be 3/4 inches.

Switch mounting base shall consist of a unitized, galvanized steel beam with three conductor dead-ending brackets.

Switches rated 600 A continuous shall be provided with two-hole terminal pads according to IEEE C37.32, figure 1.

Switches rated 1200 A continuous shall be provided with four-hole terminal pads according to IEEE C37.32, figure 1.

Terminal pads shall be tinned copper, 99% conductive with a maximum surface roughness of 32 micro inches, intended for use with aluminum or bronze connectors.

Insulators shall be silicone rubber, post type, with 3-inch bolt circles, meeting the applicable requirements of ANSI/NEMA C29.9 for TR 208.

Lifting eyes or hoisting brackets shall be provided and clearly identified to allow safe installation.

Switch shall be operated by means of a reciprocating manual handle.

Vertical control rod shall incorporate square fiberglass sections.

Switch shall be capable of being padlocked in both the open and the closed positions.

Each switch shall be supplied with sufficient operating mechanism, rods, guides, guide bearings, and couplings to allow the operating handle to be mounted (centerline of throw) 49 feet below the centerline of the steel mounting base (arm).

The operating rod shall be a combination of galvanized steel and square insulating fiberglass rod to meet the following criteria:

- The first 10 feet, which will be attached to the operating handle, shall be galvanized steel with a welded 3/8-inch diameter steel eyelet with an open diameter of 1-1/2 inches and pole mounted swing arm provision for attaching a secondary operating rod padlock in both the switch open and switch closed positions.
- The remaining upper sections (39 feet) shall be ultraviolet-inhibited, 1-3/4-inch square fiberglass tube with Nexus Veil coating. Upper section BIL shall be 10,000 volts/inch minimum.

A ground strap and connector shall be provided for grounding the operating handle and lower galvanized steel rod section.

**MATERIAL STANDARD**

Overhead Distribution Switch, 27 kV Gang-Operated

standard number: **4501.50**

superseding: June 8, 2011

effective date: May 30, 2012

page: 3 of 6

**4. Requirements, continued****4.4 Construction, continued**

Switches rated 600 A continuous shall be provided with a three-phase set of expulsion tube interrupters.

Switches rated 1200 A continuous shall be provided with a three-phase set of vacuum bottle interrupters.

**4.5 Quality**

Switch shall be of high quality design and construction providing safe and reliable operation with minimal maintenance over the life of the product.

**5. Documentation**

One set of installation instructions, operating procedures, maintenance instructions, spare parts list, and outline drawings shall be securely attached to each switch in a waterproof, ultraviolet-light-resistant envelope.

**6. Testing**

Test data that establishes compliance with the requirements of the industry standards listed in Section 3 of this material standard shall be provided upon request.

**7. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the switch's understood or published capabilities.

**8. Marking**

Switch crates shall be legibly and permanently marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Equipment serial number
- Seattle City Light's Stock Number
- Seattle City Light's Purchase Order Number

Packages containing interrupters purchased separately shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Seattle City Light's Stock Number

**9. Packaging**

Each switch shall be packaged in its own crate and delivered on its own pallet.

Pallet shall be designed for clearance and movement by either pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum vertical height of 4 inches and horizontal width of 21 inches.

Crate and pallet, including slates, blocking, and wedges, shall be unpainted wood

Interrupter sets supplied with a switch shall be shipped uninstalled and packaged within the switch crate.

Interrupters purchased separately shall be individually package to prevent damage during shipping, inside storage, and casual handling prior to installation.

**10. Shipping**

Switches may be delivered on enclosed, covered, or flatbed trucks. If switches are delivered on flatbed truck, switches shall be side-loaded. Because Washington State law requires a 10-inch minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

**11. Issuance**

Stock unit:

EA, switch

EA, replacement interrupter, single-pole

EA, interrupter shunt kit

**12. References**

**ANSI/IEEE C37.71-2001**; "Three-Phase, Manually Operated Subsurface and Vault Load-Interrupting Switches for Alternating-Current Systems"

**ANSI/NEMA C29.9-1983 (R2002)**; "Wet-Process Porcelain Insulators - Apparatus, Post Type"

**Inertia 040930G**; "High Voltage Switchgear & Automation Equipment, Section 2, Overhead Distribution Switches"; Inertia Engineering; Catalog Number 040930G; May 2008

**SCL 2501.5**; "Load Break Switch, Three-Pole, Gang-Operated for Wood Pole Mounting" (canceled); Material Standard

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert and major revision for 4501.50 (john.shipek@seattle.gov)

**MATERIAL STANDARD**

superseding: June 8, 2011

effective date: May 30, 2012

Overhead Distribution Switch, 27 kV Gang-Operated

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**13. Approved Manufacturers**

<b>13.1</b>	<b>Stock Number</b>	<b>250150</b>
	<b>Description</b>	Overhead distribution switch, horizontally-mounted, 600 A, with set of expulsion tube interrupters
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	<b>L26SLSH-SCLS</b>
		<i>where:</i>
	L	= LineBOSS Unitized Sidebreak Line Switch
	2	= 25.8 kV voltage class
	6	= 600 A current rating, ANSI 30 degree rise
	S	= silicone rubber insulators
	L	= loadbreak Amrupter interrupters
	S	= galvanized steel crossarm
	H	= horizontal upright mounting
	SCLS	= Seattle City Light special, reciprocating manual handle, 1-3/4-inch square fiberglass control rod, interrupter shunts
	<b>Main Drawing</b>	9265-1S R01
	<b>Bill of Material</b>	9265-1SB R01
<b>13.2</b>	<b>Stock Number</b>	<b>250151</b>
	<b>Description</b>	Overhead distribution switch, riser style mounting, 600 A, with set of expulsion tube interrupters
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	<b>L26SLSR-SCLS</b>
		<i>where:</i>
	L	= LineBOSS Unitized Sidebreak Line Switch
	2	= 25.8 kV voltage class
	6	= 600 A current rating, ANSI 30 degree rise
	S	= silicone rubber insulators
	L	= loadbreak Amrupter interrupters
	S	= galvanized steel crossarm
	R	= riser style mounting
	SCLS	= Seattle City Light special, reciprocating manual handle, 1-3/4-inch square fiberglass control rod, interrupter shunts
	<b>Main Drawing</b>	9265-3S R01
	<b>Bill of Material</b>	9265-3SB R01
<b>13.3</b>	<b>Stock Number</b>	<b>012119</b>
	<b>Description</b>	Replacement expulsion tube interrupter, single pole, for switches Stock Numbers 250150 and 250151 respectively
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	<b>I62-1XH-1R</b>

**MATERIAL STANDARD**

superseding: June 8, 2011

effective date: May 30, 2012

Overhead Distribution Switch, 27 kV Gang-Operated

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**13. Approved Manufacturers, continued**

<b>13.4</b>	<b>Stock Number</b>	<b>250152</b>
	<b>Description</b>	Overhead distribution switch, horizontally-mounted, 1200 A, with set of vacuum bottle interrupters
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	<b>L21SVSH-SCLS</b> <i>where:</i> L = LineBOSS Unitized Sidebreak Line Switch 2 = 25.8 kV voltage class 1 = 1200 A current rating, ANSI 30 degree rise S = silicone rubber insulators V = vacuum bottle interrupters S = galvanized steel crossarm H = horizontal upright mounting SCLS = Seattle City Light special, reciprocating manual handle, 1-3/4-inch square fiberglass control rod, interrupter shunts
	<b>Main Drawing</b>	9265-2S R01
	<b>Bill of Material</b>	9265-2SB R01

<b>13.5</b>	<b>Stock Number</b>	<b>250153</b>
	<b>Description</b>	Overhead distribution switch, riser style mounting, 1200 A, with set of vacuum bottle interrupters
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	<b>L21SVSR-SCLS</b> <i>where:</i> L = LineBOSS Unitized Sidebreak Line Switch 2 = 25.8 kV voltage class 1 = 1200 A current rating, ANSI 30 degree rise S = silicone rubber insulators V = vacuum bottle interrupters S = galvanized steel crossarm R = riser style mounting SCLS = Seattle City Light special, reciprocating manual handle, 1-3/4-inch square fiberglass control rod, interrupter shunts
	<b>Main Drawing</b>	9265-4S R01
	<b>Bill of Material</b>	9265-4SB R01

**MATERIAL STANDARD**

superseding: June 8, 2011

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Overhead Distribution Switch, 27 kV Gang-Operated

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**13. Approved Manufacturers, continued**

<b>13.6</b>	<b>Stock Number</b>	<b>012121</b>
	<b>Description</b>	Replacement interrupter, single pole, for switches Stock Numbers 250152 and 250153
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	6220-12
<b>13.7</b>	<b>Stock Number</b>	<b>013279</b>
	<b>Description</b>	600 A interrupter shunt kit
	<b>Application</b>	Upgrade 600 A Inertia switches (Stock Numbers 250150 and 250151) that were not originally provided with interrupter shunt accessory. Only one kit is required per three-phase switch.
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	6255-3A
<b>13.8</b>	<b>Stock Number</b>	<b>013280</b>
	<b>Description</b>	1200 A interrupter shunt kit
	<b>Application</b>	Upgrade 1200 A Inertia switches (Stock Numbers 250152 and 250153) that were not originally provided with interrupter shunt accessory. Only one kit is required per three-phase switch.
	<b>Manufacturer</b>	Inertia Engineering
	<b>Catalog Number</b>	6255-3A-12

**29 kV, THREE-PHASE, OVERHEAD, SCADA-CONTROLLED  
DISTRIBUTION SWITCHGEAR SYSTEMS**

**1. Scope**

This material standard applies to 29 kV, three-phase, overhead, SCADA-controlled, distribution switchgear systems. SCADA stands for supervisory control and data acquisition.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Description
012658	Remote supervisory controlled (capable), load interrupter switch, upright
012697	Remote supervisory controlled (IntelliTeam capable), load interrupter switch, upright
013250	Remote supervisory controlled ((IntelliTeam capable), load interrupter switch, vertical
012663	Control unit with SCADA-Mate switch software
012698	Control unit with IntelliTeam II system software
013272	Control unit with IntelliTeam SG system software

A complete system (at one site) includes two major components: a switch and a control unit that provides an interface between the switch and the master-station computer or peer-to-peer communication with distributed intelligence.

Switches and control units are assigned individual Stock Numbers. Different configurations of the same basic switch and control unit are available for overhead URD application.

The purpose of this standard is threefold:

- 1) Promote standardization of equipment and SCADA protocol within the overhead distribution system.
- 2) Make available a reliable family of SCADA-controlled switchgear and control components that reduces O&M expenses by sharing common training requirements and operational work practices.
- 3) Facilitate ordering by providing a cross-reference between Seattle City Light's Stock Number, common applications, and the manufacturer's catalog numbers.

**2. Application**

Switchgear is intended for use on three-phase, 26.4 kV, 4-wire, solidly grounded, wye-connected, 60 Hz systems.

Not all switches are compatible with all control units. Some control units can only accommodate basic Scada-Mate software, while other control units are designed to utilize S&C's IntelliTeam Restoration System software.

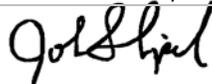
A Scada-Mate switch with a control unit provisioned with basic Scada-Mate software provides SCADA functionality to a system dispatcher.

A Scada-Mate switch with a control unit provisioned with IntelliTeam Restoration System software makes it possible to isolate a fault and restore service (to all but the faulted section of line) without the intervention of a system dispatcher. SCADA functionality is supported, but not required. Multiple switches are required to create a useful system.

In January of 2011, S&C Electric transitioned from Model 5802 automatic switch controllers operating IntelliTeam II software to Model 6801 automatic switch controllers operating IntelliTeam SG (Smart Grid) software.

For a short time in 2009, switches were purchased with grade-level, manual swing-handles to allow one person operation without requiring a bucket truck. This capability is no longer being specified due to lack of room on the pole.

For more information, distribution engineers are encouraged to consult S&C Electric's extensive on-line library.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution Switchgear Systems

standard number: **4501.55**

superseding: January 8, 2010

effective date: June 8, 2011

page: 2 of 9

**3. Industry Standards**

Except as modified by this standard, switchgear shall meet the applicable requirements of the latest revisions of:

**IEEE C37.30** - Standard Requirements for High-Voltage Switches

**ANSI/IEEE C37.32** - High Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings Manufacturing Specifications, and Application Guide

**IEEE C37.34** - Standard Test Code for High-Voltage Air Switches

**4. Construction****4.1 General**

Switch and control unit shall be integrally designed and produced. Manufacturer shall be solely responsible for the performance of the switch and control unit components as well as the complete integrated assembly.

All components of the switch and control unit shall be factory assembled and tested.

**4.2 Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the switch or control unit's understood or published capabilities.

**4.3 Quality**

Switch and control units shall be of high quality design and construction providing safe and reliable operation with minimal maintenance over the life of the product.

**4.4 Switch Ratings**

Switchgear shall have the following basic electrical ratings:

Maximum voltage	29 kV, rms
Number of phases	3-phase
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	150 kV, crest
Continuous current	600 A, rms
Short-time (1 s) withstand current	16 kA, rms symmetrical
Momentary (10 cycles) withstand current	25 kA, rms asymmetrical

Switch shall be designed for wood pole mounting.

**5. Documentation**

One instruction book shall be securely attached to each switch in a waterproof, ultraviolet-light-resistant envelope. Alternatively, one instruction book may be placed inside the control unit cabinet.

**6. Packaging**

Each switch shall be packaged in its own crate and delivered on its own pallet.

Each control unit shall be packaged in its own crate and delivered on a pallet.

Pallet shall be designed for clearance and movement by either pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum vertical height of 4 inches and horizontal width of 21 inches.

Crate and pallet, including slats, blocking, and wedges, shall be unpainted wood.

**7. Marking**

The outside of each crate shall be permanently and clearly marked with manufacturer's name or symbol, Seattle City Light's purchase order number, Seattle City Light's Stock Number, and manufacturer's equipment serial number.

**8. Shipping**

Product may be delivered on enclosed, covered, or flatbed trucks. If switches or control units are delivered on a flatbed truck, product shall be side-loaded.

Because Washington State law requires a 10 inch minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

**MATERIAL STANDARD**29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systemsstandard number: **4501.55**

superseding: January 8, 2010

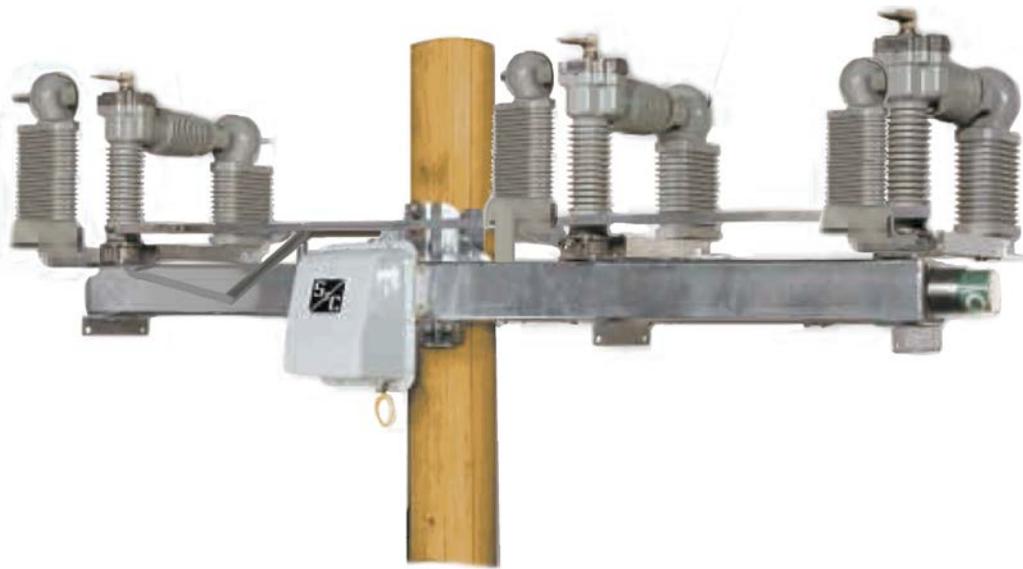
effective date: June 8, 2011

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**9. Detailed Requirements - Switches****9.1 Remote Supervisory Controlled (Capable), Load Interrupter Switch****Stock Number:** 012658**Application:** For monitoring, serving, and remote supervisory control of the overhead distribution system. Compatible with control units provisioned with basic S&C Scada-Mate switch software. Control unit is a separate Stock Number.

Because this specific configuration has three-phase voltage sensing on both jaw side and hinge side of switch (suffix -E33), it cannot be combined with an IntelliTeam provisioned control unit.

The requirements for this switch were derived from S&amp;C Descriptive Bulletin 768-30, dated September 24, 2001, S&amp;C Specification Bulletin 768-31, dated April 20, 2009, and S&amp;C Photo Sheet 768-710, dated December 20, 1999. Refer to 768-30, 768-31, and 768-710 for more information.

**Manufacturer:** S&C Electric**Type:** Scada-Mate**Catalog Number:** 148213R2-A1-G35-E33**Where:****148213R2** = Upright, extra mounting-pole clearance, with manual, non-electrical opening and closing capability**A1** = Wildlife protection**G35** = Shielded control cable in liquid-tight flexible metal-wiring conduit, 35-foot length**E33** = Three-phase voltage sensing on both jaw side and hinge side of switch**Photo:****Stock Unit:** EA

**MATERIAL STANDARD**29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systemsstandard number: **4501.55**

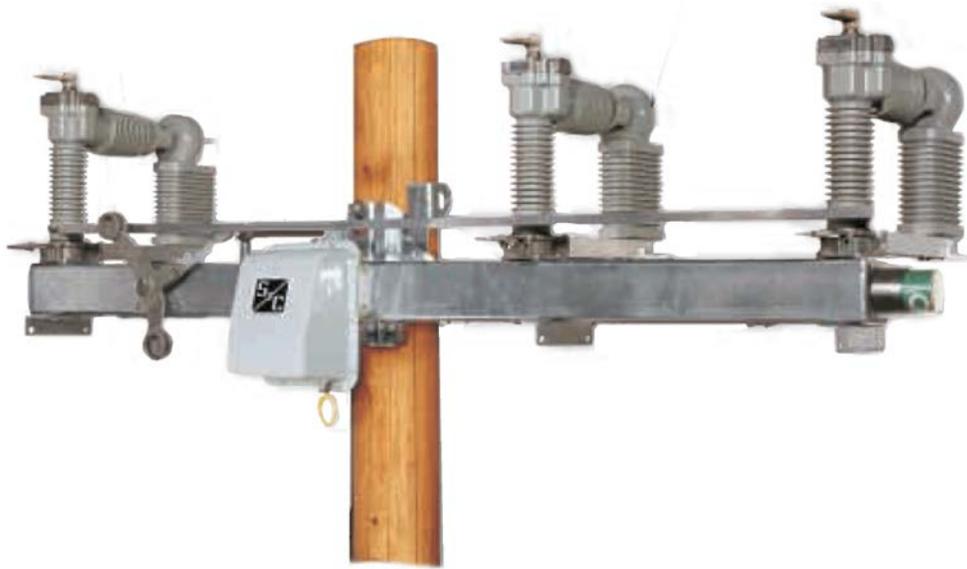
superseding: January 8, 2010

effective date: June 8, 2011

page: 4 of 9

**9 Detailed Requirements – Switches, continued****9.2 Remote Supervisory Controlled (IntelliTeam Restoration System Capable), Load Interrupter Switch****Stock Number:** 012697**Application:** For monitoring, serving, remote supervisory control, and automatic restoration of the overhead distribution system. Compatible with control units provisioned with S&C IntelliTeam Restoration System software. Control unit is a separate Stock Number.

The requirements for this switch were derived from S&amp;C Descriptive Bulletin 768-30, dated September 24, 2001, S&amp;C Specification Bulletin 768-31, dated April 20, 2009, and S&amp;C Photo Sheet 768-710, dated December 20, 1999. Refer to 768-30, 768-31, and 768-710 for more information.

**Manufacturer:** S&C Electric**Type:** Scada-Mate**Catalog Number:** 148213R2-A1-G35-E3**Where:****148213R2** = Upright, extra mounting-pole clearance, manual, non-electrical opening and closing capability**A1** = Wildlife protection**G35** = Shielded control cable in liquid-tight flexible metal-wiring conduit, 35-foot length**E3** = Three-phase voltage sensing on jaw side of switch**Photo:****Stock Unit:** EA

**MATERIAL STANDARD**29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systemsstandard number: **4501.55**

superseding: January 8, 2010

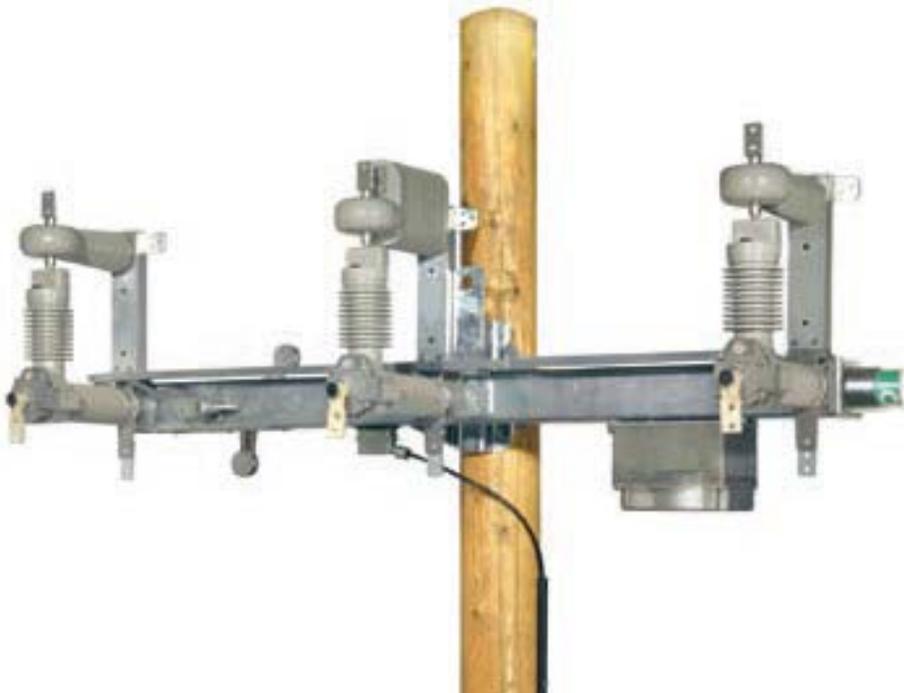
effective date: June 8, 2011

page: 5 of 9

**9 Detailed Requirements – Switches, continued****9.3 Remote Supervisory Controlled (IntelliTeam Restoration System Capable), Load Interrupter Switch****Stock Number:** 013250**Application:** For monitoring, serving, remote supervisory control, and automatic restoration of the overhead distribution system. Compatible with control units provisioned with S&C IntelliTeam Restoration System software. Control unit is a separate Stock Number.

This switch has a special application for feeder transitions between overhead and underground.

The requirements for this switch were derived from S&amp;C Descriptive Bulletin 768-30, dated September 24, 2001, S&amp;C Specification Bulletin 768-31, dated April 20, 2009, and S&amp;C Photo Sheet 768-710, dated December 20, 1999. Refer to 768-30, 768-31, and 768-710 for more information.

**Manufacturer:** S&C Electric**Type:** Scada-Mate**Catalog Number:** 148313R2-H-A1-G35-E3**Where:****148313R2** = Vertical, manual, non-electrical opening and closing capability**H** = High-speed operating mechanism**A1** = Wildlife protection**G35** = Shielded control cable in liquid-tight flexible metal-wiring conduit, 35-foot length**E3** = Three-phase voltage sensing on jaw side of switch**Photo:****Stock Unit:** EA

**MATERIAL STANDARD**

29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systems

standard number: **4501.55**

superseding: January 8, 2010

effective date: June 8, 2011

page: 6 of 9

**10. Detailed Requirements - Control Units****10.1 Control Unit with Scada-Mate Switch Software**

**Stock Number:** 012663

**Application:** For monitoring, serving, and remote supervisory control of the overhead distribution system. Switch is a separate Stock Number.

Stock Number 012663 is no longer purchased but remains active to allow units removed from service to be returned to inventory.

This specific control unit *cannot* accommodate IntelliTeam software.

The requirements for this control unit were derived from S&C Descriptive Bulletin 768-30, dated September 24, 2001, S&C Specification Bulletin 768-31, dated August 29, 2005, and from the factory direct. Refer to 768-30, 768-31, and the factory for more information.

**Manufacturer:** S&C Electric

**Type:** EnergyLine 5800 Series Automatic Switch Control

**Catalog Number:** 5801-F01-G1-JB1-K2-P0-Rxx-R98-W2

**Where:**

**5801** = Model 5801 automatic switch control base package

**F01** = For use with S&C Scada-Mate switch

**G1** = With Scada-Mate switch software

**JB1** = Pole mounting, in padlockable corrosion-resistant aluminum enclosure, 18" W x 24" H x 9-1/2" D

**K2** = Six voltage sensor/six current sensor configuration

**P0** = DNP 3.0 protocol

**Rxx** = H&L fiber-optic transceiver

**R98** = Communication device installed by S&C

**W2** = Control from power sensors

**Photo:**

**Stock Unit:** EA

## MATERIAL STANDARD

29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systems

standard number: **4501.55**

superseding: January 8, 2010

effective date: June 8, 2011

page: 7 of 9

### 10. Detailed Requirements - Control Units, continued

#### 10.2 Control Unit with IntelliTeam II System Software

**Stock Number:** 012698

**Application:** For monitoring, serving, remote supervisory control, and automatic restoration of the overhead distribution system. Switch is a separate Stock Number.

Stock Number 012698 is no longer purchased and has been replaced by Stock Number 013272. Stock Number 012698 remains active to allow units removed from service to be returned to inventory.

The requirements for this control unit were derived from S&C Descriptive Bulletin 768-30, dated September 24, 2001, S&C Specification Bulletin 768-31, dated August 29, 2005, and from the factory direct. Refer to 768-30, 768-31, and the factory for more information.

**Manufacturer:** S&C Electric

**Type:** EnergyLine 5800 Series Automatic Switch Control

**Catalog Number:** 5801-F01-H7-JB1-K1-P0-R79-R98-W2

**Where:**

**5801** = Model 5801 automatic switch control base package

**F01** = For use with S&C Scada-Mate switch

**H7** = With IntelliTeam II System software

**JB1** = Pole mounting, in padlockable corrosion-resistant aluminum enclosure, 18" W x 24" H x 9-1/2" D

**K1** = Three voltage sensor/three current sensor configuration

**P0** = DNP 3.0 protocol

**R79** = H&L fiber-optic transceiver

**R98** = Communication device installed by S&C

**W2** = Control from power sensors

**Photo:**



**Stock Unit:** EA

## MATERIAL STANDARD

29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution  
Switchgear Systems

standard number: **4501.55**

superseding: January 8, 2010

effective date: June 8, 2011

page: 8 of 9

### 10. Detailed Requirements - Control Units, continued

#### 10.3 Control Unit with IntelliTeam SG System Software

**Stock Number:** 013272

**Application:** For monitoring, serving, remote supervisory control, and automatic restoration of the overhead distribution system. Switch is a separate Stock Number.

The requirements for this control unit were derived from S&C Descriptive Bulletin 1045-30, dated January 24, 2011, S&C Specification Bulletin 1045-31, dated September 20, 2010, and from the factory direct. Refer to 1045-30, 1045-31, and the factory for more information.

**Manufacturer:** S&C Electric

**Type:** 6800 Series Automatic Switch Control

**Catalog Number:** 6801-F01-H9-JB1-K1-P0-R79-R98-W2

**Where:**

**6801** = 6800 automatic switch control base package, 100 to 140 Vac, 50/60 Hz

**F01** = For use with S&C Scada-Mate switch

**H9** = With IntelliTeam SG System software

**JB1** = Pole mounting, in padlockable corrosion-resistant aluminum enclosure, 18" W x 24" H x 9-1/2" D

**K1** = Three voltage sensor/three current sensor input configuration

**P0** = DNP 3.0 protocol

**R79** = H&L fiber-optic transceiver

**R98** = Communication device installed by S&C

**W2** = Control from power sensors

**Photo:**



**Stock Unit:** EA

## MATERIAL STANDARD

29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution Switchgear Systems

standard number: **4501.55**

superseding: January 8, 2010

effective date: June 8, 2011

page: 9 of 9

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### 11. References

**1044-31**; "S&C IntelliTEAM SG Automatic Restoration Software, Software Licensing, Specification Bulletin 1044-31"; dated September 7, 2010

**1044-34**; "IntelliTEAM SG Automatic Restoration System, Descriptive Bulletin 1044-34"; dated January 17, 2011

**1045-30**; "S&C 6801 Automatic Switch Control for Outdoor Pole-Mounted Gear, Descriptive Bulletin 1045-30"; dated January 24, 2011

**1045-31**; "S&C 6800 Series Automatic Switch Controls, Specification Bulletin 1045-31"; dated September 20, 2010

**2501.55** (renumbered to 4501.55); "29 kV, Three-Phase, Overhead, Scada-Controlled, Distribution Switchgear Systems"; Material Standard; SCL

**768-30**; "Scada-Mate Switching Systems, Outdoor Distribution, 14.5 kV through 34.5 kV"; S&C Descriptive Bulletin, dated September 24, 2001

**768-31**; "Scada-Mate Switching Systems, Outdoor Distribution, 14.5 kV through 34.5 kV - Specifications"; S&C Specification Bulletin, dated August 29, 2005

**768-710**; "Scada-Mate Switching Systems "; S&C Photo Sheet, dated December 20, 1999

**Russo, Dave**; SCL Engineer, subject matter expert for SCL Material Standard 4501.55 (dave.russo@seattle.gov)

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of SCL Material Standard 4501.55 (john.shipek@seattle.gov)

**www.sandc.com**, S&C Electric Company

**15.5 kV, Three-phase, SF6, Multi-purpose Switchgear,  
 Manually Controlled**



**1. Scope**

This standard covers 15.5 kV, three-phase, SF6-insulated, multi-purpose, manually controlled switchgear and related accessories.

This standard applies to the following Seattle City Light (SCL) stock numbers:

# of Ways	Style	Remote Low-Pressure Alarm Contacts (R-12 feature)		Section
		Yes	No	
2	Wet	013384	–	10.1
3	Wet	013345	013148 <sup>a</sup>	10.2
4	Wet	013346	013149 <sup>a</sup>	10.3

Note:

a. No purchase

The remote, portable motor operator associated with this switchgear is described in Section 11.

Standards Coordinator  
 John Shipek

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

## 2. Application

This switchgear is intended for use on 13.8 kV, 3-wire delta, three-phase, 60 Hz systems where the available fault current is less than 25 kA rms symmetrical.

All switches are provided with viewing windows to observe open gaps, ground positions, ground bus, and fault trip indicators (if so equipped).

Refer to SCL 9202.17 for detailed application information.

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## 3. Industry Standards

Except as modified by this standard, switchgear shall meet the applicable requirements of the latest revisions of:

**IEEE 386** - Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V

**IEEE C37.74** – Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV

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## 4. Construction

### 4.1 General

The switchgear assembly shall be integrally designed and produced by the manufacturer of the individual switch components. The manufacturer shall be solely responsible for the performance of the individual switch components as well as the assembly.

Padmount style switch cabinets shall be sized to accommodate the use of S&C Electric portable (remote) motor operators.

All switchgear components shall be factory assembled and tested.

### 4.2 Design Changes

The manufacturer shall inform SCL in writing of all design changes that could affect the understood or published capabilities of the switchgear.

### 4.3 Quality

Switchgear design and construction shall be of high quality and provide safe and reliable operation with minimal maintenance over the life of the product.

#### 4.4 Switch Ratings

Switchgear shall have the following basic electrical ratings:

Maximum voltage	15.5 kV, rms
Number of phases	3
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	95 kV, crest
Short-time (1 s) withstand current	25 kA, rms symmetrical
Momentary (10 cycles) withstand current	40 kA, rms asymmetrical

---

#### 5. Nameplate

Each switch shall be provided with a nameplate that meets the requirements of IEEE C37.71.

Each switch shall be provided with a label that states the amount of SF6 gas (in pounds) contained within the unit's tank.

---

#### 6. Documentation

One instruction book shall be securely attached to each switch in an ultraviolet light-resistant envelope.

Provision shall be made for SCL to obtain PDF files of all relevant, switch-specific documentation, such as:

- Installation instructions
  - Operation and maintenance instructions
  - Outline drawings
  - Wiring and schematic drawings
- 

#### 7. Packaging

Each switch shall be packaged in its own crate and delivered on its own pallet.

The pallet shall be compatible with either a pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum height of 4 in and width of 21 in.

The crate and pallet, including slats, blocking, and wedges, shall be unpainted wood.

The outside of each crate shall be permanently and clearly marked with:

- Manufacturer name or symbol
  - Seattle City Light purchase order number
  - Seattle City Light stock number
  - Manufacturer equipment serial number
- 

#### 8. Shipping

Switches may be delivered on enclosed, covered, or flatbed trucks. If switches are delivered on a flatbed truck, switches shall be side-loaded. Because Washington State law requires a 10-in minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

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#### 9. Issuance

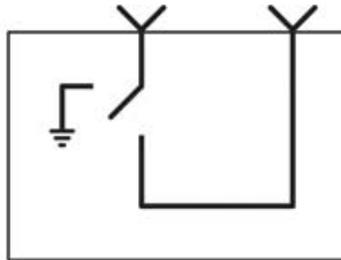
Stock Unit: EA

## 10. Detailed Requirements

### 10.1 2-Way, Wet Vault Style

Stock No.	S&C Electric Co. Vista Switch Catalog No.
013384	852102-M1-V4-L2-O-R12
<i>where:</i>	
85 =	25 kA rms symmetrical short-circuit rating
210 =	Two-way, one load interrupting way, zero fault interrupting ways
2 =	15.5 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank and submersible wiring and control housings.
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm – includes internal contact for remote low-pressure indication, with wiring to outside of tank

Figure 10.1. 2-Way, Wet Vault Style Switch



**10.2 3-Way, Wet Vault Style**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
013345	853302-M1-V4-L2-O-R12
013148 <sup>a</sup>	853302-M1-V4-L2-O

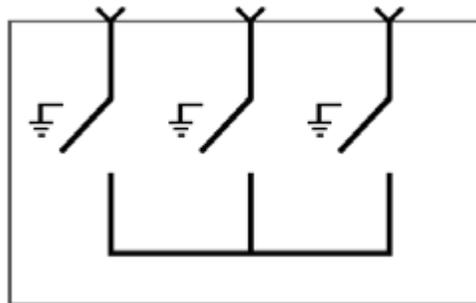
where:

85 =	25 kA rms symmetrical short-circuit rating
330 =	Three-way, three load interrupting ways, zero fault interrupting ways
2 =	15.5 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank and submersible wiring and control housings.
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm – includes internal contact for remote low-pressure indication, with wiring to outside of tank

Note:

a. No purchase

**Figure 10.2. 3-Way, Wet Vault Style Switch**



**10.3 4-Way, Wet Vault Style**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
013346	854402-M1-V4-L2-O-R12
013149 <sup>a</sup>	854402-M1-V4-L2-O

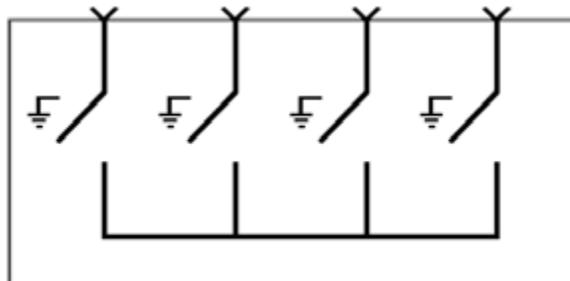
where:

85 =	25 kA rms symmetrical short-circuit rating
440 =	Four-way, four load interrupting ways, zero fault interrupting ways
2 =	15.5 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank and submersible wiring and control housings.
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm – includes internal contact for remote low-pressure indication, with wiring to outside of tank

Note:

a. No purchase

**Figure 10.3. 4-Way, Wet Vault Style Switch**



## 11. Accessories

### 11.1 Remote (Portable) Motor Operator

Stock No.	S&C Electric Co. Catalog No.	Description
None <sup>a</sup>	38323R1	Remote (portable) motor operator. Kit includes carrying case and 50-ft cable with remote control.

Note:  
a. Obtain from Tool Room

Figure 11a. Remote (Portable) Motor Operator



Figure 11b. 50-ft Cable with Remote Control



## 11.2 Anchor Bracket

Stock No.	S&C Electric Co. Catalog No.	Description
013710	CD-1720	Anchor bracket with single slotted hole for 5/8-in anchor bolt. Used to secure PMH- and Vista-type switchgear to concrete pads or floors when original brackets are missing.

Figure 11.2. Anchor Bracket



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## 12. References

SCL Design Standard 9202.17; "Vista Switch Application Guide"

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## 13. Sources

**S&C 681-31**; Vista Underground Distribution Switchgear, Specification Bulletin, October 29, 2007; S&C Electric Company

**Shetab, Muneer**; SCL Standards Engineer and subject matter expert for 4501.61 (muneer.shetab@seattle.gov)

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 4501.61 (john.shipek@seattle.gov)

**29 kV, Three-phase, SF6, Multi-purpose Switchgear,  
 Manually Controlled**



**1. Scope**

This standard covers 29 kV, three-phase, SF6-insulated, multi-purpose, manually controlled switchgear and related accessories.

This standard applies to the following Seattle City Light (SCL) stock numbers:

# of Ways	Style		Fault Interrupting		Load Interrupting		Section
					Remote Low-Pressure Alarm Contacts (R-12 feature)		
			Yes	No	Yes	No	
2	Padmount	012673	–	–	–	–	10.1
2	Padmount	–	–	–	013490	–	10.2
3	Padmount	–	–	–	012846	–	10.3
3	Wet	–	013347	–	012707 <sup>a</sup>	–	10.4
4	Wet	–	–	–	012748	–	10.5
5	Padmount	–	–	–	012709	–	10.6
5	Wet	–	–	–	012706	–	10.7
6	Padmount	–	–	–	012708	–	10.8
6	Wet	–	–	–	012705	–	10.9

Note:  
 a. No purchase

The overcurrent control adapter cables associated with this switchgear are described in Section 11.

Standards Coordinator  
 John Shipek

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

## 2. Application

This switchgear is intended for use on 26.4 kV, 4-wire, three-phase, 60 Hz, solidly grounded, wye-connected systems where the available fault current is less than 25 kA rms symmetrical.

All switches are provided with viewing windows to observe open gaps, ground positions, ground bus, and fault trip indicators (if so equipped).

Refer to SCL 9202.17 for detailed application information.

---

## 3. Industry Standards

Except as modified by this standard, switchgear shall meet the applicable requirements of the latest revisions of:

**IEEE C37.112**; Standard Inverse-Time Characteristic Equations for Overcurrent Relays

**IEEE 386**; Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V

**IEEE C57.12.28**; Switchgear & Transformers – Pad Mounted Equipment Enclosure Integrity

**IEEE C37.74** – Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV

**IEC 298**; Appendix AA – 1 - 52 kV A.C. Metal Enclosed Switchgear and Controlgear

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## 4. Construction

### 4.1 General

The switchgear assembly shall be integrally designed and produced by the manufacturer of the individual switch components. Manufacturer shall be solely responsible for the performance of the individual switch components as well as the assembly.

Padmount-style switch cabinets shall be sized to accommodate the use of S&C Electric portable (remote) motor operators.

All switchgear components shall be factory assembled and tested.

### 4.2 Design Changes

The manufacturer shall inform SCL in writing of all design changes that could affect the understood or published capabilities of the switchgear.

### 4.3 Quality

Switchgear design and construction shall be high quality and provide safe and reliable operation with minimal maintenance over the life of the product.

#### 4.4 Switch Ratings

Switchgear shall have the following basic electrical ratings:

Maximum voltage	29 kV, rms
Number of phases	3
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	125 kV, crest
Short-time (1 s) withstand current	25 kA, rms symmetrical
Momentary (10 cycles) withstand current	40 kA, rms asymmetrical

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#### 5. Nameplate

Each switch shall be provided with a nameplate that meets the requirements of IEEE C37.74.

Each switch shall be provided with a label that states the amount of SF6 gas (in pounds) contained within the unit's tank.

---

#### 6. Documentation

One instruction book shall be securely attached to each switch in an ultraviolet light-resistant envelope.

Provision shall be made for SCL to obtain PDF files of all relevant, switch-specific documentation, such as the following:

- Installation instructions
  - Operation and maintenance instructions
  - Outline drawings
  - Wiring and schematic drawings
- 

#### 7. Packaging

Each switch shall be packaged in its own crate and delivered on its own pallet.

The pallet shall be compatible with either a pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum height of 4 in and width of 21 in.

Crate and pallet, including slats, blocking, and wedges, shall be unpainted wood.

The outside of each crate shall be permanently and clearly marked with:

- Manufacturer name or symbol
  - Seattle City Light purchase order number
  - Seattle City Light stock number
  - Manufacturer equipment serial number
- 

#### 8. Shipping

Switches may be delivered on enclosed, covered, or flatbed trucks. If switches are delivered on flatbed truck, switches shall be side-loaded. Because Washington State law requires a 10-in minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

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#### 9. Issuance

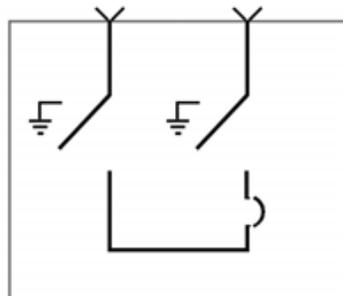
Stock Unit: EA

**10. Detailed Requirements**

**10.1 2-Way, Padmount Style, Fault Interrupting Switch**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012673	852113-L2-M1-O-P12-R31-S101 with one TA-3153
<i>where:</i>	
85 =	25 kA rms symmetrical short-circuit rating
211 =	Two-way, one load interrupting way, one fault interrupting way
3 =	29 kV voltage rating, maximum
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings without studs, at load-interrupter switch and bus terminals
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
P12 =	Pad-mounted style, two-way unit, stainless steel outer enclosure, olive green finish
R31 =	External trip provisions, allows three-pole tripping of single-pole or three-pole fault interrupters via trip signal from a remote location or an external relay in addition to standard overcurrent control
TA-3153 =	Overcurrent control adapter cable accessory for field programming of overcurrent control, USB style
S101 =	6 inch stainless steel base spacer to accommodate Portable Motor Operators

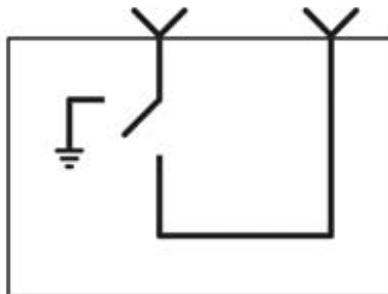
**Figure 10.1. 2-Way, Padmount Style, Fault Interrupting Switch**



**10.2 2-Way, Padmount Style, Load Interrupting Switch**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
013490	852103-M1-P12-L2-O-R2-S102
<i>where:</i>	
	85 = 25 kA rms symmetrical short-circuit rating
	210 = Two-way, one load interrupting way, zero fault interrupting ways
	3 = 29 kV voltage rating, maximum
	M1 = 600 A bushings (without studs) at all terminals
	P12 = Pad-mounted style, stainless steel outer enclosure and low-voltage compartment, olive green finish
	L2 = Potential indication with test feature with provision for low-voltage phasing
	O = Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
	R2 = Remote low-pressure alarm includes internal contact for remote low-pressure indication with wiring to outside of tank. Wires are terminated in an enclosure furnished with a terminal block for customer connections.
	S102 = 6 inch stainless steel base spacer to accommodate Portable Motor Operators

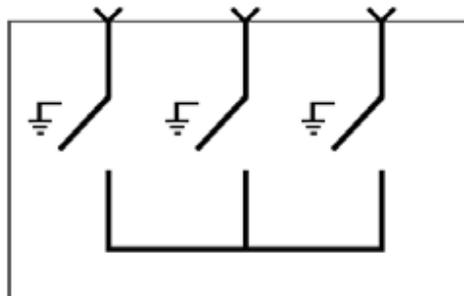
**Figure 10.2. 2-Way, Padmount Style, Load Interrupting Switch**



**10.3 3-Way, Padmount Style, Load Interrupting Switch**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012846	853303-M1-P14-L2-O-S105
<i>where:</i>	
85 =	25 kA rms symmetrical short-circuit rating
330 =	Three-way, three load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
P14 =	Pad-mounted style, stainless steel outer enclosure and low-voltage compartment, olive green finish
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
S105 =	6 inch stainless steel base spacer to accommodate Portable Motor Operators

**Figure 10.3. 3-Way, Padmount Style, Load Interrupting Switch**



**10.4 3-Way, Wet Vault Style, Load Interrupting Switch**

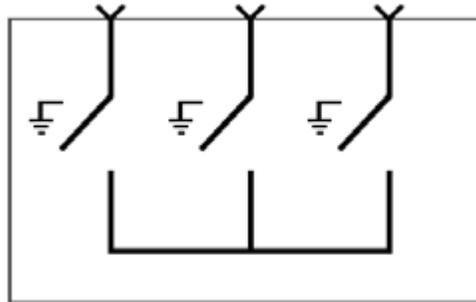
Stock No.	S&C Electric Co. Vista Switch Catalog No.
013347	853303-M1-V4-L2-O-R12
012707 <sup>a</sup>	853303-M1-V4-L2-O

where:

85 =	25 kA rms symmetrical short-circuit rating
330 =	Three-way, three load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank and submersible wiring and control housings.
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm. Includes internal contact for remote low-pressure indication, with wiring to outside of tank

Note:  
 a. No purchase

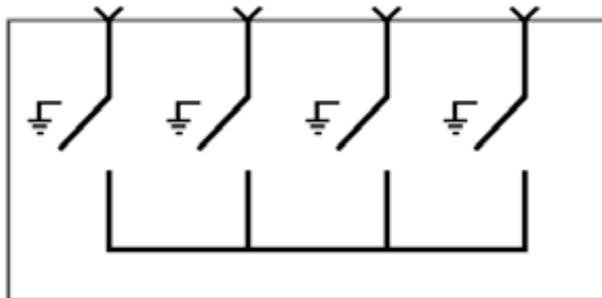
**Figure 10.4. 3-Way, Wet Vault Style, Load Interrupting Switch**



**10.5 4-Way, Wet Vault Style, Load Interrupting Switch**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012748	854403-M1-V4-L2-O
<i>where:</i>	
	85 = 25 kA rms symmetrical short-circuit rating
	440 = Four-way, four load interrupting ways, zero fault interrupting ways
	3 = 29 kV voltage rating, maximum
	M1 = 600 A bushings (without studs) at all terminals
	V4 = Wet vault mounted style. Includes stainless steel tank and submersible wiring and control housings.
	L2 = Potential indication with test feature with provision for low-voltage phasing
	O = Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)

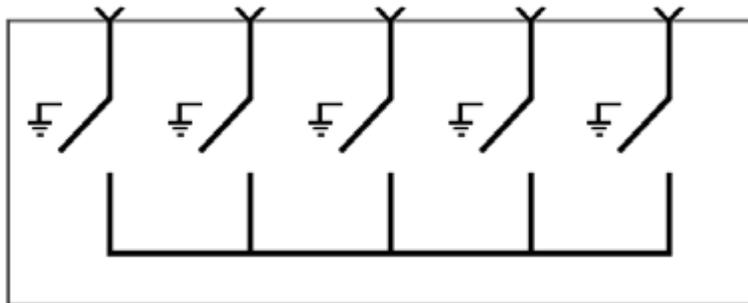
**Figure 10.5. 4-Way, Wet Vault Style, Load Interrupting Switch**



**10.6 5-Way, Padmount Style, Load Interrupting Switch**

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012709	855503-M1-P16-L2-O-S103
<i>where:</i>	
85 =	25 kA rms symmetrical short-circuit rating
550 =	Five-way, five load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
P16 =	Pad-mounted style, stainless steel outer enclosure and low-voltage compartment, olive green finish
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
S103 =	6 inch stainless steel base spacer to accommodate Portable Motor Operators

**Figure 10.6. 5-Way, Padmount Style, Load Interrupting Switch**



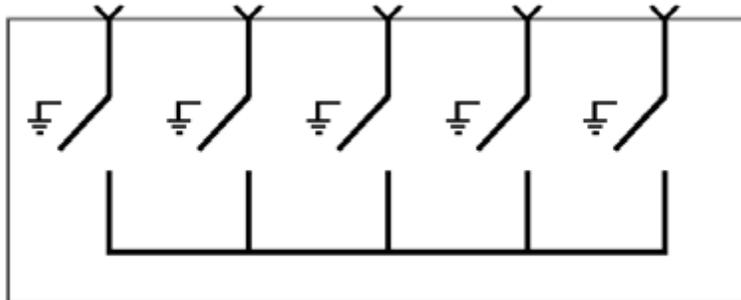
### 10.7 5-Way, Wet Vault Style, Load Interrupting Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012706	855503-M1-V4-L2-O

where:

85 =	25 kA rms symmetrical short-circuit rating
550 =	Five-way, five load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank, submersible wiring and control housings
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)

Figure 10.7. 5-Way, Wet Vault Style, Load Interrupting Switch



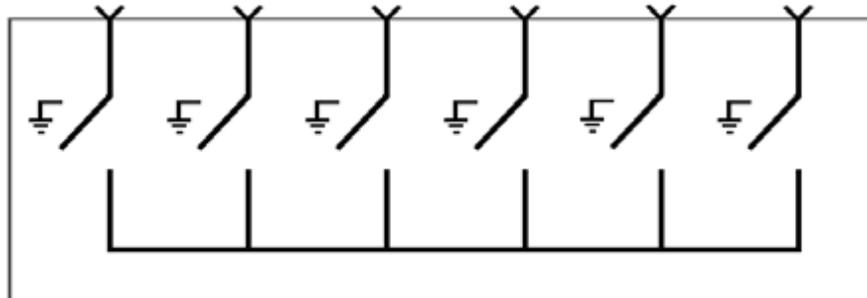
### 10.8 6-Way, Padmount Style, Load Interrupting Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012708	856603-M1-P16-L2-O-S101

where:

85 =	25 kA rms symmetrical short-circuit rating
660 =	Six-way, six load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
P16 =	Pad-mounted style, stainless steel outer enclosure and low-voltage compartment, olive green finish
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
S101 =	6 inch stainless steel base spacer to accommodate Portable Motor Operators

Figure 10.8. 6-Way, Padmount Style, Load Interrupting Switch



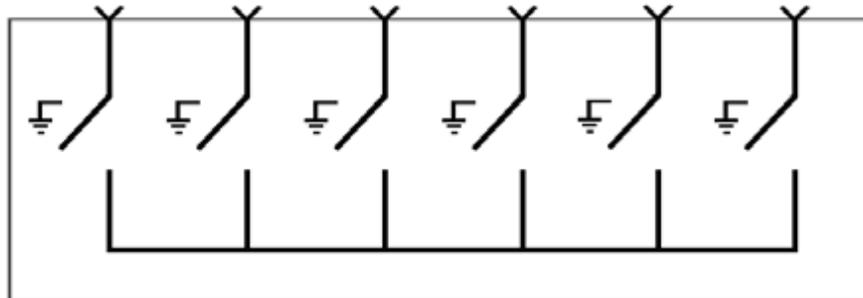
### 10.9 6-Way, Wet Vault Style, Load Interrupting Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012705	856603-M1-V4-L2-O

where:

85 =	25 kA rms symmetrical short-circuit rating
660 =	Six-way, six load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank, submersible wiring and control housings
L2 =	Potential indication with test feature with provision for low-voltage phasing
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)

Figure 10.9. 6-Way, Wet Vault Style, Load Interrupting Switch



## 11. Accessories

### 11.1 Overcurrent Control Adapter Cable, 9 Pin Style

Stock No.	S&C Electric Co. Catalog No.	Description
None <sup>a</sup>	TA-2367	Overcurrent control adapter cable with 9-pin connectors

Note:

a. Obtain from Relay Group

### 11.2 Overcurrent Control Adapter Cable, USB Style

Stock No.	S&C Electric Co. Catalog No.	Description
None <sup>a</sup>	TA-3153	Overcurrent control adapter cable with USB connectors

Note:

a. Obtain from Relay Group

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## 12. References

**SCL Design Standard 9202.17**; "Vista Switch Application Guide"

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## 13. Sources

**S&C 681-31**; Vista Underground Distribution Switchgear, Specification Bulletin, October 29, 2007; S&C Electric Company

**SCL Material Standard 2501.65 (canceled)**; "29 kV, Three-Phase, SF6, Multi-Purpose, Distribution Switchgear, Manually Controlled"

**Shetab, Muneer**; SCL Standards Engineer and subject matter expert for 4501.65 (muneer.shetab@seattle.gov)

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 4501.65 (john.shipek@seattle.gov)

**29 kV, Three-Phase, SF6, Multi-Purpose, Switchgear  
 Remote Supervisory (Capable)**



**1. Scope**

This standard covers 29 kV, three-phase, SF6-insulated, multi-purpose, remote supervisory (capable) switchgear and related accessories.

This standard applies to the following Seattle City Light (SCL) stock numbers:

**Automated Switch Controls and Fiber Optic Transceiver**

# of Ways	Style	Pedestal LVE		Wall Mount LVE		Padmount LVE		Section
		Included	Provision Only	Included	Provision Only	Included	Provision Only	
3	Wet	012704	013246	013725	013726	–	–	10.1
4	Wet	012885	013247	013727	013697	–	–	10.2
5	Wet	012703	013248	013728	013698	–	–	10.3
5	Padmount	–	–	–	–	012711 <sup>a</sup>	013244 <sup>a</sup>	10.4
6	Wet	012695	013249	013729	013696	–	–	10.5
6	Padmount	–	–	–	–	012710 <sup>a</sup>	013245 <sup>a</sup>	10.6
6	Padmount	–	–	–	–	013730 <sup>b</sup>	–	10.6

Notes:

- a. LVE is configured right-handed
- b. LVE is configured left-handed

**Accessories**

Stock No.	Description	Section
013348	Portable remote control	11.1
013350	Control cable, 50 ft	11.2
013743	Motor control battery pack (white jacketed)	11.3
013744	5802 control battery pack (black case)	11.4

Standards Coordinator  
John Shipek

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

## 2. Application

This switchgear is intended for use on 26.4 kV, 4-wire, three-phase, 60 Hz, solidly grounded, wye-connected systems where the available fault current is less than 25 kA rms symmetrical.

All switches are provided with viewing windows to observe open gaps, ground positions, ground bus, and fault trip indicators (if so equipped).

Switchgear is not furnished with batteries. Batteries are ordered as separate stock numbers.

See SCL 9202.17 for detailed application information.

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## 3. Industry Standards

Except as modified by this standard, switchgear shall meet the applicable requirements of the latest revisions of:

**C37.74**; IEEE Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV

**IEEE C57.12.28**; Pad-Mounted Equipment—Enclosure Integrity

**IEC 298**; Appendix AA – 1 - 52 kV A.C. Metal Enclosed Switchgear and Controlgear

**IEEE C37.112**; Standard Inverse-Time Characteristic Equations for Overcurrent Relays

**IEEE 386**; Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V

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## 4. Construction

### 4.1 General

The switchgear assembly shall be integrally designed and produced by the manufacturer of the individual switch components. The manufacturer shall be solely responsible for the performance of the individual switch components as well as the assembly.

All switchgear components shall be factory assembled and tested.

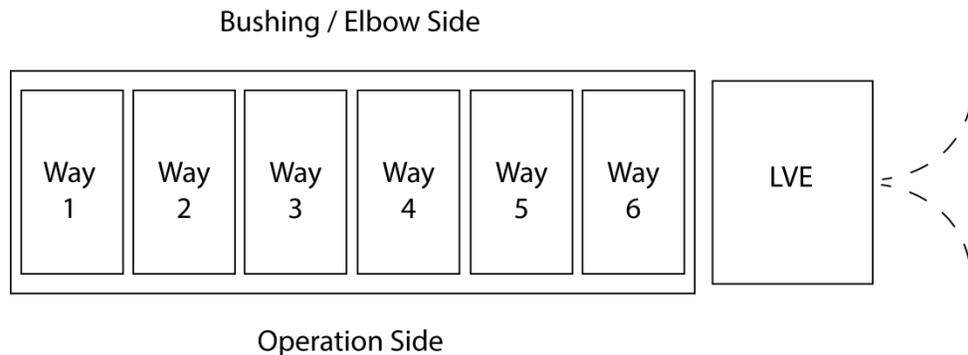
For padmount-style switches, the manufacturer's standard configuration is to permanently mount the LVE to the right-hand side of switch enclosure (when facing the operation side of the switch). See Figure 4.1. An LVE is also determined to be right-handed if it is mounted to the switch enclosure next to the last way, for example, Way 6 for a Vista 660 or Way 4 for a Vista 440. Unless specified otherwise, LVEs will be configured right-handed.

Switchgear shall be furnished without motor control or 5802 control battery packs.

For the purpose of this standard the control module designations 5802 and 6802 are used interchangeably.

Battery connection wiring shall be color coded (red for positive, black for negative) or identified by some other durable means.

**Figure 4.1. Padmount Switch with Right-hand LVE**



Pedestal type LVEs are installed on an included 12-in high skirt.

**4.2 Design Changes**

The manufacturer shall inform SCL in writing of all design changes that could affect the understood or published capabilities of the switchgear.

**4.3 Quality**

Switchgear design and construction shall be high quality and provide safe and reliable operation with minimal maintenance over the life of the product.

**4.4 Switch Ratings**

Switchgear shall have the following basic electrical ratings:

Maximum voltage	29 kV, rms
Number of phases	3
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	125 kV, crest
Short-time (1 s) withstand current	25 kA, rms symmetrical
Momentary (10 cycles) withstand current	40 kA, rms asymmetrical

**5. Nameplate**

Each switch shall be provided with a nameplate that meets the requirements of IEEE C37.74.

Each switch shall be provided with a label that states the amount of SF6 gas (in pounds) contained within the unit's tank.

**6. Documentation**

One instruction book shall be securely attached to each switch in an ultraviolet light-resistant envelope.

The manufacturer shall supply PDF files of all relevant, switch-specific documentation, such as:

- Installation instructions
- Operation and maintenance instructions
- Outline drawings
- Wiring and schematic drawings

## 7. Packaging

Each switch shall be packaged in its own crate and delivered on its own pallet.

The pallet shall be compatible with either a pallet jack or forklift.

The two openings for the pallet jack or forklift shall have a minimum height of 4 in and width of 21 in.

Crate and pallet, including slates, blocking, and wedges, shall be unpainted wood.

The outside of each crate shall be permanently and clearly marked with:

- Manufacturer name or symbol
- SCL purchase order number
- SCL stock number
- Manufacturer equipment serial number

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## 8. Shipping

### 8.1 Switches and Low Voltage Enclosures (LVEs)

Switches and LVEs may be delivered on enclosed, covered, or flatbed trucks.

Switches and LVEs delivered on a flatbed truck shall be side-loaded. Because Washington State law requires a 10-in minimum side board when driving a forklift or pallet jack onto the bed of a truck or trailer, most flatbed trucks or trailers must be side-loaded to ease off-loading.

### 8.2 Batteries

Battery packs shall be shipped fully charged.

Each battery pack shall be individually packaged to prevent damage during shipping, inside storage, and handling prior to use.

Each battery pack shall be marked with:

- S&C Electric
- Motor Control Battery Pack (aka Vista Battery Assembly) or 5802 Control Battery Pack (aka Remote Supervisory Battery Pack) as appropriate
- Date of last charge

Each battery pack shipping container shall be marked with:

- S&C Electric
- Product description
- SCL purchase order number

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## 9. Issuance

Stock Unit: EA

## 10. Detailed Requirements

### 10.1 3-Way, Wet Vault Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012704	863303-A1A2A3-B1B2B3-D1D2D3-E-G-J45-L2-M1-V4-O-R12-S101
013246	863303-A1A2A3-B1B2B3-D1D2D3-E-G-J45-L2-M1-V4-O-R12-S103
013725	863303-A1A2A3-B1B2B3-D1D2D3-E-G-J45-L2-M1-V4-O-R12-S104
013726	863303-A1A2A3-B1B2B3-D1D2D3-E-G-J45-L2-M1-V4-O-R12-S105

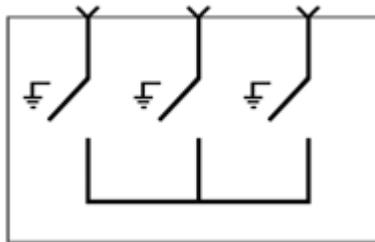
where:

86 =	25 kA rms symmetrical short-circuit rating
330 =	Three-way, three load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3 =	Motor operator package on all three ways
B1B2B3 =	Three-phase current sensing on all three ways
D1D2D3 =	Three-phase line-to-ground voltage sensing on each of three ways (1, 2, and 3)
E =	Stainless steel LVE, olive green finish
G =	Ground position push button control
J45 =	Submersible control cable that connects switch to LVE, 45 ft length (in place of standard 25 ft length)
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank, submersible wiring, and submersible control cable for attachment to LVE.
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm, with wires terminated in LVE that is furnished with a terminal block for customer connections
S101 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the 5802 automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall pedestal version includes an appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.
S103 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall pedestal version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.
S104 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the 5802 automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: 36-in tall wall-mount version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.

S105 = Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application.

LVE: 36-in tall wall-mount version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.

**Fig. 10.1. 3-Way, Wet Vault Style Switch**



## 10.2 4-Way, Wet Vault Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012885	864403- A1A2A3A4-B1B2B3B4-D1D2D3D4-E-G-J45-L2-M1-V4-R12-O-S103
013247	864403- A1A2A3A4-B1B2B3B4-D1D2D3D4-E-G-J45-L2-M1-V4-R12-O-S102
013727	864403- A1A2A3A4-B1B2B3B4-D1D2D3D4-E-G-J45-L2-M1-V4-R12-O-S100
013697	864403- A1A2A3A4-B1B2B3B4-D1D2D3D4-E-G-J45-L2-M1-V4-R12-O-S101

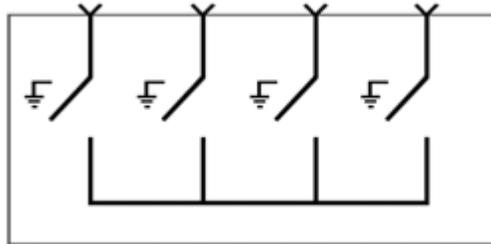
where:

86 =	25 kA rms symmetrical short-circuit rating
440 =	Four-way, four load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3A4 =	Motor operator package on all four ways
B1B2B3B4 =	Three-phase current sensing on all four ways
D1D2D3D4 =	Three-phase line-to-ground voltage sensing on each of four ways (1, 2, 3, and 4)
E =	Stainless steel LVE, olive green finish
G =	Ground position push button control
J45 =	Submersible control cable that connects switch to LVE, 45-ft length (in place of standard 25-ft length)
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault mounted style. Includes stainless steel tank, submersible wiring, and submersible control cable for attachment to LVE.
R12 =	Remote low-pressure alarm, with wires terminated in LVE that is furnished with a terminal block for customer connections
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
S103 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall pedestal version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator supplied with open-close-ground switch control.
S102 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall pedestal version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.
S100 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the 5802 automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: 36-in tall wall-mount version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.

S101 = Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application.

LVE: 36-in tall wall-mount version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.

**Fig. 10.2. 4-Way, Wet Vault Style Switch**



### 10.3 5-Way, Wet Vault Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012703	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-E-G-J45-L2-M1-V4-R12-O-S104
013248	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-E-G-J45-L2-M1-V4-R12-O-S103
013728	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-E-G-J45-L2-M1-V4-R12-O-S105
013698	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-E-G-J45-L2-M1-V4-R12-O-S102

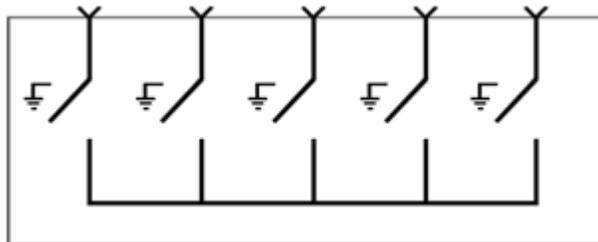
where:

86 =	25 kA rms symmetrical short-circuit rating
550 =	Five-way, five load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3A4A5 =	Motor operator package on all five ways
B1B2B3B4B5 =	Three-phase current sensing on all five ways
D1D2D3D4D5 =	Three-phase line-to-ground voltage sensing on each of five ways (1, 2, 3, 4, and 5)
E =	Stainless steel LVE, olive green finish
G =	Ground position push button control
J45 =	Submersible control cable that connects switch to LVE, 45 ft length (in place of standard 25-ft length)
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault-mounted style. Includes stainless steel tank, submersible wiring, and submersible control cable for attachment to LVE
R12 =	Remote low-pressure alarm, with wires terminated in LVE that is furnished with a terminal block for customer connections
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
S104 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 60-in tall pedestal version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.
S103 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 60-in tall pedestal version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver, includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes plate drilled and wired to accommodate future mountings.
S105 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the 5802 automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: 48-in tall wall-mount version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.

S102 = Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application.

LVE: 48-in tall wall-mount version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.

**Fig. 10.3. 5-Way Wet Vault Style Switch**



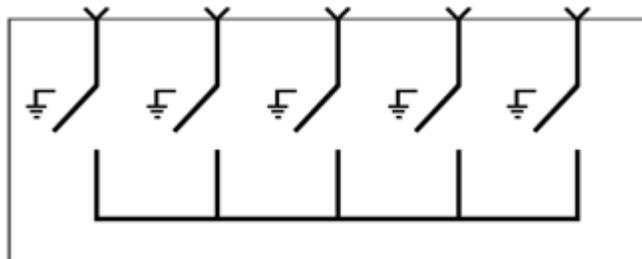
#### 10.4 5-Way, Padmount Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012711	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-G-L2-M1-O-R11-P16-S106
013244	865503-A1A2A3A4A5-B1B2B3B4B5-D1D2D3D4D5-G-L2-M1-O-R11-P16-S107

where:

86 =	25 kA rms symmetrical short-circuit rating
550 =	Five-way, five load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3A4A5 =	Motor operator package on all five ways
B1B2B3B4B5 =	Three-phase current sensing on all five ways
D1D2D3D4D5 =	Phase line-to-ground voltage sensing on each of five ways (1, 2, 3, 4, and 5)
G =	Ground position push button control
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings (without studs) at all terminals
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R11 =	Remote low-pressure alarm, with wires terminated in LVE that is furnished with a terminal block for customer connections
P16 =	Pad-mounted style, stainless steel outer enclosure and low-voltage compartment, olive green finish
S106 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall version with the LVE configured right-handed, includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control.
S107 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall version with the LVE configured right-handed, includes space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes plate drilled and wired to accommodate future mountings.

**Fig. 10.4. 5-Way, Padmount Style Switch**



### 10.5 6-Way, Wet Vault Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012695	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-E-G-J45-L2-M1-V4-O-R12-S101
013249	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-E-G-J45-L2-M1-V4-O-R12-S105
013729	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-E-G-J45-L2-M1-V4-O-R12-S109
013696	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-E-G-J45-L2-M1-V4-O-R12-S108

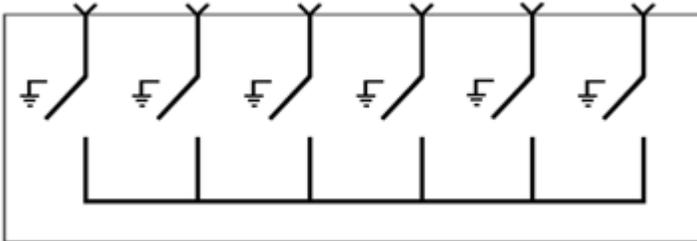
where:

86 =	25 kA rms symmetrical short-circuit rating
660 =	Six-way, six load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3A4A5A6 =	Motor operator package on all six ways
B1B2B3B4B5B6 =	Three-phase current sensing on all six ways
D1D2D3D4D5D6 =	Three-phase line-to-ground voltage sensing on each of six ways (1, 2, 3, 4, 5, and 6)
E =	Stainless steel LVE, olive green finish
G =	Ground position push button control
J45 =	Submersible control cable that connects switch to LVE, 45-ft length (in place of standard 25-ft length)
L2 =	Potential indication with test feature with provision for LVE
M1 =	600 A bushings (without studs) at all terminals
V4 =	Wet vault-mounted style. Includes stainless steel tank, submersible wiring, and submersible control cable for attachment to LVE
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R12 =	Remote low-pressure alarm with wires routed on tank for future customer connections
S101 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 60-in tall pedestal version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low-pressure alarm LED indicator, supplied with open-close-ground switch control.
S105 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 60-in tall pedestal version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes plate drilled and wired to accommodate future mountings.
S109 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the 5802 automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: 48-in tall wall-mount version includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low pressure alarm LED indicator, supplied with open-close-ground switch control.

S108 = Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application.

LVE: 48-in tall wall-mount version with space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes a plate that is drilled and wired to accommodate future mountings.

**Fig. 10.5. 6-Way Wet Vault Style Switch**



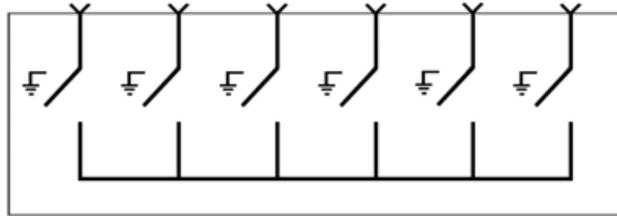
### 10.6 6-Way, Padmount Style Switch

Stock No.	S&C Electric Co. Vista Switch Catalog No.
012710	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-G-L2-M1-O-R11-P16-S102
013730	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-G-L2-M1-O-R11-P16-S103
013245	866603-A1A2A3A4A5A6-B1B2B3B4B5B6-D1D2D3D4D5D6-G-L2-M1-O-R11-P16-S107

where:

86 =	25 kA rms symmetrical short-circuit rating
660 =	Six-way, six load interrupting ways, zero fault interrupting ways
3 =	29 kV voltage rating, maximum
A1A2A3A4A5A6 =	Motor operator package on all six ways
B1B2B3B4B5B6 =	Three-phase current sensing on all six ways
D1D2D3D4D5D6 =	Three-phase line-to-ground voltage sensing on each of six ways (1, 2, 3, 4, 5, and 6)
G =	Ground position push button control
L2 =	Potential indication with test feature with provision for low-voltage phasing
M1 =	600 A bushings (without studs) at all terminals
O =	Two-hole ground pad, one per way, located below bushings or bushing wells (in lieu of standard one ground pad per tank)
R11 =	Remote low-pressure alarm, with wires terminated in LVE that is furnished with a terminal block for customer connections
P16 =	Pad mounted-style, stainless steel outer enclosure and low-voltage compartment, olive green finish
S102 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall version with LVE configured right-handed, includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low-pressure alarm LED indicator, supplied with open-close-ground switch control.
S103 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to the automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall version with the LVE configured left-handed, includes appropriate quantity of automatic switch control units to accommodate all motor operators. Includes one H&L single-mode, fiber optic transceiver. Includes remote low-pressure alarm LED indicator supplied with open-close-ground switch control.
S107 =	Switch: auxiliary contacts on all ways. Auxiliary contacts in tank connected to a terminal strip in the LVE for future connection to automated switch control(s) with provision for temporary disconnection when testing motor operators. Connections shall be waterproof for submersible application. LVE: special 48-in tall version with the LVE configured right-handed, includes space for future mounting of automatic switch control units to accommodate all motor operators. Includes space for future mounting of one transceiver. Includes remote low pressure alarm LED indicator supplied with open-close-ground switch control. Enclosure includes plate drilled and wired to accommodate future mountings

**Fig. 10.6. 6-Way, Padmount Style Switch**



## 11. Accessories

### 11.1 Portable Remote Control

Stock No.	S&C Electric Co. Catalog No.	Description
013348	TA-2424	Portable remote control for a permanent motor operator. Use with a 50-ft control cable, Stock No. 013350, to operate a switch located in the same in-building vault as the LVE.

### 11.2 Control Cable

Stock No.	S&C Electric Co. Catalog No.	Description
013350	9931-616	50-ft control cable for portable remote control for a permanent motor operator. Use with a portable remote control, Stock No. 013348, to operate a switch located in the same in-building vault as the LVE.

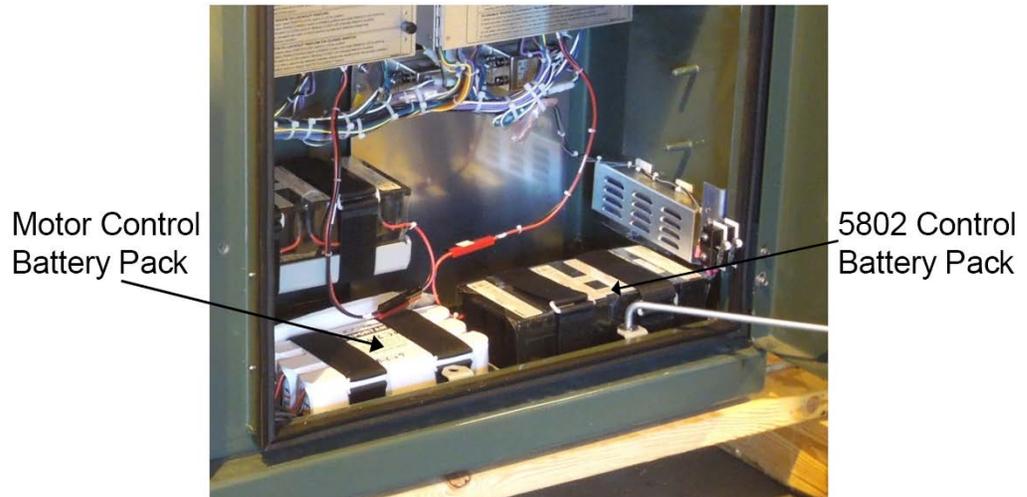
### 11.3 Motor Control Battery Pack (White Jacketed)

Stock No.	S&C Electric Co. Catalog No.	Description
013743	QCUA-5601-3	36 Vdc, 5 Ah, battery assembly. Motor control battery packs are also known as Vista battery assemblies. One Stock No. 013743 is required per switch. This battery provides power to remote supervisory (capable) Vista switch motor operators. Motor operators will not operate without a battery in the circuit. Switchgear and batteries are ordered as separate stock numbers. See Figure 11.4.

### 11.4 5802 Control Battery Pack (Black Case)

Stock No.	S&C Electric Co. Catalog No.	Description
013744	591-000190-02	36 Vdc, 8 Ah, battery assembly. 5802 control battery packs are also known as remote supervisory battery packs. Note: 3- and 4-way switches require two Stock No. 013744. 5- and 6-way switches require three Stock No. 013744. This battery provides backup power to remote supervisory (capable) Vista switch 5802 controls. Switchgear and batteries are ordered as separate stock numbers. See Figure 11.4.

**Figure 11.4. Battery Pack Identification**



## 12. References

**SCL Design Standard 9202.17**; "Vista Switch Application Guide"

## 13. Sources

**S&C 1042-501**; "S&C Series Automatic Switch Controls With IntelliTeam II Automatic Restoration System," June 1, 2005, S&C Electric Company

**S&C 1044-31**; "IntelliTeam SG Automatic Restoration Software, Software Licensing, Specification Bulletin 1044-31," dated September 7, 2010

**S&C 1044-34**; "IntelliTeam SG Automatic Restoration System, Descriptive Bulletin 1044-34," dated January 17, 2011

**S&C 1045-30**; "S&C 6801 Automatic Switch Control for Outdoor Pole-Mounted Gear, Descriptive Bulletin 1045-30," dated January 24, 2011

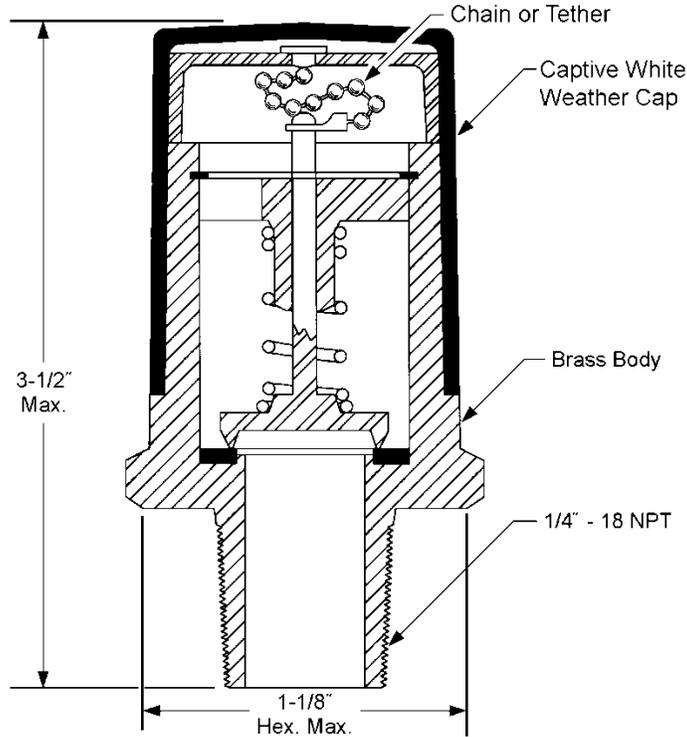
**S&C 682-31**; "Remote Supervisory Vista Underground Distribution Switchgear, Specification Bulletin," December 17, 2007, S&C Electric Company

**SCL Material Standard 2501.67** (canceled); "29 kV, Three-Phase, SF6, Multi-Purpose, Distribution Switchgear, Remote Supervisory (Capable)"

**Shetab, Muneer**; SCL Standards Engineer and subject matter expert for 4501.67 (muneer.shetab@seattle.gov)

**Shipek, John**; SCL Standards Supervisor, and originator and subject matter expert for 4501.67 (john.shipek@seattle.gov)

**Valve, Transformer Pressure Relief**



The **Transformer Pressure Relief Valve** shall be of the general configuration and dimensions shown and shall be designed to operate under most severe conditions found in overhead distribution transformer service.

The valve body and poppet shall be made of solid brass. All other components such as pins, retainer rings, and springs shall be of non-ferrous alloys or corrosion-resistant steel. The sealing gasket shall be of Viton or Buna N.®

The valve shall have a captive plastic weather cap that will automatically disengage itself upon any operation of the relief valve, revealing a red target. The cap shall be white or other light color, shall hang down on a chain or tether and be easily seen from the ground at night with no lights. The red target shall be either a band or disc normally hidden by the cap. A pull ring is acceptable but not required.

**Operation Requirements:**

Cracking pressure	8 - 10 PSIG
Reseal pressure	8 - 10 PSIG
Min. flow rate @ 15 PSIG	50 - SCFM

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 John Shipek

Unit Director  
 Darnell Cola

# MATERIAL STANDARD

**Stock Unit:** EA

**Stock Number:** 294001

**Approved Manufacturers:**

VIAT	302-080-01 I
Heartland	HPV-1343

In October 2015, this standard was renumbered from 2940.1 to 4503.10.

**Sectionalizer, Dry Type, Resettable, 38 kV, 200 Ampere**

**1. General**

- 1.1 This specification covers overhead type, cutout mounted single-phase, 38 kV, 200 ampere dry sectionalizers.
- 1.2 The sectionalizers shall be field resettable and shall require no replaceable parts to reset.
- 1.3 The sectionalizer shall fit into both Chance/Hubbell type C and S&C type XS cutout bodies.

**2. Service**

This sectionalizer is intended for use on a 26,400-volt, three-phase, 60 Hertz overhead distribution system.

**3. Ratings**

Maximum Design Voltage .....	38 kV
Basic Impulse Insulation Level (BIL).....	150 kV
Continuous Current Rating .....	200 amperes
Minimum Actuating Current Rating .....	320 amperes
Maximum Thermal Rating .....	300 amperes
Momentary Current Rating .....	12,000 amperes, asym.
Short-Circuit Rating – 15 Cycle.....	8,600 amperes, sym.
One second .....	4,000 amperes, sym.
Three second .....	3,200 amperes, sym.
Ten second.....	2,500 amperes, sym.
Dead Line Detector Threshold .....	300 milliamperes
Reset Time       25 seconds	
Surge Current Withstand .....	65,000 amperes
Number of Counts 2	

**4. Nameplate** Each sectionalizer shall have a nameplate or label with the following information:

- (a) Manufacturer's name and catalog number.
- (b) Voltage rating.
- (c) Continuous current rating.
- (d) Actuating current rating.
- (e) Number of counts

**5. Guarantee**

Any sectionalizer failing due to defective design, material, and/or workmanship within 12 months after being energized or 18 months after delivery shall be repaired or replaced without cost to Seattle City Light. Any defect in design, material, and/or construction discovered within this period shall be corrected on all units furnished on this order at the manufacturer's expense either by repair or replacement.

**6. Approved Manufacturers**

Stock No.	Description	A. B. Chance/ Hubbell Cat. No.
210111	Electronic Sectionalizer, Resettable, 38 kV, 150 kV BIL, 200 Ampere continuous rating, 2 counts, to fit Stock No. 682099 C/O. For use on 26 kV system.	C740-392T

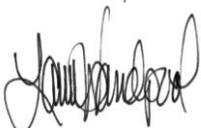
**Stock Unit:** EA

In October 2015, this standard was renumbered from 2501.45 to 4504.45.

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 Darnell Cola





## 27 kV Metal-Enclosed Interrupter (MEI) Switchgear

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## 27 kV Metal-Enclosed Interrupter (MEI) Switchgear

### 1. Foreword

#### 1.1 Scope

This standard covers general requirements for 27 kV metal-enclosed interrupter (MEI) switchgear assemblies containing, but not limited to, such devices as interrupter switches; selector switches; power fuses; control, instrumentation and metering devices; and protective equipment for the control and protection of apparatus used for distribution of electrical power.

This standard is applicable only to metal-enclosed interrupter (MEI) switchgear ultimately owned by Seattle City Light.

Metal-enclosed interrupter (MEI) switchgear is intended for use on a 26.4 kV, three-phase, 60 Hz, 4-wire, solidly grounded, isolated neutral distribution system.

In addition to addressing the purely technical aspects of metal-enclosed (MEI) switchgear, this Material Standard may also be used by the Purchaser as a guide to:

- Develop site-specific requirements
- Assemble bid packages
- Aggregate bid information

Detailed, site-specific requirements shall be according to:

- Site-Specific One Line Diagram
- Site-Specific Requirements (text-based)

Purchaser is directed to **Appendix A** for information related to developing site-specific requirements.

This standard is not applicable to switchgear assemblies containing power circuit breakers, also known as metal-clad switchgear.

#### 1.2 Standards

Metal-enclosed interrupter (MEI) switchgear assembly and components shall meet the requirements of the following standards and codes:

- 6801.4 - City Light Material Standard, 21 kV Heavy Duty Distribution Class Metal-Oxide Surge Arrester, dated October 18, 2004
- C37.20.3-2001 - IEEE Standard for Metal-Enclosed Interrupter Switchgear
- C37.20.4-2001 – IEEE Standard for Indoor AC Switches (1kV-38kV) for Use in Metal-Enclosed Switchgear
- C37.40-2003 – IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- ANSI C37.22-1997 – Preferred Ratings and Related Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear
- C57.12.28-1999 – ANSI Pad-Mounted Equipment-Enclosure Integrity
- C2-2002 – National Electric Safety Code (NESC)
- NEMA 250-2003 – Enclosures for Electrical Equipment (1000 Volts Maximum)
- Revised Code of Washington (RCW) 19.29.010
- Q9001-2000 – ANSI/ISO/ASQ Quality Management Systems: Requirements

**MATERIAL STANDARD****27 kV Metal-Enclosed Interrupter (MEI) Switchgear****1.3 Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. Seattle City Light General Terms and Conditions
3. Site-specific one line diagram
4. Site-specific requirements
5. This Seattle City Light Material Standard
6. Other referenced Seattle City Light Material Standards
7. National and state codes
8. Industry standards

**2. Ratings****2.1 Basic Electrical**

Switchgear shall have the following basic electrical ratings:

Maximum voltage	27 kV, rms
Number of phases	3-phase
Number of wires	4-wire, multi-grounded neutral
Power frequency	60 Hz
Lightning-impulse withstand voltage (BIL)	125 kV, crest
Power-frequency withstand voltage	60 kV, rms

**2.2 Temperature Limitations**

Switchgear components shall conform to the temperature limits set forth in the following industry standards:

<b>Component</b>	<b>Standard</b>
Insulating materials	IEEE C37.20.3, Section 5.5
Buses and connections	IEEE C37.20.3, Section 5.5
Surrounding air	IEEE C37.20.3, Section 5.5
Parts subject to contact by personnel	IEEE C37.20.3, Section 5.5
Switches	IEEE C37.20.4, Section 5.18
Fuse assemblies	IEEE C37.40, Table 1

**3. Construction****3.1 General**

Service conditions shall be usual as defined in IEEE C37.20.3, Section 4.

General construction requirements shall be according to IEEE C37.20.3, Section 7.

Switchgear shall be outdoor rated.

**MATERIAL STANDARD**

**27 kV Metal-Enclosed Interrupter (MEI) Switchgear**

**3.2 Arc Resistance**

Switchgear is not required to be arc-resistant according to the requirements of C37.20.7 – IEEE Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults

**3.3 General Compartment Requirements**

Compartments shall meet the following dimensional requirements:

Overall height	120 inches minimum
Overall width	60 inches minimum
Overall depth	48 inches minimum

Compartments shall meet the following electrical clearance requirements:

Bare energized bus to ground	7-1/2 inches minimum
Bare energized bus to bus	9 inches minimum
Bare energized bus to inside main compartment door	9 inches minimum
protective inner door	7-1/2 inches minimum

For the purpose of determining electrical clearances, assume outdoor terminations with three-inch diameter skirts will be used.

Viewing windows shall be provided according to the requirements of IEEE C37.20.3, Section 7.4.3 with the following clarifications:

- Elevation above the floor of the center of the viewing windows shall be between 48 and 66 inches. Exceptions to this requirement will be made for certain ancillary device compartments.
- When standing directly in front of the window (with compartment door closed) and looking in the direction of the visible break, viewing angle shall not exceed +/- 30 degrees off (horizontal) perpendicular.

Compartment doors shall be provided with a means to be fixed open.

Inside ceiling surfaces shall be coated with anti-condensation material.

**3.4 Cable Termination Compartment Requirements**

In addition to general compartment requirements, cable termination compartments shall meet the following requirements.

- Switchgear entrance bays shall be designed for bottom feed.
- Conduits shall be installed to turn up.
- Cable termination compartment shall meet the following dimensional requirements:
  - Distance from conduit end to middle phase termination landing pad shall be 60 inches minimum. Upon request and following agreement, Seattle City Light will provide a pit up to 2'-1" deep to obtain this minimum clearance.
- Each phase landing pad shall be provided with two sets of two 5/8-inch diameter holes on 1-3/4-inch vertical centers, each set separated horizontally 4-1/2 inches on center. Provide one additional 7/16-inch diameter hole per pad at least 1-3/4 inches away from the other holes for connecting surge arrester leads.
- A grounded base plate shall be provided inside the termination compartment, predrilled with three 7/16-inch diameter holes for mounting surge arresters. Surge arresters will be furnished and installed by Seattle City Light. Refer to City Light Material Standard 6801.4 / Stock Number 680117.

**MATERIAL STANDARD****27 kV Metal-Enclosed Interrupter (MEI) Switchgear****3.4 Cable Termination Compartment Requirements, continued**

- A vertically mounted length of 1-5/8 inch by 1-5/8 inch strut channel shall be mounted on each side of the termination compartment. A third length of 1-5/8 inch by 1-5/8 inch strut channel shall be installed between the first two for mounting cable support hardware (provided by Seattle City Light).
- Because Seattle City Light owned switchgear does not contain a metering compartment, no EURSERC-related requirements are cited here. However, as a convenient reference for Seattle City Light engineers and large customers who may need to acquire their own switchgear, a review of Seattle City Light metering compartment requirements appears in **Appendix E**.

**3.5 Nameplates**

Switchgear assembly shall be provided with nameplates conforming to the requirements of IEEE C37.20.3, Section 7.4.1 with the clarification that the nameplates also include:

- Year of manufacturer
- Purchase Order Number

Nameplates shall be stainless steel and affixed to the switchgear with stainless steel fasteners.

**3.6 Materials**

Switchgear material requirements shall be according to IEEE C37.20.3, Section 7.5.1.

Material shall be steel.

**3.7 Coating System Qualification**

Coating system shall meet the qualification requirements of ANSI C57.12.28, Section 5 with the following clarifications:

- **Section 5.2.4** – Enclosure color  
The topcoat color shall be Munsell 8.3 G6.10 / 0.54 (light gray).
- **Section 5.3** - Coating system test specimens  
Reasonable dimensional variations of test specimens are acceptable.
- **Section 5.4.1** – Salt spray test  
All test specimens shall be tested in the salt spray chamber for a period of:
  - 1500 hours continuously for indoor rated MEI switchgear,
  - 2500 hours continuously for outdoor rated MEI switchgear,except for the short daily interruptions necessary to inspect the test specimen or replenish the solution in the reservoir.
- **Section 5.4.5** – Insulating fluid resistance test  
The requirements of this section are waived.

**3.8 Finish**

Switch live parts, bus, and surfaces which are stainless steel, galvanized steel, glass, plastic viewing ports, porcelain, or which serve a dielectric purpose shall be left unpainted.

**3.9 Physical Access Control**

Each compartment containing high voltage components shall provided with the following:

- Protective inner door consisting of a solid, high-strength, transparent, full-length, hinged, bolted-closed barrier (Lexan, clear polycarbonate, or approve equivalent) inside each compartment main door in order to comply with Washington Administrative Code (WAC) 296-45-325, Table 1. Table 1 states for phase-to-phase voltages between 15.1 and 36.0 kV, the AC live work minimum approach distance shall be two feet ten inches.
- Padlockable door handle.
- Pentahead bolt.

**3.10 Enclosure Category**

Switchgear assembly enclosure category shall be B as defined in IEEE C37.20.3. Refer to Annex A.2 of IEEE C37.20.3 for category definitions.

**3.11 Ventilation**

Vents shall be provided at the top and bottom of the enclosure for air circulation.

Vents shall be equipped with filters to minimize dust and dirt ingress.

Vent filters shall be accessible from outside of the enclosure to allow the filters to be maintained without having to de-energize the switchgear.

Vents shall be designed to prevent the entrance of foreign objects.

**3.12 Humidity Control**

Each compartment shall be provided with an electric, strip-type, space heater to minimize condensation inside the compartment.

Space heater elements shall be enclosed within a perforated guard to protect against inadvertent contact.

Space heaters shall be wired to terminal blocks and protected with fuses or a separate circuit breaker.

Space heaters shall be controlled by a humidistat.

Space heater fuses (or circuit breaker) shall be accessible from outside high-voltage compartments.

Space heater power shall be provided by an internal source.

**3.13 Convenience Outlets**

Switchgear shall be provided with two 20 ampere ground-fault-interrupter (GFI) type convenience outlets.

Convenience outlets shall be located at the opposite ends of the switchgear.

**3.14 Storage**

Provision inside the transformer bay door shall be made for storing spare control and instrument transformer fuses.

**3.15 Seismic Withstand Capability**

Metal-enclosed switchgear shall be designed to avoid damage or loss of function and remain operational during and following an earthquake. The term "operational" means that rotating components will not freeze, pressure vessels will not rupture, supports will not collapse, systems required to be weatherproof will remain weatherproof, and components required to respond actively (such as control linkages, switch contacts, relays, motors, pumps, valves and similar items) will respond actively.

Equipment shall not change operational state due to the seismic event, that is, a device in the open position shall remain open; if closed, it shall remain in the closed position.

Zone 4 seismic requirements shall apply.

UBC Importance Factor shall be 1.25.

**MATERIAL STANDARD****27 kV Metal-Enclosed Interrupter (MEI) Switchgear****4. Basic Components****4.1 Load Interrupter Switches**

Load interrupter switches shall be stationary mounted.

Load interrupter switches shall have the following ratings:

Maximum voltage	27 kV
Lightning-impulse withstand (BIL)	125 kV, crest
Power frequency withstand voltage	60 kV, rms
Power frequency	60 Hz

Load interrupter switches shall meet the electrical endurance capabilities of ANSI C37.22, Tables 3 with the following clarifications:

- Number of operations (under same conditions) shall be doubled.

Load interrupter switches shall meet the mechanical endurance capabilities of ANSI C37.22, Tables 4.

**4.2 Load Interrupter Switch Operators**

Load interrupter switch operator shall meet the applicable requirements of ANSI C37.22, Table 5.

**4.3 Power Fuse Mountings**

Power fuse mountings shall be as stated in site-specific requirements.

**4.4 Power Fuses**

Power fuses shall be as stated in site-specific requirements.

**4.5 Insulators**

Interrupter switch, fuse mounting, and bus support insulators shall be electrical grade, cycloaliphatic epoxy or wet porcelain type.

Insulators shall have:

- Successful operating history of at least 10 years in a similar application.
- Ablative action or inorganic glaze to ensure non-tracking properties.
- Adequate leakage distance established by test per IEC Publication 507, First Edition, 1975.
- Mechanical strength commensurate with the short circuit rating of the complete metal-enclosed (MEI) switchgear assembly.
- Lightning-impulse withstand (BIL) commensurate with the rating of the complete metal-enclosed (MEI) switchgear assembly.

**4.6 Bus and Connections**

Phase and neutral/ground bus shall be rectangular copper bar.

Phase and neutral/ground bus shall be bare.

Phase and neutral/ground bus system shall have a short circuit rating equal to that of the integrated assembly.

Neutral bus and the ground bus shall be one and the same.

A separate, insulated neutral bus is not desired and shall not be provided. Neutral/ground bus shall have a continuous current rating of 600 A.

**MATERIAL STANDARD**

**27 kV Metal-Enclosed Interrupter (MEI) Switchgear**

**4.6 Bus and Connections, continued**

Neutral/ground bus shall extend the full length of the assembly.

Neutral/ground bus shall be bonded to the switchgear's frame and maintain electrical continuity throughout the integrated assembly.

Neutral/ground bus shall be connected to a two-hole grounding pad welded to the surface of the enclosure inside each vertical section.

Bus system joint connections shall be silver-plated.

Bus system joints shall utilize at least two bolts per connection.

Bus system shall not utilize braided conductor.

Cable termination bus shall be equipped with one-inch diameter ball-type grounding studs (one per phase plus neutral/ground), Salisbury catalog number 21191, to allow each phase to be safely checked for voltage with a hotstick-type voltage sensor and then grounded with hotstick-installed, ball and socket-type grounding system.

A hotstick-removable insulating cover, Salisbury catalog number 21236, shall be provided for each normally energized ball-type grounding stud.

Bay-to-bay bus transitions shall incorporate solid-type through bushings to prevent (in the event of a fault) the transmission of ionized gases to adjacent cubicles.

**4.7 Surge Arresters**

Surge arrester mounting points shall be provided inside the metal-enclosed switchgear cabinetry, where indicated on one line diagram.

Surge arresters shall be provided and installed by Seattle City Light.

Surge arresters shall meet the requirements of Seattle City Light Material Standard 6801.4, Stock Number 680117.

Surge arrester installation shall meet the requirements of NESC C2, Section 19.

**4.8 Instrument Transformers**

Current transformers shall meet the requirements of IEEE C37.20.3, Section 5.6.

If current transformers are required, ratings shall be as shown on the site-specific one-line diagram.

**4.9 Auxiliary Power Transformer**

Auxiliary power transformer shall have the following ratings:

Frequency:	60 Hz
Phase:	1
Voltage and taps	
HV:	25564 Grd Y / 14760 V
LV:	240/120 V
HV basic impulse insulation level (BIL):	125 kV, crest

Auxiliary power transformers' temperature rise above ambient shall not exceed 115 degrees C.

According to the requirements of the Revised Code of Washington (RCW), Section 19.29.010, Rule 5, auxiliary power transformer shall bear a tag that states:

- This transformer has been tested at rated line voltage and has successfully passed all applicable tests specified by ANSI and NEMA.

**4.9 Auxiliary Power Transformer, continued**

Tag shall include:

- Transformer serial number
- Date of test
- Name of person performing test

Auxiliary power transformer shall be protected by a primary, current-limiting fuse.

Auxiliary power transformer shall be sized to accommodate the maximum design load of the switchgear plus convenience outlets.

**5. Protection and Control****5.1 Protection and Control**

Protection and control shall be as stated in site-specific requirements.

Purchaser is directed to **Appendix F** for information related to developing site-specific protection and control schemes.

**5.2 Source Transfer**

If source transfer control capability is required, it shall be accomplished by means of one of the following controllers:

- S&C Electric Company Micro-AT Source Transfer Control
- Schweitzer Engineering Laboratories SEL-351

Substitutions will not be considered.

**5.3 Open-Phase Detector**

If open phase detection is required, it shall be accomplished by means of one of the following devices:

- S&C Electric Company Open-Phase Detector – Type SPD
- S&C Electric Company Open-Phase Detector – Type ZSD
- Schweitzer Engineering Laboratories SEL-351

Substitutions will not be considered.

**5.4 Pendant Switch Controller**

Load interrupter switch operators shall be designed to accommodate a pendant-type controller for remote opening and closing of the load interrupter switch.

Pendant-type controller shall consist of a fifty-foot cable with an electrical connector on one end for plugging into the load interrupter switch operator and a watertight box on the other with push button-type control switches.

Each complete metal-enclosed interrupter (MEI) switchgear assembly containing at least one load interrupter switch operator shall be provided with two pendant-type controllers.

**5.5 SCADA**

SCADA capability shall be as stated in site-specific requirements.

## 6. Alternative Construction

Substitutions or alternative construction, which provides Seattle City Light with equal or better functionality, quality, strength, service life, or maintainability, will be considered and evaluated.

Bids incorporating substitutions shall include data that substantiates the proposed construction method or component has equal or better functionality, quality, strength, service life, or maintainability than the item specified.

Substitutions and alternative construction shall meet or exceed all cited standards and codes.

All proposed substitutions and alternative construction shall be summarized on **Appendix B – Bidder's Data Sheet**.

## 7. Special Tools

Each metal-enclosed interrupter assembly (MEI) shall be provided with at least one set of any special tools or equipment required to operator, maintain, inspect, and test the switchgear.

Special is defined as not usually on hand at an average electric utility, or important to be stored on-site, with the switchgear.

## 8. Testing and Certification

### 8.1 Quality Assurance

Supplier shall adhere to ANSI/ASQ Q9001 to assure proper design, production, and testing of the complete metal-enclosed interrupter (MEI) assembly.

### 8.2 Design Tests

Design tests of the complete metal-enclosed interrupter (MEI) assembly shall be performed according to IEEE C37.20.3, Section 6.2.

Design tests of the individual load interrupter switches shall be performed according to IEEE C37.20.4, Section 6.2.

### 8.3 Production Tests

Production tests of the complete metal-enclosed interrupter (MEI) assembly shall be performed according to IEEE C37.20.3, Section 6.3.

Production tests of the individual load interrupter switches shall be performed according to IEEE C37.20.4, Section 6.3.

### 8.4 Conformance Tests

Conformance testing of the complete metal-enclosed interrupter (MEI) assembly is not required.

Conformance testing of individual load interrupter switches is not required.

### 8.5 Field Dielectric Tests

Field dielectric testing will be performed by Seattle City Light personnel.

## 9. Design Review

Seattle City Light reserves the right to have a representative(s) perform a technical review of the metal-enclosed (MEI) switchgear design prior to the design being released to manufacturing. Technical review, if performed, will be at the supplier's manufacturing facility. Seattle City Light will provide notification (at the time Approval Drawings are returned) as to whether such a review is desired.

**10. Test Witnessing**

Seattle City Light reserves the right to have a representative(s) present and observe production tests and/or inspect the metal-enclosed (MEI) switchgear prior to shipment. Photocopies of preliminary test results shall be supplied to Seattle City Light representative(s) witnessing the tests, upon request. Supplier shall provide Seattle City Light at least fourteen (14) days written notice prior to testing to allow Seattle City Light's representatives to be present at tests.

**11. Documentation****11.1 General**

All documentation shall be in English and use customary inch-pound units.

**11.2 Bidder's Information**

Bidder shall furnish two (2) sets of the following information to Seattle City Light's Purchasing Department:

- Completed **Appendix B** – Bidder's Data Sheet
- The documents and drawings listed in **Appendix C** – Bidder Supplied Documents, Drawings, and Lists

Bid drawings and documents shall be marked with Seattle City Light's Request for Proposal (RFP) number.

**11.3 Approval Drawings**

Successful bidder/supplier shall furnish three (3) sets of the approval drawings and documents listed in **Appendix D** – Drawing and Documentation List (approval and final) to Seattle City Light's Purchasing Department.

Supplier's schedule shall include transmittal time and the twenty (20) working days Seattle City Light will require to conduct its review.

All approval drawings shall be endorsed for approval and be marked with Seattle City Light's purchase order number and supplier's shop order number.

Seattle City Light will review each drawing and document and return one (1) copy of each to the supplier together with a transmittal letter summarizing Seattle City Light's comments.

The transmittal letter will indicate the approval status of each drawing and document reviewed by Seattle City Light. Approval status categories are as follows:

ACCEPTED – WITHOUT COMMENT - Item is approved by SCL as to general scope and content; however, the supplier is not relieved of their obligation to meet all of the requirements of the Material Standard.

ACCEPTED – WITH COMMENTS NOTED - Item is approved by SCL as to general scope and content subject to the minor changes noted on the item; however, the supplier is not relieved of their obligation to meet all of the requirements of the Material Standard.

NOT ACCEPTED - REVISE AND RESUBMIT - Item is not approved by SCL. Supplier shall specifically address and/or incorporate all SCL comments into a revised submittal, and resubmit the item to SCL for approval.

Seattle City Light will review all revised and resubmitted drawings and documents and return one (1) copy of each, together with a transmittal letter, to the supplier within (10) working days after receipt. Drawings and documents shall bear a revised revision date. Revised areas of the submittal shall be circled.

Supplier shall present a complete and acceptable submittal package to Seattle City Light not later than the second submittal of an item.

Seattle City Light reserves the right to withhold monies due the supplier to cover the unplanned cost of review beyond the second submittal.

Corrections indicated on submittals returned by Seattle City Light shall be considered as changes necessary to meet the requirements of this Material Standard and shall not be taken as the basis for claims for extra work.

**11.4 Final Certified Drawings and Instruction Books**

After approval of all submittals by Seattle City Light, supplier shall furnish four (4) sets of the final, certified drawings, instruction books, spare parts list, and test reports listed in **Appendix D** – Drawing and Documentation List (approval and final) to Seattle City Light's Purchasing Department.

All final, certified drawings (etc.) shall be endorsed correct for construction and be marked with Seattle City Light's purchase order number and supplier's shop order number.

In addition to the above four (4) sets, one (1) set of drawings, instruction books, spare parts list, and test reports shall be shipped with one of the switchgear bays, suitably protected from shipping damage and weather.

**12. Training****12.1 Operations and Maintenance**

Supplier shall provide **two** days of training, eight (8) hours each day, for up to 25 personnel covering the installation, operation, maintenance, troubleshooting and repair of the switchgear.

Supplier shall provide training within one (1) month of receipt of switchgear by Seattle City Light.

Supplier shall provide as course material certified drawings, instruction books, spare parts list, and test reports.

Supplier shall submit proposed course outline to Seattle City Light's Purchasing Department for review, comment, and approval four (4) weeks prior to shipping completed switchgear.

**12.2 Engineering**

Supplier shall provide **one** day of training, eight (8) hours each day, for up to 25 personnel covering the installation, operation, maintenance, troubleshooting and repair of the switchgear.

Engineering training will precede Operations and Maintenance training.

Supplier shall provide as course material certified drawings, instruction books, spare parts list, and test reports.

Supplier shall submit proposed course outline to Seattle City Light's Purchasing Department for review, comment and approval no later than two (2) months prior to shipping completed switchgear.

**13. Warranty**

Warranty general terms and conditions for metal-enclosed (MEI) switchgear shall be as specified in Seattle City Light's purchase order.

Warranty period for metal-enclosed (MEI) switchgear shall be a minimum of twelve (12) months from date of energization, or eighteen (18) months from date of receipt, whichever is earlier, or as stated on Seattle City Light's Request for Proposal or Purchase Order.

**14. Shipping**

Freight terms shall be FOB destination, freight prepaid and allowed, or as stated on Seattle City Light's Request for Proposal or Purchase Order.

Shipping destination shall be as specified on the site-specific requirements document or Seattle City Light's Request for Proposal or Purchase Order.

Exterior and interior of switchgear shall be received reasonably free from road dust, dirt, and other contamination. If it is necessary for Seattle City Light personnel to clean the switchgear, the supplier will be billed for their time.

Seattle City Light personnel will be responsible for rigging and off-loading metal-enclosed switchgear bay assemblies from delivery vehicles.

**15. Approved Manufacturers**

- Federal Pacific
- Powercon Corporation
- S&C Electric Company

As of October 2015, this standard has been renumbered from 2501.85 to 4505.85.

**APPENDIX A - SITE-SPECIFIC REQUIREMENTS DEVELOPMENT WORKSHEET****A.1 Scope**

The purpose of this worksheet is to assist the Purchaser with the development of a set of detailed, site-specific requirements for a complete metal-enclosed interrupter (MEI) switchgear assembly.

The results of this work shall be:

- Site-Specific One Line Diagram, and a
- Site-Specific Requirements (text-based) Document

Each of the above shall be titled and dated so they can be easily referred to in the body of the Request for Proposal and (later) the Purchase Order.

**A.2 General**

Due to the variety of apparatus, enclosure, and control choices offered by industry and the countless bay variations mandated by the system this worksheet cannot be considered more than a guide. This worksheet does not and cannot cover all situations.

The Purchaser should be familiar with their system, switchgear accessibility, local environment, applicable national and state codes, and applicable industry standards.

The Purchaser should be aware that most manufacturers of metal-enclosed interrupter (MEI) switchgear are willing to offer (at no cost) informative product technical bulletins and technical advice.

Major metal-enclosed (MEI) switchgear design choices related to application include:

- Radial (single or multiple)
- Looped-primary
- Primary-selective (common bus or split bus)

Purchaser is directed to **Appendix F** for information related to developing site-specific protection and control schemes.

It is recommended that foundation construction work not proceed until after approved, metal-enclosed (MEI) switchgear base plan and anchor details are in hand.

**A.3 One Line Diagram**

One line diagram shall bear a project title, drawing number, revision number, and revision date.

One line diagram shall include at least the following information:

- Nominal system voltage
- Available (and future anticipated) line-to-line symmetrical short circuit current
- X/R ratio, if other than 15
- Maximum continuous main bus current
- Function of each bay (cable entrance, feeder, auxiliary, metering, or spare)
- Basic components contained in each bay (bus, interrupter switches, fuses, instrument transformers, surge arresters, meters, relays, etc.)
- Current transformer ratings (basic impulse level, rated primary and secondary currents, accuracy class, continuous thermal current rating factor)
- Interconnections of basic components
- Normally open and normally closed switch positions
- Bay designation numbers
- Each switch shall be identified as being manual or power-operated. If power operated, indicated if "stored energy" or "run and trip" type
- Point of service demarcation
- Conceptual foundation and conduit plan

**MATERIAL STANDARD****27 kV Metal-Enclosed Interrupter (MEI) Switchgear****A.4 Requirements (Text-Based)**

Site-specific requirements document shall bear a project title and revision date.

Site-specific requirements document shall include the following information:

- Constraints related to installation, for example, providing dimensions of a small entryway to the room where the switchgear will be installed.

Below is a list of design choices that are not normally addressed by the one line diagram. It is presented here for convenience.

- If switchgear will be exposed to unusual service conditions, state clarification. If no clarification is made, switchgear will be designed for usual service conditions. Refer to IEEE C37.20.3, Section 8 for guidance.
- If switchgear is required to be arc-resistant according to the latest revision of C37.20.7 – IEEE Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults, state clarification and indicate if:
  - Type 1 (front only) Accessibility or
  - Type 2 (front, back, and sides) Accessibility
- If no clarification is made, switchgear will **not** be designed to be arc-resistant.
- Indicate size and number per phase of primary, source cables.
- If switchgear neutral bus is to exist separately from the ground bus, state clarification. If no clarification is made, switchgear will be designed with a combined function neutral/ground bus.
- If switchgear is required to have other than bottom feed, state clarification. If no clarification is made, switchgear will be designed for bottom feed.
- If switchgear enclosure is required to be other than light gray, state clarification, If no clarification is made, switchgear enclosure will be light gray.
- If switchgear is required to be Enclosure Category A or C, state clarification. If no clarification is made, switchgear will be designed as Enclosure Category B. Refer to IEEE C37.20.3, Annex A.2 for category definitions.
- Minimum time for load interrupter switch to change state from closed to open and from open to close. This information gives insight into what kind of load interrupter operator is required.
- If a preference exists for switch operator control voltage, state clarification. Standard choices are 24, 48, 120, or 250 volts DC or 120, 240 volts AC single-phase, or 208Y/120 or 240 volts AC polyphase.
- If the complete metal-enclosed interrupter (MEI) switchgear assembly or individual load interrupter switches require conformance testing, state clarification. If no clarification is made, conformance testing will not be performed.

**A.5 Shipping**

Site-specific requirements document shall include:

- Facility name
- Shipping destination address
- Facility contact and phone number

The supplier (or carrier) shall notify Seattle City Light's facility contact a minimum of 48 hours before the shipment arrives at the destination site so that off-loading arrangements can be made.

**A.6 Assembling the Bid Package**

The Purchaser shall assemble the following documents (referenced to each other as indicated) into a bid package:

- I. Seattle City Light Request for Proposal
  - A. Site-specific one line diagram
  - B. Site-specific text-based requirements
  - C. This Material Standard (2501.85)
- II. Seattle City Light General Terms and Conditions

Bidder is responsible for obtaining copies of all other referenced and/or applicable codes and standards.

Seattle City Light Material Standards are available online. Refer to: [www.seattle.gov/light/engstd/](http://www.seattle.gov/light/engstd/)

**MATERIAL STANDARD**

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

STANDARD NUMBER: **4505.85**

PAGE: 15 of 23

SUPERSEDING: December 22, 2005

EFFECTIVE DATE: October 29, 2015

**APPENDIX B - BIDDER'S DATA SHEET**

Seattle City Light Request for  
Proposal (RFP) number

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Respondent

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**Manufacturer Identification**

Manufacturer's name, home office address,  
contact, and phone number

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Manufacturing plant address, contact, and phone  
number (if different than above)

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Number of years in business, successfully  
manufacturing and delivering similar products

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**General**

Unit price (\$)

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Approval drawings (weeks after receipt of order)

---

Manufacture time (week after receipt approval)

---

Point of shipment

---

Method of shipment

---

Shipping time (time)

---

Total delivery time (weeks after receipt of order  
including two weeks for Seattle City Light  
approval review)

---

**MATERIAL STANDARD**

**27 kV Metal-Enclosed Interrupter (MEI) Switchgear**

**Preventive Maintenance**

Estimated labor hours and material cost for preventive maintenance tasks recommended by manufacturer to be performed during the first ten (10) years of service

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**Warranty**

After receipt (months)

---

After energization (months)

---

**Optional extended warranty, if any**

After receipt (months / \$ adder)

---

After energization (months / \$ adder)

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**Manufacturer's Sales and Service Identification**

Agency name, address, contact, and phone number of manufacturer's nearest sales office or representation

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Agency name, address, contact, and phone number of manufacturer's nearest engineering field service office

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**APPENDIX C – BIDDER SUPPLIED DOCUMENTS, DRAWINGS, AND LISTS**

- C.1** Catalog literature
- C.2** Proposed switchgear assembly one line diagram
- C.3** Representative switchgear outline drawing showing:
- Individual bay dimensions
  - Basic components
  - Phase, neutral, and ground bus
  - Source cable training
  - Viewing windows
  - Weights
  - Base plan
  - Anchor details
  - Bill of material
- C.4** Clear indication if pit is required (and how deep) to obtain minimum clearances cited in Section 3.4 - Cable Termination Compartment Requirements.
- C.5** Representative wiring and schematic diagrams
- C.6** Ratings, technical summaries, make, and model of basic components, including, but not limited to:
- Load interrupter switches
  - Load interrupter switch operators
  - Fuse mountings
  - Insulators
  - Bus
  - Surge arresters
  - Instrument transformers
  - Control devices (hardware and software)
  - Wiring
- C.7** Representative bus connection (including bill of material)
- C.8** Design test data for the complete metal-enclosed interrupter (MEI) switchgear assembly as cited in IEEE C37.20.3, Section 6.2.
- C.9** Design test data for the load interrupter switches as cited in IEEE C37.20.4, Section 6.2.
- C.10** Seismic capability conformance documentation. This may be the product of physical testing or finite element analysis (FEA) software.
- C.11** Proof of QA/QC certification(s)
- C.12** Summary of factory QA/QC program
- C.13** Representative shipping, rigging, and off-loading delivery vehicle information
- C.14** Representative installation, operation, and maintenance manual(s)
- C.15** Summary descriptions (including estimated labor hours and material cost) for the preventive maintenance tasks the manufacturer recommends be performed during the first ten years of service.
- C.16** Warranty
- C.17** Extended warranty, if any
- C.18** List at least five projects completed within the last three years to supply 15 kV to 38 kV metal-enclosed (MEI) switchgear. List shall include:
- Project name
  - Customer name, address, and contact phone number
  - Equipment summary
  - Indoor or outdoor?
  - Number of bays
  - Arc resistant enclosure?
  - Voltage rating (kA)
  - Main bus rating (A)
  - Switch/fuse interrupting rating (MVA)
  - Relay description (hardware and software)
  - Year completed
  - Contract amount (\$)

**MATERIAL STANDARD**

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

**APPENDIX D - DRAWING AND DOCUMENTATION LIST****For Approval**

- |  |   |
|--|---|
| <p><b>D.1</b> Switchgear assembly one line diagram</p> <p><b>D.2</b> Switchgear outline drawing, showing:</p> <ul style="list-style-type: none"> <li>▪ Individual bay dimensions</li> <li>▪ Basic components</li> <li>▪ Phase, neutral, and ground bus</li> <li>▪ Source cable training</li> <li>▪ Viewing windows</li> <li>▪ Weights</li> <li>▪ Base plan</li> <li>▪ Anchor details</li> <li>▪ Bill of material</li> </ul> <p><b>D.3</b> Three line wiring, schematic, and logic diagrams</p> <p><b>D.4</b> Ratings and technical summaries of basic components, including, but not limited to:</p> <ul style="list-style-type: none"> <li>▪ Load interrupter switches</li> <li>▪ Load interrupter switch operators</li> <li>▪ Fuse mountings</li> <li>▪ Insulators</li> <li>▪ Bus and connectors</li> <li>▪ Surge arresters</li> <li>▪ Instrument transformers</li> <li>▪ Control devices (hardware and software)</li> <li>▪ Wiring</li> </ul> | <p><b>D.5</b> Nameplate drawings</p> <p><b>D.6</b> Design test data for the complete metal-enclosed interrupter (MEI) switchgear assembly as cited in IEEE C37.20.3, Section 6.2.</p> <p><b>D.7</b> Design test data for the load interrupter switches as cited in IEEE C37.20.4, Section 6.2.</p> <p><b>D.8</b> Current transformer ratio correction factor, phase angle, and excitation curves (typical)</p> <p><b>D.9</b> Step and touch potential analysis</p> <p><b>D.10</b> Seismic capability conformance documentation</p> <p><b>D.11</b> Installation, operation, and maintenance manual(s)</p> <p><b>D.12</b> Rigging diagrams for lifting and unloading switchgear</p> <p><b>D.13</b> Spare parts list including:</p> <ul style="list-style-type: none"> <li>▪ Description of part</li> <li>▪ Catalog number</li> <li>▪ Unit price</li> <li>▪ Typical lead-time</li> <li>▪ Origin of stock</li> <li>▪ Recommended quantity</li> </ul> <p><b>D.14</b> Special tools required to operated, maintain, inspect, and test switchgear list</p> <p><b>D.15</b> Standard warranty</p> <p><b>D.16</b> Extended warranty, if any</p> |
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**Final**

- D.17** All of the items listed above (approved versions), plus
- D.18** Certified (production) test reports

**MATERIAL STANDARD**

27 kV Metal-Enclosed Interrupter (MEI) Switchgear

**APPENDIX E – SEATTLE CITY LIGHT METERING COMPARTMENT REQUIREMENTS****E.1 Scope**

The information presented in this appendix is applicable only to 27 kV metering compartments contained within customer-owned, metal-enclosed interrupter (or metal-clad) switchgear.

**E.2 Basic Requirements**

Metering compartment shall meet the requirements of the latest revision of:

- NFPA 70 (NEC)
- Electric Utility Service Equipment Requirements Committee (EUSERC) Section 400, Metering and Service Equipment

**Note:** Because EUSERC requirements are revised on an annual basis, be sure to refer to the latest revision.

In 2004, the applicable EUSERC drawing for enclosure requirements specific to 27 kV metal-enclosed interrupter (MEI) switchgear was:

- 401A – High Voltage Metering Enclosure 15001 to 27000 Volt Service, revision 2.

**E.3 Seattle City Light Requirements**

In addition to the above, Seattle City Light imposes further requirements:

- Distance from conduit end to middle phase termination landing pad shall be 60 inches minimum. Seattle City Light may provide a pit up to 2'-1" deep to obtain minimum clearance. This requirement supercedes EUSERC drawing 401A, revision 2, dated 12/03, sheet 2 of 2, 20800/27000 column, Dimension G, floor of compartment to phase landing pad.
- Distance from end of grounding ball to inside protective inner door shall be 12 inches minimum. This requirement supercedes EUSERC drawing 401A, revision 2, dated 12/03, sheet 2 of 2, 20800/27000 column, Dimension A.
- Conduits shall be installed to turn up.
- Three lifting eyes shall be provided to facilitate installation or replacement of metering current transformers.
- Neutral pad shall be insulated for phase to ground voltage passing between the termination compartment and the metering compartment. A copper pad predrilled with two sets of 9/16-inch diameter holes on 1-3/4-inch centers shall be provided inside the termination compartment.
- Bus shall be bare copper.
- Cable termination bus shall be equipped with one-inch diameter ball-type grounding studs (one per phase plus ground), Salisbury catalog number 21191, to allow each phase to be safely checked for voltage with a hotstick-type voltage sensor and then grounded with hotstick-installed, ball and socket-type grounding system.
- A hotstick-removable insulating cover, Salisbury catalog number 21236, shall be provided for each normally energized ball-type grounding stud.
- Each phase landing pad shall be provided with two sets of two 5/8-inch diameter holes on 1-3/4-inch vertical centers, each set separated horizontally 4-1/2-inch on center. Provide an additional 7/16-inch diameter hole per pad at least 1-3/4 inches away from the other holes for connecting surge arrester leads.
- A grounded base plate shall be provided inside the termination compartment, predrilled with three 7/16-inch diameter holes for mounting surge arresters. Surge arresters will be furnished and installed by Seattle City Light. Refer to City Light Material Standard 6801.4 / Stock Number 680117.
- A vertically mounted length of 1-5/8 inch by 1-5/8 inch strut channel shall be mounted on each side of the termination compartment. A third length of 1-5/8 inch by 1-5/8 inch strut channel shall be installed between the first two for mounting cable support hardware (provided by Seattle City Light).
- Protective inner door consisting of a solid, high-strength, transparent, full-length, hinged, bolted-closed barrier (Lexan, clear polycarbonate, or approve equivalent) inside each compartment main door in order to comply with Washington Administrative Code (WAC) 296-45-325, Table 1. Table 1 states for phase-to-phase voltages between 15.1 and 36.0 kV, the AC live work minimum approach distance shall be two feet ten inches.
- Compartment door handles shall be designed to accommodate a padlock shackle for physical access control.

**E.3 Seattle City Light Requirements, continued**

- Compartment doors shall be designed to accommodate a pentahead bolt for back-up physical access control.
- Inside ceiling surfaces shall be coated with anti-condensation material.
- Provide anti-condensation heater near floor.
- Vents shall be provided at the top and bottom of the enclosure for air circulation.
- Vents shall be equipped with filters to minimize dust and dirt ingress.
- Vent filters shall be accessible from outside of the enclosure to allow the filters to be maintained without having to de-energize the switchgear.
- Vents shall be designed to prevent the entrance of foreign objects.
- Compartment entrances shall be provided with rain shields.
- Seattle City Light will provide all instrument transformers.

**E.4 Approval**

Seattle City Light Electric Service Engineering (ESE) shall be the customer's point of contact for all communication and submittals.

Because site-specific metering compartment requirements may vary, customer shall submit manufacturer's design drawings to Seattle City Light Electric Service Engineering (ESE) for review and approval.

Seattle City Light Electric Service Engineering (ESE) shall coordinate the review of the manufacturer's design drawings with Seattle City Light's Meter Section.

Customer shall obtain Seattle City Light approval before releasing metering compartment design to the switchgear manufacturer for construction.

**APPENDIX F – RECOMMENDED PROTECTION AND CONTROL SCHEMES**

**F.1 Scope**

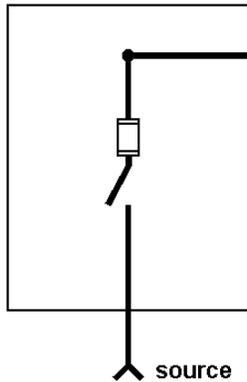
The information presented in this appendix was created to facilitate the development of site-specific, 27 kV metal-enclosed interrupter (MEI) switchgear protection and control requirements.

The Purchaser or assigned design engineer is encouraged to contact the System Protection Protection Group for counsel and advice at the earliest stage of the project.

**F.2 Recommended Schemes**

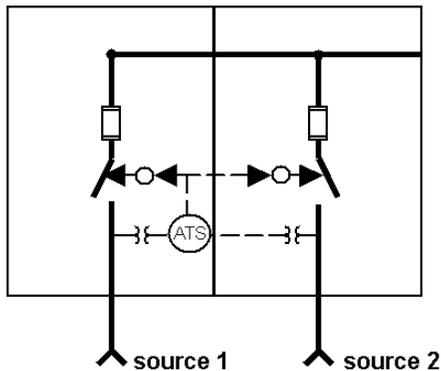
Below are the recommended schemes for five common engineering situations that may be found at Seattle City Light:

**F.2.1 Incoming Cubical - Radial Feed System**



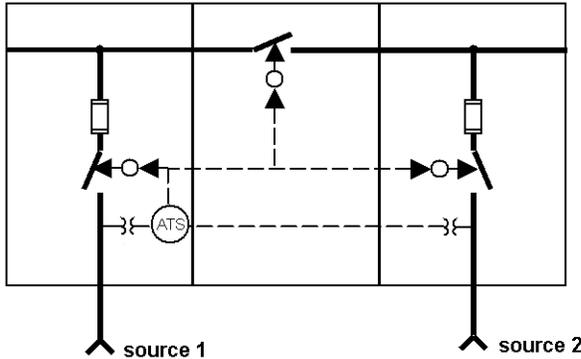
Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device.

**F.2.2 Incoming Cubical - Dual Feed System without Tie Switch**



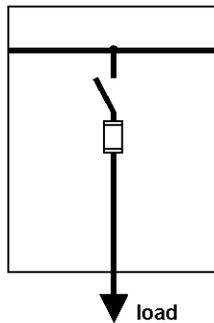
Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Automatic Transfer Switch. Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device. Automatic Transfer option shown. Manual Switching at the discretion of SCL distribution design engineer.

**F.2.3 Incoming Cubical - Dual Feed System with Tie Switch**



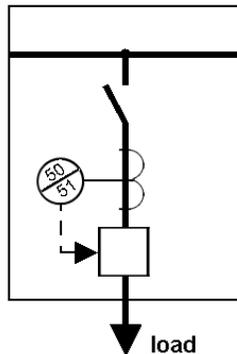
Comments - Overcurrent Protection: Max Size 175E, (S&C Standard Speed). Automatic Transfer Switch. Fuse may not be required at the discretion of SCL distribution design engineer. Fuse must coordinate with upstream protection device. Automatic Transfer option shown. Manual Switching at the discretion of SCL distribution design engineer.

**F.2.4 Feeder Cubical - Small Transformer (less than 3 MVA)**



Comments - Overcurrent Protection: Max Size 65X - Cooper, (full range current limiting fuse). Fuse must coordinate with upstream protection device.

**F.2.5 Feeder Cubical - Large Transformer (3 MVA and greater)**



Comments - Overcurrent Protection: Relay, with Phase and Ground Elements; must coordinate with upstream protective devices. Circuit Breaker. The switchgear required for this scheme is outside the scope of this Material Standard.

**F.3 Approval**

All protection and control schemes for 27 kV metal-enclosed interrupter (MEI) switchgear assemblies shall be reviewed and approved by the System Protection Group.

## Switchgear, 27 kV, Three-Pole, Padmount

### 1. Scope

- 1.1 This document specifies self-contained, totally enclosed, outdoor, metalclad, 27-kV, three-phase switchgear assembly with a switched source and either (1) three additional un-fused switched ways, (2) three-phase load tap(s) with either fused holders that are suitable for load interruption or (3) electronic fuses. The switch, tap and fuse configuration will be specified in the purchase order.
- 1.2 This switchgear is intended for use on a 26.4-kV, three-phase, 60-Hertz, grounded neutral underground distribution system. The load will be single- and three-phase, distribution transformers serving public-use facilities that require high reliability.

### 2. General

- 2.1 Except as modified by this specification, the switchgear furnished shall comply with the material and testing requirements of the latest revisions of all applicable standards by ANSI, IEEE, and NEMA.
- 2.2 The manufacturer shall be solely responsible for the performance of the basic switch components as well as the complete integrated assembly as rated.
- 2.3 All components of the switchgear shall be completely factory assembled and tested.
- 2.4 The manufacturer shall provide sufficient notice to allow Seattle City Light representatives to inspect the switchgear during its manufacture, if requested.

### 3. Ratings

- 3.1 The rating of the entire switchgear assembly shall be 27 kV.
- 3.2 The source switch(es) and the un-fused switched ways shall have a continuous current rating of 600 amperes and a live switching rating of 400 amperes. The switch shall have a two-time, fault-closing duty cycle of 22,400 amperes asymmetrical at 27 kV.
- 3.3 Each power fuse mounting shall have a continuous current rating of 200 amperes and a load-switching rating of 200 amperes. They shall have a minimum, one-time, fault-closing, duty cycle of 20,000 amperes asymmetrical and a two-time, fault-closing duty cycle of 13,000 amperes asymmetrical at 27 kV. The power fuses, if specified, shall be rated to interrupt 540 MVA, three-phase, symmetrical at rated voltage.
- 3.4 The short-circuit, fault duty rating of the power fuse mounting and interrupters shall be 540 MVA or 12,500 amperes RMS symmetrical.
- 3.5 Each electronic fuse mounting shall have a continuous current rating of 600 amperes and a load-switching rating of 200 amperes. The minimum interrupting rating of the electronic fuses shall be 40,000 amperes RMS symmetrical. It shall have a minimum, one-time, fault-closing, duty cycle of 22,400 amperes asymmetrical and a two-time, fault-closing duty cycle of 13,000 amperes asymmetrical at 27 kV.
- 3.6 Each fused tap, fuse, and fuse assembly shall be capable of withstanding full line-to-line AC voltage (27 kV) across each fuse unit after operation.

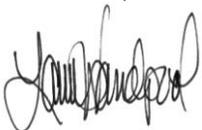
### 4. Insulation

- 4.1 The basic impulse insulation level shall be 125-kV BIL.
- 4.2 The maximum RIV at 1,000 kHz shall be 100 microvolts when energized at rated voltage.

Standards Coordinator  
Laura Vanderpool

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



## 5. Primary Connections

- 5.1 All terminal pads shall have two holes sized and spaced per NEMA standards (9/16" holes drilled on 1-3/4" centers) that shall be located at least 34" above the lowest point of the switchgear for connecting the cables. A 12" base spacer may be necessary to achieve the termination height required. There shall be ample clearance around these landing pads to accommodate the following terminators:

Raychem	Type HVT	3M	5600
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- 5.2 A primary connector, S&C #4745 or prior user-approved equal, shall be furnished for every primary termination.

## 6. Interlocks and Barriers

- 6.1 Each switch shall have a removable front barrier to guard against inadvertent contact with the live parts. These barriers shall be capable of being inserted in the open gap when the switch is in the open position.
- 6.2 All switches shall have means of padlocking in the open position.
- 6.3 Each power or electronically fused switch shall have a movable front barrier to guard against inadvertent contact with live parts. These barriers shall be capable of being inserted in the open gap when the power or electronic fuses are in the disconnect position.
- 6.4 All phase separation panels and barriers shall be of inert material. The manufacturer shall insure that the phase separation panels will not warp or bend and or in any way decrease design clearances.

## 7. Grounding Studs

- 7.1 Each switch terminal, each fuse terminal, and each compartment ground terminal shall have a stud for attaching working grounds that use hot-line clamps such as A.B. Chance #1530GP (0.745" to 0.162").
- 7.2 These studs shall be located in such a manner that the clamps may be readily applied or removed with a "hotstick."
- 7.3 The grounding studs shall be capable of carrying the fault duty of the switchgear.
- 7.4 The compartment grounding studs shall be at least 10" long.

## 8. Buses

All buses shall be of copper or aluminum. Buses wrapped with organic material will not be permitted. All joints shall have suitable hardware and treatment to prevent harmful oxidation and loss of optimum contact pressure. All switches and fuse mountings shall have a grounded steel base between the contact end support insulator and the hinge end support insulator to eliminate possible energization across the open gap.

## 9. Fuses and Mounting

- 9.1 The power fuse mountings, when specified, shall be **completely** interchangeable with all parts of S&C Electric Company SML-20, 45° opening disconnect style, vertically mounted with silencer unless otherwise specified on the purchase order.
- 9.2 Each power fuse compartment shall be furnished with end fittings for three fuses and, if specified, six fuses with ampere ratings as specified in the purchase requisition.
- 9.3 The power fuse mounting disconnects shall be quick-break and fully capable of load-break operation unless otherwise specified.

## 10. Electronic Fuses

- 10.1 The electronic fuse components and mountings, when specified, shall be completely interchangeable with all parts of the S & C Electric Company Fault-Fiter, disconnect style, unless otherwise specified on the purchase order.
- 10.2 Each electronic fuse compartment shall be furnished with holders for three electronic fuses.

## 11. Switches

The switches shall be provided with quick-make and quick-break mechanisms.

## 12. Motor operators

PMH-5 type switches shall be supplied with factory installed S & C type PM motor operators including 24 volt dc ZSD relay with 400 ampere blocking level, potential transformer, current transformers, battery packs and battery charger.

## 13. Arrester Mounting

The switch manufacturer shall incorporate provisions for mounting surge arresters in all 600 ampere switch compartments. The arresters to be mounted will be 17 kV MCOV heavy-duty distribution class gaped or ungaped metal oxide arresters. The bottom mounting on the arrester will consist of a 3/8" threaded stud with washers and nut. Seattle City Light will provide and install the arresters.

## 14. Fault Indicator Mounting

The switch manufacturer shall incorporate mounting provisions for a three phase fault indicator in each 600 ampere switch compartment. A single window shall be provided in the door of each 600 ampere switch compartment.

## 15. Enclosure

- 15.1 The switchgear cabinet shall be constructed to provide adequate space, volume, and strength for fuse handling, fuse exhaust, and venting, and shall withstand all pressure build-up during interruption without permanent distortion or damage to any portion of the structure.
- 15.2 Access to the unit for maintenance and cable termination shall be through the doors to the switch or to the switch or fuse compartments only. The doors shall be secured with a padlock shackle and penta head bolts for back-up protection.
- 15.3 The enclosure ground connection shall consist of one (or more) unpainted, copper-faced steel or stainless steel pad(s), 2" x 3-1/2" with two 9/16" - 13 NC holes spaced on a 1-3/4" center. The pad(s) shall be welded to the frame on the interior of the frame near the high-voltage conductor entrances.
- 15.4 The cabinet shall be 11 gauge (0.12 inches) minimum thickness stainless steel.
- 15.5 Four-compartment padmount enclosure shall be mountable without overhanging on a concrete pad, 84" wide x 79" deep, allowing a one-inch concrete margin around the perimeter of the enclosure. (Footprint 82" wide x 76-3/4" deep.)
- 15.6 Two-compartment padmount enclosure shall be mountable without overhanging on a concrete pad, 45" x 67-1/2" deep, allowing a one-inch concrete margin around the perimeter of the enclosure. (Footprint 43" wide x 65-1/4" deep.)
- 15.7 The cabinet shall have an equivalent of 4" x 12" or 48 square inches of ventilation in each sectioned cubicle of the cabinet, designed to provide cross-ventilation. The ventilation method shall be tamper proof.
- 15.8 The entire underside of the roof shall be coated with a "no-drip" asphalt-base mastic, minimum 1/8" thick.
- 15.9 The enclosure shall meet all requirements for enclosure security required by ANSI C57.12.28.
- 15.10 Provisions for securing the enclosure to the concrete pad shall include attachments for all four sides.

## 16. Paint Finish

- 16.1 The color of the finish coat shall be Munsell 7GY 3.29/1.5 padmount green.
- 16.2 The paint coating system shall meet all of the enclosure coating system performance requirements specified by the latest revision of ANSI C57.12.28.

## 17. Data to be Submitted for Qualification as an Approved Manufacturer

Each manufacturer shall submit with its qualification proposal the data listed below. The manufacturer shall submit a description of any changes, additions, or exceptions to this specification it proposes, together with the reasons for the departure. Product evaluation will be conducted on the basis of the information submitted. The drawings and data furnished must be sufficient in detail and clarity to enable making a complete and positive check with the technical provisions of this specification.

- (a) Outline drawings with overall dimensions including those dimensions described in Sections 5.1, 15.5, and 15.6.
- (b) Information concerning details of construction including type of stainless steel to be used.
- (c) Complete fuse data.
- (d) Detailed information on short-circuit capability.
- (e) State all electrical tests given and whether these tests apply to all units or only to sample units.
- (f) Total weight of complete switchgear assembly.
- (g) Electrical schematics.
- (h) Indicate construction and testing compliance per latest revision of ANSI C57.12.28.
- (i) Names and addresses of users of the equipment the bidder intends to furnish.
- (j) One copy of an instruction book covering installation, operation, and maintenance of the equipment.

## 18. Data to be Submitted with Bid

Each bidder shall submit with its proposal the data listed below. The bidder shall submit a description of any changes, additions, or exceptions to this specification it proposes, together with the reasons for the departure. Product evaluation and conformance to specification will be determined on the basis of the information submitted. The drawings and data furnished must be sufficient in detail and clarity to enable making a complete and positive check with the technical provisions of this specification.

- (a) Outline drawings with overall dimensions including those dimensions described in Sections 5.1, 15.5, and 15.6.
- (b) Statement of type of stainless steel to be used.
- (c) Total weight of complete switchgear assembly.
- (d) Electrical schematics.
- (e) Indicate construction and testing compliance per latest revision of ANSI C57.12.28.
- (f) One copy of an instruction book covering installation, operation, and maintenance of the equipment.

## 19. Data to be Furnished by Successful Bidder

The successful bidder shall supply:

- (a) Outline drawings with overall dimensions; see Sections 5.1, 15.5, and 15.6, dimension requirements.
- (b) One copy of an instruction book covering installation, operation, and maintenance of the equipment shall be packaged in a water resistant envelope and placed inside each switch.
- (c) Time-current curves of all fuses and protective relays.
- (d) One certified copy of all standard tests except as noted below.
- (e) One certified copy of the enclosure coating system performance tests required by ANSI C57.12.28 only when requested.
- (f) One certified copy of the enclosure security performance tests required by ANSI C57.12.28 only when requested.

**20. Guarantee**

If any part of this equipment fails due to defective design, material, and/or workmanship within 24 months after delivery, it shall be replaced without cost to Seattle City Light.

**21. Patents and Infringements**

The manufacturer shall defend Seattle City Light against any litigation arising from all patent infringements of the equipment furnished under this specification. If such equipment is judged as infringing, the manufacturer shall either secure for Seattle City Light the right for its continued use, or replace it with non-infringing devices that comply with this specification at no cost to Seattle City Light.

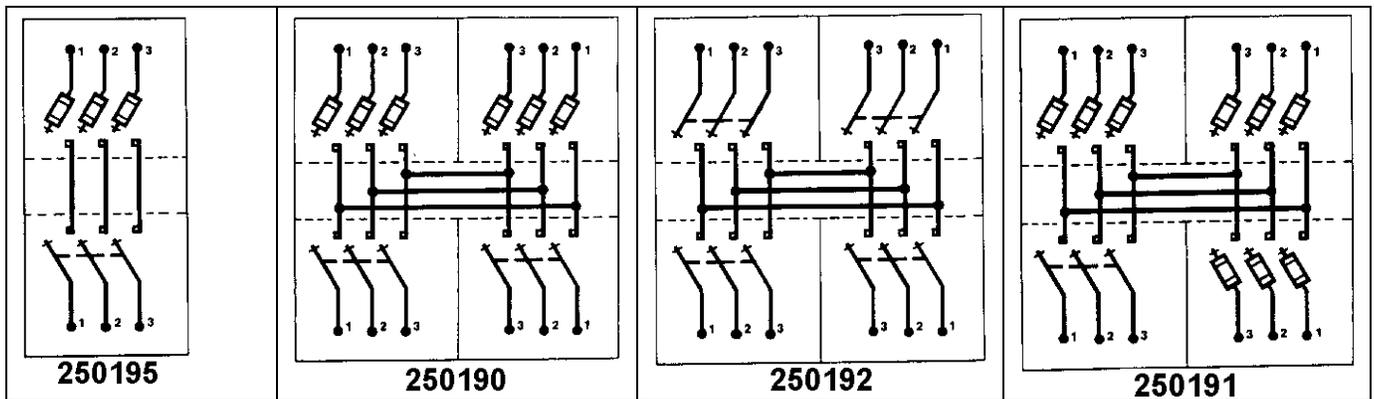
**22. Approved Manufacturers**

Stock No.	Description	Type	S & C Cat. No.
250195	3Ø 2-Way 1 600A switch & 1 set of Fault-Fiter fuse mountings	PMH-5	156513R3- A10-F12-K20-P5-E102, Rev. 0
250190	3Ø 4-Way 2 600A switches & 2 sets of SM-20 fuse mountings	PMH-9	55153R3-A10-F12-K18-P5
250192	3Ø 4-Way 4 600A switches	PMH-10	55243R3-A10-F12-K18-P5
250191	3Ø 4-Way 1 600A switch & 3 sets of SM-20 fuse mountings	PMH-12	55173R3-A10-F12-K18-P5
250163	Motor Operator Kit w/ ZSD Relay with 400 Ampere blocking level	PM	38971R2-A1-A10-Y8-Z1

- A10 Stainless steel enclosure w/ "olive green" finish
- F12 Fault indicator provisions w/ viewing windows in (SS) doors
- K18 12" stainless steel spacer
- K20 24" stainless steel spacer

P5 Mounting provisions for "18 kV" arresters  
 From S&C cat. Section 662-32, pages 8 thru 10 dated May 31, 1994

**SWITCH CONFIGURATION DIAGRAMS**



In October 2015, this standard was renumbered from 2501.9 to 4507.90.

## Capacitor, 26 kV, 1200 kvar, Three-Phase, Pole-Mounted

### 1. Scope

This specification applies to the furnishing of pole-mounted, three-phase 1,200 kvar shunt capacitors for a 26Y/15 kv solid grounded neutral distribution system. The completed assembly shall have three switches and be completely prewired (both the capacitor and the switch control circuits).

### 2. General

The capacitors furnished under this specification shall meet all applicable ANSI, NEMA, and OSHA standards except as modified by this specification.

### 3. Rating

- 3.1 The reactive rating shall be 1,200 kvar.
- 3.2 The voltage rating shall be 26,400 Grd. Y/15,240.

### 4. Insulation Levels

- 4.1 The insulation level of all live parts (except the control circuits) shall be 125 kv BIL.
- 4.2 The RIV of the switch shall not exceed 250 microvolts at 17.4 kv.
- 4.3 The RIV of the completed assembly shall not exceed 250 microvolts at rated voltage.

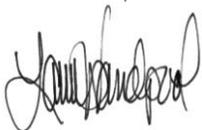
### 5. Insulating Materials

- 5.1 The charged surfaces shall be separated by high-voltage film.
- 5.2 The insulating compound shall be low in toxicity and be biodegradable. Polychlorinated byphenyls (Askarels) or other chlorinated hydrocarbons are not acceptable and will be considered as noncompliant with this specification.
- 5.3 The insulating compound shall have a PCB level of less than 1 ppm, and a decal or tag shall be affixed to each capacitor tank in a prominent place confirming this PCB level.

### 6. Capacitor Units

- 6.1 Each capacitor unit shall be constructed with internal discharge resistors that will reduce the residual voltage to 50 volts or less within five minutes.
- 6.2 Each capacitor bank shall be provided with a two bolt cable to flat grounding terminal located on the pole side of the frame and capable of accepting a minimum of three #4 AWG copper jumpers.
- 6.3 Each capacitor unit shall be made up of 200 kvar single-phase units and have two bushings with no internal grounds. Bids will not be accepted for three-phase units. Each of the two bushings shall have at least a 17-inch creepage distance, be colored sky gray, and be supplied with insulating caps.
- 6.4 All terminals and connectors shall be copper with plating for bimetallic connections.

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Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



**7. Oil or Vacuum Switches**

- 7.1 The switches shall have a continuous rating of 200 amperes and be designed for interrupting this reactive current.
- 7.2 The switch bushings shall have at least 17-inch creepage distance, be sky gray in color, and be supplied with insulating caps.
- 7.3 The control voltage shall be 120V.
- 7.4 The switches shall be McGraw-Edison type NR, G.E. type FKC 2, Joslyn VerSaVac Vacuum, Westinghouse type CRS, or prior user approved equal.

**8. Completed Assembly**

- 8.1 Each assembled bank shall consist of capacitors and switches mounted on a bracket suitable for pole mounting.
- 8.2 A common junction box shall be mounted on the pole mounting. All control wiring shall be terminated in this junction box.
- 8.3 The completed assembly shall be painted with a semi-gloss dark green, similar in color to Munsell 7GY 3.29/1.5 and shall be highly resistant to oil and weathering. Reasonable color variations are acceptable on approval. A sky gray may be furnished only as an alternative with prior user approval.

**9. Nameplates**

Corrosion-proof nameplates shall be attached to each capacitor unit.

**10. Warranties**

Should any capacitor unit, oil switch, or other related components fail within one year after installation, it shall be repaired or replaced promptly at the expense of the supplier.

**11. Patents and Infringements**

The manufacturer shall defend the Seattle Lighting Department against any litigation arising from all patent infringements of the equipment furnished. If such equipment is judged as infringing, the manufacturer shall either secure for the Lighting Department the right for its continued use, or replace it with non-infringing devices that comply with this specification at no cost to the Seattle Lighting Department.

**12. Data to be Supplied with Bid**

- 12.1 Average losses in watts per kvar at 30°C ambient temperature after eight hours of energization. Losses due to the internal discharge resistors shall be included in these electrical losses.
- 12.2 Outline drawings of the assembled bank including capacitor unit dimensions.
- 12.3 Type of insulating compound used and the toxicity and biodegradability of same. Bidder shall supply a completed OSHA Form 20, "Material Safety Data Sheet." Also the following additional information shall be supplied.
  - a. Results of all known tests on acute toxicity on mammals and fish, e.g., LD50 for 14-day old rats and for bluegill.
  - b. Results of all known tests on subacute or chronic toxicity, based on prolonged feeding to mammals and fish.
  - c. Results of all tests on biodegradability, e.g., the standard River Die Away Test, and bioaccumulation after prolonged exposure.
  - d. Results of all tests for carcinogenicity, mutagenicity, teratogenicity, embryotoxicity, and fetotoxicity, if available.
  - e. Planned studies or studies in progress, either by the manufacturer, independent parties, or as a result of the TSCA Testing Committee's recommendations by EPA.
  - f. Required disposal procedures and other recommended or required handling precautions.
- 12.4 Field experience on failure rates.
- 12.5 Data on proposed oil or vacuum switch to be used.

12.6 The following capacitor design details shall be included in the bid proposal:

- a. Capacitor unit working voltage.
- b. Number of series sections in capacitor unit.
- c. Rated voltage between foils.
- d. Number of sheets of film, paper film, or paper between foils.
- e. Thickness of each sheet of film, paper-film, or paper between the foils - in mils.
- f. Total paper and/or film thickness between foils - in mils.
- g. Dielectric stress of paper, paper film, or paper - in volts per mils.
- h. A graph showing average watts loss/kvar vs. ambient temperature from -40° C to +40° C for a 200 kvar unit for a 10-hour energization period.
- i. A graph showing watts loss vs. temperature from -40° C to +40°C for a 200 kvar unit after eight hours of energization.

**13. Award of Bid**

The award of the purchase order shall be based on the following:

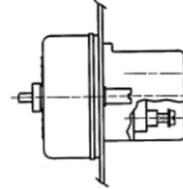
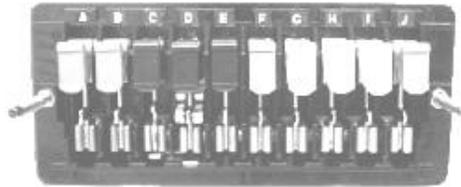
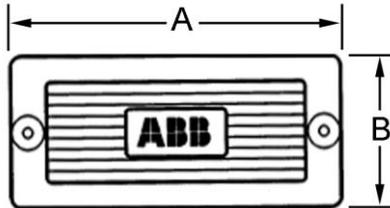
- 13.1 Bid Price
- 13.2 Losses evaluated at \$2,800 per kilowatt.
- 13.3 Overall appearance of assembled bank. A compact silhouette is desired.
- 13.4 Evaluation of design details as covered in Section 12.6.
- 13.5 The data submitted with the bid.
- 13.6 The bidder's qualifications.
- 13.7 Special disposal and handling procedures required or recommended by the manufacturer or government agency.
- 13.8 The extent of the warranties and guarantees.

**Stock No. 313871**

In October 2015, this standard was renumbered from 3138.7 to 4509.45.

**MATERIAL STANDARD**

**SWITCH, TEST, 600 VOLT, 30 AMP**



- Test Switches**, of the configuration shown shall be semi-flush mounted. They provide fast, safe and reliable access to components and circuits on panel boards and switchboards without disconnecting existing wiring. All measurements and tests can be performed at the test switch, without taking any devices out of service.

Type FT-1 Switches and related Test Plugs have all the features necessary for applications involving the measurement of individual currents and voltages associated with substation instrumentation and protection devices. Specially designed for the measurement of potential elements, current elements, and make-before-break short-circuit elements related to Current Transformer (CT) circuits.

- Terminals:** Standard screw type terminal connections are located at the rear of the switch. The terminals are separated from each other by polycarbonate barriers that are part of the molded base. The barriers provide adequate insulation as well as adequate wiring space between terminals.
- Poles:** combinations of 1 to a maximum of 10 individual poles or switch units. Each pole is identified by a letter (A to J), which is visible along the top of the base from left to right. The individual switch units are of a knife blade type. There are two different types of switch units available: potential poles and current poles. Potential poles (P), are configured as single, non-shorting knife blades for use in potential, trip, or control circuits. Current poles are configured in sets of two, (C-C), for use with current circuits; and consist of a current test jack, a shorting spring, a shorting blade, and a non-shorting blade.

**4. References**

**ABB Descriptive Bulletin 41-077INTL;** "Flexitest™ Switch Type FT-1 and FT-1X", Effective February 2004, Supersedes DB 41-077 dated January 2004.  
**SCL Material Standard 2805.00;** (renumbered to 4903.35 in October 2015)

**5. Stock Unit: EA**

Stock Number	Number Positions	CT	PT	Dimensions, in.		Approved Manufacturer and Catalog Numbers
				A	B	
012647	10	0	10	6.375	2.813	ABB 129A501G01
012649	10	3	4	-	-	129A514G01

Standards Coordinator  
John Shipek

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

## Kilowatthour Meter, Single-Phase, Solid-State, Electronic



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Standards Coordinator  
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*Darnell Cola*

## 2. Scope

This standard covers the requirements for single-phase, solid-state, kilowatthour meters.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Form Designation	Current Class	Rated Voltage (V)	External Wires	Meter Type
011677	4S	20	240	3	C1SR
011679	2S	200	240	3	C1SR
012413	4S	20	120 to 480	3	kV2c
012432	2S	320	240	3	I-210+
012678	1S	100	120	2	I-210+
012780	3S	20	120 to 480	2	kV2c
400035	2S	200	240	3	I-210+

Polyphase, solid-state, kilowatthour meters are outside the scope of this standard and are covered in SCL 4913.05.

## 3. Application

Single-phase kilowatthour meters are used to measure and record the electric energy usage of mainly residential and small commercial customers.

## 4. Industry Standards

Single-phase kilowatthour meters shall meet the applicable requirements of the latest revision of the following industry standards:

**ANSI C12.1-2008**; Electric Meters Code for Electricity Metering

**ANSI C12.10-2011**; Physical Aspects of Watthour Meters-Safety Standard

**ANSI C12.18-2006**; Protocol Specification for ANSI Type 2 Optical Port

**ANSI C12.20-2010**; Electricity Meters - 0.2 and 0.5 Accuracy Classes

**IEC 61000-4-4:2012**; Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

**IEEE 519**; IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

**IEEE C37.90.1-2012**; IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

**ISO 9000:2005**; Quality Management Systems

## 5. Requirements

### 5.1 Common

The vendor shall specify all tools and training necessary to verify meter accuracy, and to install and maintain a meter. This includes support equipment (hardware), documentation (manuals, instructions, etc.), and software.

Software shall include site licenses, upgrades, tracking, life expectancy, and compatibility (such as any standard read protocol).

Each single-phase kilowatthour meter shall be provided with a nameplate meeting the requirements of SCL 4980.10.

Single-phase kilowatthour meters shall meet the requirements listed in Table 5.1.

**Table 5.1. Common Requirements for Single-Phase Kilowatthour Meters**

Attribute	Value
Phase	Single
Mounting	Socket S (detachable)
Frequency	60 Hz
Accuracy Class	(See Section 5.2 in this standard.)
Construction	Solid-state operation 5- or 6-character Liquid Crystal Display (LCD) Single-mold polycarbonate cover Current transformer built into base Dustproof and raintight for outdoor use Sealed effectively with a T-bar seal
Input voltage, operating range	± 20%
Temperature, operating range, degrees	
°C	-40 to +85
°F	-40 to +185

## 5.2 Detailed

Single-phase kilowatthour meters shall meet the requirements listed in Table 5.2.

**Table 5.2. Detailed Requirements for Single-Phase Kilowatthour Meters**

Stock No.	Accuracy		Metering Type	Reading	Format	Register Multiplier
	Class	Meter Option <sup>1</sup>				
011677	0.5	1	Non-demand	kWh	xxxxx	Kr = TF
011679	0.5	1	Non-demand	kWh	xxxxx	Kr = 1
012413	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
012432	0.5	N/A	Non-demand	kWh	xxxxx	Kr = 1
012678	0.5	N/A	Non-demand	kWh	xxxxx	Kr = 1
012780	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
400035	0.5	N/A	Non-demand	kWh	xxxxx	Kr = 1

Notes

1. See section 5.4 in this document for a definition of each option.
2. Or as programmed by the user.
3. The interval is 15 minutes (set for shortest consecutive rolling subintervals).

## 5.3 Accuracy Class

The accuracy of each single-phase kilowatthour meter shall meet the requirements as specified in SCL 4980.05.

## 5.4 Meter Options

### Option 1

Itron meters shall be able to transmit energy reads with continuous RF transmission.

Transmissions must be compatible with existing SCL meter reading equipment. Meters shall be set for 5-digit read with  $K_r$  (multiplier) = 1 for a self-contained meter or  $K_r = TF$  (transformer factor) for a transformer-rated meter.

Transmission module identification shall be clearly marked on the meter. It shall also be included in the certified test report as noted in SCL 4980.05.

The following communication modules are approved:

- Itron Centron R300 in a high power configuration at 100 mW output.
- Itron Centron R300 in a standard power configuration at 0.75 mW output.

### Option 2

Programmable soft switches for demand, reactive, recorders, etc., shall be programmable both into the meter and back out of the meter using an ANSI Type 2 Optical Port as specified in ANSI C12.18.

## 5.5 Meter Register

### 5.5.1 Common

Software used to program the register shall be compatible with Windows 7 and available to SCL for use on Technical Metering computers. Software shall be onsite, licensed for use by SCL and acceptable to the users.

A pulsing infrared or LCD output on the register shall be provided for testing watthours.

Optical meter communications for reading, programming, and for configuring soft switches shall be performed through an ANSI Type 2 Optical Port as specific in ANSI C12.18.

The serial number shall be 9 digits or fewer. Details on size and style of serial numbers are given in SCL 4980.10 (sections 4.1 and 4.2).

The following features and functions shall be provided on the register or nameplate:

- Potential indication on the display of each energized element (if not otherwise shown on the meter).
- Power flow indication on the display to determine load and direction.
- A segment check as part of the normal display sequence.
- A programmable "K" value, if used. Display is optional.
- An electronics self-check to indicate errors.
- Space on the meter's front, and visible through the cover, for multiplier and other programmable values (such as the "K" value).
- The SCL security code (applies to any meters with an optical communications port, except Stock Numbers 011677 and 011679). Contact the SCL meter lab for details.

### 5.5.2 Non-Demand Metering

A serial-numbered Encoder Receiver Transmitter (ERT) communication module, if used, must be readily removable (preferably without tools after the meter cover is removed).

Kilowatthours shall be displayed or programmed to display on a 5-digit LCD.

The following features and functions shall be provided on the register or nameplate:

- Kilowatthours identified on the display if there is any possibility of confusion. This indication may be a 2-digit code.
- Provisions for field installation of pulse output board or other options.
- Programmable by SCL to accumulate delivered-only kWh, received-only kWh, delivered plus received kWh, and delivered minus received kWh (not applicable to Stock No. 011677 and 011679).
- Instantaneous power reading on the display in addition to the energy reading (applicable only to Stock No. 012678 and 012683).

### 5.5.3 Demand Metering

Demand register interval lengths shall be 1 hour, 30 minutes, and 15 minutes. Also, demand register subintervals shall be 3 minutes or less or programmable to 3 minutes or less for a 15-minute interval.

Digital source pulses that drive the register functions of energy, reactive, and demand shall be specified as  $K_n$  or  $K_n / n$  where  $n$  = the number of pulses required to produce the specified energy or reactive value ( $K_n$ ).

Kilowatthours, kilovarhours, and maximum kilowatts demand shall be displayed or programmed to display on a 5- or 6-digit (user programmable) LCD.

The following features and functions shall be provided on the register or nameplate:

- Kilowatthours, kilovarhours, and maximum kilowatts demand identified on the display. This indication may be a 2-digit code.
- A unique program number stored in the register (display is optional).
- A pulsing infrared or LCD output on the register for testing watthours and varhours.

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## 6. Testing

### 6.1 Test Data

Test data that establishes compliance with the requirements of ANSI C12.1 and this standard shall be provided upon request.

### 6.2 Certified Test Data File

A certified test data file shall be provided as specified in SCL 4980.05.

### 6.3 Calibrations

Calibrations shall be stable whether fixed or adjustable by SCL personnel.

Adjustments (on adjustable meters) may be made by using either hardware or software. All adjustments shall be stable over the life of the meter.

### 6.4 Meter Acceptability

Meter acceptability shall be determined through sample evaluation by SCL. Test results obtained during acceptance or verification testing shall meet the requirements as specified in SCL 4980.05.

## 6.5 Testing Capability

Single-phase kilowatthour meters shall be capable of being tested using existing utility test equipment.

Field tests shall be performed in a test mode that does not affect the measured register data. Or, the register read must be able to be reset to a reading.

The test mode may be accessed through software or a switch (hardware), or both.

Provisions shall be made to assure that a meter cannot be inadvertently left in the test mode. This shall be done through a software program or by a message on the display (least desirable) when the meter is placed back in service.

## 7. Design Changes

The manufacturer shall inform SCL in writing of all design changes that could affect the understood or published capabilities of the product.

## 8. Marking

Single-phase kilowatthour meters, cartons, and shipping containers shall be labeled according to the requirements of SCL 4980.10.

## 9. Packaging

Single-phase kilowatthour meters shall be packaged to prevent damage during shipping, handling, and inside storage.

Single-phase kilowatthour meters shall be packaged up to four per carton.

Cartons shall be shipped stacked and shrink wrapped to wood pallets.

## 10. Issuance

EA.

## 11. Approved Manufacturers

Stock No.	Form Designation	Current Class	Rated Voltage (V)	External Wires	Manufacturer	Meter Type	Part No.
011677	4S	20	240	3	Itron	C1SR	0190510
011679	2S	200	240	3	Itron	C1SR	0190507
012413	4S	20	120 to 480	3	GE Energy	kV2c	787X300080
012432	2S	320	240	3	GE Energy	I-210+	726X500134
012678	1S	100	120	2	GE Energy	I-210+	726X100131
012780	3S	20	120 to 480	2	GE Energy	kV2c	787X300077
400035	2S	200	240	3	GE Energy	I-210+	727X200116

## 12. References

**SCL Material Standard 4980.05;** "Test Data Requirements, Electricity Meters"

**SCL Material Standard 4980.10;** "Bar Code, Nameplate, Shipping Label Requirements, Electricity Meters"

### 13. Sources

**Byun, Robin**; SCL Standards Engineer, subject matter expert, and originator of 4911.05  
(robin.byun@seattle.gov)

**Gilmore, Dan**; SCL Meter Technician and subject matter expert for 4911.05  
(dan.gilmore@seattle.gov)

## Kilowatthour Meter, Polyphase, Solid-State, Electronic



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## 2. Scope

This standard covers the requirements for polyphase, solid-state, kilowatthour meters.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Form	Current Class	Rated	External Wires	Meter Type
	Designation		Voltage (V)		
012396	9S	20	120 to 480	4	kV2c
012407	16S	200	120 to 480	4	kV2ce
012414	16S	200	120 to 480	4	kV2c
012433	12S	200	120 to 480	3	kV2c
012434	45S	20	120 to 480	3	kV2c
012683	25S	200	120	3	I-210+n
013368	12S	200	120	3	CN1SR

Single-phase, solid-state, kilowatthour meters are outside the scope of this standard and are covered in SCL 4911.05.

## 3. Application

Polyphase, solid-state, kilowatthour meters are used to measure and record the electric energy usage of commercial and industrial customers.

## 4. Industry Standards

Polyphase, solid-state, kilowatthour meters shall meet the applicable requirements of the latest revision of the following industry standards:

**ANSI C12.1-2008**; Electric Meters Code for Electricity Metering

**ANSI C12.10-2011**; Physical Aspects of Watthour Meters-Safety Standard

**ANSI C12.18-2006**; Protocol Specification for ANSI Type 2 Optical Port

**ANSI C12.20-2010**; Electricity Meters - 0.2 and 0.5 Accuracy Classes

**IEC 61000-4-4:2012**; Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

**IEEE 519**; IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

**IEEE C37.90.1-2012**; IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

**ISO 9000:2005**; Quality Management Systems

## 5. Requirements

### 5.1 Common

The vendor shall specify all tools and training necessary to verify meter accuracy, and to install and maintain a meter. This includes support equipment (hardware), documentation (manuals, instructions, etc.), and software.

Software shall include site licenses, upgrades, tracking, life expectancy, and compatibility (such as any standard read protocol).

Each polyphase kilowatt-hour meter shall be provided with a nameplate meeting the requirements of SCL 4980.10.

Polyphase kilowatt-hour meters shall meet the requirements listed in Table 5.1.

**Table 5.1. Common Requirements for Polyphase Kilowatt-hour Meters**

Attribute	Value
Phase	Poly
Mounting	Socket S (detachable)
Frequency	60 Hz
Accuracy Class	(See Section 5.2 in this standard.)
Construction	Solid-state operation 5- or 6-character LCD display Single-mold polycarbonate cover Current transformer built into base Dustproof and raintight for outdoor use Sealed effectively with a T-bar seal 5 <sup>th</sup> terminal in the 9:00 position
Input voltage, operating range	± 20%
Temperature, operating range, degrees °C	-40 to +85
°F	-40 to +185

## 5.2 Detailed

Polyphase kilowatt-hour meters shall meet the requirements listed in Table 5.2.

**Table 5.2. Detailed Requirements for Polyphase Kilowatt-hour Meters**

Stock No.	Accuracy Class	Meter Option <sup>1</sup>	Metering Type	Reading	Format	Register Multiplier
012396	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
012407	0.2	N/A	Non-demand	kWh	xxxxx	Kr = 1
012414	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
012433	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
012434	0.2	2	Demand	kWh kvarh kW	xxxxxx <sup>2</sup> xxxxxx <sup>2</sup> xxx.xxx <sup>2,3</sup>	Programmable
012683	0.5	N/A	Non-demand	kWh	xxxxx	Kr = 1
013368	0.5	1	Non-demand	kWh	xxxxx	Kr = 1

Notes

1. See section 5.4 in this document for a definition of each option.
2. Or as programmed by the user.
3. The interval is 15 minutes (set for shortest consecutive rolling subintervals.)

### 5.3 Accuracy Class

The accuracy of each meter shall meet the requirements as specified in SCL 4980.05.

### 5.4 Meter Options

#### Option 1

Itron meters shall be able to transmit energy reads with continuous RF transmission.

Transmissions must be compatible with existing SCL meter reading equipment. Meters shall be set for 5-digit read with Kr (multiplier) = 1 for a self-contained meter or Kr = TF (transformer factor) for a transformer-rated meter.

Transmission module identification shall be clearly marked on the meter. It shall also be included in the certified test report as noted in SCL 4980.05.

The following communication modules are approved:

- Itron Centron R300 in a high power configuration at 100 mW output.
- Itron Centron R300 in a standard power configuration at 0.75 mW output.

#### Option 2

Programmable soft switches for demand, reactive, recorders, etc., shall be programmable both into the meter and back out of the meter using an ANSI Type 2 Optical Port as specified in ANSI C12.18.

### 5.5 Meter Register

#### 5.5.1 Common

Software used to program the register shall be compatible with Windows 7 and available to SCL for use on Technical Metering computers. Software shall be onsite, licensed for use by SCL and acceptable to the users.

A pulsing infrared or LCD output on the register shall be provided for testing watthours.

Optical meter communications for reading, programming, and for configuring soft switches shall be performed through an ANSI Type 2 Optical Port as specified in ANSI C12.18.

The serial number shall be 9 digits or fewer. Details on size and style of the serial number are included in SCL 4980.10.

The following features and functions shall be provided on the register or nameplate:

- Potential indication on the display of each energized element (if not otherwise shown on the meter).
- Power flow indication on the display to determine load and direction.
- A segment check as part of the normal display sequence.
- A programmable "K" value, if used. Display is optional.
- An electronics self-check to indicate errors.
- Space on the meter's front, and visible through the cover, for multiplier and other programmable values (such as the "K" value).
- The SCL security code (applies to any meters with an optical communications port). Contact the SCL meter lab for details.

### 5.5.2 Non-Demand Metering

A serial-numbered Encoder Receiver Transmitter (ERT) communication module, if used, must be readily removable (preferably without tools after the meter cover is removed).

Kilowatthours shall be displayed or programmed to display on a 5-digit LCD.

Integral registers must share the meter's serial number.

The following features and functions shall be provided on the register or nameplate:

- Kilowatthours identified on the display if there is any possibility of confusion. This indication may be a 2-digit code.
- Provisions for field installation of pulse output board or other options.
- Programmable by SCL to accumulate delivered-only kWh, received-only kWh, delivered plus received kWh, and delivered minus received kWh (not applicable to Stock No. 013368).
- Instantaneous power displayed in the normal display. The display shall be an auto-ranging value (applicable only to Stock No. 012683).

### 5.5.3 Demand Metering

Demand register interval lengths shall be 1 hour, 30 minutes, and 15 minutes. Also, demand register subintervals shall be 3 minutes or less or programmable to 3 minutes or less for a 15-minute interval.

Digital source pulses that drive the register functions of energy, reactive, and demand shall be specified as  $K_n$  or  $K_n / n$  where  $n$  = the number of pulses required to produce the specified energy or reactive value ( $K_n$ ).

Kilowatthours, kilovarhours, and maximum kilowatts demand shall be displayed or programmed to display on a 5- or 6-digit (user programmable) LCD.

The following features and functions shall be provided on the register or nameplate:

- Kilowatthours, kilovarhours, and maximum kilowatts demand identified on the display. This indication may be a 2-digit code.
- A unique program number stored in the register (display is optional).
- A pulsing infrared or LCD output on the register for testing watthours and varhours.

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## 6. Testing

### 6.1 Test Data

Test data that establishes compliance with the requirements of ANSI C12.1 and this standard shall be provided upon request.

### 6.2 Certified Test Data File

A certified test data file shall be provided as specified in SCL 4980.05.

### 6.3 Calibrations

Calibrations shall be stable whether fixed or adjustable by SCL personnel.

Adjustments (on adjustable meters) may be made by using either hardware or software. All adjustments shall be stable over the life of the meter.

### 6.4 Meter Acceptability

Meter acceptability shall be determined through sample evaluation by SCL. Test results obtained during acceptance or verification testing shall meet the requirements as specified in SCL 4980.05.

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## 6.5 Testing Capability

Meters shall be capable of being tested using existing utility test equipment.

Field tests shall be performed in a test mode that does not affect the measured register data. Or, the register read must be able to be reset to a reading.

The test mode may be accessed through software or a switch (hardware), or both.

Provisions shall be made to assure that a meter cannot be inadvertently left in the test mode. This shall be done by through a software program or by a message on the display (least desirable) when the meter is placed back in service.

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## 7. Design Changes

The manufacturer shall inform SCL in writing of all design changes that could affect the understood or published capabilities of the product.

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## 8. Marking

Polyphase kilowatthour meters, cartons, and shipping containers shall be labeled according to the requirements of SCL 4980.10.

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## 9. Packaging

Polyphase kilowatthour meters shall be packaged to prevent damage during shipping, handling, and inside storage.

Polyphase kilowatthour meters shall be packaged up to four per carton.

Cartons shall be shipped stacked and shrink wrapped to wood pallets.

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## 10. Issuance

EA.

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## 11. Approved Manufacturers

Stock No.	Form Designation	Current Class	Rated Voltage (V)	External Wires	Manufacturer	Meter Type	Part No.
012396	9S	20	120 to 480	4	GE Energy	kV2c	784X900077
012407	16S	200	120 to 480	4	GE Energy	kV2ce	784X400305
012414	16S	200	120 to 480	4	GE Energy	kV2c	787X400138
012433	12S	200	120 to 480	3	GE Energy	kV2c	787X100069
012434	45S	20	120 to 480	3	GE Energy	kV2c	784X500150
012683	25S	200	120	3	GE Energy	I-210+n	727X000074
013368	12S	200	120	3	Itron	CN1SR	0190519

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## 12. References

**SCL Material Standard 4980.05**; "Test Data Requirements, Electricity Meters"

**SCL Material Standard 4980.10**; "Bar Code, Nameplate, Shipping Label Requirements, Electricity Meters"

### 13. Sources

**Byun, Robin**; SCL Standards Engineer, subject matter expert, and originator of 4913.05  
(robin.byun@seattle.gov)

**Gilmore, Dan**; SCL Meter Technician and subject matter expert for 4913.05  
(dan.gilmore@seattle.gov)

## Certified Test Data Requirements, Electricity Meters



### 1. Scope

This standard covers the requirements for certified test data from 0.2 and 0.5 accuracy class electricity meters.

### 2. Application

Certified test data is used for the approval and verification of 0.2 and 0.5 accuracy class electricity meters.

### 3. Industry Standards

Certified test data shall meet the requirements of the latest revision of the following industry standards:

**ANSI C12.1-2008**; Electric Meters Code for Electricity Metering

**ANSI C12.10-2011**; Physical Aspects of Watthour Meters - Safety Standard

**ANSI C12.20-2010**; Electricity Meters - 0.2 and 0.5 Accuracy Classes

**IEC 61000-4-4:2012**; Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

**IEEE C37.90.1-2012**; IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

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## 4. Requirements

### 4.1 Certified Test Report

Certified test reports shall be supplied by email.

The email shall be sent to the meter lab at [meter.test@seattle.gov](mailto:meter.test@seattle.gov).

### 4.2 Certified Test Data Format

The certified test data file shall contain the following information in American Standard Code for Information Interchange (ASCII) format.

A heading with each line in text, in the following order:

- Line #01 - Manufacturer
- Line #02 - Type
- Line #03 - Form
- Line #04 - Class
- Line #05 - Volts
- Line #06 - Test amps
- Line #07 - Watthour constant
- Line #08 - Wires
- Line #09 - Stators
- Line #10 - Register ratio
- Line #11 - Shaft reduction
- Line #12 - Multiplier
- Line #13 - Cost
- Line #14 - Purchase date
- Line #15 - Purchase order (PO) number
- Line #16 - Stock number
- Line #17 - Comm ID Type (any additional information up through line 19)
- Line #18 - (for future use)
- Line #19 - (for future use)
- Line #20 - Comma separated data header<sup>1</sup>
- Line #21 - Comma separated data<sup>2</sup>

---

<sup>1</sup> Line 20 contains the certified data header for listed data:

BarCode,Ser#,CL#,FL,PF,LL,LF,LP,MF,MP,RF,RP,Crt,Pal,CommID,CommIDType

Either FL,PF,LL or LF,LP,MF,MP,RF,RP are required.

A comma shall be included in place of unlisted data. For example, if CommID is not installed, its comma is still necessary.

Nothing prevents all the identified series and element tests above from being listed.

See Table 4.2 for data definitions.

<sup>2</sup> Line 21 begins the variable data record given as comma separated data. The record contains the meter bar code, serial number (in text), company number, certified test results, carton number, pallet number, and communications identification when applicable. Any data not given is identified in place by a comma.

**Table 4.2. Comma-separated Data Header in Line 20**

Abbreviation	Definition
BarCode	Bar Code
Ser#	Serial number
CL#	City Light assigned number
FL	Full load series unity test in a 3.2% format
PF	Power factor series 50% power factor test in 3.2% format
LL	Light load series unity test in 3.2% format
LF	Left element full load in 3.2% format
LP	Left element 50% power factor in 3.2% format
MF	Middle element full load in 3.2% format
MP	Middle element 50% power factor in 3.2% format
RF	Right element full load in 3.2% format
RP	Right element 50% power factor in 3.2% format
Crt	Carton number
Pal	Pallet number
CommID	Each meter's communications contacting identity
CommIDType	Communications module description

### 4.3 Examples of Certified Test Data Files

In the following two examples, a line number (Line #01) is included for clarification. This number does not appear in the actual test data file.

#### Example #1

Line #01 - Itron  
 Line #02 - C1SR  
 Line #03 - 2S  
 Line #04 - 200  
 Line #05 - 240  
 Line #06 - 30  
 Line #07 - 1  
 Line #08 - 3  
 Line #09 - 1  
 Line #10 - 1  
 Line #11 - 100  
 Line #12 - 1  
 Line #13 - 102.01  
 Line #14 - 9/28/2004  
 Line #15 - SCL-0000012345-P  
 Line #16 - 11679  
 Line #17 - R300HP  
 Line #18 -  
 Line #19 -  
 Line #20 - Barcode,Ser#,CL#,FL,PF,LL,LF,LP,MF,MP,RF,RP,Crt,Pal,CommID,CommIDType  
 Line #21 - 1NF000750795AZB02,750795,750795,100.09,99.95,100,,,,,,,,,1,1,12345678,R300HP  
 Line #22 - 1NF000750796AZB02,750796,750796,100.1,99.93,100.03,,,,,,,,,1,1,12345671,R300HP  
 Line #23 - 1NF000750797AZB02,750797,750797,100.12,99.99,100.11,,,,,,,,,1,1,12345672,R300HP

**Example #2**

- Line #01 - GE
- Line #02 - KV2C
- Line #03 - 9S
- Line #04 - 20
- Line #05 - 120-480
- Line #06 - 2.5
- Line #07 - 1.8
- Line #08 - 4
- Line #09 - 3
- Line #10 -
- Line #11 -
- Line #12 - 1
- Line #13 - 264
- Line #14 - 1/20/2004
- Line #15 - SCL-0000010081-P
- Line #16 - 400144
- Line #17 -
- Line #18 -
- Line #19 -
- Line #20 - Barcode,Ser#,CL#,FL,PF,LL,LF,LP,MF,MP,RF,RP,Crt,Pal,CommID,CommIDType
- Line #21 - KZD028064370GCC03,28064370,750579,99.99,100,100,99.99,99.98,100.01,100.02,99.99,100,1B0001,3,,
- Line #22 - KZD028064371GCC03,28064371,750580,99.99,99.97,100.01,100,100.01,100.02,99.98,99.99,100.02,1B0001,3,,
- Line #23 - KZD028064372GCC03,28064372,750581,100.01,99.97,100.02,100.03,100,100,99.99,99.98,99.97,1B0001,3,,

**4.4 Accuracy Class**

**4.4.1 Class 0.2 Accuracy**

Class 0.2 accuracy of each meter shall be documented through a certified test report.

Test results shall not exceed the following error limits:

**Table 4.4.1a. Series Tests for Class 0.2 Accuracy**

Test	Error limit
Full Load	± 0.10%
Light Load	± 0.15%
Power Factor	± 0.15%

**Table 4.4.1b. Element Balance for Class 0.2 Accuracy**

Test	Error limit
Unity	± 0.20%
Power Factor	± 0.30%

Test results obtained during acceptance or verification testing shall not differ from the certified test reports bar ( $\bar{x}$ ) by more than the following sigma ( $\sigma$ ).

**Table 4.4.1c. Series Tests During Acceptance or Verification Testing**

Test	Error limit
Full Load	± 0.15%
Light Load	± 0.20%
Power Factor	± 0.20%

**Table 4.4.1d. Element Balance During Acceptance or Verification Testing**

Test	Error limit
Unity	± 0.25%
Power Factor	± 0.35%

**Example: (Full Load)**

Mfg. ( $\bar{x}$ ) = 100.05%

Acceptable limits are 99.90% to 100.20%, (100.05% ± 0.15%)

SCL tests show ( $\bar{x}$ ) = 100.10%, ( $\sigma$ ) = 0.10%

The meters are acceptable because their statistical percentage of 1  $\sigma$  is between 100.00% and 100.20%, and that is within the limits of 99.90% and 100.20%.

**4.4.2 Class 0.5 Accuracy**

Class 0.5 accuracy of each meter shall be documented through a certified test report.

Test results shall not exceed the following error limits:

**Table 4.4.2a. Series Tests for Class 0.5 Accuracy**

Test	Error limit
Full Load	± 0.25%
Light Load	± 0.35%
Power Factor	± 0.50%

**Table 4.4.2b. Element Balance for Class 0.5 Accuracy (Polyphase)**

Test	Error limit
Unity	± 0.40%
Power Factor	± 0.50%

Test results obtained during acceptance or verification testing shall not differ by more than the following sigma ( $\sigma$ ) from the certified test reports bar  $x$  ( $\bar{x}$ ).

**Table 4.4.2c. Series Tests During Acceptance or Verification Testing**

Test	Error limit
Full Load	± 0.25%
Light Load	± 0.35%
Power Factor	± 0.50%

**Table 4.4.2d. Element Balance During Acceptance or Verification Testing (Polyphase)**

Test	Error limit
Unity	± 0.60%
Power Factor	± 0.70%

**Example: (Full Load)**

$$\text{Mfg } (\bar{x}) = 100.10\%$$

Acceptable limits are 99.85% to 100.35%,  $(100.10\% \pm 0.25\%)$

SCL tests show  $(\bar{x}) = 100.15$ ,  $(\sigma) = 0.20$ , (limits of 99.95% to 100.35%)

The meters are acceptable because their statistical percentage of  $1 \sigma$  is between 99.95% and 100.35% which is within the limits of 99.85% to 100.35%.

---

**5. References**

**SCL Material Standard 4911.05**; "Kilowatthour Meters, Single-Phase, Solid-State, Electronic"

**SCL Material Standard 4913.05**; "Kilowatthour Meters, Polyphase, Solid-State, Electronic"

**SCL Material Standard 4980.10**; "Bar Code, Nameplate, Shipping Label Requirements, Electricity Meters"

---

**6. Sources**

**Byun, Robin**; SCL Standards Engineer, subject matter expert, and originator of 4980.05

**Gilmore, Dan**; SCL Meter Technician and subject matter expert for 4980.05

**Matsen, Chuck**; SCL Meter Technician and subject matter expert for 4980.05

## Bar Code, Nameplate, and Shipping Label Requirements, Electricity Meters



### 1. Scope

This standard covers the requirements for electricity meter bar codes, nameplates, and shipping labels.

### 2. Application

Bar codes are used by meter electricians and meter technicians to identify, verify, and track electricity meters during shipping, receiving, testing, and installation.

### 3. Industry Standards

Bar coded nameplates and shipping labels shall meet the requirements of the latest revision of the following industry standards:

**ANSI C12.1-2008**; Electric Meters Code for Electricity Metering

**ANSI C12.10-2011**; Physical Aspects of Wattour Meters—Safety Standard

**ANSI MH10.8.1-2005**; Automatic Identification and Data Capture Techniques Used in Shipping, Receiving, and Transport Applications

**NEMA Publication EI-P3-1984**; Bar Coding of Wattour Meter Nameplate Data

**AEP Meter Barcodes**; <http://www.aep.com/about/b2b/meterBarcodes>

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## 4. Requirements

All new meters shall have the bar code information placed on the meter nameplate as specified in ANSI C12.10, 3.7.5.3 Barcoding Specifications.

The bar code shall be easily visible and readable with a noncontact scanner from the front of the meter with the meter cover on.

### 4.1 Meter Nameplate

#### 4.1.1 Nameplate Information

The meter nameplate shall include the following information:

- Manufacturer
- Type
- Form
- Class
- Volts
- Test amps
- Watthour constant
- Test constant (Kt)
- Number of wires
- Number of stators
- Frequency of 60 Hz
- Hardware and firmware versions for solid-state meters
- "Seattle City Light"
- Bar code with manufacturer serial number
- Bar code interpretation
- Serial number
- 6-digit SCL number printed separately if it is not imbedded in the serial number
- Bar code for the 6-digit SCL number.

#### 4.1.2 Serial Number

Each meter nameplate shall include a unique manufacturer's serial number and a 6-digit number specified by Seattle City Light (SCL).

The 6-digit SCL number shall be imbedded in the serial number as the last 6 digits of the serial number, or it shall be printed as a separate number on the nameplate.

See Figures 4.1.3a and 4.1.3b.

In both cases, the 6-digit SCL number shall be formatted as follows:

- Font: sans serif
- Weight: bold
- Height: at least 0.25 inches
- Width: at least 60% of the height (except for the number "1").

The manufacturer's serial number that precedes the 6-digit SCL number should be smaller to distinguish it from the SCL number.

#### 4.1.3 Bar code

A bar code that follows the 17-character American Electric Power (AEP) standard shall be placed on the nameplate.

The bar code shall be Code 39 or Code 128.

The bar code shall conform to the meter specification bar code with leading zeros in the serial number.

The first 3 and last 5 characters in the bar code indicate the specifications of the meter.

The last character of the bar code identifies whether the 6-digit SCL number is imbedded in the serial number or is a separate number.

- A “2” states that this is a meter and the 6-digit SCL number is imbedded.
- A “3” states that this is a meter and that the 6-digit SCL number is separate.

A separate bar code for the 6-digit SCL number shall be printed if it is not imbedded in the serial number. See Figure 4.1.3b.

The words “Seattle City Light,” the bar code, and an interpretation of the bar code shall appear in a space sized at least 0.5 in by 2.5 in. Table 4.1.3 describes the text height of each line.

**Table 4.1.3. Text Height Requirements for Bar Codes**

Line	Description	Text Height (in)
1	Seattle City Light	0.1
2	Bar code per the meter specification	0.2
3	Interpretation of the bar code	0.1

**Figure 4.1.3a. Label with a 6-digit SCL Number Imbedded in the Serial Number (Not to Scale)**



**Figure 4.1.3b. Label with a 6-digit SCL Number Separate from the Serial Number (Not to Scale)**



**4.2 Identification of Carton and Pallet Contents**

Each carton shall have one or two labels on the same side.

Each label shall include at least the following:

- Manufacturer
- Type
- Form
- Class
- Volts
- Seattle City Light purchase order (PO) number
- Seattle City Light stock number (if given on the specification).

Figure 4.2a shows a label that contains the minimum required information.

**Figure 4.2a. Label without Barcodes or Serial Numbers**

**XYZ Company, type X, Form 2S, Class 200, 240 Volts, SCL PO#, and SCL Stock #**

Each meter inside each carton shall be identified to that carton.

The bar codes of the meters inside shall be on the same side of the carton as the generic information.

AEP barcodes for meters shall be configured as shown in Figure 4.2b, 4.2c, or 4.2d and shall identify the following:

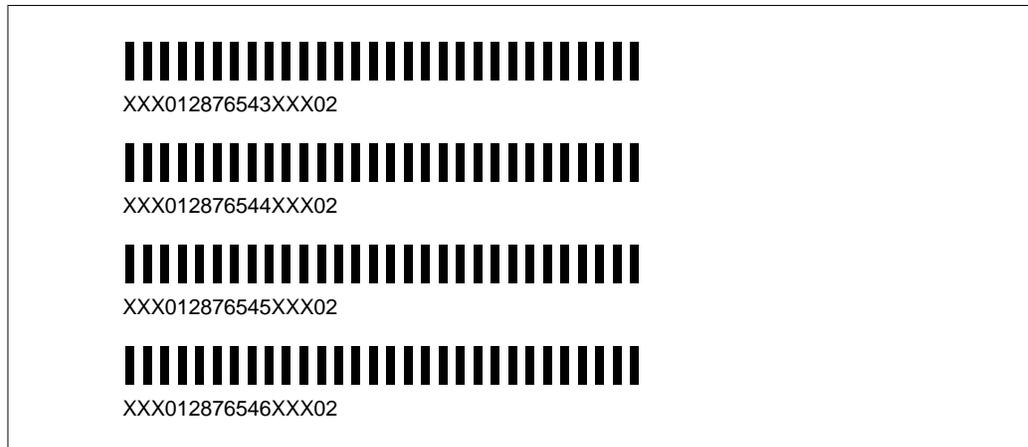
- Manufacturer's serial number
- Bar code interpretation
- SCL assigned number if it is not imbedded in serial number
- Bar code for any separate SCL assigned number.

Cartons and pallets shall be labeled as follows:

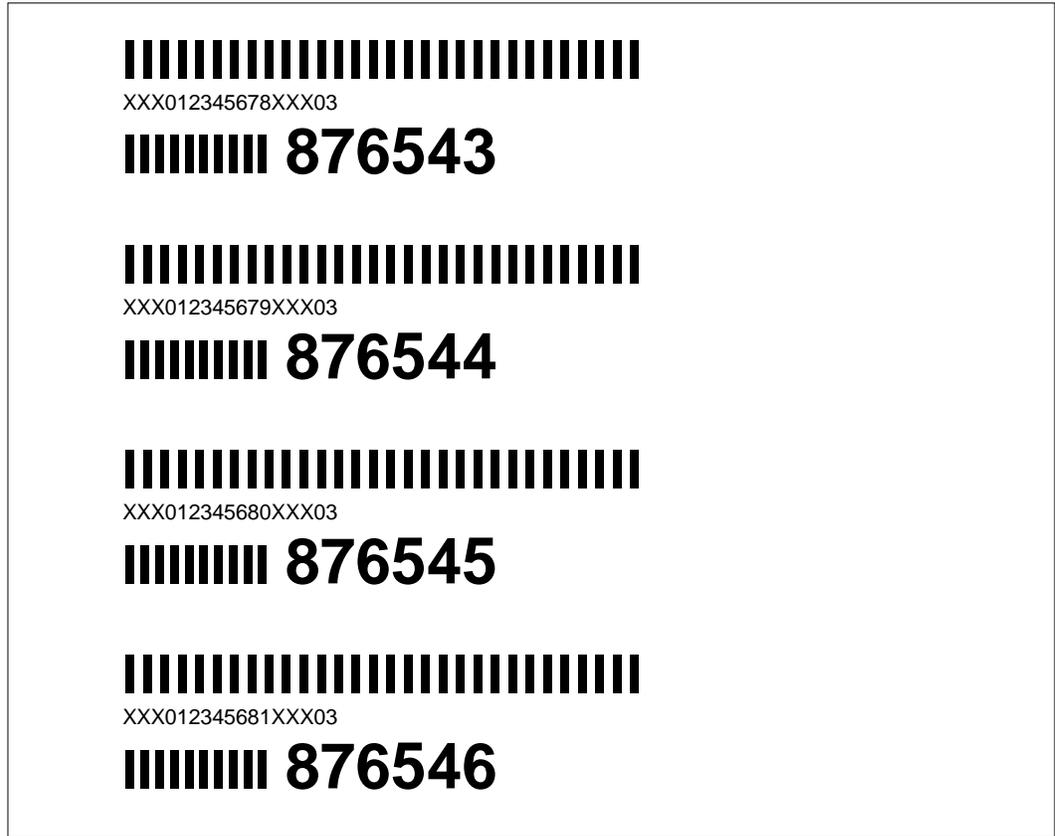
- Cartons shall use the label in Figure 4.2e
- Pallets shall use the label in Figure 4.2f
- Bar codes for meters shall be separate from other bar codes.

These requirements are necessary to avoid confusion while scanning bar codes for the contents inside the carton.

**Figure 4.2b. Label with an Embedded 6-digit SCL Number**



**Figure 4.2c. Label with a Separate 6-digit SCL Number**



**Figure 4.2d. Label with a Separate 6-digit SCL Number and Additional Information**

**XYZ Company, type X, Form 2S, Class 200, 240 Volts, PO#, and stock#**

XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXX012345678XXX03

XXXXXXXX **876543**

XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXX012345679XXX03

XXXXXXXX **876544**

XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXX012345680XXX03

XXXXXXXX **876545**

XXXXXXXXXXXXXXXXXXXXXXXXXXXX  
XXX012345681XXX03

XXXXXXXX **876546**

Figure 4.2e. Label with Bar Codes on the Carton

<b>Meter Type</b> MFR Name	<b>WATTHOUR METER</b>	
	<b>Assembled in USA</b>	
<b>Catalog Number</b>	<b>Class 200</b>	<b>Wire 3</b>
<b>726X200349</b>	<b>Volts 240</b>	<b>Hz 60</b>
	<b>Form 2S</b>	<b>TA 30</b>
<b>SEATTLE CITY LIGHT</b>		
S/N Range this order: 52186684 Thru 52188603		
<b>Pallets this Order:</b>	<b>Quantity This Order: 1920</b>	
<b>0061-0080</b>		
	<b>Carton Contains Serial Numbers</b>	
	<b>SCL Numbers</b>	
	<b>1ND052188404A8B03</b>	
		<b>833261</b>
	<b>1ND052188405A8B03</b>	
		<b>833262</b>
	<b>1ND052188406A8B03</b>	
		<b>833263</b>
	<b>1ND052188407A8B03</b>	
		<b>833264</b>
<b>Pallet: 0078</b>	<b>Carton: 0431</b>	
<b>Stock Number: 400035</b>	<b>Cartons This Order:</b>	
<b>Customer P/O: 0016810017</b>	<b>0001 – 0480</b>	
<b>MFR P/O: 91002556</b>	<b>MFR Line No.: 1</b>	
<b>SCL Numbers This Pallet</b>		
<b>833581</b>		<b>833676</b>
	<b>Thru</b>	

**Figure 4.2f. Label with Bar Codes on the Pallet**

<b>Meter Type</b> MFR Name	<b>WATTHOUR METER</b>	
	<b>Assembled in USA</b>	
<b>Catalog Number</b>	<b>Class 200</b>	<b>Wire 3</b>
<b>726X200349</b>	<b>Volts 240</b>	<b>Hz 60</b>
	<b>Form 2S</b>	<b>TA 30</b>
<b>SEATTLE CITY LIGHT</b>		
<b>Pallet: 0078</b>		
<b>Stock Number: 400035</b>	<b>Cartons This Order:</b>	
<b>Customer P/O: 0016810017</b>	<b>0001 – 0480</b>	
<b>MFR P/O: 91002556</b>	<b>MFR Line No.: 1</b>	
<b>Serial Numbers This Pallet</b>		
<b>MFR Serial No.</b>	<b>From</b>	
		<b>1ND052188404A8B03</b>
	<b>To</b>	
		<b>1ND052188523A8B03</b>
<b>SCL Serial No.</b>	<b>From</b>	
		<b>833581</b>
	<b>To</b>	
		<b>833700</b>
<b>Quantity</b>		
	<b>120</b>	

## 5. Nameplate Approval

The manufacturer shall submit drawings or samples of initial nameplate designs to Seattle City Light's Meter Department for approval prior to production.

Initial nameplate designs shall be submitted by email to the meter lab at [meter.test@seattle.gov](mailto:meter.test@seattle.gov).

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## 6. References

**SCL Material Standard 4911.05**, "Kilowatthour Meters, Single-Phase, Solid-State, Electronic"

**SCL Material Standard 4913.05**, "Kilowatthour Meters, Polyphase, Solid-State, Electronic"

**SCL 4980.05 Material Standard**, "Certified Test Data Requirements, Electricity Meters"

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## 7. Sources

**Byun, Robin**; SCL Standards Engineer, subject matter expert, and originator of 4980.10 ([robin.byun@seattle.gov](mailto:robin.byun@seattle.gov))

**Gilmore, Dan**; SCL Meter Technician and subject matter expert for 4980.10 ([dan.gilmore@seattle.gov](mailto:dan.gilmore@seattle.gov))

**Matsen, Chuck**; SCL Meter Technician and subject matter expert for 4980.10 ([chuck.matsen@seattle.gov](mailto:chuck.matsen@seattle.gov))

**WOOD POLES, BUTT-TREATED, CEDAR**



**1. Scope**

This material standard covers the requirements for butt-treated, solid, western redcedar, wood utility poles.

This material standard applies to cedar poles up to 60 feet in length.

This material standard applies to the following Seattle City Light Stock Numbers:

Length, ft	Class 1	Class 3
30	501030	503030
40	501040	503040
50	501050	503050
55	501055	-
60	501060	-

**2. Application**

Wood poles are used in single-pole utility structures. The poles described herein are considered to be simple cantilever members subject to traverse loads only.

In general, Class 1 poles should be used for any 3-phase construction regardless of wire size and Class 3 poles should be used for 1-phase, secondary, streetlight and guy pole construction. Other pole classes may be required when a pole loading analysis using O-Calc or similar pole loading programs determines a higher class of pole is needed.

The poles cited below are given for historical purposes only and should not be ordered.

Class 2 and Class 4 poles have been determined to be redundant with Class 1 and Class 3 poles respectively, and therefore no longer necessary.

Length, ft	Class 2	Class 4
30	502030	504030
35	502035	504035
40	011958	-
50	502050	-
55	502055	-
60	502060	-

Thirty-five-foot poles have been determined to be redundant with the availability of the thirty-foot and forty-foot pole, and are therefore no longer necessary

Length, ft	Class 1	Class 3
35	501035	503035

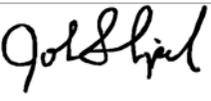
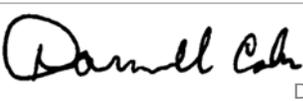
Each pole requires a pole liner. Refer to Material Standard 5092.00.

**3. Industry Standards**

Wood poles shall meet the applicable requirements of the following industry standards:

**American Wood Protection Association** (AWPA) Book of Standards, published 2008, including, but not limited to:

**AWPA A3-08** - Standard Methods for Determining Penetration of Preservatives and Fire Retardants

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**MATERIAL STANDARD**

Wood Poles, Butt-Treated, Cedar

standard number: **5072.00**

superseding: July 20, 2010

effective date: July 25, 2013

page: 2 of 3

**3. Industry Standards, continued**

**AWPA A5-05** - Standard Methods for Analysis of Oil-Borne Preservatives

**AWPA P8-08** - Standard for Oil-Borne Preservatives

**APWA P9-06** - Standards for Solvents and Formulations for Organic Preservative Systems

**AWPA T1-08** - Use Category System: Processing and Treatment Standard

**AWPA U1-08** - Use Category System: User Specification for Treated Wood

**ANSI O5.1-2002** - American National Standard for Wood Products - Specifications and Dimensions [Note: This ANSI standard number contains a leading letter "O" not zero, typical]

**ANSI O5.1c-2004** - American National Standard for Wood Products - Supplement to ANSI O5.1-2002 (and Consolidation of ANSI O5.1a-2003 and ANSI O5.1b-2003)

**ASTM D9-87** (Re-approved 1992) - Standard Terminology Relating to Wood

**4. Conflict**

Where conflict exists, the following order of precedence shall apply:

- 4.1 Seattle City Light Purchase Order (PO)
- 4.2 Seattle City Light General Terms and Conditions
- 4.3 This Material Standard
- 4.4 ANSI O5.1 and AWPA Standards
- 4.5 Other industry standards

**5. Quality and Dimensions**

Wood pole Use Category shall be UC4B according to the requirements of AWPA U1.

Wood pole species shall be western redcedar.

Wood pole quality and dimensions shall meet the requirements of ANSI O5.1 with the following clarifications:

- 5.1 All wood shall be cut from live trees.
- 5.2 Poles shall be shaved according to the requirements of ANSI O5.1, Section 7.4.
- 5.3 The tops of all poles shall be roofed at an angle of approximately 15 degrees, from the face of the pole to the back of the pole.
- 5.4 Poles shall have a two-inch wide by 1/2-inch deep notch on the pole face 12' - 0" from the pole butt.

5.5 Poles 50 feet or less shall be burn-branded according to the requirements of ANSI O5.1 at  $10' \pm 2''$  from the pole butt.

5.6 Poles 55 feet or more shall be burn-branded according to the requirements of ANSI O5.1 at  $14' \pm 2''$  from the pole butt

**6. Preservative Treatment**

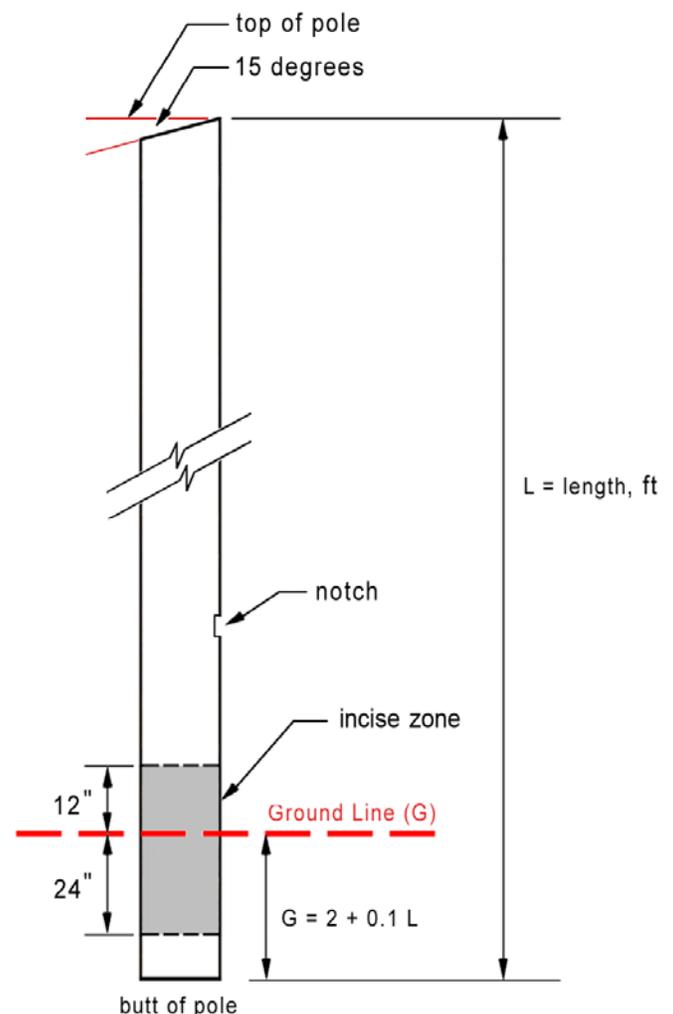
Wood poles shall be processed and treated according to the requirements of AWPA T1.

**6.1 Incising**

Poles shall be deep incised in accordance with AWPA T1 to a depth of at least 5/8 inch.

Incising shall extend 12 inches above and 24 inches below the ground line.

Figure 6, Pole Section



**MATERIAL STANDARD**

Wood Poles, Butt-Treated, Cedar

standard number: **5072.00**

superseding: July 20, 2010

effective date: July 25, 2013

page: 3 of 3

**6. Preservative Treatment**, continued

Table 6, Ground Line Distance from Butt

Pole Length (L) ft	Ground Line Distance from Butt (G) ft
30	5.5
35	6
40	6
50	7
55	7.5
60	8

**6.2 Treatment**

Wood poles shall be butt-treated with copper naphthenate meeting the requirements of AWWA P8 compounded with hydrocarbon solvent, Type A, carrier meeting the requirements of AWWA P9.

Carrier and co-solvent shall not contain greater than 15% bio-fuel product. Any deviation from this requirement shall have the prior written approval of Seattle City Light.

The carrier shall be free of polycyclic aromatic hydrocarbons (PAH), and contain no chlorinated co-solvent.

Poles shall be treated from butt of pole to the top of incise zone.

**6.3 Preservative Retention and Penetration**

Net retention of copper naphthenate preservative in poles after treatment shall be not less than 0.120 pounds per cubic foot (UC4B), in accordance to AWWA U1.

The depth of preservative penetration shall be not less than 3/4-inch, in accordance with AWWA T1.

**7. Testing and Test Methods**

Test data that establishes compliance with the requirements of AWWA A5, AWWA A3 and this Material Standard shall be provided upon request.

Copper naphthenate concentration in wood shall be determined according to the requirements of AWWA A5.

Copper naphthenate penetration in wood shall be determined according to the requirements of AWWA A3.

**8. Documentation****8.1 General**

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

**8.2 Bidder's Data**

Bidder shall return the following technical information with the bid:

- Manufacturer's name
- Manufacturing plant location(s) (all possible)
- Material Safety Data Sheet (MSDS) for the preservative used in the treatment process
- Material Safety Data Sheet (MSDS) for the solvent used in the treatment process
- All exceptions to Seattle City Light requirements with reference to the requirement to which exception is taken; indicate if no exceptions taken

Bid information shall be presented in a clear and consolidated manner for ease of review.

**8.3 Plant QA Process**

Upon request, supplier shall provide information describing the manufacturing plant's quality assurance processes.

**9. Shipping and Handling**

Poles shall be delivered by trucks with "self loading" capability.

Poles shall be handled according to AWWA M4 and ANSI O5.1.

**10. Issuance**

EA

**11. Approved Manufacturer**

Stella-Jones Corporation

**12. References**

**5092.00**; "Pole Liner"; Material Standard; SCL

**Combs, Brad**; SCL Strategic Advisor and subject matter expert (brad.combs@seattle.gov)

**Crume, Stephen**; SCL Joint Use Manager and subject matter expert (stephen.crume@seattle.gov)

**IEEE 1217-2001**, *Guide for Preservative Treatment of Wood Distribution and Transmission Line Structures*; IEEE

**Shipek, John**; SCL Standards Engineer; subject matter expert and co-originator of 5072.00 (john.shipek@seattle.gov)

**Standards Engineering Directive No. 07-001**; dated October 10, 2007, SCL; author, Chris Detter

**Wang, Quan**; SCL Standards Engineer; subject matter expert and co-originator of 5072.00 (quan.wang@seattle.gov)

## Wood Poles, Pressure-Treated, Douglas Fir



### 1. Scope

This standard covers the requirements for pressure-treated, solid, Douglas fir, wood utility poles.

This standard applies to Douglas fir poles up to 110 ft in length.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Length (ft)	Class 1	Class H1	Class H2	Class 3
30	012904	-	-	012910
40	012906	-	-	012912
50	012907	012436	012449	012913
55	012908	012437	012450	-
60	012909	012438	012451	-
65	531065	012439	012452	-
70	531070	012440	012454	-
75	531075	012441	012455	-
80	531080	012442	012456	-
85	531085	012443	012458	-
90	531090	012444	012459	-
95	531095	012445	012460	-
100	531100	012446	012462	-
105	531105	012447	012463	-
110	531110	012448	012464	-

Standards Coordinator  
 Quan Wang

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

## 2. Application

Wood poles are used in single-pole utility structures. The poles described herein are considered to be simple cantilever members subject to transverse loads only.

In general, Class 1 poles should be used for any 3-phase construction regardless of wire size and Class 3 poles should be used for single-phase, secondary, streetlight and guy pole construction. Other pole classes may be required when a pole loading analysis determines a higher class of pole is needed.

*The poles cited below are given for historical purposes only and should not be ordered.*

Class 2 poles have been determined to be redundant with Class 1 poles, and are therefore no longer necessary.

Also, with the availability of 30-ft and 40-ft poles, 35-ft poles have been determined to be redundant and are therefore no longer necessary.

Length (ft)	Class 2	Length (ft)	Class 2
65	531065	090	531090
70	531070	095	531095
75	531075	100	531100
80	531080	105	531105
85	531085		

Length (ft)	Class 1	Class 3
35	012905	012911

Each pole requires a pole liner. Refer to SCL 5092.00.

## 3. Industry Standards

Wood poles shall meet the applicable requirements of the following industry standards:

**American Wood Protection Association (AWPA)** Book of Standards, published 2008, including, but not limited to:

**AWPA A3-08** - Standard Methods for Determining Penetration of Preservatives and Fire Retardants

**AWPA A5-05**; Standard Methods for Analysis of Oil-Borne Preservatives

**AWPA M4-06**; Standard for the care of Preservative-treated Wood Products

**AWPA P8-08**; Standard for Oil-Borne Preservatives

**APWA P9-06**; Standards for Solvents and Formulations for Organic Preservative Systems

**AWPA T1-08**; Use Category System: Processing and Treatment Standard

**AWPA U1-08**; Use Category System: User Specification for Treated Wood

**ANSI O5.1-2002**; American National Standard for Wood Products - Specifications and Dimensions

**ANSI O5.1c-2004**; American National Standard for Wood Products - Supplement to ANSI O5.1-2002 (and Consolidation of ANSI O5.1a-2003 and ANSI O5.1b-2003)

**ASTM D9-87** (Re-approved 1992); Standard Terminology Relating to Wood

#### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

- Seattle City Light purchase order (PO)
- Seattle City Light general terms and conditions
- This standard
- ANSI O5.1 and AWPA standards
- Other industry standards

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#### 5. Quality and Dimensions

Wood pole Use Category shall be UC4B according to the requirements of AWPA U1.

Wood pole species shall be Coastal Douglas fir.

Wood pole quality and dimensions shall meet the requirements of ANSI O5.1 with the following clarifications:

- All wood shall be cut from live trees.
- Poles shall be flat-roofed.
- Poles shall have a two-inch wide by 1/2-inch deep notch on the pole face 12 ft 0 in from the pole butt.
- Poles 50 ft or less shall be burn-branded according to the requirements of ANSI O5.1 at 10 ft  $\pm$  2 in from the pole butt.
- Poles 55 feet or more shall be burn-branded according to the requirements of ANSI O5.1 at 14 ft  $\pm$  2 in from the pole butt

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#### 6. Pre-drilled-through Bolt Holes

Wood poles shall have bolt holes pre-drilled prior to treatment to allow penetration of treatment.

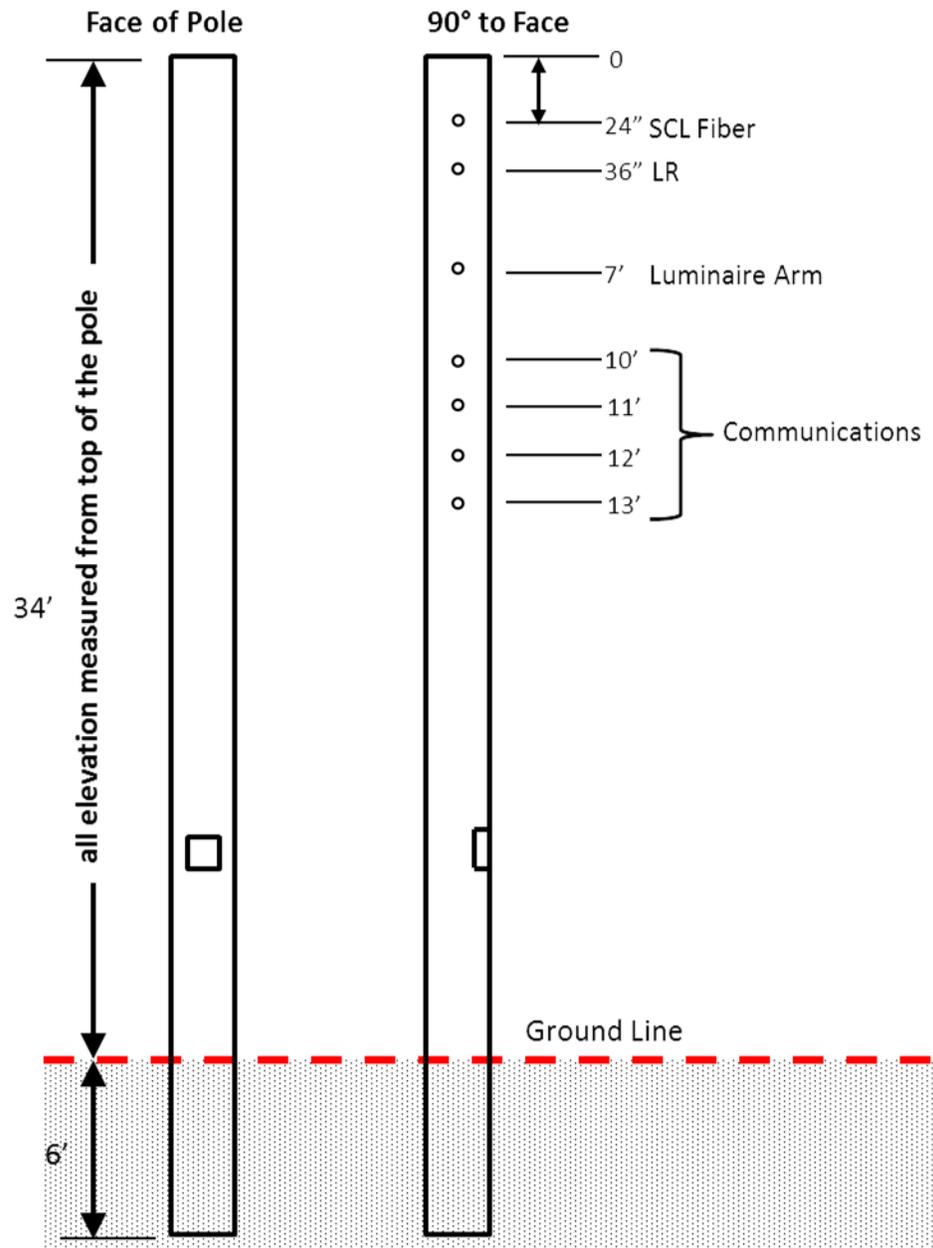
All holes shall be 11/16 inches in diameter to accommodate 5/8-inch hardware unless otherwise noted.

Through-bolt heights on the pole shall be in accordance with Figures 6a and 6b.

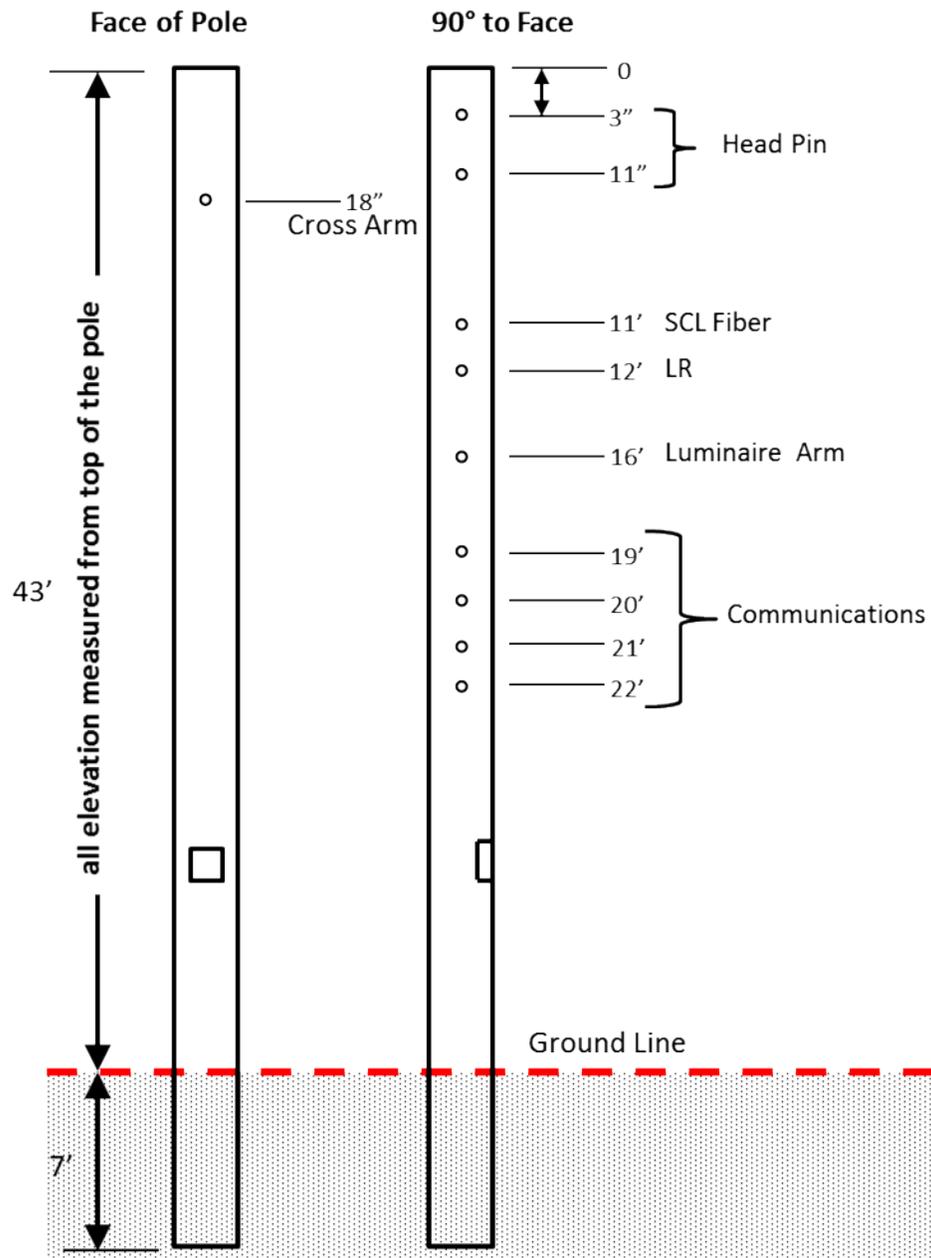
All 30 ft, 55 ft (corner), and transmissions poles shall NOT be pre-drilled.

Bolt holes for guying and transformers shall be field drilled.

Figure 6a. 40-ft Pole Bolt-hole Distances from the Top



**Figure 6b. 50-ft Pole Bolt-hole Distances from the Top**



## 7. Preservative Treatment

Wood poles shall be processed and pressure treated according to the requirements of AWPA T1.

### 7.1 Incising

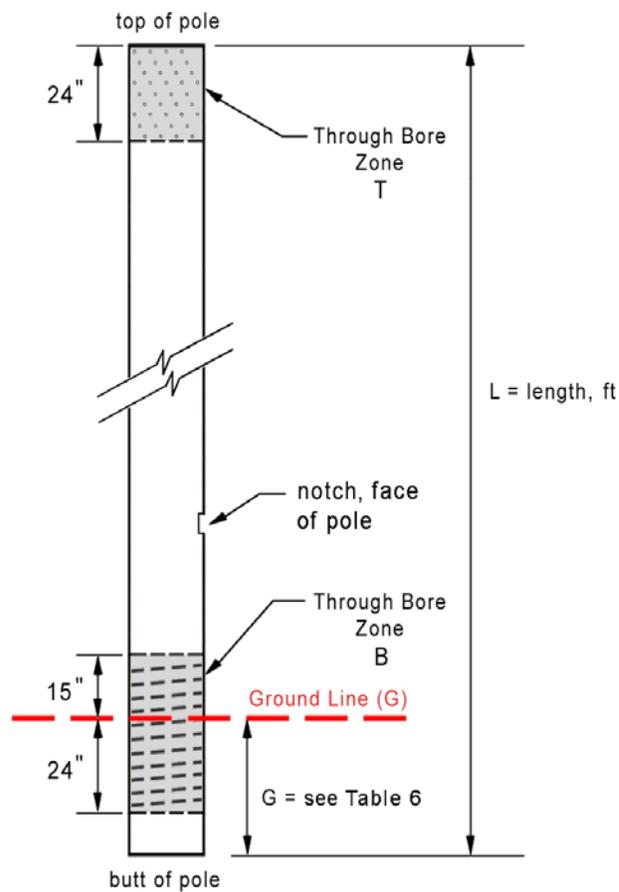
Poles shall be incised full-length after shaving but before seasoning. Minimum incising depth shall be 1/2 in.

### 7.2 Boring

Poles shall be through-bored prior to treatment to enhance penetration of the preservative into the pole according to Figures 7.2a through 7.2f and Table 7.2.

All through-bored holes shall have a nominal diameter of 7/16 in or 1/2 in.  
Ground Line (G) also known as Pole Setting Depth, shall be in accordance with Table 7.2.  
Through-boring shall be done without charring or glazing the inner surfaces.  
All holes shall be through-bored from one direction.  
Through-bore Zone B of the pole shall be done on the face of the pole.  
Through-bore Zone T of the pole shall be done 45 degrees to the face of the pole.  
Edge Distance (ED) shall be  $2 \pm 1/2$  in.

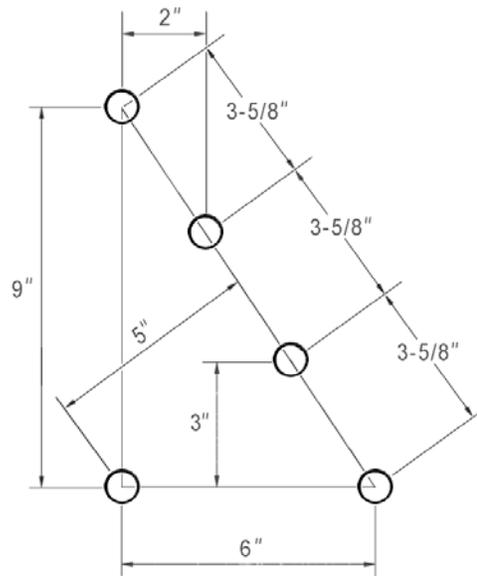
**Figure 7.2a. Pole Section**



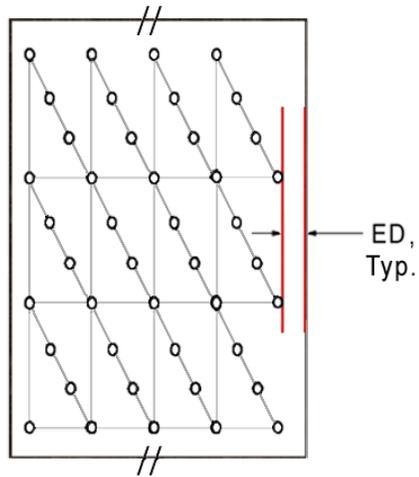
**Table 7.2. Ground Line Distance from Butt**

Pole Length (L) (ft)	Ground Line Distance from Butt (G) (ft)
30	5.5
40	6
50	7
55	7.5
60	8
65	8.5
70	9
75	9.5
80	10
85	10.5
90	11
95	11
100	11
105	12
110	12

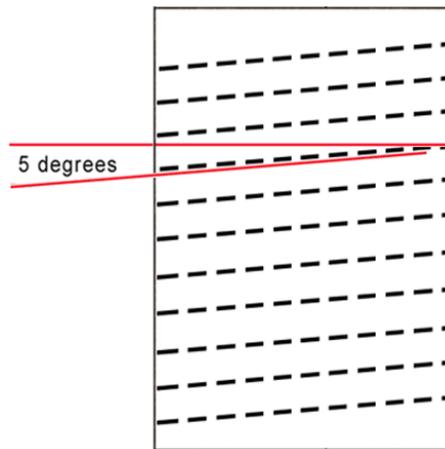
**Figure 7.2b. Pattern for Through-boring Template**



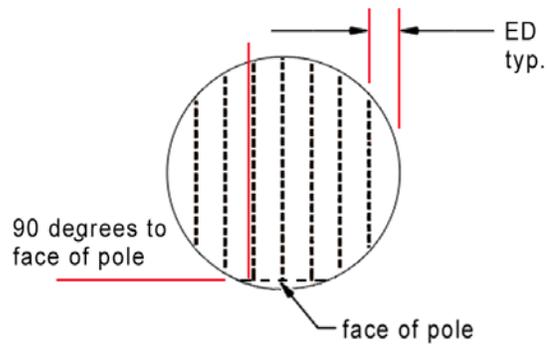
**Figure 7.2c. Through-bore Zone**



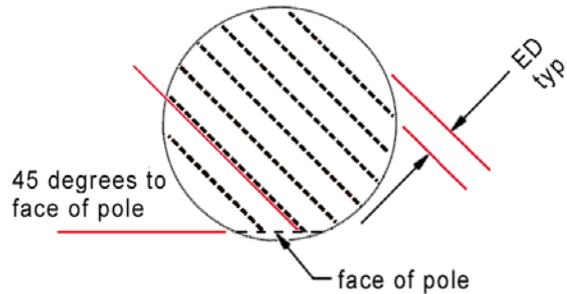
**Figure 7.2d. Through-bore Zone, Side View**



**Figure 7.2e. Through-bore Zone, B-Section**



**Figure 7.2f. Through-bore Zone, T-Section**



### 7.3 Treatment

Wood poles shall be treated full length with copper naphthenate meeting the requirements of AWPA P8 compounded with hydrocarbon solvent, Type A, carrier meeting the requirements of AWPA P9.

Carrier and co-solvent shall be 100 percent pure diesel product. The carrier shall be free of polycyclic aromatic hydrocarbons (PAH), and contain no chlorinated co-solvent.

### 7.4 Preservative Retention and Penetration

Net retention of copper naphthenate preservative in poles after treatment shall be not less than 0.095 pounds per cubic foot (UC4B), in accordance to AWPA U1.

The depth of preservative penetration shall be not less than 2-1/2 inch, specified under AWPA T1.

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## 8. Testing and Test Methods

Test data that establishes compliance with the requirements of AWPA A5, AWPA A3 and this Material Standard shall be provided upon request.

Copper naphthenate concentration in wood shall be determined according to the requirements of AWPA A5.

Copper naphthenate penetration in wood shall be determined according to the requirements of AWPA A3.

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## 9. Documentation

### 9.1 General

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

### 9.2 Technical Information

Upon request, supplier shall provide the following technical information:

- Manufacturer's name
- Manufacturing plant location(s) (all possible)
- Material Safety Data Sheet (MSDS) for the preservative used in the treatment process
- Material Safety Data Sheet (MSDS) for the solvent used in the treatment process
- Pole treatment report, including preservative charge, penetration, and retention.

Technical information shall be presented in a clear and consolidated manner for ease of review.

### 9.3 Plant QA Process

Upon request, supplier shall provide information describing the manufacturing plant's quality assurance processes.

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### 10. Shipping and Handling

Poles shall be delivered by trucks with "self loading" capability.

Poles shall be handled according to AWPA M4 and ANSI O5.1.

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### 11. Issuance

EA

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### 12. Approved Manufacturer

McFarland Cascade

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### 13. References

**SCL Material Standard 5092.00**; "Pole Liners"

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### 14. Sources

**IEEE 1217-2001**, Guide for Preservative Treatment of Wood Distribution and Transmission Line Structures; IEEE Power Engineering Society, New York, NY

**Combs, Brad**; SCL Strategic Advisor and subject matter expert for 5082.00 (brad.combs@seattle.gov)

**Crume, Stephen**; SCL Joint Use Manager and subject matter expert for 5082.00 (stephen.crume@seattle.gov)

**Munyao, Manfred**; SCL Joint Use Engineer and subject matter expert for 5802.00 (manfred.munyao@seattle.gov)

**Shipek, John**; SCL Standards Engineer; subject matter expert and co-originator of 5082.00 (john.shipek@seattle.gov)

**Standards Engineering Directive No. 07-001**; dated October 10, 2007, SCL; author, Chris Detter

**Wang, Quan**; SCL Standards Engineer; subject matter expert and co-originator of 5082.00 (quan.wang@seattle.gov)

**POLE LINERS**



**1. Scope**

This material standard covers the requirements for barrier protection systems for wood utility poles, using pole liners and sealing tape.

This Material Standard applies to the following Seattle City Light Stock Numbers shown:

Stock No.	Description, width x length	Pole Liner fits the following pole lengths, ft
012862	pole liner, 30" x 8'	30 to 40
012863	pole liner, 38" x 10'	50 to 60
012864	pole liner, 38" x 11'	65 to 75
012865	pole liner, 42" x 13'	80 to 100
012940	self adhesive silicon tape, roll	one roll per liner

For pole liners longer than 13 feet, please contact Material Control.

The self-adhesive tape is used to affix the pole liner to the pole.

**2. Application**

Barrier protection systems are used to augment preservative treated wood poles and wood based components for ground contact uses. The barrier protection system protects the susceptible portions of

the underlying wood pole against decay and termite damage. Barrier protection systems are made of impermeable, weather resistant material and are permanently affixed to the wood with tape. Barrier protection systems also prevent any chemical leaching from the pole into the surrounding groundwater and soil.

For recommended pole and pole liner application, see Table 1.

**3. Industry Standards**

Barrier protection systems shall meet the applicable requirements of the following industry standards:

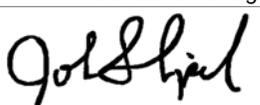
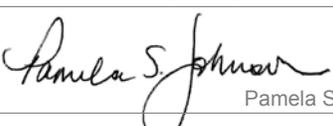
**American Wood Protection Association** (AWPA) Book of Standards, published 2008, including, but not limited to:

**AWPA P20-08** – All Barrier Protection System

**AWPA U1-08** – Use Category System: Specification for Treated Wood.

**AWPA E7-07** – Standard Method of Evaluating Wood Preservatives by Field Tests with Stakes

**ASTM D4801 – 08** Standard Specification for Polyethylene Sheeting in Thickness of 0.25 mm [0.010 in.] and Greater

standards coordinator	standards manager	unit director
 Quan Wang	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

**4. General Requirement**

All barrier protection systems shall meet the requirements of AWPA P20 with the following clarifications:

- Barrier protection systems shall meet the specification of ASTM D4801 for weather resistance. Other materials used for barrier protection systems shall demonstrate equivalent weather resistant performance and form a barrier between treated wood and surrounding soil.
- Barrier protection systems shall have performance rating of 7 or better on the field stacking tests conducted according to AWPA E7.
- Barrier protection systems must be compatible with wood poles treated with Copper Naphthenate and other preservatives detailed in AWPA.
- Termite resistance shall be documented for all barrier system components in accordance with AWPA E1.

**5. Attributes**

5.1 Pole liners

Pole liners shall be constructed of three layers. The layers shall have the following attributes:

Pole Liner		Nominal Thickness, in
layer 1	polyethylene	0.0035
layer 2	copper foil	0.0007
layer 3	polyethylene terephthalate (PET)	0.0035
total		0.0077

5.2 Sealing Tape

Sealing tape shall be of silicon material and be self fusing.

Sealing tape shall be black and have the following attributes:

- thickness, nominal: 0.0197 in
- width, nominal: 4 in
- length, nominal: 10 ft

**6. Packaging**

Pole liner and silicon tape shall be packaged separately to prevent damage during shipping and storage.

Each package shall be marked with Seattle City Light's stock number, manufacturer's name or symbol and manufacturer's catalog number.

**7. Issuance**

liner EA

tape RL

**8. Approved Manufacturers**

Copper Care Wood Preservative Inc.

Stock No.	Description, width x length	Copper Care Catalog No.
012862	pole liner, 30" x 8'	9005
012863	pole liner, 38" x 10'	9006
012864	pole liner, 38" x 11'	9007
012865	pole liner, 42" x 13'	9008
012940	self adhesive silicon tape, roll	9021

**9. References**

**5082.00**; "Wood Poles, Pressure-treated, Douglas fir;" Material Standard; SCL

**5072.00**; "Wood Poles, Butt-treated, Cedar;" Material Standard; SCL

**Wang, Quan**; SCL Standards Engineer; subject matter expert and originator of 5092.00 (quan.wang@seattle.gov)

## Composite Utility Poles, Modular



### 1. Scope

This material standard covers the requirements for modular composite utility poles and their accessories.

Composite utility poles are sometimes referred to as fiberglass or fiber-reinforced-polymer (FRP) poles.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Description
013313	30 foot, class H1 assembly
013172	40 foot, class H2 assembly
013173	50 foot, class 1, assembly
013174	55 foot, class 1, assembly
013175	Jacking lug
013176	Climbing step
013177	Climbing step hole plug
013524	Pole module joining hardware kit

### 2. Application

Composite utility poles have at least two particular applications:

- 1) Back lot sites where material and tools must be packed in or where it is not economical to employ a large crane to lift material over a home or other structure, and

- 2) Wetlands or other environmentally sensitive areas where the use of treated wood poles should be avoided.

30- and 40-foot poles are provided pre-drilled to accommodate a secondary spool insulator angle bracket, stock number 690402.

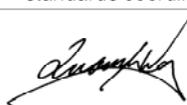
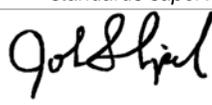
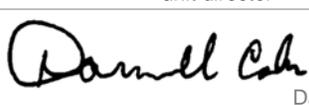
50- and 55-foot poles are provided pre-drilled to accommodate a pole top insulator bracket, stock number 563253, and a secondary spool insulator angle bracket, stock number 690402.

The 2007 National Electrical Safety Code (NESC) allows the same Strength Factors to be used as for steel and pre-stressed concrete poles, providing that the composite pole strengths are specified as 5% Lower Exclusion Limit (LEL) values.

Contact the Civil/Structural group for situations where a composite pole will be subjected to heavy vertical or combined (vertical and transverse) loads.

Composite utility poles are typically direct buried.

Jacking lugs and climbing steps are not included with the pole assemblies. Climbing steps for *above* the first ten feet must be ordered separately, while climbing steps for the *first* ten feet may be available from the Tool Room. Jacking lugs may also be available from the Tool Room.

standards coordinator	standards supervisor	unit director
 Quan Wang	 John Shipek	 Darnell Cola

**2. Application**, continued

Design engineers should refer to Table 2 for the recommended number of pole climbing steps to order for a given pole.

**Table 2**

Pole height, overall (ft)	Total number of climbing steps	Number of climbing steps above first ten feet
30	13	7
40	21	15
50	28	22
55	32	26

One pole assembly requires four (reusable) jacking lugs. Climbing steps are permanently installed in pre-drilled holes, one every 15 inches, beginning approximately 10 feet above grade.

Climbing step hole plugs are for plugging the climbing step holes in the first ten feet of the pole. Plugs are removable, reusable, and included with pole assembly.

Individual pole modules range in weight from 142 to 299 pounds.

The manufacturer of this modular composite utility pole system can produce poles of any class up to 120 feet.

Some field drilling is required to assemble modular composite poles. This work requires carbide drill bits available from the Tool Room.

In some cases, five feet must be trimmed off the tip end to attain the desired pole length.

**3. Industry Standards**

Composite utility poles shall meet the requirements of the following industry standard:

**ASCE 104-2003** - Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Utility Line Structures

**Table 4.1**

Stock No.	Pole Length (ft)	NESC Class	RStandard Modules	Pole Weight, Total (lb)	Tip Diameter (in)	Base Diameter (in)
013313	30	H1	M1, M2	312	8.21	12.56
013172	40	H2	M1, M2, M3	488	8.78	15.31
013173	50	1	M1L, M2, M3	599	7.71	15.31
013174	55	1	M1, M2, M3, M4	776	8.91	18.27

**4. Pole Requirements**

Composite utility poles shall be made from ultra-strong polyurethane resin and E-glass fiber.

Composite utility poles shall be ultraviolet-light resistant, suitable for long-term outdoor exposure.

Composite utility poles shall be gray.

For the purpose of this standard, NESC pole classification shall be Grade C.

Each composite utility pole assembly shall consist of:

- top cap, Figure 4.1
- top cap fastening screws (self-tapping #8)
- pole modules
- pole module joining hardware kit (bolts, blind nuts, and washers), Figure 4.2
- base plate, Figure 4.3
- base plate fastening hardware kit (J-bolts, nuts, and washers), Figure 4.4
- jacking lug hole plugs
- climbing step hole plugs, set of five for first ten feet of the pole
- assembly and installation guide in weather-proof, ultraviolet light-resistant envelope

Poles shall be pre-drilled at the factory with climbing step and bracket holes.

Climbing step hole spacing shall be 15 inches  $\pm$ 3 inches and begin approximately two feet above grade and end approximately 6-1/2 feet from the tip end.

Bracket holes shall be drilled 90 degrees from step holes.

Bracket hole details shall be according to Table 4.2

**Figure 4.1. Top Cap**



**Figure 4.3. Base Plate**



**Figure 4.2. Pole Module Joining Hardware**



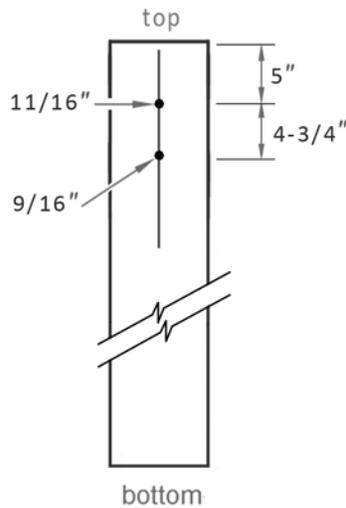
**Figure 4.4. Base Plate Fastening Hardware**



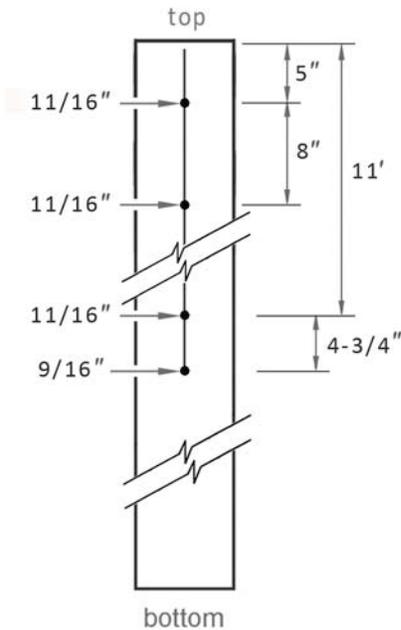
**Table 4.2. Bracket Notes**

Stock No.	Pole length (ft)	Bracket hole details
013313	30	Figure 4.5
013172	40	Figure 4.5
013173	50	Figure 4.6
013174	55	Figure 4.6

**Figure 4.5. Bracket holes, 30-ft and 40-ft pole**



**Figure 4.6. Bracket holes, 50-ft and 55-ft pole**



**5. Pole Accessories**

Composite utility pole accessories:

- Jacking lug with instructions, Figure 5.1
- Climbing step, Figure 5.2
- Climbing step hole plug
- Pole module joining hardware kit (3/4-inch bolt, blind nut, and washer), Figure 5.3

**Figure 5.1. Jacking Lug**



**Figure 5.2. Climbing Step**



**Figure 5.3. Pole Module Joining Hardware Kit**



**6. Marking**

Each composite pole section shall be permanently and legibly marked with the following information:

- Module number
- Production serial number
- Module weight

Each complete composite pole assembly shall be provided with an aluminum tag containing, but not limited to, the following information:

- Manufacturer
- Length
- Class
- Month/year of manufacture

The aluminum identification tag shall be permanently affixed to the pole at a minimum height of 3 feet above the ground line.

**7. Testing and Test Data**

Composite pole test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Documentation shall be in English and use customary inch-pound units.

**10. Approved Manufacturer**

Stock No.	Description	RStandard, Calgary, AB
013313	30 foot, class H1, assembly	RSP-0300-F-0102-C-GY-000
013172	40 foot, class H2, assembly	RSP-0400-F-0103-C-GY-000
013173	50 foot, class 1, assembly	RSP-0500-F-1L03-C-GY-000
013174	55 foot, class 1, assembly	RSP-0550-F-0104-C-GY-000
013175	Jacking lug with instructions	RSK-JL-SS
013176	Climbing step	7237
013177	Climbing step hole plug	H-HP-113-I
013524	Pole module joining hardware kit	RSK-BN-250-75-GD

**11. References**

**Hodges, Norm**; SCL Standards Engineer and subject matter expert for 5214.14 (norm.hodges@seattle.gov)

**IEEE C2-2007**; National Electrical Safety Code (NESC); 2007

**Lu, Curtis**; SCL Standards Engineer and subject matter expert for 5214.14 (curtis.lu@seattle.gov)

**8. Packaging**

Each shipping package shall be marked with:

- Manufacturer's Name
- Seattle City Light Purchase Order Number
- Seattle City Light Stock Number

Top caps, top cap fastening screws, pole module joining hardware kits, base plates, base plate fastening hardware kits (J-bolts, nuts, and washers), jacking lug hole plugs, climbing step hole plugs, and assembly and installation guide shall be packaged together and labeled for the pole module set to which they belong.

**9. Issuance**

**Unit:** EA

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 5214.14 (john.shipek@seattle.gov)

**RS Technologies**; www.grouparsi.com

**RS Technologies**; www.rstandard.com

**CROSSARMS, DOUGLAS-FIR, TREATED**



**1. Scope**

This standard covers the requirements for utility pole crossarms.

This standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Type	Length, ft
540205	primary	06
540146	primary feeder	10
540220	26kV	10
540209	wing	11
540221	switch	12
540014	alley	14
540016	alley	16
540018	alley	18
540022	alley	22
541365	H structure brace	44

**2. Application**

Crossarms are used in overhead line construction.

**3. Industry Standards**

Crossarms shall meet the requirements of the latest revisions of the following industry standards:

**ANSI O5.3-2002:** "American National Standard for Wood Products - Solid Sawn-Wood Crossarms and Braces - Specifications and Dimensions"

**AWPA U1-2008:** "Use Category System; User Specification for Treated Wood"

**4. General Requirements**

**4.1 General**

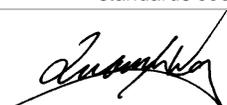
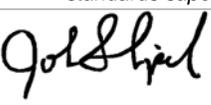
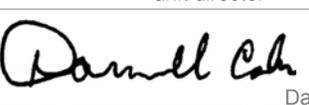
Crossarms shall be constructed from Douglas-fir (*Pseudotsuga menziesii*), Coastal variety.

Crossarms shall meet the requirements of ANSI O5.3.

**4.2 Marking**

Crossarms shall be marked or branded according to ANSI O5.3 with the following clarification:

Each crossarm shall be marked or branded "CL".

standards coordinator	standards supervisor	unit director
 Quan Wang	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Crossarms, Douglas Fir, Treated

**4. General Requirements, continued**

**4.3 Treatment**

Crossarms shall be pressure treated with copper naphthenate preservative according to AWPA U1.

Preservative retention shall be in accordance with AWPA U1 section 3.0 Sawn Products UC3A.

**4.4 Edges**

Edges shall be eased as follows:

Top radius 3/8"

Bottom radius 1/8"

**4.5 Incising**

Crossarms shall be incised on all four sides to a uniform depth of 3/16 inch prior to treatment.

**4.6 Dimensions and Drilling**

Dimensions and drilling shall be as stated in section 5.

Pin hole diameters shall be 13/16 inches unless otherwise noted.

**4.7 Tolerances**

Dimensional tolerances shall be as follows:

Length ..... ± 1/4"

Width ..... ± 1/16"

Height ..... + 1/8" - 1/16"

Top radius easing ..... ± 1/8"

Bottom radius easing ..... ± 1/16"

Pin hole diameter ..... + 1/32" - 3/32"

All other hole diameters ..... ± 1/16"

**5. Detailed Requirements**

Stock Number	Arm Type	Pin Positions	Arm Dimension			Drilled
			Width, in	Height, in	Length, ft	
540205	primary	4-pin	3-1/2	4-1/2	06	per Fig. 5.1
540146	primary feeder	6-pin	4-1/2	5-1/2	10	per Fig. 5.2
540220	26kV	8-pin	3-1/2	4-1/2	10	per Fig. 5.3
540209	wing	9-pin	3-1/2	4-1/2	11	per Fig. 5.4
540221	switch	none	4-3/4	5-3/4	12	per Fig. 5.5
540014	alley	none	4-3/4	5-3/4	14	blank
540016	alley	none	4-3/4	5-3/4	16	blank
540018	alley	none	4-3/4	5-3/4	18	blank
540022	alley	none	4-3/4	5-3/4	22	blank
541365	H structure brace	none	4	12	44	blank

5. Detailed Requirements, continued

Note: All Figure dimensions in inches, except Figure 5.5.

Figure 5.1, Primary Arm, 6 foot, 4-pin (540205)

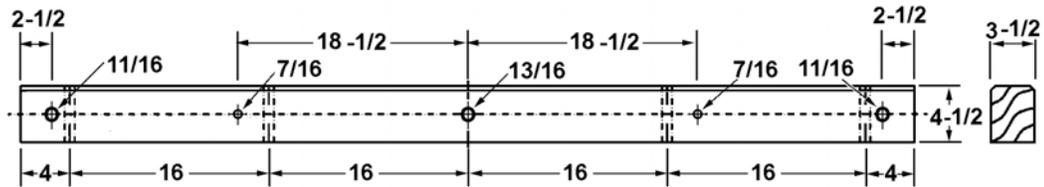


Figure 5.2, Primary Feeder Arm, 10 foot, 6-pin (540146)

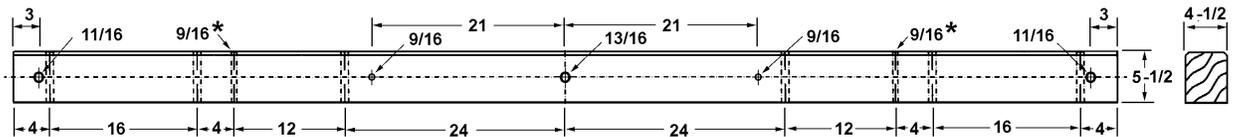


Figure 5.3, 26 kV Arm, 10 foot, 8-pin (540220)

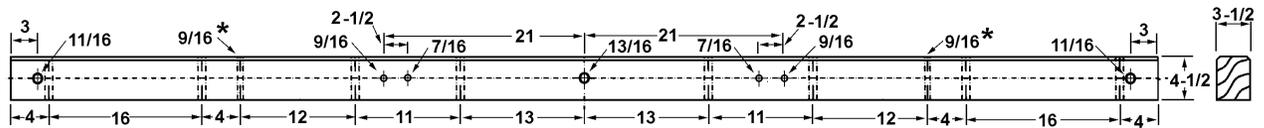


Figure 5.4, Wing Arm, 11 foot, 9-pin (540209)

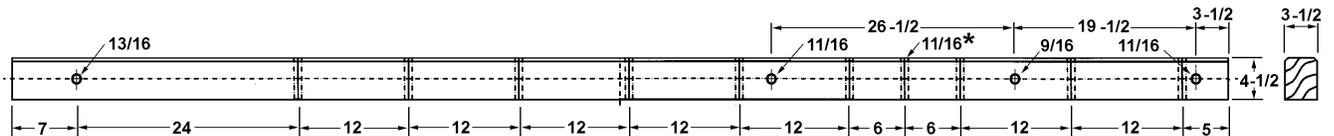
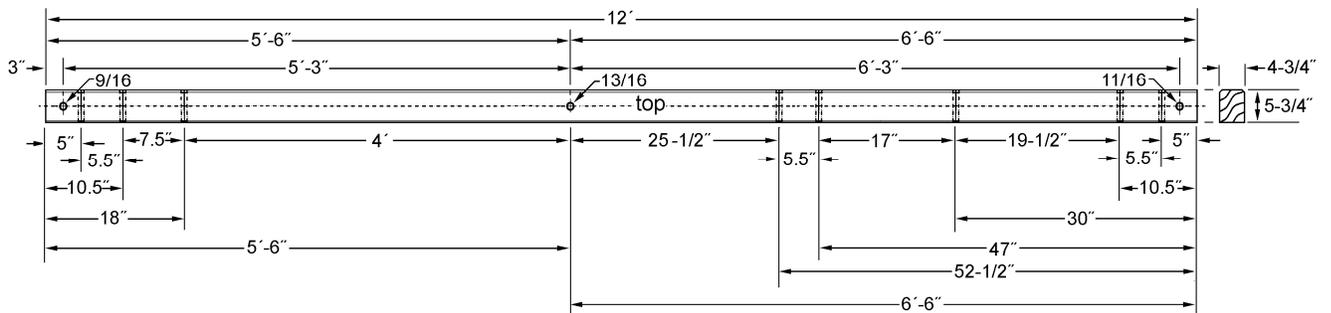


Figure 5.5, 26 kV Switch Arm, 12 foot, (540221)



**6. Packaging**

**6.1 Bundle Size**

Crossarms shall be packaged in bundles as follows:

Crossarm Sizes Width x Height x Length	Bundle Sizes	
	Quantity	Width x Height
3-1/2" x 4-1/2" x all	50 each	10 x 5
4-1/2" x 5-1/2" x all	25 each	05 x 5
4-3/4" x 5-3/4" x all	25 each	05 x 5

**6.2 Bundle Construction**

The bundles shall have spacer strips between each lay of arms and each bundle shall be securely bound with flat metal strapping.

**6.3 Bundle Marking**

Each crossarm bundle shall be legibly marked with the following information:

- Manufacturer's identification
- Gross weight
- Tare weight
- Net weight
- Date of manufacturer
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Issuance**

**Stock Unit:** EA

**8. Approved Manufacturers**

- Brooks Manufacturing Co.
- DIS-TRAN Wood Products, LLC
- Pennington Crossarm Co.

**9. References**

**AWPA C25:** "American Wood-Preservers' Association Standard, Sawn Crossarms – Preservative Treatment by Pressure or Thermal Process;" AWPA (withdrawn)

**SCL D4-1,** "Standard Crossarms," (canceled); Construction Standard)

**Shipek, John;** SCL Standards Engineer, subject matter expert and originator of 5400.00 (john.shipek@seattle.gov)

**Wang, Quan;** SCL Standards Engineer and subject matter expert for 5400.00 (quan.wang@seattle.gov)

## Dead End Assembly, Fiberglass



### 1. Scope

This standard covers the requirements for 4-pin position fiberglass dead end crossarm assemblies.

This standard applies to Seattle City Light (SCL) Stock No. 013636.

### 2. Application

Fiberglass dead end assemblies are used to construct the overhead distribution system.

Dead end assemblies consist of a crossarm, a mounting bracket with a double-guy attachment, and two eye nuts on the front and back of the crossarm.

### 3. Industry Standards

Fiberglass dead end assembly components shall meet the applicable requirements of the following industry standards:

**ASTM A 36**; Specification for Structural Steel

**ASTM A 123**; Specification for Zinc (Hot-Galvanized) Coating on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips

**ASTM A 153**; Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware

**ASTM D635**; Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

**ASTM D2344**; Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

**ASTM D2584**; Standard Test Method for Ignition Loss of Cured Reinforced Resins

**ASTM D3917**; Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes

**ASTM D4385**; Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

**ASTM E 165**; Practice for Liquid Penetrant Inspection Method

**ASTM E 709**; Practice for Magnetic Particle Examination

**ASTM G154**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**ANSI B1.1**; Unified Inch Screw Threads

**ANSI O5.3**; Solid Sawn-Wood Crossarms and Braces - Specifications and Dimensions

**AWS D1.1**; Structural Welding Code

**RUS 1724e-151**; Mechanical Loading on Distribution Crossarms

**RUS 1724e-200**; Design Manual for High Voltage Transmission Lines

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## 4. General Requirements

### 4.1 Crossarm Material

Crossarm material shall be self-extinguishing.

Crossarm material shall conform to the chemical and mechanical properties as specified in accordance with ASTM D2344, D2584, D3917, and G154 test methods.

Crossarm material shall be boron-free to prevent corrosive failures.

Crossarm exterior color shall be brown.

### 4.2 Protective Coating

Fiberglass crossarms shall be treated with UV resistant coating to protect against UV degradation.

Crossarms shall be tested for accelerated weathering and ultraviolet aging for 2500 hours without any degradation of strength or modulus of elasticity (MOE) and without deterioration of color in accordance with ASTM G154.

UV coating shall have a minimum protective life expectancy of 40 years.

### 4.3 Hardware, Structural Steel and Accessories

All steel components shall be compliant with ASTM A36, A572, or A871 specifications. Only the grades of steel cited in the above ASTM specifications will be allowed unless approved by Seattle City Light Standards.

Mounting bracket shall be made of hot-rolled steel or welded structural steel.

All hardware, including mounting bracket, bolts, washers, and nuts shall be hot-dipped galvanized in accordance with ASTM A153 and shall have a finger-free fit.

Mounting bracket dimensions shall be as shown in Figure 5.2a.

## 5. Detailed Requirements

Fiberglass dead end assemblies shall be designed and fabricated to conform to the requirements of ASTM D3917 and ANSI O5.3.

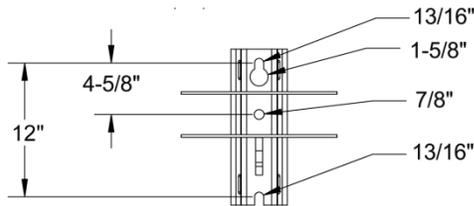
**5.1 Dimensions**

**Table 5.1. Dimensional Crossarm Tolerances**

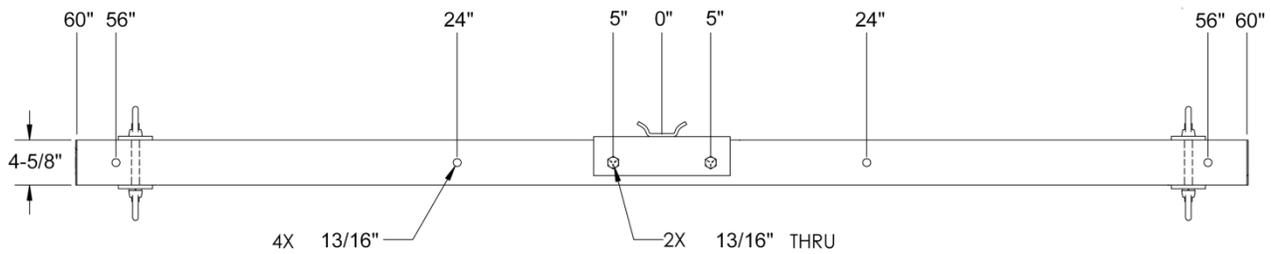
Length	±1/4 in
Height	±1/8 in
Width	±1/8 in
Hole spacing	1/16 in, minimum
Hole diameter	±1/16 in

**5.2 Assembly Dimensions**

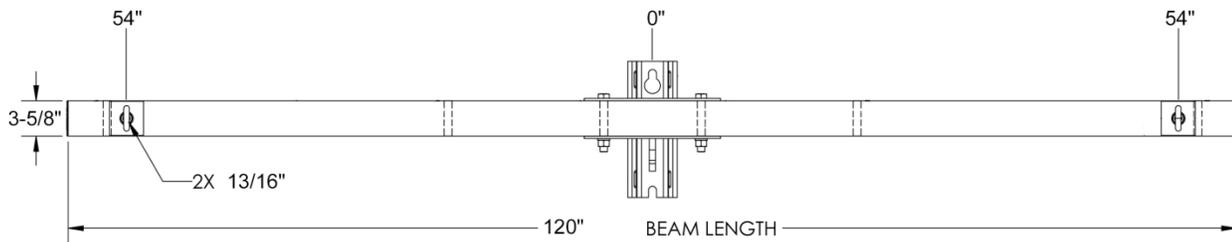
**Figure 5.2a. Mounting Bracket Dimensions**



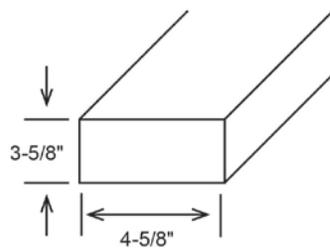
**Figure 5.2b. Top View Dimensions**



**Figure 5.2c. Front View Dimensions**



**Figure 5.2d. End View Dimensions**



### 5.3 Assembly Component List

Each assembly shall consist of the following:

Component	Quantity
Fiberglass crossarm beam with end caps	1
Dead end mount assembly	1
Bolt, 3/4-10 x 5-1/2 in	2
Lock washer, 3/4 in	4
Hex nut, 3/4-10	2
Square washer, 13/16 in, 3-1/2 in x 3/8 in	4
Eye nut, 3/4-10	4 (2 ea on front and back of crossarm)

Crossarm box structure shall not be compressed during hardware installation.

### 5.4 Assembly Strength Properties

Fiberglass dead end assemblies shall meet or exceed the strength properties cited in Table 5.4.

**Table 5.4. Assembly Strength Properties**

Ultimate Capacity	Requirement
Longitudinal (lb/wire)	10,000
Vertical (lb/wire)	2500
Transverse (lb <sub>f</sub> )	1150

**Note:** Strength properties are based on a two-wire configuration, 6 inches from arm end.

Fiberglass crossarms shall meet or exceed ultimate moment capacity and deflection characteristics of equivalent wood arms for of each major axis (wood crossarm based on a Modulus of Rupture (MOR) of 7400 psi and Modulus of Elasticity (MOE) of 1.8x10<sup>6</sup> psi) in accordance with ANSI O5.3.

Attachment points for pin-type insulators must meet the following transverse pin test requirements in accordance with ANSI O5.3:

- Transverse load shall be applied to a 1-3/8-in thread pin with a 2-1/4-in washer mounted on the fiberglass crossarm.
- Fiberglass member shall withstand transverse load up to 750 lb without crushing.
- Transverse load to be gradually increased to 1650 lb or ultimate, whichever comes first and results shall be reported.

Crossarms shall not exhibit more than 3.25-in of deflection in any direction when subjected to the maximum loading expected for 954.5 kcmil ACSR "Rail" conductor with a 125-ft ruling span and a 250-ft maximum span under NESC 250B Medium. Vertical, longitudinal and transverse loads are to be applied simultaneously.

## 6. Marking

Each assembly shall be marked legibly with the following:

- Name or trade mark of the manufacturer
- Year of manufacture
- Specified mechanical load
- Product serial number or identification number

Marking shall be placed in a location on the crossarm and of a size and font that is visible from the ground. Marking shall be non-metallic. Marking requirements shall also be detailed on the fabrication drawings.

## 7. Packaging

Assemblies shall be packaged in bundles of 25.

Each assembly bundle shall be marked legibly with the following information:

- Manufacturer identification number
- Gross weight
- Tare weight
- Net weight
- Date of manufacturer
- Seattle City Light purchase order number
- Seattle City Light stock number

## 8. Issuance

EA

## 9. Approved Manufacturers

Manufacturer:	PUPI
Catalog Number:	DA3000120E24473
where:	
D =	Dead end
A =	Dead end 12-inch hole space, double guy attachment
30 =	Beam series = 3000
0 =	Number of beams in assembly = 1
0 =	TorqueGuard bushings included in all holes
120 =	Length (in inches)
E =	Eye nuts front and back side
2 =	2-wire position
447 =	Drill specs, SCL
3 =	Brown

<b>Manufacturer:</b>	<b>Aluma-Form</b>
Catalog Number:	<b>FDA30B-2-120-EB-IP-FG-SCL</b>
<i>where:</i>	
FDA =	Fiberglass dead end arm
30 =	Extra heavy duty
B =	B = Brown
2 =	2-wire position
120 =	Length (in inches)
EB =	Double eye bolts
IP =	Pin holes with inserts
FG =	Fabricated gain with a double guy attachment
SCL =	Drill specs, SCL

## 10. Sources

**Maloney, Jim;** SCL Asset Management Strategic Advisor, subject matter expert for 5417.05 (jim.maloney@seattle.gov)

**National Electrical Safety Code (NESC), C2-2012 Edition;** Institute of Electrical and Electronics Engineers (IEEE) Inc., New York, NY, 2011

**PUPI;** www.pupicrossarms.com

**Wang, Quan;** SCL Standards Engineer and originator of 5417.05 (quan.wang@seattle.gov)

**CROSS-PLATE ANCHORS**



**1. Scope**

This standard covers the requirements for cross-plate anchors.  
 This standard applies to Seattle City Light Stock Number 562058.  
 Helical and Manta-Ray anchors and anchor accessories are outside the scope of this standard.

**2. Application**

Cross-plate anchors are used to create attachment points to the earth, typically for connecting down guys.  
 Cross-plate anchors are used in areas where the equipment necessary to install screw anchors cannot gain access.  
 The ultimate holding capacity of an anchor is heavily dependent on soil type and condition.  
 Cross-plate anchors are made for installation in holes drilled by power diggers. Because the size of the hole does not affect holding capacity, the hole can be dug by the same auger that is used to dig the pole holes on transmission projects.  
 Cross-plate anchors are installed in a diagonal bored hole which is undercut so the anchor is at right angles to the guy. A rod trench is either cut with a trenching tool or drilled with a small power auger. Both anchor and rod trench should be refilled and tamped.  
 Stock number does not include rod.  
 Refer to pertinent design standards and manufacturer's literature for more information.

**3. Attributes**

Stock Number	562058
Description	cross-plate anchor
Material	steel
Anchor rod connection point	1-inch diameter, threaded hole
Area, sq in	400
Coating	corrosion-resistant asphalt paint
Auger hole diameter, in	24
Holding capacity, no safety factor, lbs	
Soil Class 3	45,000
Soil Class 4	37,000
Soil Class 5	30,000
Soil Class 6	23,500
Soil Class 7	18,000
Weight, nominal, lbs	34

**4. Marking**

Each cross-plate anchor shall be permanently and legibly marked with manufacturer's name or symbol.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Cross-Plate Anchors

standard number: **5622.17**

superseding: new  
 effective date: May 30, 2012  
 page: 2 of 2

**5. Packaging**

Cross-plate anchors shall be packaged to prevent damage during shipping, handling, and inside storage.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

**6. Issuance**

EA

**7. Approved Manufacturers**

Stock Number	Description	Hubbell Power Systems/ Chance	Hydel Enterprises, Inc.
562058	cross-plate anchor	X24	24CPA

**10. References**

**Hubbell Power Systems**; Chance; Anchors, Product Catalog; January 2012

**Circa Enterprises**; www.circaent.com

**Hubbell Power Systems**;  
 www.hubbellpowersystems.com

**Hydel Enterprises Inc.**; PoleLine Catalogue;  
 dWK38047-2M-0504

**SCL D6-4**; "Guying and Anchoring"; Construction Standard

**SCL 5620.7** (canceled); "Anchor Plate"; Material Standard

**SCL 5622.33**; "Helical Anchors and Accessories"; Material Standard

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert for SCL Material Standard 5622.17 (john.shipek@seattle.gov)

**MANTA RAY ANCHORS**



**1. Scope**

This standard covers the requirements for Manta Ray anchors. Manta Ray anchors are also known as driven tipping plate soil anchors.

This standard applies to the following Seattle City Light Stock Number 562050.

Helical and cross-plate anchors and anchor accessories are outside the scope of this standard.

**2. Application**

Manta Ray anchors are used to create attachment points to the earth, typically for connecting down guys.

The ultimate holding capacity of an anchor is heavily dependent on soil type and condition.

After driving the anchor to the required depth, the driving tool (called drive steel) is removed. The anchor is then tipped and proof tested with a locking kit from its edgewise-driving position to present its bearing area to the soil. This is called "load locking" and provides an immediate proof test of each anchor.

In some applications, Manta Ray anchors are driven into the soil with a 90 lb. pavement breaker and coupled drive steel. Pneumatic or hydraulic breakers are acceptable, but a 90 lb. weight class breaker is necessary.

Use with round rod extension, Stock Number 562096, and triple eye nut, Stock Number 565274.

Refer to pertinent design standards and manufacturer's literature for more information.

**3. Industry Standards**

Manta Ray anchors shall meet the applicable requirements of the following industry standard:

**ASTM A153-2005**; "Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware," 2005

**4. Attributes**

Stock Number	562050
Description	Manta Ray anchor
Material	steel
Anchor rod diameter	#6 to 3/4-inch
Coating	hot dip galvanized
Holding capacity, 2:1 safety factor, lbs	
Soil Class 3	20,000
Soil Class 4	18,000 – 20,000
Soil Class 5	15,000 – 20,000
Soil Class 6	10,000 – 15,000
Soil Class 7	8,000 – 12,000
Weight, nominal, lbs	12

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

# MATERIAL STANDARD

Manta Ray Anchors

standard number: **5622.24**

superseding: new  
effective date: May 30, 2012  
page: 2 of 2

## 5. Marking

Each Manta Ray anchor shall be permanently and legibly marked with manufacturer's name or symbol

## 6. Packaging

Cross-plate anchors shall be packaged to prevent damage during shipping, handling, and inside storage.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

## 7. Issuance

EA

## 8. Approved Manufacturer

Stock Number	Description	Williams Form Engineering Corporation
562050	Manta Ray anchor	MR-1

## 9. References

**SCL D6-4**; "Guying and Anchoring"; Construction Standard

**SCL 5622.33**; "Helical Anchors and Accessories" Material Standard

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert and for SCL Material Standard 5622.24 (john.shipek@seattle.gov)

**Williams Form Engineering Corporation**; Catalog No. 111u; www.williamsform.com

## Helical Anchors and Accessories



### 1. Scope

This standard covers the requirements for helical anchors and anchor accessories. Helical anchors are also known as *helix* or *screw anchors*. Individual helixes are also known as *flights*.

This standard applies to the following Seattle City Light (SCL) stock numbers:

<b>Stock No.</b>	<b>Description</b>
562028	Anchor, single helix, 12-in diameter
012185	Anchor, double helix, assembly
562043	Anchor, triple helix, assembly
562102	Rod extension, square, 1-1/2 in by 5 ft
562096	Rod extension, round, 1 in by 3-1/2 ft
562090	Rod extension, round, 1 in by 1-1/2 ft, assembly
562110	Coupling, round rod extension
565274	Nut, triple eye

Plate anchors and Manta Ray anchors are outside the scope of this standard.

Standards Coordinator  
John Shipek

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

## 2. Application

Helical anchors and accessories are used to create attachment points to the earth, typically for connecting down guys.

The ultimate holding capacity of an anchor is heavily dependent on soil type and condition.

More than 50 years ago, Chance, now a division of Hubbell Power Systems, developed an anchor system called PISA®, which stands for power installed screw anchor. Years later, Earth Contact Products developed an equivalent system called PITA, which stands for power installed torque anchor. PISA® and PITA components should be interchangeable.

Round rod extension coupling, Stock Number 562110, may be used with single helix or Manta Ray anchors.

Double and triple helix anchors, Stock Numbers 012185 and 562043 respectively, are provided with triple eye guy adapters.

Refer to pertinent design standards and manufacturer's literature for more information.

## 3. Industry Standards

Helical anchors and accessories shall meet the applicable requirements of the following industry standards:

**ASTM A153-2005**; "Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware"

**ASTM A575-96(2007)**; "Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades"

**ASTM A576-90b (2006)**; "Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality"

## 4. Attributes

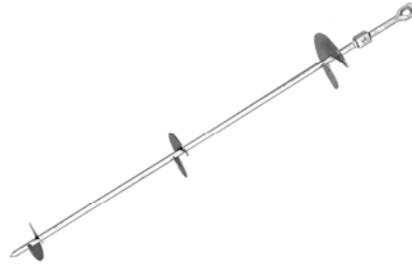
<b>Stock No.</b>	<b>562028</b>
Description	anchor, single helix, 12-inch diameter
Torque Rating, ft lb	15,000
Coating	painted
Weight, nominal, lb	29



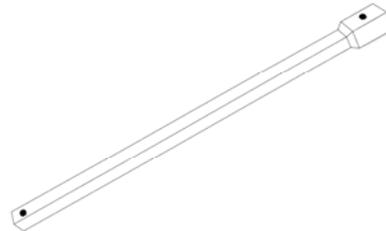
<b>Stock No.</b>	<b>012185</b>
Description	Anchor, double helix, 36-inch lead section with 18-inch, triple eye guy adapter assembly. Helix diameters 8 and 10 inches.
Tensile Strength, lb	70,000
Torque Rating, ft lb	7,000
Coating	Hot-dipped galvanized
Weight, nominal, lb	67



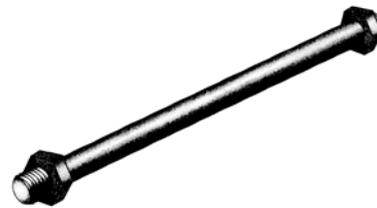
<b>Stock No.</b>	<b>562043</b>
Description	Anchor, triple helix, 84-in lead section with 18-inch, triple eye guy adapter assembly. Helix diameters 10, 12, and 14 inches.
Tensile Strength, lb	70,000
Torque Rating, ft lb	7,000
Coating	Hot-dipped galvanized
Weight, nominal, lb	108



<b>Stock No.</b>	<b>562102</b>
Description	Rod extension, square, 1-1/2-in by 5 ft
Tensile Strength, lb	70,000
Torque Rating, ft lb	7,000
Coating	Hot-dip galvanized
Weight, nominal, lb	42



<b>Stock No.</b>	<b>562096</b>
Description	Rod extension, round, 1 in by 3-1/2 ft
Tensile Strength, lb	36,000
Coating	Hot-dip galvanized
Weight, nominal, lb	9



<b>Stock No.</b>	<b>562090</b>
Description	Rod extension, round, 1 in by 1-1/2 ft, assembly
Tensile Strength, lb	36,000
Coating	Hot-dip galvanized
Weight, nominal, lb	5
Fabrication details	Per latest revision of SCL drawing A-5304



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<b>Stock No.</b>	<b>562110</b>
Description	Coupling, round rod extension, 3/4 in and 1 in
Tensile Strength, lb	23,000 / 36,000
Coating	Hot-dip galvanized
Weight, nominal, lb	0.5

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<b>Stock No.</b>	<b>565274</b>
Description	Nut, triple eye, 3/4 in or 1 in
Tensile Strength, lb	23,000 / 36,000
Coating	Hot-dip galvanized
Weight, nominal, lb	3

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## 5. Marking

Each anchor and rod extension (except shop-made Stock Number 562090) shall be permanently and legibly marked with manufacturer's name or symbol

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## 6. Packaging

Anchors, rod extensions and accessories shall be packaged to prevent damage during shipping, handling, and inside storage.

Individual packages shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

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## 7. Issuance

EA

## 8. Approved Manufacturers

Stock No.	Description	Manufacturer and Catalog Number		
		Earth Contact Products	MacLean Power Systems	Hubbell Power Systems/Chance
562028	Anchor, single helix, 12-in diameter	HTAX-250-100(12)	TDH250-114	C102-5002
012185	Anchor, double helix, assembly	TAF-150-363(8,10)	D-6632-TU	12654-3AE
562043	Anchor, triple helix, assembly	TAF-150-843(10,12,14)	D-6637-TU	12654-3EJN
562102	Rod extension, square, 1-1/2 in by 5 ft	TAE-150-60	D-6620-U	12656
562096	Rod extension, round, 1 in by 3-1/2 ft	TAR-100-42	D-1003-1/2	C102-1987 or 12338P
562090	Rod extension, round, 1 in by 1-1/2 ft [see note]	-	-	-
562110	Coupling, round rod extension	TAC-100	D-354	12247P
565274	Nut, triple eye	TAN-100-003	D-6567	12585

Note: Stock Number 562090 is a shop-made assembly. Refer to Section 4 for fabrication details.

## 9. References

**SCL Construction Guideline D6-4;** "Guying and Anchoring"

**Earth Contact Products;** Utility Industry Anchor Design and Maintenance Manual; 2011

**Earth Contact Products;** [www.ecputility.com](http://www.ecputility.com)

**Hubbell Power Systems; Chance;** Product Catalog; Anchors; January 2012

**Hubbell Power Systems;** [www.hubbellpowersystems.com](http://www.hubbellpowersystems.com)

**Ogi, Irv;** SCL Civil Engineer; subject matter expert for SCL Material Standard 5622.33 (Irving.Ogi@Seattle.Gov)

**Shipek, John;** SCL Standards Engineer, subject matter expert and originator of SCL Material Standard 5622.33 (john.shipek@seattle.gov)

**Maclean Power Systems;** [www.maclepower.com](http://www.maclepower.com)

**SCL Drawing A-5304;** Rev.0, dated 3/6/2013, Rod Extension 1"x1'-6"

**BRACE, CROSSARM**

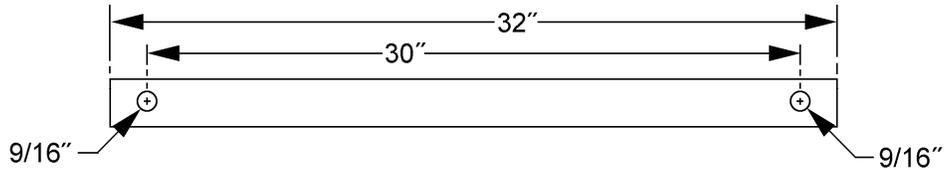


Figure 1, Flat Crossarm Brace 1/4" x 1-1/4"

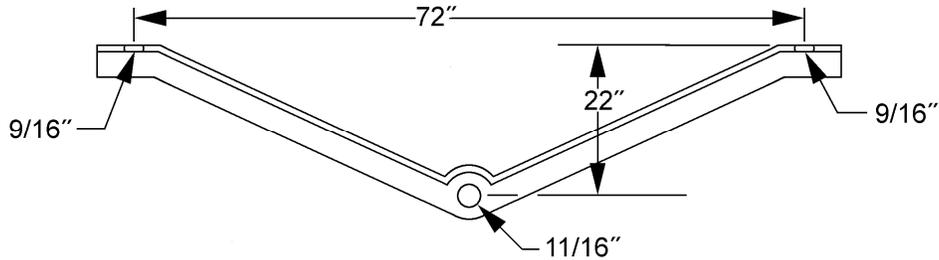


Figure 2, Angle Crossarm Brace 3/16" x 1-3/4" x 1-3/4"

1. **Flat Crossarm Braces.** Figure 1, shall be fabricated from hot-rolled bar steel, in accordance with EEI TDJ-6, except as modified herein (9/16" holes at both ends).
2. **Angle Crossarm Braces** shall be of the configuration shown in Figure 2, fabricated from one piece of structural steel, in accordance with EEI TDJ-6, as it applies to angle crossarm braces.
3. **Flat and Angle Crossarm Braces** shall be hot-dipped galvanized after fabrication per ASTM A 153 (3 mils minimum).
4. **Packaging** shall be in accordance with EEI Packaging Standards.
5. **Reference Specifications:** EEI TDJ-6; ASTM A 153
6. **Stock Unit:** EA

**Approved Manufacturers**

Stock Number	Figure	Chance	Cooper	Joslyn	Village Ironworks
563005	1	T203-0463	-	-	AB-32-WI
563010	2	-	DB2L3	J-1512	-

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

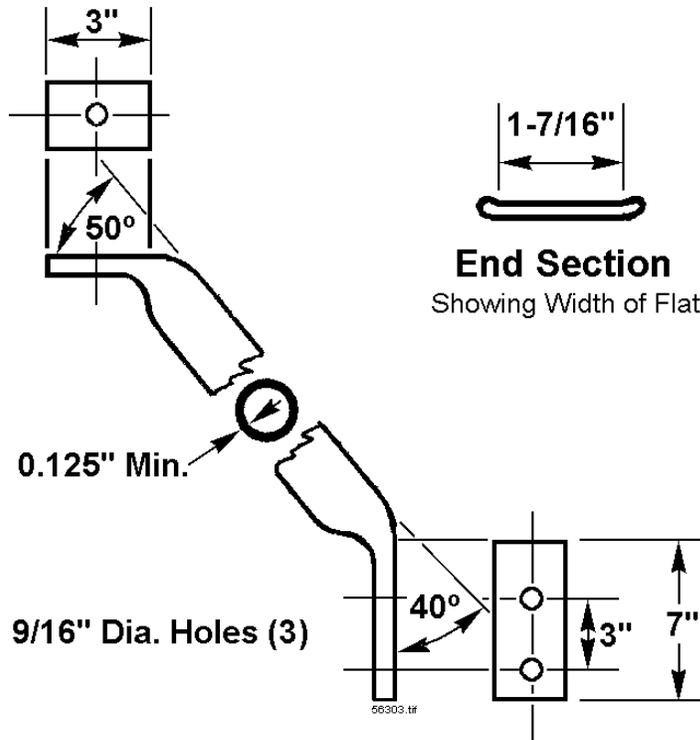
*John Chinner*

UNIT DIRECTOR

*Harold Gray*

**MATERIAL STANDARD**

**BRACES,  
 5-FOOT (NOM.) ALUMINUM SPECIAL**



**5-Foot (nominal) Aluminum Special Braces** shall be of the configuration and dimensions shown. The braces shall be made of 1-1/2-inch outside diameter extruded aluminum alloy tubing or Schedule 40 aluminum alloy pipe of 1-1/4-inch standard pipe size. The tubing or pipe shall be 6 feet in length. The tubing or pipe shall be 6063 alloy with a T6 temper and shall conform to ASTM Specification B429.

The braces shall be free of splits or sharp edges; however, surface cracks on the edges of flats are acceptable.

**Reference Specification:** ASTM B429, latest revision

**Stock Unit:** EA

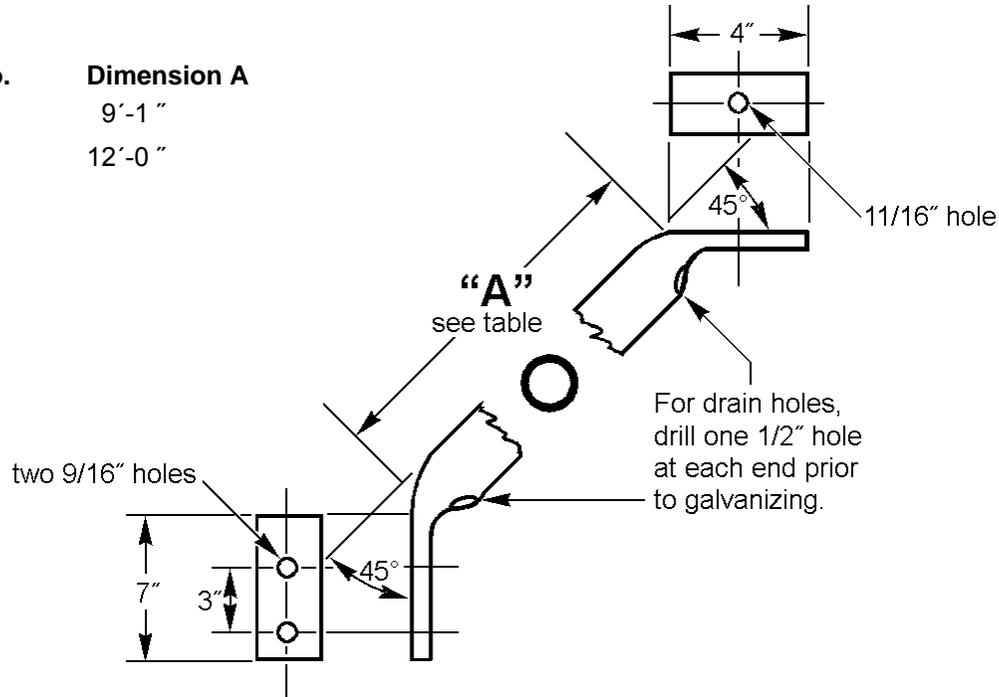
**Stock Number:** 563013

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. J.</i>

# MATERIAL STANDARD

## BRACES, STEEL 9-FOOT AND 12-FOOT SPECIAL PIPE

Stock No.	Dimension A
563015	9'-1"
012504	12'-0"



**9-Foot and 12-foot (nominal) Special Pipe Braces** shall be of the configuration and dimensions shown and shall be made of 1-1/4-inch, Schedule 40, standard black steel pipe conforming to the requirements of ASTM Specification A53.

The braces shall be free of cracks, splits, or other deformations resulting from forming the pads.

The braces shall be galvanized after fabrication in accordance with ASTM Specification A153.

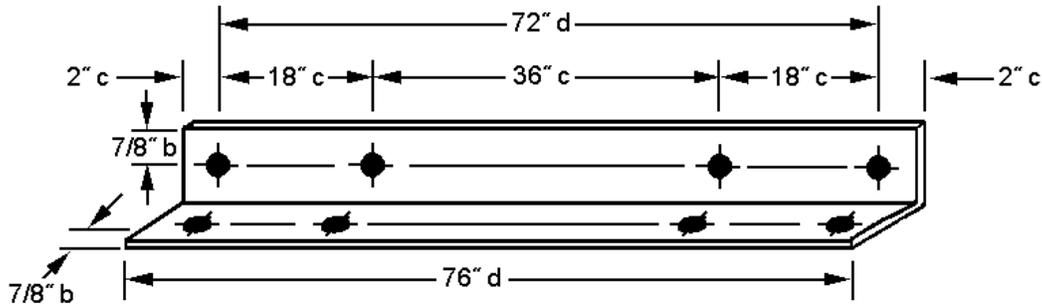
**Reference Specifications:** ASTM A53 and A153, latest revisions

**Stock Unit:** EA

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Charles L. Shaffer</i>	<i>John Chinner</i>	<i>Harold Gray</i>

**MATERIAL STANDARD**

**BRACES, CROSSARM  
 VERTICAL SPACING**



1. **Vertical Crossarm Braces** shall be of the configuration and dimensions shown. They shall be fabricated from 2" x 2" structural steel angle of 1/4" thickness and shall meet the requirements of EEI TD 6.  
 Holes may be either drilled or punched and shall be of 11/16" diameter.  
 Braces shall be hot-dip galvanized after fabrication in accordance with ASTM A123.
2. **Tolerance:** Coded as:  $b \pm 1/32"$   $c \pm 1/16"$   $d \pm 1/8"$
3. **Reference Specifications:** EEI TD 6 and ASTM A123, latest revisions.
4. **Stock Unit:** EA
5. **Stock Number:** 563019

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Goldspiel</i>	<i>John Schinner</i>	<i>Harold Gray</i>

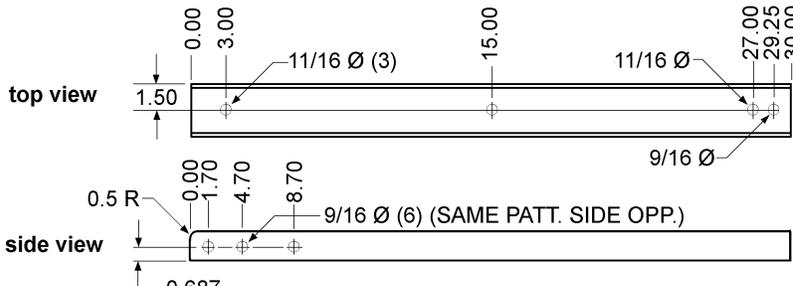
SEATTLE CITY LIGHT  
**MATERIAL STANDARD**

STANDARD NUMBER: **5631.1**  
 PAGE: 1 of 1  
 DATE: September 21, 2001  
 REV: April 10, 2002

**BRACKET, COMMUNICATIONS, CABLE ATTACHMENT**

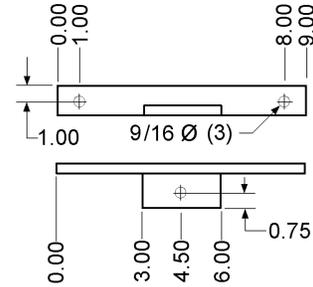
All dimensions are in inches.

Tolerances: Holes - 0", + 0.031"; all other ± 0.125"



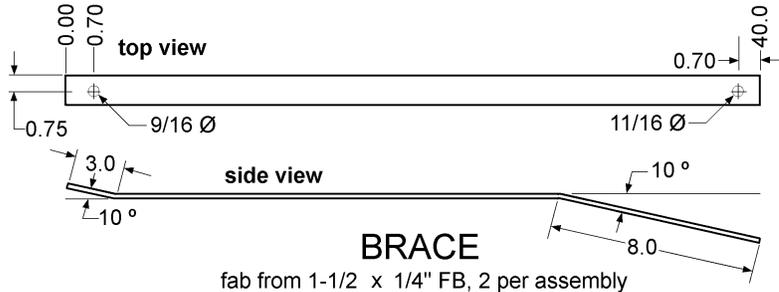
**HORIZONTAL STRUT**

fab from 3 x 4.1" channel, 1 per assembly



**POLE SHOE**

fab from 2 x 2 x 1/4" angle, or may be a welded assembly, 1 per assembly



**BRACE**

fab from 1-1/2 x 1/4" FB, 2 per assembly

Item	Length, Inches	Material, Inches	Number Per Assembly
Horizontal Strut	30	3 x 4.1 Channel	1
Pole Shoe	9	2 x 2 x 1/4 Angle	1
Braces	40	1-1/2 x 1/4 FB	2

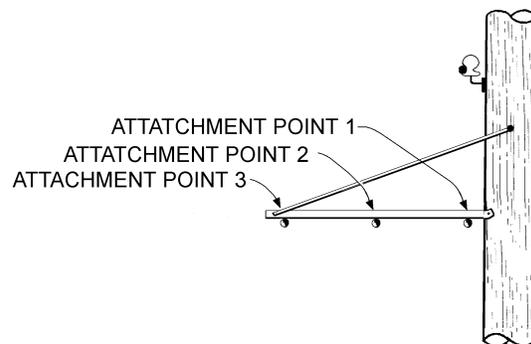
**Galvanizing:** All parts shall be hot-dipped galvanized after fabrication per ASTM A 153 (3 mils min.).

**Packaging:** Shall be in accordance with EEI Packaging Standards.

**Reference Specifications:** ASTM A 153

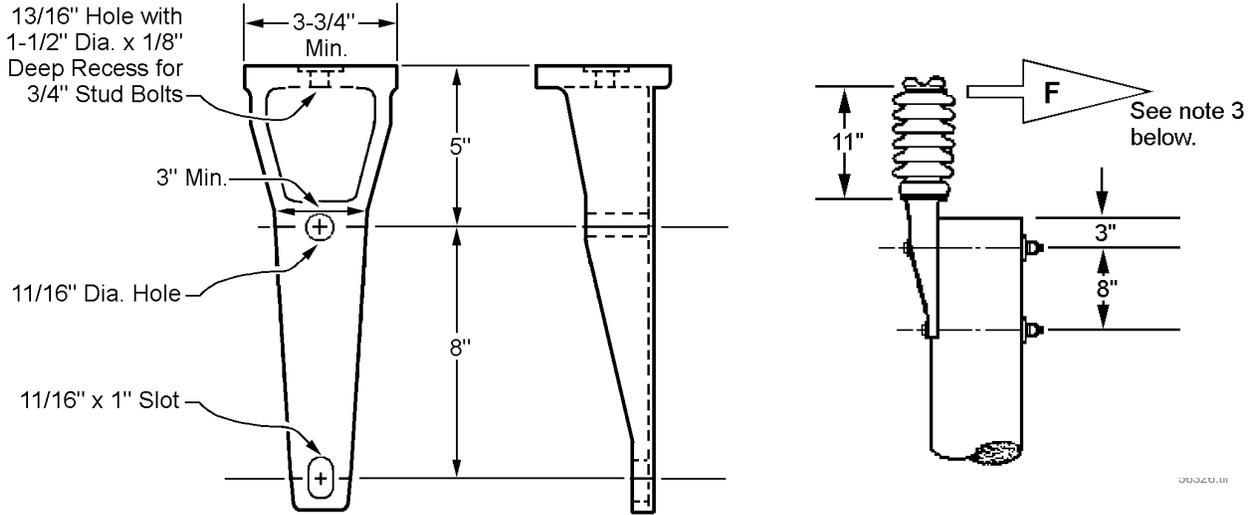
**Stock Unit:** EA

Stock Number	Approved Manufacturer
010408	Al Book's Custom Welding



ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John Edinger</i>	<i>Harold Juy</i>

**BRACKET  
POLE-TOP POST INSULATOR**



**1. General.** Pole-top post insulator brackets shall be of the configuration shown above (reasonable variations are acceptable). The brackets shall accommodate 34.5 kV post-type insulators; ANSI C27.7 Class 57-2S or 57-12S.

**2. Material.** The brackets shall be made of one of the following:

- (a) Malleable iron per ASTM A47, galvanized per ASTM A153 (3 mils minimum)
- (b) Ductile iron per ASTM A536, galvanized per ASTM A153 (3 mils minimum)
- (c) Steel channel per ASTM A36, galvanized per ASTM A153 (3 mils minimum) (for steel channel brackets, particular attention should be given to the requirement for the stud bolt recess on the top)
- (d) 356-T6 cast aluminum alloy

**3. Strength.** The bracket shall withstand a force ( **F** ) of 2,800 pounds (12,500 N) when gradually applied to the neck of an insulator as shown above.

**Reference:** ANSI C27.7; ASTM A36, A47, A153, A536

**Stock Units:** EA

Stock Number	Approved Manufacturer
563253	MacLean PTB55-8 or P532

standards coordinator	standards supervisor	unit director
<i>John Shipek</i> John Shipek	<i>John Shipek</i> John Shipek	<i>Darnell Cola</i> Darnell Cola

## Bracket, Mounting, for Horizontal Post Insulators



### 1. Scope

This standard covers the requirements for horizontal post insulator mounting brackets. This standard applies to Seattle City Light (SCL) Stock No. 580510.

### 2. Application

Horizontal post insulator mounting brackets are for mounting 34.5 kV horizontal post insulators on wood poles.

### 3. Industry Standards

Horizontal post insulator mounting brackets shall meet the applicable requirements of the latest revision of the following industry standards:

**ASTM A47**; "Standard Specification for Ferritic Malleable Iron Castings"

**ASTM A153/153M**; "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

**ASTM A536**; "Standard Specification for Ductile Iron Castings"

**ASTM A575**; "Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades"

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



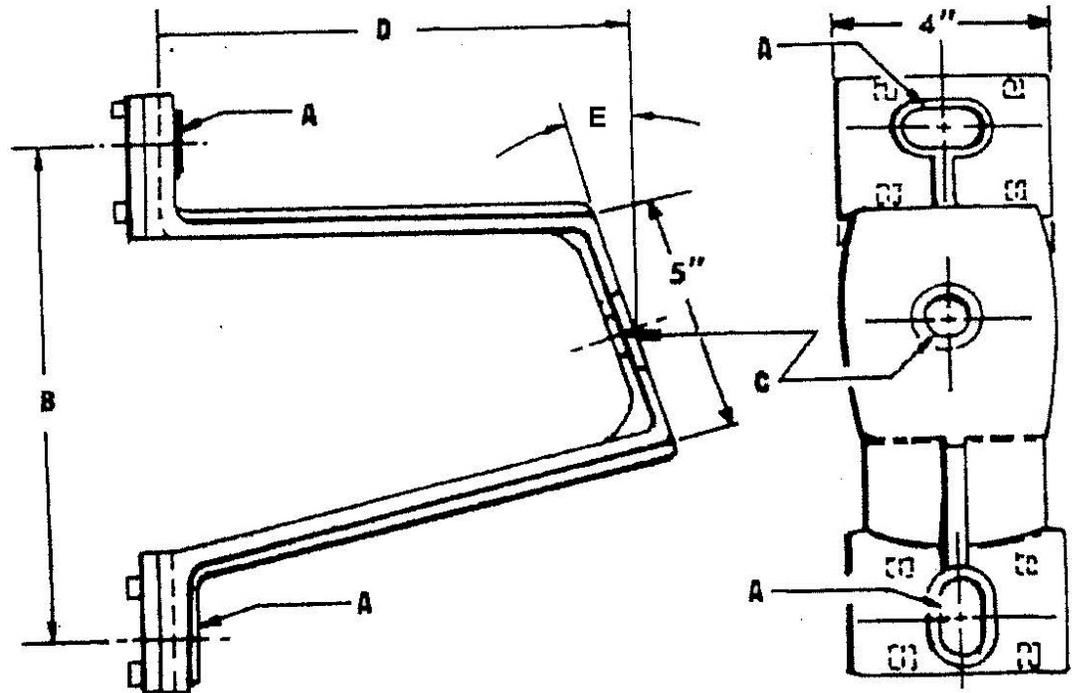
**4. Requirements**

The bracket shall be configured as shown in Figure 4 and Table 4. A base angle of 5 to 15 degrees is acceptable.

**Table 4. Bracket Requirements**

Material	Ductile iron, hot dip galvanized
Weight/100 (lb), nominal	861

**Figure 4. Bracket Dimensions**



A	B	C	D	E
Hole or slot for 5/8" mounting bolt	10"	Hole for 3/4" insulator stud bolt	9" pole clearance	5°-15° base angle

## 5. Approved Manufacturer

MacLean Power Systems HIB-109-5

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## 6. Packaging

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- SCL stock number
- Quantity contained

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
  - Country of origin
  - Product description
  - SCL purchase order number
- 

## 7. Issuance

Stock Unit: EA

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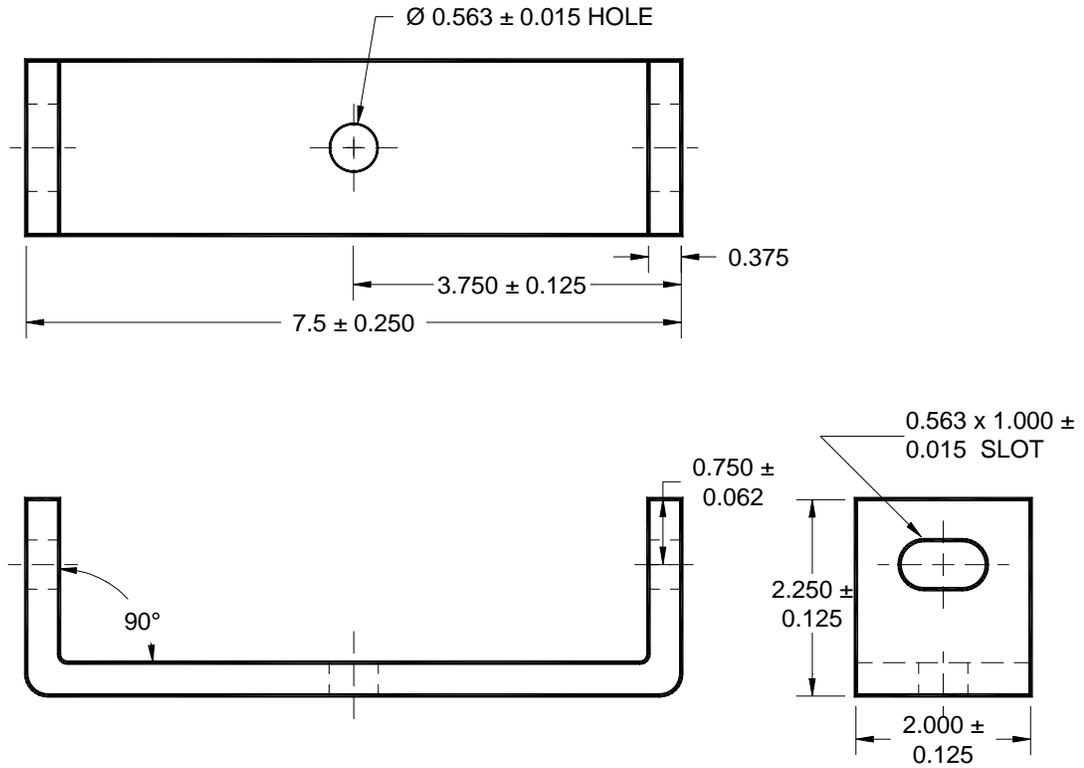
## 8. Sources

**SCL Material Standard 5632.7**; "Bracket, Mounting Horizontal Post Insulator" (canceled)

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist, and originator and subject matter expert for 5632.07 (kathy.tilley@seattle.gov)

# MATERIAL STANDARD

## ADAPTER, PARALLEL CABLES TO SINGLE ARRESTER



563210.dwg

All dimensions are in inches.

**Material:** 0.375" x 2" aluminum plate (Alloy 6061-T6)

Lightly break all edges and corners.

**Stock Number:** 563226

ORIGINATOR

*Jim S. Horn*

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

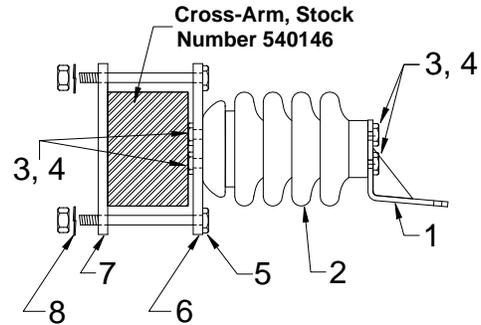
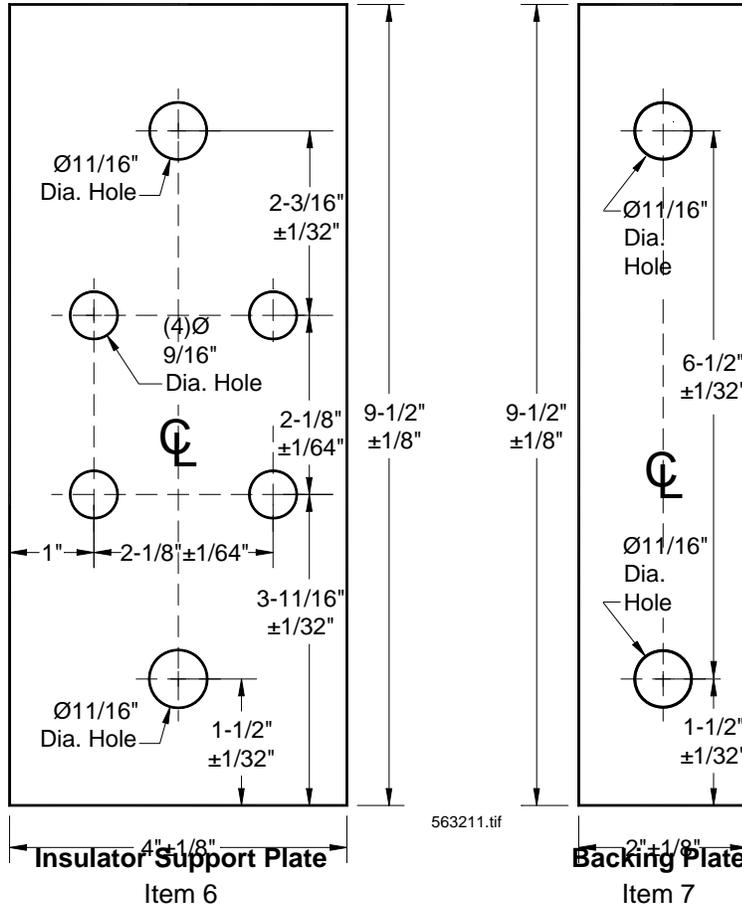
*John Chinner*

UNIT DIRECTOR

*Betty Robin*

# MATERIAL STANDARD

## BRACKET ASSEMBLY CROSSARM MOUNTED CUTOUT FOR CONTAMINATED AREAS



**Note:** Bracket is intended to secure station insulator (Stock No. 690187) to a 10 foot, 6 pin crossarm (Stock No. 540146).

**Insulator Support Bracket Stock No.:**  
 563228

**Material:** 1/4" mild steel plate

**Surface preparation:** Hot dip galvanized per ASTM A153

### Material List

Item	Qty	Description	Stock No.
1	1	Bracket, Cutout Mounting, Material. Standard 5632.2	563224
2	1	Insulator, Station Post	690187
3	8	Screw, Hex Head Cap, 1/2" - 13NC x 1"	784825
4	8	Lock Washer, 1/2", Galvanized	584255
5	2	Bolt, 5/8" x 6", Machine, Galvanized	780836
6	1	Insulator Support Plate (shop made, this spec)	563228
7	1	Backing Plate (shop made, this spec)	
8	2	Lock Washer, 5/8"	788156

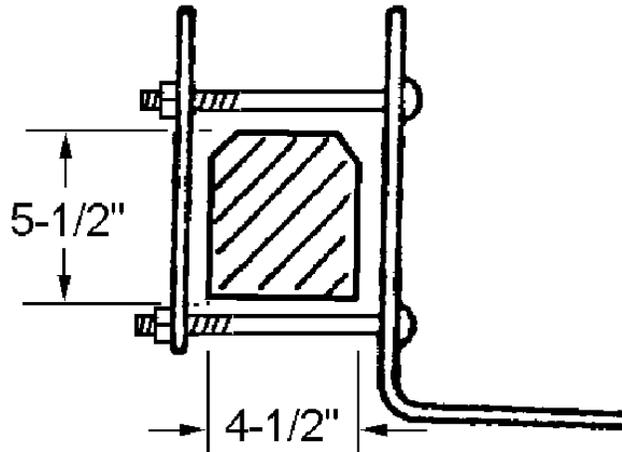
**Stock Unit:** EA

**Assembly Stock No.:** 563227 (includes all of the items in the Material List)

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. Jry</i>

**MATERIAL STANDARD**

**CUTOUT MOUNTING BRACKET  
 for CROSSARMS**



Stock No.  
 682097

**CROSSARM CUTOUT MOUNTING BRACKETS** shall be of the configuration shown, and shall accommodate a feeder crossarm of 5 1/2" height and 4 1/2" width.

**Packaging.** Each bracket shall be packaged individually, either by being assembled with all hardware as a unit, or by supplying all components required for one bracket in a bag or box.

**Reference Specifications:** NEMA SG 2, ANSI C37.42, C.L. Material Standard 6837.1 (latest revisions)

**Stock Unit:** Each

Stock No.	Approved Manufacturers			
	ABB	Cooper	Joslyn	S & C
682097	366C926G05	DM36B1	J26634	KA-70185-SX bkt. w/6" conn. bolts & assoc. hardware

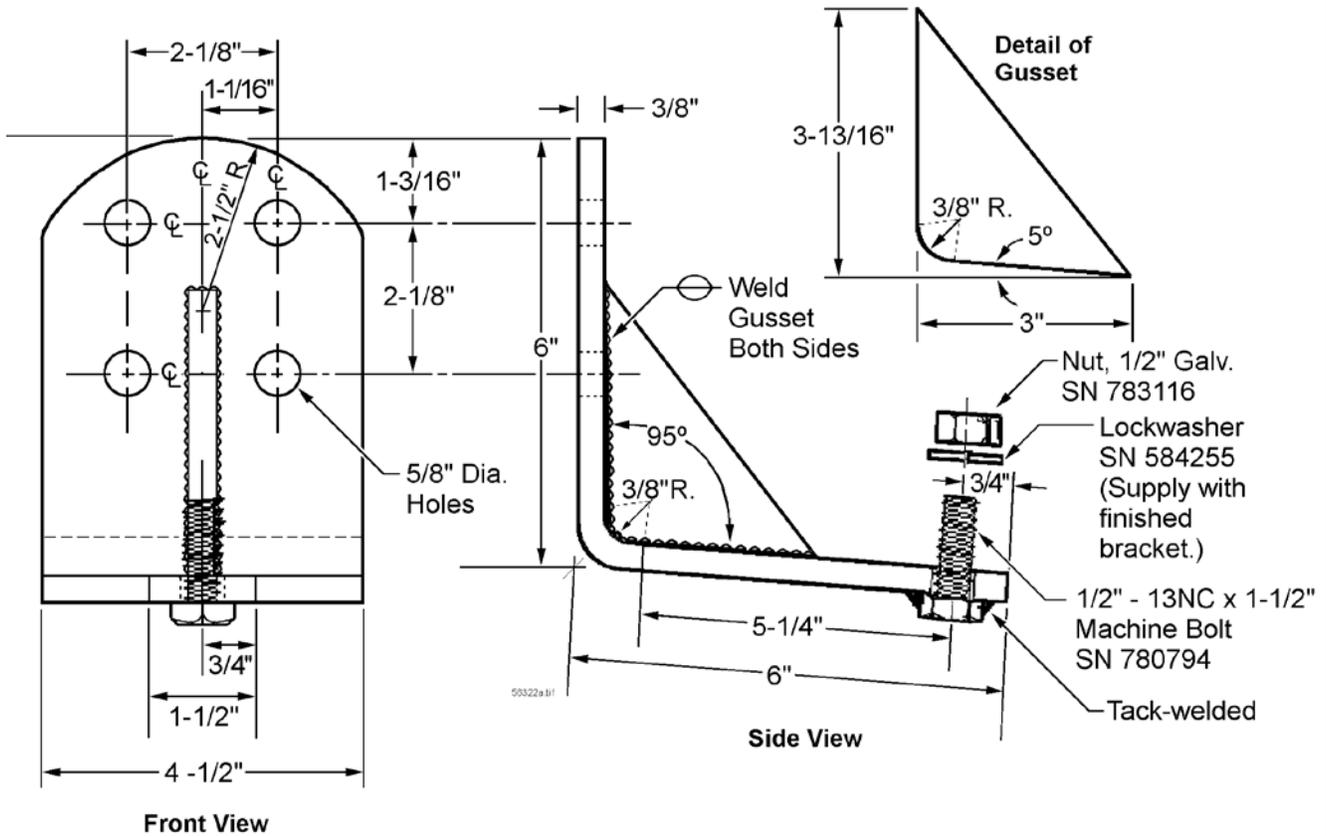
ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Betty Robin</i>

# MATERIAL STANDARD

## BRACKET - CUTOUT MOUNTING

**Cutout Brackets** for mounting fused cutouts directly to an insulator shall be of the configuration shown, and shall be fabricated from 3/8" x 4 1/2" hot rolled carbon steel strip, commercial quality meeting the requirements of ASTM Specification A569.

The brackets shall be truly formed and free from sharp edges, burrs, cracks or other deformations.

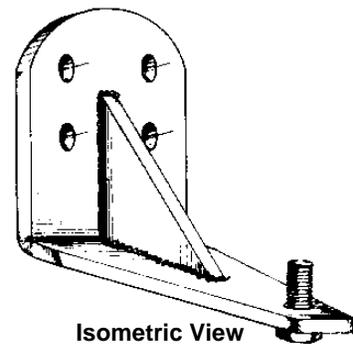


After fabrication, the brackets shall be galvanized in accordance with ASTM Specification A123.

**Stock Unit:** EA

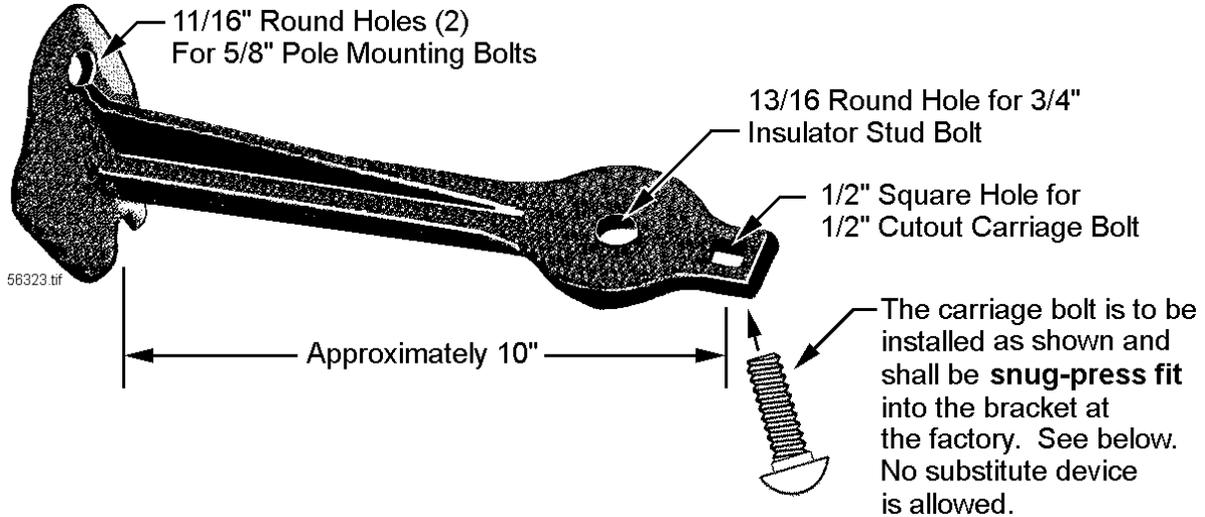
**Stock Number:** 563224

**Reference Specifications:** ASTM A569, A123, latest revision



ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Pinner</i>	<i>Harold Gray</i>

**BRACKET - POLE MOUNTING CUTOUT**



**Pole-Mounting Cutout Brackets**, of the configuration shown, are used to mount 26-kV open-type cutouts, with single 1/2-inch carriage bolt, directly to pole. The bracket shall be made of malleable iron conforming to ASTM A47, carbon steel conforming to ASTM A569, or ductile iron conforming to ASTM A536.

The brackets shall be free of sand holes, sharp edges, or other imperfections, and shall be galvanized after fabrication in accordance with ASTM A153.

The primary use of this bracket is for cutout mounting; the flat area with 13/16" hole for Insulator mounting capability is optional. Bid acceptance will be based on low bid for cutout use.

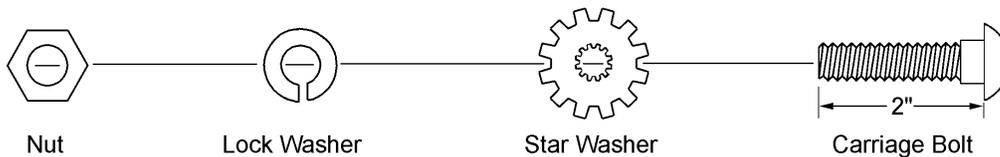
**Reference Specifications:** ASTM A47, ASTM A153, ASTM A536, ASTM A569, latest revisions.

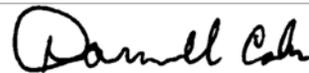
**Stock Unit:** EA

Stock No.	Approved Manufacturer	Catalog No.
563222	MacLean	I-AC-75B

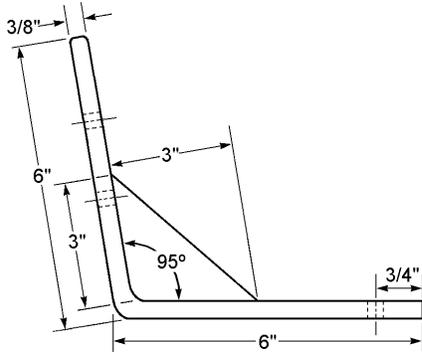
The manufacturer's catalog number listed is for reference only, and is not intended to indicate compliance with this specification.

**Carriage Bolt Assembly:**

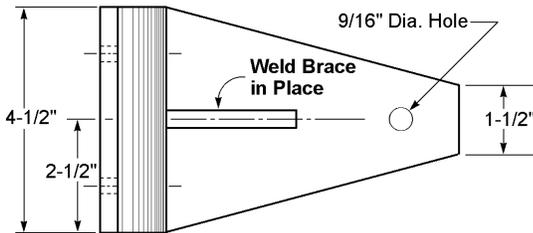


standards coordinator	standards supervisor	unit director
 Brett Hanson	 John Shipek	 Darnell Cola

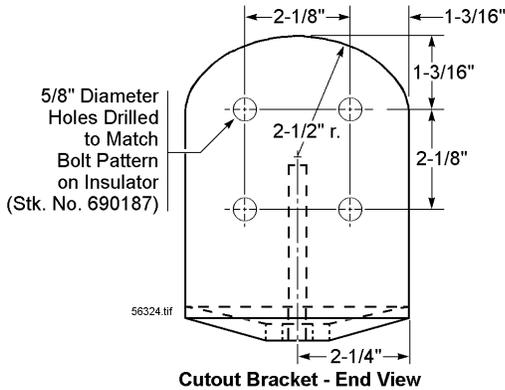
**BRACKET ASSEMBLY:  
 POLE-MOUNTED CUTOUT FOR CONTAMINATED AREAS**



**Cutout Bracket - Side View**

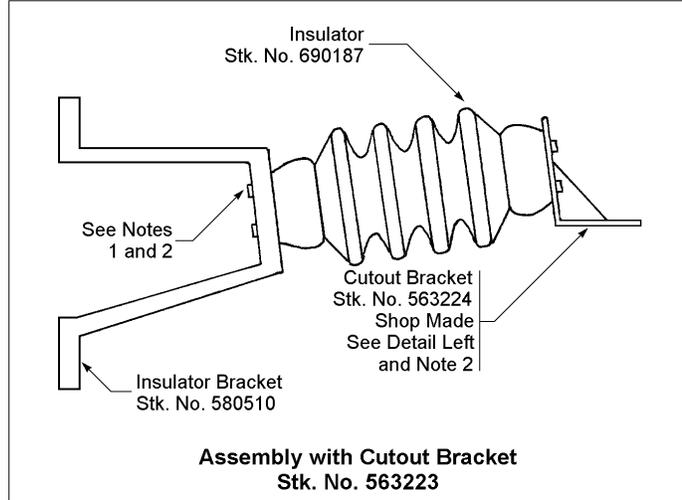


**Cutout Bracket - Top View**



**Cutout Bracket - End View**

**Cutout Bracket  
 Stk. No. 563224**



**Notes:**

1. Shop to drill holes in bracket to match bolt pattern on insulator.
2. Mount insulator bracket and cutout bracket with 1/2" - 13 x 1" hex head cap screws (Stk. No. 784825) and 1/2" galvanized lock washers (Stk. No. 584255) (8 each required).

**Reference Specifications:** ASTM A569, A123, latest revisions

**Stock Units:** EA

**Cutout Bracket Stk. No.:** 563224 (Shop Made)

**Insulator Stk. No.:** 690187

**Insulator Bracket Stk. No.:** 580510

**Assembly Stk. No.:** 563223

**Cutout Brackets** for mounting fuse cutouts directly to insulator shall be of the configuration shown, and shall be fabricated from 3/8" x 4-1/2" hot-rolled carbon-steel strip, commercial quality meeting the requirements of ASTM Specification A569.

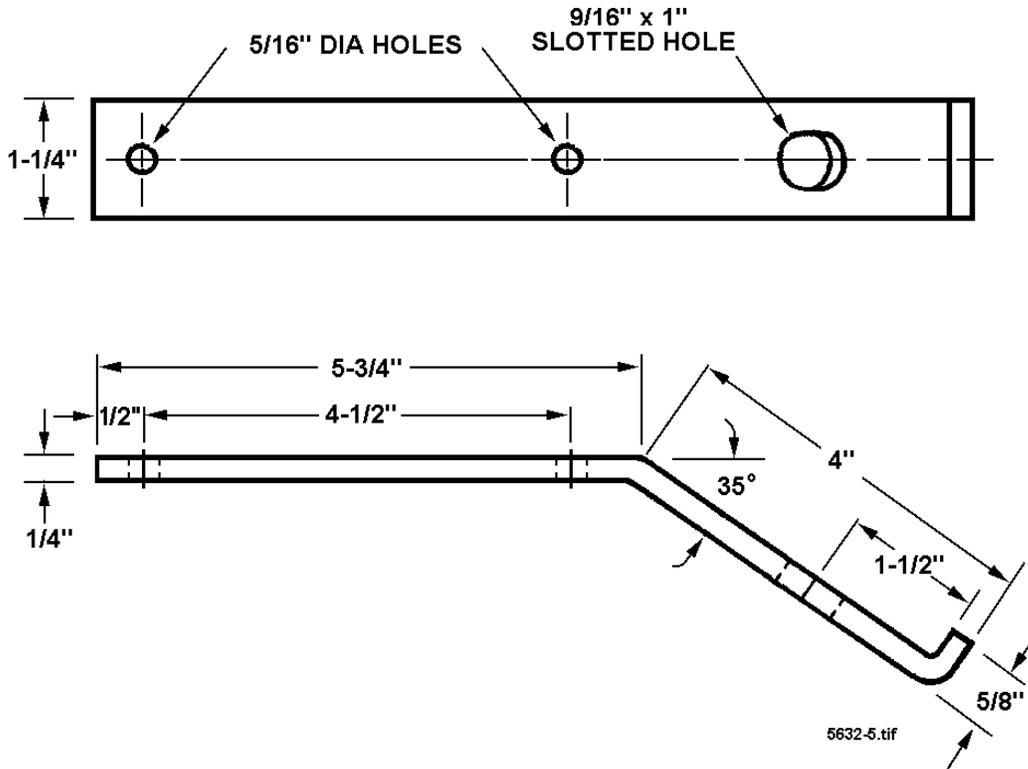
The brackets shall be truly formed and free from sharp edges, burrs, cracks, or other deformations.

After fabrication, the brackets shall be galvanized in accordance with ASTM Specification A123.

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Pinner</i>	<i>Hardee J. J.</i>

# MATERIAL STANDARD

## BRACKET NUMBER BOARD MOUNTING



**NUMBER BOARD MOUNTING BRACKETS** are used for mounting number boards on wood poles that have switches on them. The brackets shall be made of hot-rolled bar steel conforming to ASTM Specification A569.

The brackets shall be galvanized, after fabrication, in accordance with ASTM Specification A153.

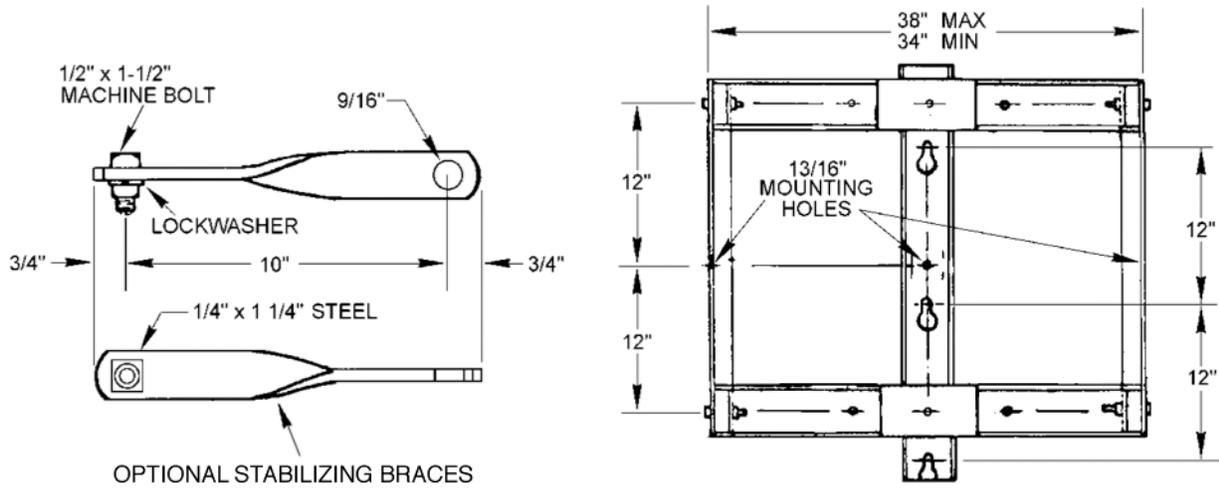
**Reference Specifications:** ASTM A569, A153 latest revisions.

**Stock Unit:** EA

**Stock Number:** 563225

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles J. Shaffer</i>	<i>John A. Kinnaman</i>	<i>Betty Robin</i>

**Bracket, Transformer Cluster Mounting**



CLUSTER MOUNTING BRACKET

**1. Scope**

**Transformer Cluster Mounting Brackets** shall be of the general configuration shown. Structural variations may be approved, provided the mounting and spacing dimensions shown are adhered to and the bracket is designed for a 200-percent safety factor for transformers and weights listed in the table below.

**2. Industry Standards**

ANSI C57.120; ANSI H35.1; ASTM A153; Latest Revisions

**3. Requirements**

**Steel.** Channel steel used in the fabrication of the brackets shall conform to ASTM A283; flat steel plate shall conform to ASTM A575.

**Nuts and Bolts.** Nuts and bolts required to secure the transformers to the brackets shall conform to EEI-TD-1, and shall be furnished with the cluster brackets.

**Transformer Mounting Hole Spacing, Electrical and Physical Clearances for Transformers with Side-Wall Bushings** shall be in accordance with the requirements of ANSI C57.12.20, "Standards for Distribution Transformers, Overhead Type".

**Galvanizing.** Steel brackets shall be galvanized after fabrication, in accordance with ASTM A153.

**4. Approved Manufacturers**

Stock No.	Description	Hubbell
563291	One stabilizing brace and hardware assembly (order four for each installation)	PSC2128031
563294	Cluster mounting bracket for up to (3) 250 kVA transformers (2500 lb each), 7500 lb total	DT8C1
011959	Replacement bolt kit for 563294	DF34M1

**5. Stock Unit: EA**

Standards Coordinator  
Brett Hanson

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

## Brackets, Two-Transformer Cluster Mount



### 1. Scope

This standard covers the requirements for transformer cluster mounting brackets.  
This standard applies to Seattle City Light Stock No. 563295.

### 2. Application

Transformer cluster mounting brackets are intended for mounting two transformers on a single bracket to a pole.

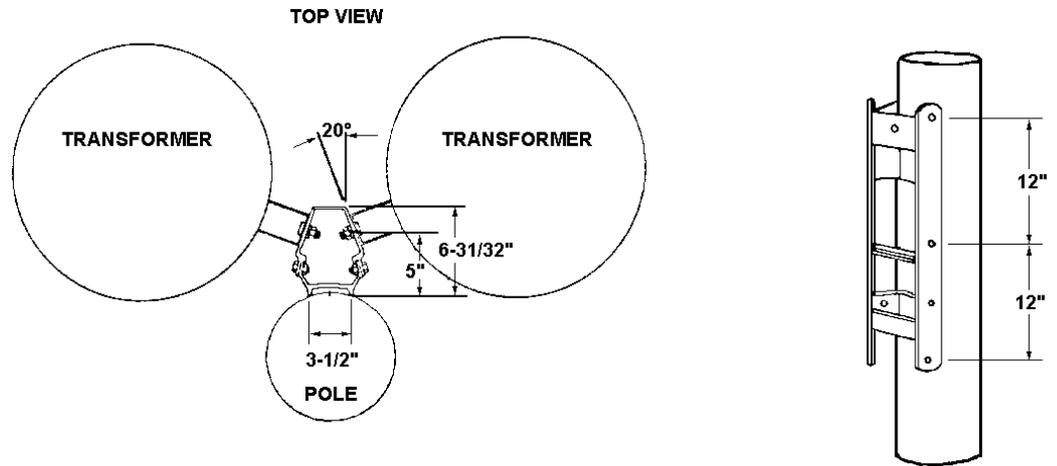
### 3. Industry Standards

**IEEE C57.12.20-2011**; Standard for Overhead Type Distribution Transformers, 500 kVA and Smaller: High Voltage, 34 500 Volts and Below; Low Voltage, 7970/13 800Y Volts and Below

**ASTM A153**; Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**4. Requirements**

**Figure 4. Brackets, Two-Transformer Cluster Mount**



**4.1 Material**

Transformer cluster mounting brackets shall be of the configuration shown in Figure 4. Brackets shall be designed for a 200% safety factor for a total maximum transformer weight of 4000 lb.

Brackets shall be steel channel or plate, hot-dipped galvanized per ASTM A153.

**4.2 Mounting**

Mounting to the pole shall be by 3/4-in through bolts; band-type mounting is not acceptable.

Each bracket shall include four 3/4-in and two 5/8-in hot-dipped galvanized nuts, bolts, and lock washers for mounting transformers with IEEE C57.12.20 type "A" or "B" lugs.

**4.3 Lifting Eyes**

Each bracket shall include one lifting eye free of all sharp edges or burrs.

**5. Issuance**

Stock Unit: EA

**6. Approved Manufacturer**

Stock No.	Manufacturer	Catalog No.
563295	Hubbell/A. B. Chance	C212-0001

**7. Sources**

**Hanson, Brett**; SCL Standards Engineer and subject matter expert for 5632.91 (brett.hanson@seattle.gov)

**FITTINGS**  
**SIDEWALK PIPE GUY**

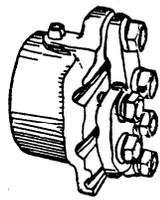


Figure 1  
Guy Clamp

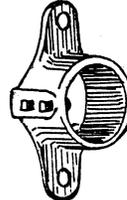


Figure 2  
Pole Plate

**SIDEWALK PIPE GUY FITTINGS** consist of pole plates and guy clamps. These fittings shall be of the configurations shown and shall be made of malleable iron in accordance with ASTM Specification A47.

The pole plate base shall be curved to fit the pole.

Sidewalk pipe fittings shall be galvanized in accordance with ASTM Specification A153.

Reference Specifications: ASTM A47, A153, latest revisions.

Stock Unit: Each

Stock Number	Fig, No.	Pipe Size In.	Approved Manufacturers		
			McGraw	Joslyn	Lindsey
565054	1	2-1/2	DG5D1		
565105	2	2-1/2	DG2D1	JO521	2140 R3214

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## Deadend, Guy, Aluminum Automatic Feed-Through



### 1. Scope

This standard covers the requirements for aluminum automatic feed-through deadends.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Wire Diameter (in)	Bail
565053	1/4	Standard
565048	5/16	Standard
565049	5/16	Extended
012084	3/8	Standard
565051	7/16	Standard
565052	7/16	Extended

### 2. Application

Automatic deadends are used to deadend 1/4-in through 7/16-in aluminum or galvanized steel guy wire.

For deadending 9/16-in guy wire, see SCL 5650.35.

### 3. Requirements

Deadends shall be made from the following:

- Aluminum yoke and shell (6061-T6 aluminum alloy)
- Solid bails (Type 304 stainless steel)

Each deadend shall be an integral unit after assembly.

Deadends shall be capable of holding a minimum of 95% of the rated strength of the guy wire.

Deadends shall be equipped with a pilot cup to cap the strand and prevent individual strands from splaying during installation.

Deadends shall meet the requirements described in Table 3 and Figure 3.

Standards Coordinator  
Kathy Tilley

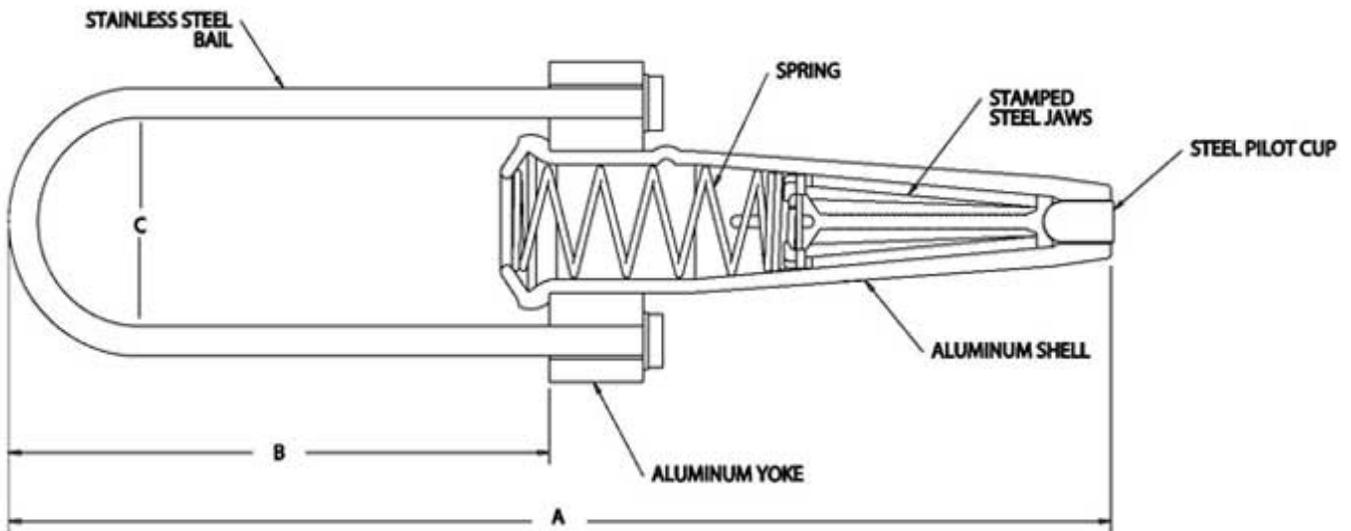
Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

**Table 3. Deadend Requirements**

Stock No.	Wire Diameter (in)	Dimensions, Minimum (in)		
		A	B	C
565053	1/4	9.2	3.9	1.4
565048	5/16	10.0	5.3	1.6
565049	5/16	15.3	5.3	1.6
012084	3/8	12.9	6.5	1.6
565051	7/16	14.7	6.7	2.1
565052	7/16	21	6.7	2

**Figure 3. Deadend Requirements**



**4. Packaging**

Deadends shall be shipped assembled.

The standard package quantity shall not exceed four per box.

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- SCL stock number
- Quantity contained

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Country of origin
- Product description
- SCL purchase order number
- SCL stock number

## 5. Issuance

Stock unit: EA

---

## 6. Approved Manufacturers

<b>Stock No.</b>	<b>Size (in)</b>	<b>Bail</b>	<b>Hubbell Power Systems Catalog No.</b>	<b>MacLean Power Systems Catalog No.</b>
565053	1/4	Standard	GDE5100	5100
565048	5/16	Standard	GDE5101	5201
565049	5/16	Extended	–	5201-L
012084	3/8	Standard	–	5202
565051	7/8	Standard	–	5203
565052	7/8	Extended	–	5203-L

---

## 7. References

**SCL Material Standard 5650.3**; “Deadend, Guy, Aluminum Automatic Feed-Through” (canceled)

**SCL Material Standard 5650.35**; “Deadend, Guy, Aluminum, Automatic Feed-Through, Adjustable”

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## 8. Sources

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist, originator, and subject matter expert of 5650.30 (kathy.tilley@seattle.gov)

## Deadend, Guy, Aluminum Automatic Feed-Through, Adjustable



### 1. Scope

This standard covers the requirements for aluminum adjustable automatic feed-through deadends.

This standard applies to Seattle City Light (SCL) Stock No. 565055.

### 2. Application

Adjustable automatic deadends are used to deadend 9/16-in aluminum or galvanized steel guy wire.

For deadending 1/4-in through 7/16-in guy wire, see SCL 5650.30.

### 3. Requirements

Deadends shall be made from the following:

- Aluminum yoke and shell (6061-T6 aluminum alloy)
- Solid bails (Type 304 stainless steel)

Each deadend shall be an integral unit after assembly.

Deadends shall be capable of holding a minimum of 95% of the rated strength of the guy wire.

Deadends shall be equipped with a pilot cup to cap the strand and prevent individual strands from splaying during installation.

Deadends shall be adjustable from 0 to 18 inches.

Deadends shall meet the requirements described in Table 3a, Table 3b, and Figure 3.

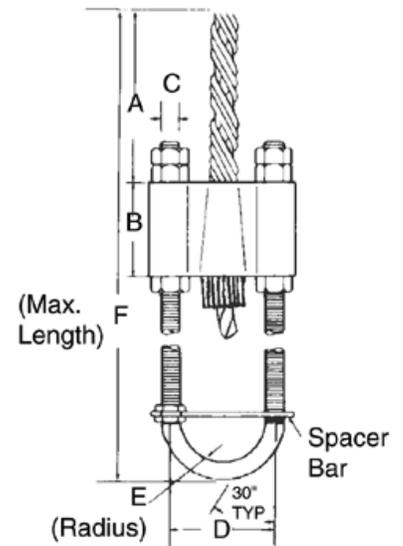
Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

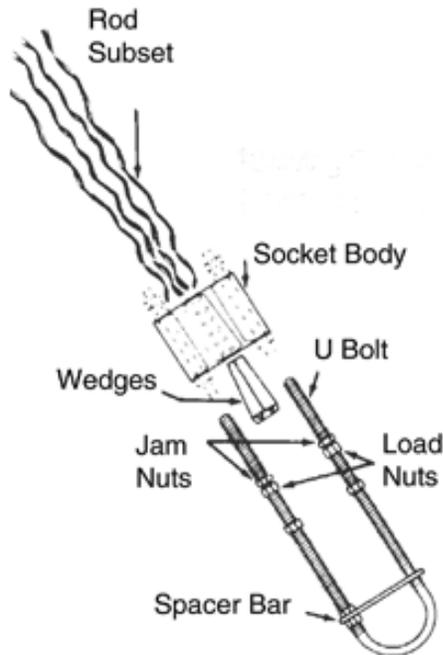
Unit Director  
Darnell Cola

**Table 3a. Deadend Requirements**

Wire Diameter (in)	Dimensions (in)					
	A	B	C	D	E	F
9/16 (7 or 19 wire)	28	3 1/4	5/8	3 1/4	3/4	52



**Figure 3. Deadend Configuration**



**Table 3b. Deadend Rating**

Strength Rating (lb)	Color code
35,000	Yellow

#### 4. Packaging

Deadends shall be shipped assembled.

Standard package quantity shall not exceed four per box.

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- SCL stock number
- Quantity contained

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
  - Product description
  - SCL purchase order number
  - SCL stock number
- 

#### 5. Issuance

Stock unit: EA

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#### 6. Approved Manufacturers

Hubbell Power Systems 916GA18

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#### 7. References

**SCL Material Standard 5650.30**; "Deadend, Guy, Aluminum Automatic Feed-Through"

**SCL Material Standard; 5630.3**; "Deadend, Guy, Aluminum Automatic Feed-Through"  
(canceled)

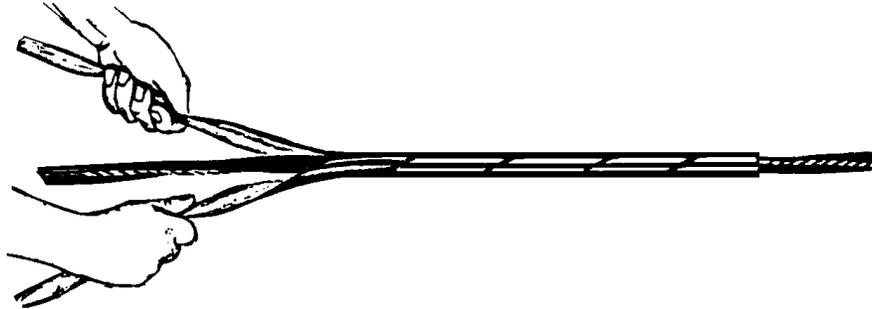
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#### 8. Sources

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist, originator, and subject matter expert of 5650.35 (kathy.tilley@seattle.gov)

# MATERIAL STANDARD

## GUARD, PLASTIC WIRE



**Plastic Wire Guards** are used to protect conductors from mechanical abrasion from tree limbs or other obstructions.

Wire guards shall be made of high-strength, high-impact, polyvinyl chloride thermoplastic compound that has good abrasion resistance, a low-moisture absorption rate, and excellent weathering ability.

Wire guards shall be helically slit and cut to six-foot lengths.

Shipping containers shall be marked with the type, size, and quantity of the items, the City Purchase Order number, the name and address of the manufacturer, and the address of the Seattle City Light receiving warehouse.

**Stock Unit:** EA

Stock Number	Dimensions			Approved Manufacturers	
	ID, Inches	Wall Thickness, Inches	Length, Feet	Hubbell/Chance	Preformed
565180	1	0.093	6	PFG 32-38	PTG-0155

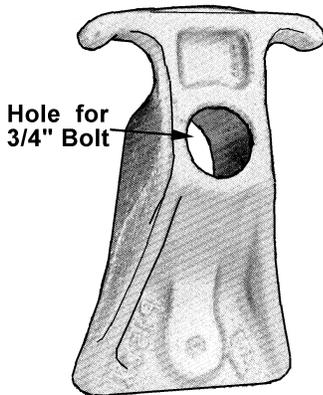
ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John Chinner</i>	<i>Harold J. J...</i>

# MATERIAL STANDARD

## GUY HOOKS & POLE EYE PLATES

### GUY HOOK INTEGRAL SPUR TYPE

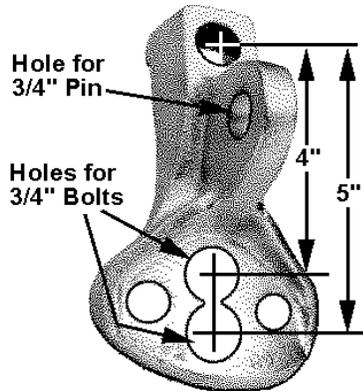
Figure 1



**RATED**  
 Rated for 1/2"  
 (Min.) Wire

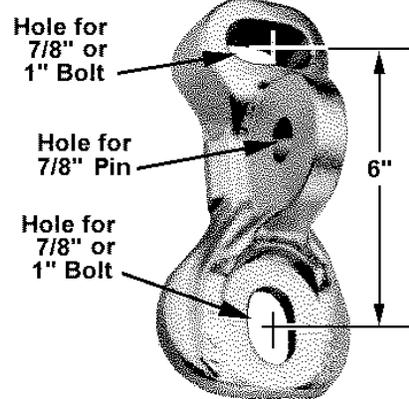
### POLE EYE PLATES

Figure 2



**MINIMUM RATINGS**  
 20,000 lbs @ 45°  
 20,000 lbs @ 90°

Figure 3



**MINIMUM RATINGS**  
 36,000 lbs @ 45°  
 30,000 lbs @ 90°

**Guy Hooks and Pole Eye Plates** of the configuration shown shall be made of malleable iron conforming to ASTM A47 or ductile iron conforming to ASTM A536.

**The Spur and Teeth of the Guy Hook** shall be integral parts of the hook and designed to resist down slotting of the bolt hole when under vertical load. The hook or plate shall accommodate pull-off angles from 0° to 90°.

**The Guy Hooks and Pole Eye Plates** shall be galvanized, after fabrication, in accordance with ASTM A153.

**Reference Specifications:** ASTM A47, A536, A153, latest revisions. .

**Stock Unit:** EA

Stock Number	Fig. No.	Approved Manufacturers				
		Hubbell/ Anderson	Hubbell/ Chance	MacLean	Line Hardware Inc.	Richards
565195	1	—	GH6-ILS	GA-6X	HGA-75CS	—
565198	2	GSP-05	GEP-6	PEP-66-45	—	RPEP88
565199	3	—	GEP-7A	EPR88-7*	—	—

\* This part will have 77-7 as cast-on part number. Manufacturer uses common casting for both parts.

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## Formed-Wire Aluminum-Clad Guy Grip



### 1. Scope

This standard covers the material requirements for formed-wire guy grips. This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
565122	5/16-in Alumoweld
565124	7/16-in Alumoweld
565126	9/16-in Alumoweld

### 2. Application

Guy grips are used to connect guy wires conforming to ASTM B416 to pole anchoring systems. Guy wire systems are used to support utility poles and related structures.

Each guy grip is rated to hold more than the rated breaking strength (RBS) of the guy strand it fits.

Guy grips are not rated for use on primary or secondary wire, nor should these be used on Aluminum Conductor Steel Reinforced (ACSR) conductors.

### 3. Industry Standards

Guy grips shall meet the applicable requirements of the following industry standards:

**ASTM B415-98(2013)**; Standard Specification for Hard-Drawn Aluminum-Clad Steel Wire

**ASTM B416-98(2013)**; Standard Specification for Concentric-Lay-Stranded Aluminum-Clad Steel Conductors

Standards Coordinator  
Kathy Tilley

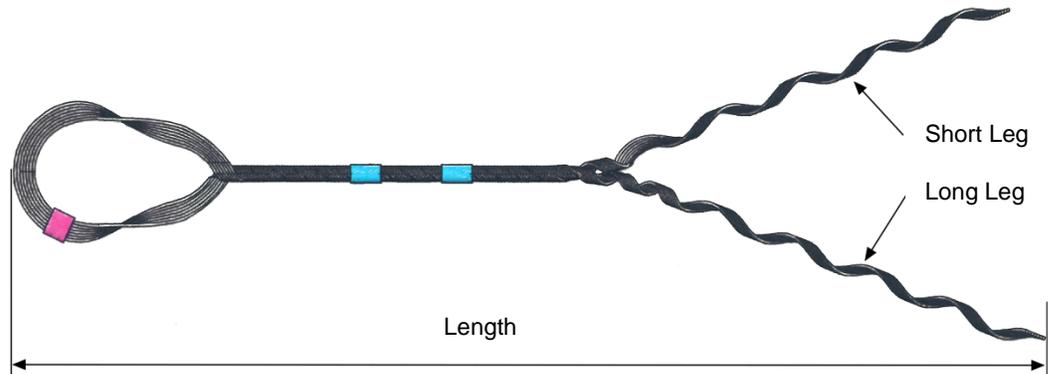
Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

**4. General Requirements**

Guy grips shall be of the configuration detailed in Figure 4.

**Figure 4. Guy Grip Configuration**



The loop end shall be a twisted loop and not flared.

Guy grips shall be made of high-strength spring steel wire, conforming to ASTM B416.

Guy grips shall be designed to hold the full-rated strength of aluminum-covered guy strands per Table 4 (on the next page of this document).

Each grip shall have identifying marks to indicate the proper crossover points for both large and small strain insulators.

One leg of the grip shall be longer than the other to facilitate easy removal from the strand.

The contact area of each grip shall be coated with a high-friction abrasive grit.

**4.1 Wire**

Before stranding, the aluminum-clad steel wire shall meet the requirements of ASTM B415.

**4.2 Lay**

The preferred lay for guy grip wire is 13.5 times the outside diameter of that layer.

The lay shall be between 10 and 16 times the outside diameter.

Guy grips shall be left-hand lay unless otherwise specified.

**Table 4. General Requirements**

Stock No.	Size (in)	Guy Wire Diameter (in)	Guy grip length (in)	Rate Strength (lb)
565122	5/16	0.308–0.311	26, -1/+0	10,000
565124	7/16	0.395–0.444	37, -1/+0	20,000
565126	9/16	0.571–0.591	50	34,290

## 5. Packaging

Guy grips shall be packaged to prevent damage from shipping, inside or outside storage and casual handling.

Guy grips shall be packaged as detailed in Table 5.

**Table 5. Packaging**

<b>Stock No.</b>	<b>Size (in)</b>	<b>Units/package</b>
565122	5/16	50
565124	7/16	10-25
565126	9/16	10-20

A tag shall be attached to the outside of each package detailing:

- Manufacturer's name or symbol
- Size of guy grip
- Manufacturer's catalog number
- Date of manufacture
- SCL stock number

---

## 6. Issuance

Unit: EA

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## 7. Approved Manufacturers

<b>Stock No.</b>	<b>Size (in)</b>	<b>Manufacturer</b>	<b>Catalog</b>	<b>Color Code</b>
565122	5/16	Helical	HG 521-10M	Black
		Preformed	AWDE-4116	Black
		MacLean	DE-AC4116	Black
565124	7/16	Helical	HG 528-20M	Green
		Preformed	AWDE4126	Yellow
565126	9/16	Preformed	BG-4173	Orange
		MacLean	DE-AC4133	Orange

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## 8. Sources

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist, subject matter expert and originator of 5651.40 (kathy.tilley@seattle.gov)

**MATERIAL STANDARD**

**MARKER  
 PLASTIC GUY**



**Plastic Guy Markers** shall be of the general configuration shown, and shall be made of high-impact, rigid polyvinyl chloride compound or UV-stabilized high-density polyethylene. See applicable ASTM specifications below for materials.

The markers shall be eight feet in length and equipped with positive clamping devices to securely and rigidly hold the marker to the strand and/or anchor rod. The attachments shall accommodate guy strand to 9/16-inch diameter and/or anchor rods to one inch in diameter. The top clamp may be either as shown above or approved clamping design of guy marker as shown below. The color of the markers shall be yellow.

The steel fasteners shall be hot dipped galvanized in accordance with ASTM Specification A153, or cadmium plated (Type TS) in accordance with ASTM Specification A165, or stainless steel. Helical pigtail fasteners also allowed.

**Additional** approved clamping design showing cross-sectional area of marker. ---"omega"



**Reference Specifications:** ASTM A153, A165, and D1784, latest revisions.

**Stock Unit:** EA

**Stock Number:** 565168

**Approved Manufacturers:** Electrical Materials Co. Cat. No. 70-7YPLUG  
 Joslyn Manufacturing Co., Cat. No. J5718  
 Preformed Line Products, Cat. No. PG-5718  
 Virginia Plastics, Cat. No. TG112 2S 8Y

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# MATERIAL STANDARD

## GUY CABLE FITTINGS EYE NUTS



Fig. 1  
Oval Eye Nut



Fig. 2  
Strand Eye Nut



Fig. 3  
Twin Strand Eye Nut

**Galvanized Eye Nuts** shall be of the configuration shown and shall meet the requirements of EEI TDJ-5. Optional or alternate configurations shown in Data Sheet 1 of TDJ-5 are not acceptable. Eye nuts may be cast of malleable iron (ASTM A47) or ductile iron (ASTM A536). Shipping containers shall be marked with the type and quantity of items, City Purchase Order number, name and address of the manufacturer, and the address of the receiving warehouse. Packaging shall conform to EEI Packaging Standards.

**Reference Specifications:** ASTM A47, A536, EEI Pkg. Stds., latest revisions.

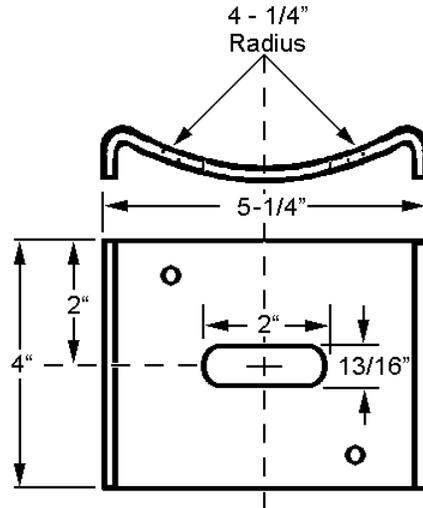
**Stock Unit:** EA

Stock Number	Figure Number	Bolt Diameter, Inches	Approved Manufacturers			
			Chance	Dixie	Line Hardware	Utilities Services
565252	1	5/8	6502	D6502	OEN-58	450
565254	1	3/4	6503	D6503	OEN-34	451
565258	2	5/8	6510	D6510	TEN-58	C580
565260	2	3/4	6511	D6511	TEN-34	C340
565266	3	3/4	6561	D6561	TWN-34	5964

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**MATERIAL STANDARD**

**GAINS, POLE**



**Pole Gains** shall be of the configuration and dimensions shown and shall be of 3/16" carbon steel strip conforming to ASTM Specification A569.

Pole gains shall be galvanized after fabrication in accordance with ASTM Specification A153.

Packaging shall be in accordance with EEI Packaging Standards.

**Reference Specifications:** ASTM A569, A153, EEI Pkg. Stds., latest revisions.

**Stock Unit:** EA

**Approved Manufacturers:** Hubbell/Chance DG9M1, Joslyn J4060, Kortick K4325

**Stock Number:** 565313

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# MATERIAL STANDARD

## SPLICES, AUTOMATIC FULL-TENSION GUY STRAND



**Automatic Full-Tension Splices** for aluminum-covered steel strand shall be designed to hold a minimum of 95 percent of the rated breaking strength of the strand with which they are used.

The shell shall be made of high-strength, corrosion-resistant, aluminum alloy, drawn, seamless tubing meeting the requirements of ASTM B 210. Gripping units of case-hardened steel or high-strength aluminum alloy, to develop the required strength, are acceptable. The ends of the tubing shall be flared to facilitate insertion of the guy strand.

The splices shall be filled with a corrosion-inhibiting compound and individually packaged.

**Reference Specification:** ASTM B 210, latest revision.

**Stock Unit:** EA

Stock No.	Strand Range Dia., In.	Rated Breaking Strength of Strand, Lbs.	Approved Manufacturer
			MacLean
565337	0.270 - 0.315	10,270	5041
565338	0.392 - 0.455	20,000	5043
010699	0.455 - 0.520	24,210	5044

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SEATTLE CITY LIGHT  
**MATERIAL STANDARD**

STANDARD NUMBER: **5664.1**  
 PAGE: 1 of 1  
 DATE: April 1, 1985  
 REV: May 15, 2003

**WIRE, GUY AND SHIELD  
 ALUMINUM COVERED STEEL STRAND**

**Aluminum Covered Steel Guy Strands** shall conform to the requirements of ASTM B 416.

**Packaging and Marking**

**Coils:** Coils shall be delivered already mounted on disposable safety guy wire dispensers, Preformed Line Products Cat. No. SGD-0700 or equal. Coils and dispensers shall be suitably protected to minimize damage to strands during shipment or handling. Paper wrapping on individual coils is not preferred. The maximum outside diameter of the coil shall be 28 inches; the minimum inside diameter of the coil shall be 18 inches. A durable tag shall be attached to each coil, giving the size of the wire, weight of the coil, wire length, the manufacturer's name or trademark, and the City of Seattle purchase order number. Each end of the coil shall be securely fastened to the coil with the starting end identified.

**Reels:** Reel lengths shall be shipped on non-returnable wood reels of NEMA WC 26 type and dimensions. The manufacturer may provide smaller reel sizes than shown below if in conformance with NEMA WC 26 but no smaller than Size 3624. We require a drive pin hole of at least 1-1/2 inches. The inner end of the wire shall be brought to the outside of the reel flange and securely fastened with steel staples appropriate to the wire size. The inner end shall not be brought out through the reel arbor. The outer end shall be fastened with steel staples appropriate to the wire size to the inner side of the flange. Reels must be delivered in upright position suitable for side unloading by forklift, and not strapped or palleted. The reels shall be legibly marked with the size of the wire, weight, length of wire, the manufacturer's name or trademark, and the City of Seattle purchase order number. The wire shall be adequately protected to insure safe delivery without damage. Tare weight shall be printed on all reels.

**Reference Specifications:** ASTM B 416, NEMA WC 26, latest editions.

**Stock Unit:** FT

**Approved Manufacturers:** Alumoclad de Mexico, Conex, Intral, U. S. Alumoweld.

Stock Number	Strand Dia., In.	Nominal Dia., In.	Rated Break Strength, Lbs.	Lb., Per 100 Feet	Length Per Coil, Feet	Length Per Reel, Feet, ±10%	Max. NEMA Reel Size	Catalog Numbers, All Manufacturers
566406	0.306	5/16 (10M)	10,000	16.47	500	—	—	10M
*566407	0.306	5/16 (10M)	10,000	16.47	—	10,000	4024	10M
566408	0.444	7/16 (20M)	20,000	34.70	250	—	—	20M
*566409	0.444	7/16 (20M)	20,000	34.70	—	5,000	4024	20M
566410	0.572	9/16	34,290	56.58	250	—	—	19-#9 AWG
566425	0.486	—	22,730	41.63	250	—	—	7-#6 AWG

\*Special order by Engineering only. Lead time is a minimum of four months.

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**PINS, INSULATOR  
 GALVANIZED FORGED STEEL**



**FORGED STEEL INSULATOR PINS:** Pins with 1-inch diameter lead threads shall be made in accordance with EEI Specification TD-17.

**PACKAGING:** The pins shall be packaged in accordance with EEI Packaging Standards.

**REFERENCE SPECIFICATIONS:** EEI TD-17, EEI Pkg. Standards., latest revisions.

**Stock Unit:** Each

Stock Number	Approved Manufacturers							
	Chance	Hubbell	Joslyn	Kortick	Cooper	Oliver	Util. Serv.	FWC
567105	881-A	981-A	J204 J204Z	K7105	DP2S5	3507	559	FW204

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**CAST ALUMINUM STREETLIGHT BASE AND COLLAR ASSEMBLIES**



**1. Scope**

This standard covers the requirements for cast aluminum streetlight base and collar assemblies. These assemblies are also known as historic, ornamental, or Chief Seattle bases.

This standard applies to the following Seattle City Light stock numbers:

Stock Number	Description
568031	Base assembly with access door
568033	Collar assembly, 10-inch diameter
568039	Collar assembly, 12-inch diameter
568114	Access door (if ordered separately)

Material requirements for cast *bronze* streetlight base and collar assemblies are outside the scope of this standard. They are found in Material Standard 5680.44.

Material requirements for cast aluminum streetlight base and collar assemblies intended for installation over 16-inch diameter poles are outside the scope of this standard. Sixteen-inch diameter poles are matched with a special, oversized Chief Seattle base that was developed exclusively for the Seattle Department of Transportation (SDOT) for the Mercer Corridor Improvement project. SDOT is responsible for these special base and collar assemblies and molds.

Poles, arms, and luminaries are outside the scope of this standard.

**2. Application**

Cast streetlight base and collar assemblies are used to support and decorate streetlight poles in city-designated historic areas and City Light-designated streetlight districts.

Table 2 identifies areas where bronze and aluminum assemblies have been installed. Contact City Light Streetlight Engineering for up-to-date application information.

**Table 2, Decorative Streetlight Base Locations**

Streetlight Districts	Casting Material
Pioneer Square	Bronze
International District	Aluminum
Westlake (3rd Avenue, Westlake Park, Pine Street, Pike Street)	Aluminum
5th Avenue central business district	Aluminum

Use 10-inch diameter collars on fluted steel poles. Use 12-inch collars on Metro strain poles located in Westlake Park. The same base will accommodate either size collar.

**3. Industry Standards**

Castings shall meet the applicable requirements of the following industry standard:

**ASTM B26-12**; "Standard Specification for Aluminum-Alloy Sand Castings"

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Cast Aluminum Streetlight Base and Collar Assemblies

standard number: **5680.33**

superseding: new  
 effective date: February 14, 2013  
 page: 2 of 3

**4. Requirements**

**4.1. General**

Casting patterns are the property of Seattle City Light, a department of the City of Seattle. Parts produced from the City's patterns shall not be used by any other entity without prior, written approval by the City.

Pattern tooling shall not be altered or modified without the prior approval of Seattle City Light Standards.

Casting material shall be ANSI 356.0/UNS A03560 and meet the requirements of ASTM B26, Table 1.

Casting material temper shall be F (as fabricated) and meet the requirements of ASTM B26, Table 2.

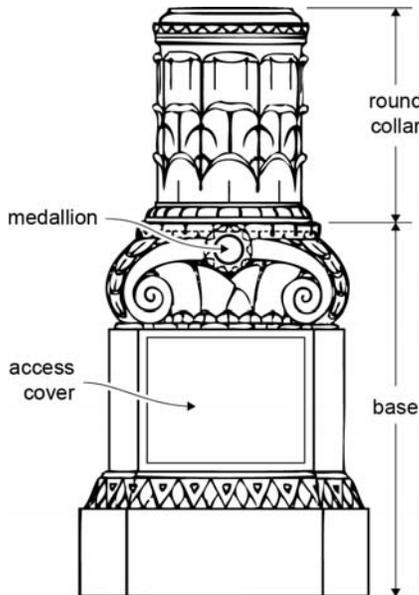
Joining-surface gaps shall not exceed 1/16th inch.

Bases, collars, access doors, and medallions shall be finished with Sherwin-Williams POWDURA TGIC Powder Coating, DGS2-40003, Railroad Green.

The supplier shall assemble pieces according to Sections 4.2 through 4.6. A quantity-one stock number shall consist of one assembly.

Collar and base assemblies shall be secured to each other using four 1/4-20 x 3/8-inch stainless-steel, cup-point, set screws, (SSCP (SS))

**Figure 4.1, Base and Collar Assembly**



**4.2. Base Assembly**

Each base assembly shall be composed of two casting halves and one access door made using the patterns furnished by Seattle City Light.

Base assembly casting halves and access door shall be assembled by the supplier and secured with six 1/4-20 x 1-inch stainless-steel, flat-head, socket-cap screws (FHSC (SS)).

**4.3. Collar Assembly**

Each collar assembly shall be composed of two pieces made using the pattern furnished by Seattle City Light.

Collar assembly casting halves shall be assembled by the supplier and secured with four 10-24 x 1-inch FHSC (SS).

**4.4. Access Door**

The access door shall be secured to the base with two 10-24 x 1 FHSC (SS).

**4.5. Medallion**

Four medallions shall be used to lock the collar assembly to the base assembly.

Two medallions shall be of the fish design and two medallions shall be of the Chief Seattle design.

**Figure 4.5, Medallions**



Like designs shall be installed on faces opposite from each other.

**5. First Article Inspection and Approval**

The successful bidder shall submit the number of the aluminum alloy they plan to use number to Seattle City Light Standards for approval prior to fabricating the first production piece.

The successful bidder shall submit a sample of aluminum with the proposed powder coating to Seattle City Light Standards for approval of color and quality before fabricating the first production piece.

The successful bidder shall submit a first production piece to Seattle City Light Standards for approval before fabricating the balance of the order.

## MATERIAL STANDARD

Cast Aluminum Streetlight Base and Collar Assemblies

standard number: **5680.33**

superseding: new  
effective date: February 14, 2013  
page: 3 of 3

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### 6. Packaging

Streetlight assemblies shall be packaged in wood crates designed to protect against damage that could occur during shipping, handling, or long-term outside storage.

Crates shall be secured to pallets for handling by forklift. A loaded pallet shall not exceed 4 feet in height or 1,000 pounds in weight.

Each crate shall be legibly marked or tagged with the following information:

- Manufacturer's name
- Product description
- Seattle City Light's stock number
- Seattle City Light's purchase order number

### 7. Issuance

Stock Unit: EA

### 8. Approved Manufacturer

Travis Pattern & Foundry, Inc. – Spokane, Washington

### 9. References

**SCL 5680.0**; "Ornamental Cast Base and Collar, Aluminum, for Streetlight Standards"; (canceled); Material Standard

**SCL 5680.44**; "Cast Bronze Streetlight Base and Collar Assemblies; Material Standard

**Streetlight Handbook**, Seattle City Light, July 2000

**Shipek, John**; SCL Standards Engineer; originator of 5680.33 (john.shipek@seattle.gov)

**Sande, BJ**; Travis Pattern & Foundry, subject matter expert for 5680.33

**ASME B18.12-2001** - Glossary of Terms for Mechanical Fasteners

[www.travispattern.com](http://www.travispattern.com)

**CAST BRONZE STREETLIGHT BASE AND COLLAR ASSEMBLIES**



**1. Scope**

This standard covers the requirements for cast bronze streetlight base and collar assemblies. These assemblies are also known as historic, ornamental, or Chief Seattle bases.

This standard applies to the following Seattle City Light stock numbers:

Stock Number	Description
568030	Base assembly with access door
568032	Collar assembly, 10-inch diameter
012474	Collar assembly, 12-inch diameter
568116	Access door (ordered separately)

Material requirements for cast *aluminum* streetlight base and collar assemblies are outside the scope of this standard. They are found in Material Standard 5680.33. Poles and fixtures are outside the scope of this standard.

**2. Application**

Cast streetlight base and collar assemblies are used to support and decorate streetlight poles in city-designated historic areas and City Light-designated streetlight districts.

Table 2 identifies areas where bronze and aluminum assemblies have been installed. Contact City Light Streetlight Engineering for up-to-date application information.

**Table 2, Decorative Streetlight Base Locations**

Streetlight Districts	Casting Material
Pioneer Square	Bronze
International District	Aluminum
Westlake (3rd Avenue, Westlake Park, Pine Street, Pike Street)	Aluminum
5th Avenue central business district	Aluminum

Use 10-inch diameter collars on fluted steel poles. Use 12-inch collars on Metro strain poles located in Westlake Park. The same base will accommodate either size collar.

**3. Industry Standards**

Castings shall meet the applicable requirements of the following industry standard:

**ASTM B584-11**; “Standard Specifications for Copper Alloy Sand Castings for General Applications”

**4. Requirements**

**4.1 General**

Casting patterns are the property of Seattle City Light, a department of the City of Seattle. Parts produced from the City’s patterns shall not be used by any other entity without prior, written approval by the City.

Patterns shall not leave the United States.

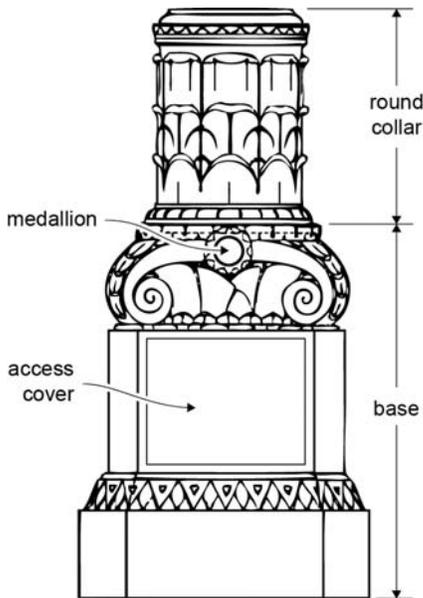
Patterns shall not be altered or modified without prior, written approval by the City.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
John Shipek	John Shipek	Darnell Cola

**MATERIAL STANDARD**

**4. Requirements** continued

**Figure 4.1,** Base and Collar Assembly



The City retains the right to reclaim the patterns at any time at its discretion.

Casting material shall be C87600-series silicon-bronze alloy as specified in ASTM B584, Table 1.

Casting surfaces shall be uncoated.

Joining-surface gaps shall not exceed 1/16<sup>th</sup> inch.

The supplier shall assemble pieces according to Sections 4.2 through 4.5. A quantity-one stock number shall consist of one assembly.

Collar and base assemblies shall be secured to each other using four 1/4-20 x 3/8-inch, silicon-bronze, cup-point, set screws (SSCP (SB)).

**4.2 Base Assembly**

Each base assembly shall be composed of two casting halves and one access door made using the patterns furnished by Seattle City Light.

The base assembly casting halves and access door shall be assembled by the supplier and secured with six 1/4-20 x 1-inch silicon bronze, flat-head socket-cap screws (FHSC (SB)).

**4.3 Collar Assembly**

Each collar assembly shall be composed of two pieces made using the pattern furnished by Seattle City Light.

Collar assembly casting halves shall be assembled by the supplier and secured with four 10-24 x 1-inch FHSC (SB) screws.

**4.4 Access Door**

The access door shall have nominal dimensions of 12-1/8 inches wide by 8-3/4 inches high.

The access door shall be secured to the base with two 10-24 x 1-inch FHSC (SB) screws.

**4.5 Medallion**

Four medallions shall be used to lock the collar assembly to the base assembly.

Two medallions shall be of the fish design and two medallions shall be of the Chief Seattle design.

**Figure 4.5,** Medallions



Like designs shall be installed on faces opposite from each other.

**5. First Article Inspection and Approval**

The successful bidder shall submit the UNS number of the copper alloy they intend to use to Seattle City Light Standards for approval prior to fabricating the first production piece.

The successful bidder shall submit a first production piece to Seattle City Light Standards for approval prior to fabricating the balance of the order.

**6. Packaging**

Streetlight assemblies shall be packaged in wood crates designed to protect against damage that could occur during shipping, handling, or long-term outside storage.

Crates shall be secured to pallets for handling by a forklift. Loaded pallets shall not exceed 4 feet in height or 1,000 pounds in weight.

Each crate shall be legibly marked or tagged with the following information:

- Manufacturer's name
- Product description
- Seattle City Light's stock number
- Seattle City Light's purchase order number

**7. Issuance**

Stock Unit: EA

## **MATERIAL STANDARD**

Cast Bronze Streetlight Base and Collar Assemblies

standard number: **5680.44**

superseding: New

effective date: January 29, 2013

page: 3 of 3

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### **8. Approved Manufacturer**

Travis Pattern & Foundry, Inc. – Spokane, Washington

### **9. References**

**SCL 5680.0**; “Ornamental Cast Base and Collar, Aluminum, for Streetlight Standards”; (canceled)  
Material Standard

**SCL 5680.33**; “Cast Aluminum Streetlight Base and Collar Assemblies”; Material Standard

**Streetlight Handbook**, Seattle City Light,, July 2000

**Shipek, John**; SCL Standards Engineer and originator of 5680.44.

**Sande, BJ**; Travis Pattern & Foundry, subject matter expert for 5680.44

**ASME B18.12-2001** - Glossary of Terms for Mechanical Fasteners

[www.travispattern.com](http://www.travispattern.com)

## Steel Streetlight Pole and Arm Assemblies



### 1. Scope

This standard covers the requirements for steel streetlight pole and arm assemblies.

This standard applies to the following Seattle City Light Stock Numbers:

Stock No.	Description	Color
013464	21-1/2 ft, tapered steel pole	Black
013465	4-ft span, 1-ft rise tapered steel arm	Black

### 2. Application

Steel streetlight poles are only used to support stock number 013526, 90-watt Domus LED in black.

These assemblies are used exclusively by the Seattle Parks and Recreation along Lake Washington Boulevard in the Arboretum.

Steel streetlight pole and arm assemblies are special-ordered.

Steel streetlight pole and arm assemblies are owned by the Seattle Parks and Recreation and maintained by Seattle City Light.

Steel streetlight pole and arm assemblies are installed to achieve a mounting height of 22 feet, nominal.

Steel streetlight pole and arm assemblies are installed onto 4-bolt, 11-1/2-inch bolt circle streetlight pole foundations, stock number 568028.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Steel streetlight pole and arm assemblies shall meet the applicable requirements of the latest revision of the following industry standards:

**AASHTO Standard Specifications** for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

**ASTM A 153** Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM A 307** Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

**ASTM B 117** Standard Practice for Operating Salt Spray Apparatus

**ASTM D 2247** Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

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### 4. Requirements

#### 4.1 General

Steel streetlight pole and arm assemblies shall conform to the details in Valmont drawing WA181261P1.

Steel streetlight pole and arm assemblies shall be designed and fabricated to conform to the requirements of AASHTO standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Steel streetlight pole and arm assemblies shall consist of a tapered, galvanized steel shaft welded to a steel base and complete with pressure-mounted nut cover discs.

#### 4.2 Steel Arm

Each steel arm shall be high-strength steel tubing of one-piece construction.

**Table 4.2. 4-ft Steel Bracket Arm – Seattle City Light Stock No. 013465**

Span	4 ft
Rise	1 ft
Base outer diameter	3 in
Finish	Black, RAL 9005

#### 4.3 Pole Shaft

Steel pole shaft shall be high-strength steel tubing of one-piece construction.

**Table 4.3. 22-ft Mounting Height – Seattle City Light Stock No. 013464**

Mounting height, nominal	22 ft
Pole length, nominal	21-1/2 ft
Cross section	Round
Pole-base diameter, nominal	6 in
Pole-top diameter, nominal	5-1/2 in

#### 4.4 Grounding

A tapped grounding pad equipped with either a 1/4-20 x 1/2 or 3/8-16 x 1 stainless steel screw shall be provided and located on the interior of the pole opposite the handhole or directly adjacent to the handhole.

#### 4.5 Pole Handhole

**Table 4.5. Handhole Specifications**

Size, minimum (in)	5 in x 7-1/2 in
Finish/Color	Match pole finish/color
Location	Centered 18 in above base

The handhole shall be reinforced so as to result in no loss of shaft strength.

The handhole shall be attached with stainless steel screws. The cover shall be weatherproof.

#### 4.6 Pole Base Plate

Base plate shall be fixed and sized to accommodate four one-inch anchor bolts spaced 90 degrees apart on an 11-1/2 inch bolt circle.

#### 4.7 Pole Finish

The finish shall be polyester powder coated black, color RAL 9005.

#### 4.8 Pole Top Cap

A removable pole top cap held in place with three stainless steel set-screws shall be included.

#### 4.9 Festoon Outlet

None required.

#### 4.10 Anchor Bolts

None required.

## 5. Packaging

Steel streetlight pole and arm assemblies shall be protected with a spiral wrapping of heavy waterproof material for protection during shipping and installation. When necessary, rip cord shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Product description
- Quantity contained
- Seattle City Light's Stock Number

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## 6. Issuance

Stock Unit: EA

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## 7. Approved Manufacturers

<b>Stock No.</b>	<b>013464</b>
Description	21-1/2-ft Steel Streetlight Pole
Manufacturer	Valmont Industries, Inc.
Catalog No.	DS32-850A216-0'LMA-HH-FPGV-LAB
<b>Stock No.</b>	<b>013465</b>
Description	4-ft Steel Streetlight Arm
Manufacturer	Valmont Industries, Inc.
Catalog No.	4'LMA-FPGV

---

## 8. References

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5683.01;  
(yaochiem.chao@seattle.gov)

**Pompeo, Brenda**; SCL engineer, subject matter expert for 5683.01;  
(brenda.pompeo@seattle.gov)

**Valmont; Drawing No. WA181261P1** - Lake Washington Blvd, Lighting Structures,  
dated May 22, 2012

**LIGHTING CONTACTOR CONTROLLER**



**1. Scope**

This standard covers the requirements for lighting contactor controllers.

This standard applies to the following Seattle City Light Stock Number: **012776**

**2. Application**

Contact relay switch controllers allow control of multiple streetlights with a single street light photocontrol. The number of streetlights capable of being controlled is limited by the load rating of the contactor. Photocontrol unit, Stock Number 569333, is wired remotely from the contactor.

**3. Industry Standards**

Contact controller enclosures shall meet the applicable requirements of the following industry standards:

**NEMA Standards Publication 250-2003**, Enclosures for Electrical Equipment (1000 volts maximum)

**ANSI/ IEC 60529-2004**, Degrees of Protection Provided by Enclosures (IP Code)

**4. Detailed Requirements**

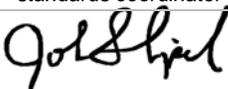
**Manufacturer:** Ripley Lighting Controls

**Catalog Number:** **CC-100-3-NO-E-M-U-H-120-277**  
 with one **A004001**

Where:

- CC** = Electromagnetic contactor
- 100** = Load amps per pole
- 3** = Number of poles
- NO** = Normally open
- E** = NEMA 4X (Weatherproof)  
Corresponding generally to ANSI/ IEC 60529
- M** = Without photocontrol receptacle (wired for remote)
- U** = Breaker on load side
- H** = Hand-off-auto switch
- 120-277** = Control voltage with multi-tap control transformer
- A004001** = 24-inch mounting bracket

Enclosure shall be fabricated from type 304 or 316 stainless steel.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

## Material Standard

Lighting Contactor Controller

standard number: **5685.00**

superseding: June 29, 2007  
effective date: October 5, 2011  
page: 2 of 2

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### 5. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

### 6. Packaging

Contactors shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

A mounting bracket shall be bundled with each contactor controller.

Each individual package shall be marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

Each contactor controller shall be provided with installation instructions and an internal schematic diagram.

### 7. Issuance

Stock Unit: EA

### 8. References

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator for 5685.00  
(john.shipek@seattle.gov)

[www.ripleylightingcontrols.com](http://www.ripleylightingcontrols.com)

**STREETLIGHT PHOTOCONTROLS**



**1. Scope**

This standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Description
569333	Streetlight photocontrol
569334	Shorting cap

**2. Application**

Photocontrols are used as light-sensing switches to control luminaries. Photocontrols are designed to switch lamps off during the day and switch lamps on at night.

A shorting cap is installed in place of photocontrol when a lamp is needed to stay on 24 hours a day.

**3. Industry Standard**

Streetlight photocontrols and shorting caps shall meet the applicable requirements of:

**ANSI C136.10-2006** - American National Standard for Roadway and Area Lighting Equipment—Locking-type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

**4. Construction**

**4.1 Common**

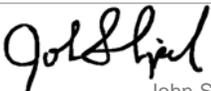
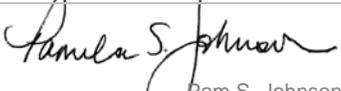
Photocontrols and shorting caps shall be provided with a means of sealing according to the requirements of ANSI C136.10, Section 4.3.

**4.2 Photocontrols**

Color code	blue
Plug type	locking type, three-pole, three-wire
Photosensor type	silicon
Operating voltage range, volts, ac	105 to 305
Load rating, incandescent lamp, minimum, watts	1,000
Load rating, high-intensity discharge (HID), minimum, VA	1,800
Operating temperature range, ambient, degrees C	-40 to +65
Turn on response time range, seconds	0.5 to 5.0
Turn off response time range, seconds	0.5 to 5.0
Turn on light level, fc	2.8 +/- 0.6
Turn off light level, maximum, fc	5.1
Turn-off/turn-on ratio, nominal	1.5
Failure mode, nominal	fail-on

Each photocontrol shall be provided with a means to conveniently and permanently record date of installation and date of removal.

Each photocontrol shall be provided with an internal, 160 joule minimum, metal-oxide varistor (MOV) type surge arrester.

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pam S. Johnson

**MATERIAL STANDARD**

**4. Construction, continued**

**4.3 Shorting Caps**

Color code	black
Plug type	locking type, three-pole, three-wire

**5. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

**6. Testing**

Photocontrols and shorting caps shall be tested according to the requirements of ANSI C136.10. Test results shall be provided upon request.

**7. Marking**

Each individual photocontrol and shorting cap shall be marked with the following information:

- Manufacturer's name
- Model number
- Voltage rating
- Load rating
- North orientation
- Rotation of installation and removal

**8. Packaging**

Photocontrols and shorting caps shall be individually packaged to prevent damage from storage and handling.

From the outside of each individual package, the manufacturer's name and model number shall be clearly visible.

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

Shipping container weight shall not exceed 50 pounds.

**9. Issuance**

Stock Unit: EA

**10. Approved Manufacturers**

Manufacturers	Catalog Numbers	
	Photocontrol SCL Stock No. 569333	Shorting Cap, SCL Stock No. 569334
Area Lighting Research (ALR)/ Tyco	6190-VPS	MC-10
Dark to Light (DTL)	DP124-2.6-TJ J50	RA1013
Fisher Pierce Outdoor Lighting Controls (OLC)	7673C-70578	FPS1039
Selc	8483	8483-SC
Sun-Tech	P124-2.5-SCL	S-1039

**11. References**

Shipek, John; SCL Standards Engineer, subject matter expert and originator of 5693.00 (john.shipek@seattle.gov)  
 Smalley, Ed; subject matter expert; (ed.smalley@seattle.gov)

## Streetlight Photocontrols, 20-Year Design Life



### 1. Scope

This material standard covers the requirements for twenty-year design life streetlight photocontrols.

This material standard applies to Seattle City Light Stock Number 013129.

Standard-life streetlight photocontrols are outside the scope of this Standard.

### 2. Application

Photocontrols are used as light-sensing switches to control luminaires. Photocontrols are designed to switch lamps off during the day and switch lamps on at night.

Twenty-year design life photocontrols are intended for use with light-emitting-diode (LED) style streetlight luminaires.

Twenty-year design life photocontrols are technically compatible with standard high pressure sodium (HPS) luminaires, but due to their relatively high initial material cost and long life, are considered a poor match for that application.

### 3. Industry Standard

Photocontrols shall meet the applicable requirements of the following industry standard:

**ANSI C136.10-2006** - American National Standard for Roadway and Area Lighting Equipment—Locking-type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

### 4. Requirements

Assembled photocontrols and each of their individual components shall be designed and constructed to have a nominal life of 20 years.

Color code	Black
Plug type	Locking type, three-pole, three-wire
Photosensor type	Silicon
Operating voltage range, volts, ac	105 to 305
Load rating, LED, minimum, watts	1,000
Load rating, incandescent lamp, minimum, watts	1,000
Load rating, high-intensity discharge (HID), minimum, VA	1,800
Operating temperature range, ambient, degrees C	-40 to +70
Turn on response time range, seconds	0.5 to 5.0
Turn off response time range, seconds	0.5 to 5.0
Turn on light level, fc	2.8 +/- 0.6
Turn off light level, maximum, fc	5.1
Turn-off/turn-on ratio, nominal	1.5
Failure mode, nominal	Fail-on

Photocontrol circuit boards shall be constructed of glass epoxy material.

Circuit board components shall be protected from the environment with a thin, transparent coating that does not promote heat build up.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shippek

Unit Director  
Darnell Cola

**MATERIAL STANDARD**

Streetlight Photocontrols, 20-Year Design Life

standard number: **5693.10**

superseding: December 18, 2013

effective date: February 17, 2015

page: 2 of 2

**4. Requirements, continued**

Each photocontrol shall be provided with a means to conveniently and permanently record date of installation and date of removal.

Each photocontrol shall be provided with an internal, 160 joule minimum, metal-oxide varistor (MOV) type surge arrester.

Photocontrols shall be provided with a means of sealing according to the requirements of ANSI C136.10, Section 4.3.

Photocontrol base gasket shall be fabricated from a neoprene blend.

**5. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

**6. Testing**

Photocontrols shall be tested according to the requirements of ANSI C136.10. Test results shall be provided upon request.

**7. Marking**

Each individual photocontrol shall be marked with the following information:

- Manufacturer's name
- Model number
- Voltage rating
- Load rating
- North orientation
- Rotation of installation and removal

**8. Packaging**

Photocontrols shall be individually packaged to prevent damage from storage and handling.

From the outside of each individual package, the manufacturer's name and model number shall be clearly visible.

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

Shipping container weight shall not exceed 50 pounds.

**9. Issuance**

Stock Unit: EA

**10. References**

**SCL Material Standard 5693.00**; "Streetlight Photocontrols" [*Standard Life*]

[www.ripleylightingcontrols.com](http://www.ripleylightingcontrols.com)

[www.sun-tech.biz](http://www.sun-tech.biz)

**11. Sources**

**Chao, Yaochiem**; SCL Standards Engineer and subject matter expert of 5693.10 (yaochiem.chao@seattle.gov)

**Shipek, John**; SCL Standards Engineer, and subject matter expert and originator of 5693.10 (john.shipek@seattle.gov)

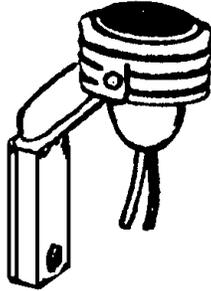
**12. Approved Manufacturers**

Manufacturers and Catalog Numbers

Stock No.	Ripley Lighting Controls	Dark To Light	Sun-Tech (Sunrise Technologies, Inc.)
013129	6390LL-BK-2.8	DLL 127-2.8-BK-JU	TRS-2-8190

# MATERIAL STANDARD

## PHOTOELECTRIC CONTROL MOUNTING BRACKET



The **Mounting Brackets for Photoelectric Controls** may be made of aluminum or galvanized steel. The material and twist-lock receptacle shall conform to ANSI C136.10.

**Reference Specification:** ANSI C136.10 (latest revision).

**Stock Unit:** EA

Stock Number	Approved Manufacturers	
	Fisher-Pierce	Precision
568046	S476-71	M-2A

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Sam S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Kinner</i>	<i>Harold Guy</i>

## Bracket, Aluminum Luminaire Support for Wood Poles



### 1. Scope

This standard covers the requirements for aluminum bracket luminaire supports for wood poles.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Rise (in)	Span (ft)
570501	12	3.25
570502	24	6
570503	24	8
013653	48	6
013654	48	8
570507	48	10

### 2. Application

Luminaire support brackets are used for mounting streetlight luminaires on wood poles.

Luminaire support brackets are installed using one 5/8-in thru bolt, and two 1/2-in lag screws.

Two-inch NPS round tube with .125-in wall thickness is equivalent to a 2-3/8-in outer diameter.

### 3. Industry Standards

Aluminum bracket luminaire supports shall meet the applicable requirements of the following industry standards:

**ANSI C136.13-2004**; latest revision - American National Standards for Roadway and Area Lighting Equipment – Metal Brackets for Wood Poles

**AASHTO Fifth Edition 2009**; American Association of State Highway and Transportation Officials – Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

### 4. Requirements

#### 4.1 Luminaire Support Brackets

Luminaire support brackets for wood pole mounting shall meet the applicable requirements of ANSI C136.13, except as modified herein.

Brackets shall be made from seamless tubing or continuously welded, seamed tubing having a tapered elliptical-to-round configuration as shown. Spot-welded construction is not acceptable.

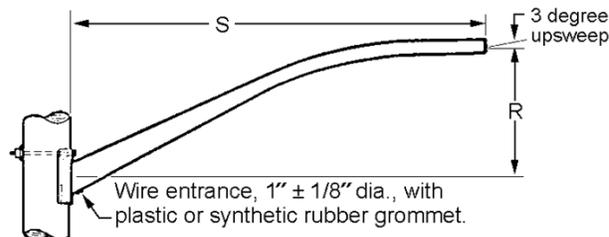
Brackets shall be made of high-strength aluminum alloy capable of withstanding the loading of Sections 12 and 13 and Table 1 of ANSI C136.13.

The luminaire attachment end shall terminate in a 2-in NPS round tube section measuring 7 inches (minimum) in length.

The pole plate shall have a radius of 4-1/2 to 5-3/4 in.

Brackets shall be resistant to the corrosive and erosive action of atmospheric conditions typically encountered in industrial and seaboard areas.

**Figure 4.1. Bracket Span and Rise**

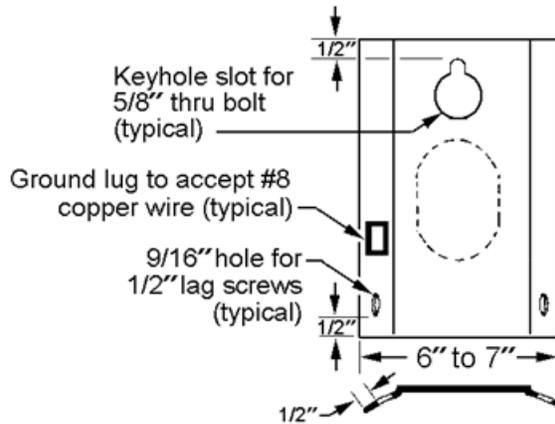


**Table 4.1. Luminaire Support Brackets**

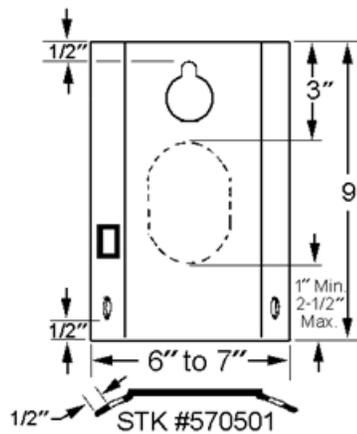
Stock No.	Bracket		Luminaire Max. Wt. (lb)
	Span (S) (ft)	Rise (R) (in)	
570501	3.25	12	50
570502	6.00	24	50
570503	8.00	24	50
013653	6.00	48	50
013654	8.00	48	50
570507	10.00	48	50

**4.2 Mounting**

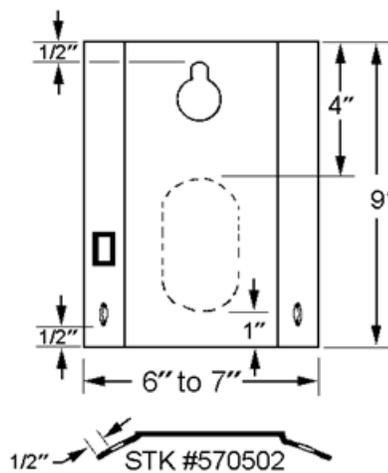
**Figure 4.2.1. General Mounting Detail**



**Figure 4.2.2. Mounting Detail, Stock No. 570501**

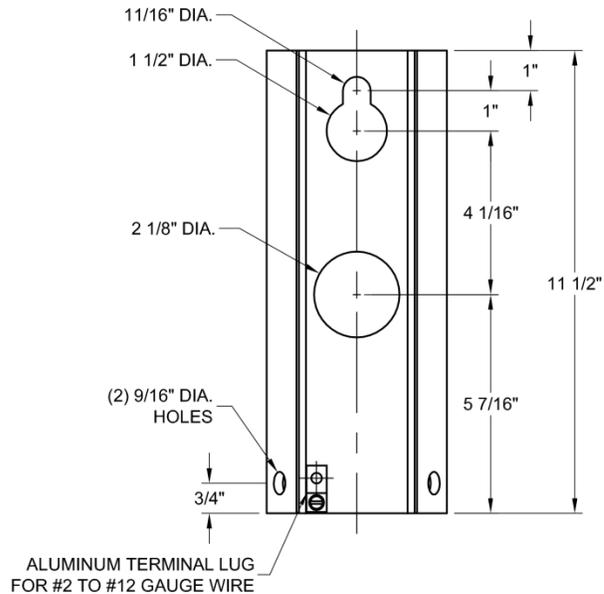


**Figure 4.2.3. Mounting Detail, Stock No. 570502**





**Figure 4.2.6. Mounting Detail, Stock Nos. 013653 and 013654**



**5. Marking**

Support brackets shall be permanently marked with the manufacturer's name or trademark.

**6. Packaging**

Support brackets shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage.

**7. Issuance**

Stock unit: EA

**8. Approved Manufacturers**

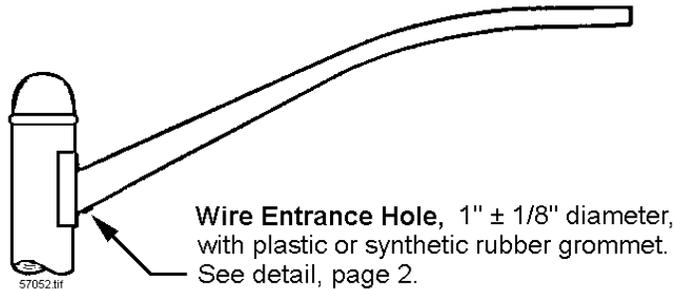
Stock No.	Bracket		Approved Manufacturers	
	Span (S) (ft)	Rise (R) (in)	HAPCO	Valmont/ Lexington-Standard
570501	3.25	12	Order by description	1MA0412B475
570502	6.00	24	Order by description	1MA0624B475
570503	8.00	24	Order by description	1MA0630B86
013653	6.00	48	Order by description	1MA0648B475A
013654	8.00	48	Order by description	1MA0848B475A
570507	10.00	48	Order by description	1MB1048B475B

**9. Sources**

**Chao, Yaochiem**; SCL Standards Engineer and subject matter expert for 5705.10 (yaochiem.chao@seattle.gov)

# MATERIAL STANDARD

## BRACKET, ALUMINUM LUMINAIRE SUPPORT FOR METAL POLES



**Luminaire Support Brackets** for mounting on metal or fiberglass streetlight poles are intended for use with luminaires weighing a maximum of 76 pounds. The support brackets shall meet the applicable requirements of ANSI C136.13 except as modified herein.

The support brackets shall be made of high-strength aluminum alloy capable of withstanding the load requirements of Sections 12 and 13 of ANSI C136.13. The brackets shall be seamless, tapered tubes having an elliptical shape in the vertical plane at the pole end, and terminating in a 2-inch round section having a minimum length of 7 inches at the luminaire attachment end. Spot welded construction is not acceptable. For pole plate details, see page 2 of this standard.

The brackets shall be resistant to the corrosive and erosive action of normally prevailing atmospheric conditions in industrial and seaboard areas.

A one-inch diameter  $\pm$  1/8-inch, **wire entrance hole** shall be drilled on the bottom side of the bracket near the base. The hole edge shall be provided with a plastic or synthetic rubber grommet. For wire entrance hole details, see page 2 of this standard.

**Stainless steel bolts and nuts** shall be 1/2 - 13NC, Class 2A and 2B in accordance with USA Standard B 1.1. Stainless steel may be AISI Types 304 or 305. Lock washers shall be AISI Type 302 stainless steel in accordance with USA B27.1.

**Marking.** The brackets shall be permanently marked with the manufacturer's name or trademark.

**Packaging.** The brackets shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage.

**Reference Specifications:** ANSI C136.13; USA B 1.1, B 27.1;

AISI 304 and 305, latest revisions.

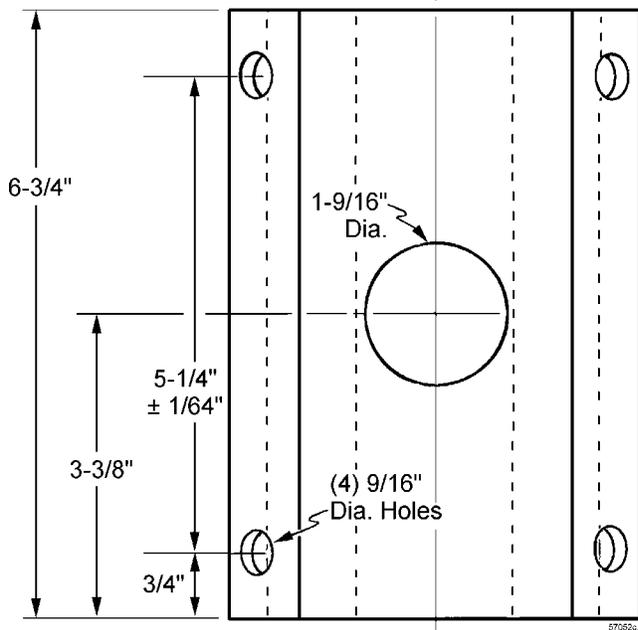
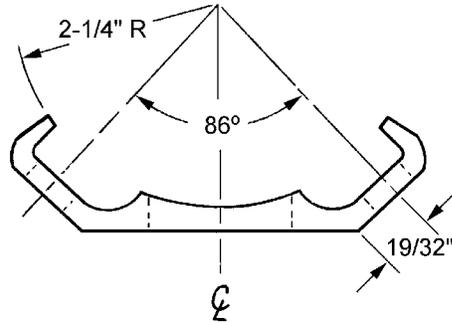
**Stock Unit:** EA

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Schinner</i>	<i>Harold J. J.</i>

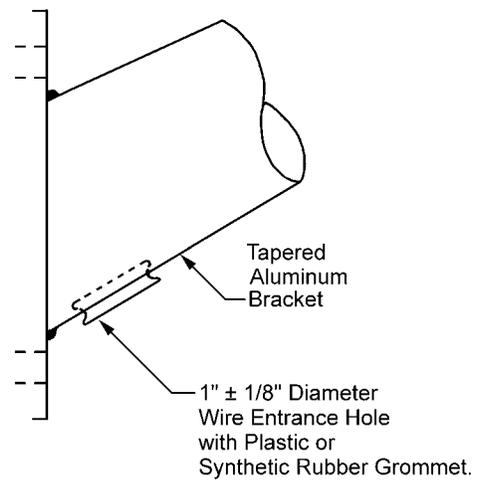
# MATERIAL STANDARD

## BRACKET, ALUMINUM LUMINAIRE SUPPORT

### Pole Plate Details



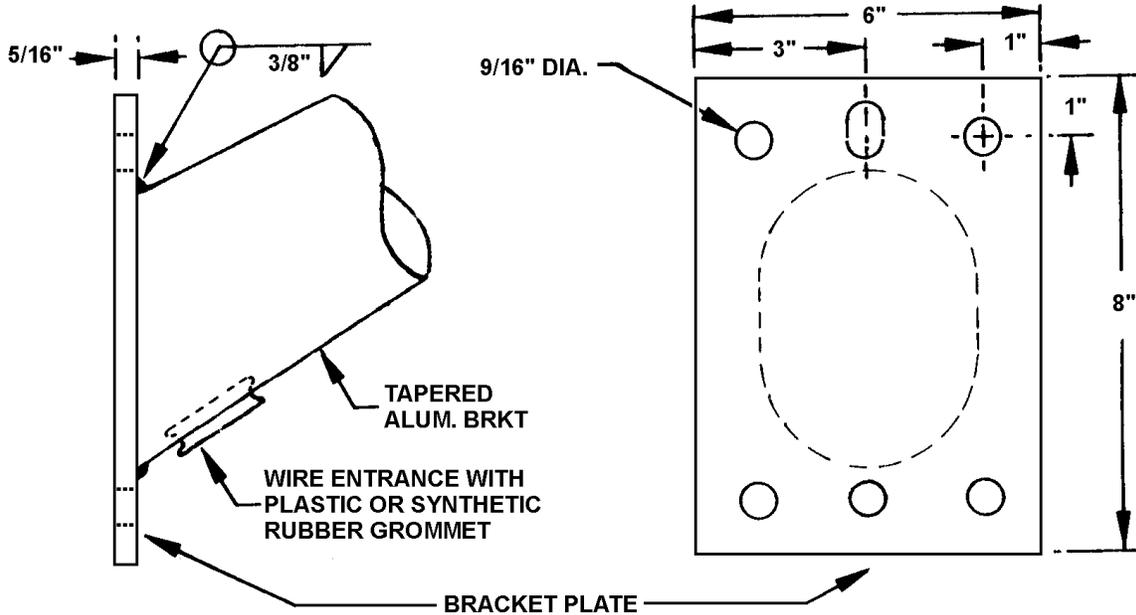
### Wire Entrance Hole Details



Stock Number	Bracket		Approved Manufacturers	
	Length, Feet	Rise, Inches	HAPCO	Valmont/Lexington Standard
570525	4	30	62802	570525
570526	6	30	62803	570526
570527	8	30	62804	570527
570528	10	30	63884	570528

# MATERIAL STANDARD

## BRACKET, ALUMINUM, LUMINAIRE SUPPORT FOR ALLEY WALL MOUNTING



**Luminaire Support Brackets** shall meet the applicable requirements of ANSI C136.13 except as modified herein. The brackets are intended for mounting on alley wall surfaces of wood, brick, or stone.

The support brackets shall be a tapered elliptical configuration as shown, and shall be made of high-strength alloy capable of withstanding the loading of Sections 12 and 13 of ANSI C136.13. The luminaire attachment end shall terminate in a 2-inch NPS round tube section of 7 inches minimum length. The mounting plate shall be of the dimensions shown and made of 6061-T6 aluminum alloy.

The brackets shall be resistant to the corrosive and erosive action of normally prevailing atmospheric conditions encountered in industrial seaboard areas.

**Marking.** The brackets shall be permanently marked with the manufacturer's name or trademark.

**Packaging.** The brackets shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage.

Reference Specifications: ANSI C136.13, latest revision.

Stock Unit: EA

Stock Number	Bracket		Maximum Weight of Luminaire-Lbs.	Approved Manufacturers
	Length-Ft.	Rise-In.		Lexington
570512	3.25	12	50	570512

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles J. Shaffer</i>	<i>John L. Skinner</i>	<i>Betty Robin</i>

**MATERIAL STANDARD**

**FLOODLIGHT, HIGH PRESSURE SODIUM**

- 1. **High Pressure Sodium Floodlight** shall be outdoor type, utilizing lamps in the horizontal position, and intended for operation on distribution voltages as specified in the purchase order.

Floodlight shall consist of floodlight housing, lamp socket, ballast, and photoelectric cell receptacle. Floodlights shall have an ANSI approved decal (three inches square) attached to the housing so as to be readily visible from the ground, indicating the lamp type color code, i.e., gold for "high pressure sodium," and the lamp wattage by numerical code. Floodlight distribution patterns shall conform to NEMA Type 6 horizontal beam spread and Type 5 vertical to provide sharp cutoff at the property line. All cutoff application occurs at 80 degrees or less above nadir. Distribution shall be free from hot spots.

- 2. **Construction**

Die cast aluminum housing suitable for wet locations, with heavy-gauge galvanized steel yoke which shall have aiming quadrants marked in 10 degree increments. Photoelectric control receptacle shall be NEMA three terminal, polarized twist-lock type; lamp socket shall be spring loaded center contact, high pressure sodium socket which is pulse rated for 4 kV. Floodlight will be prewired with four feet of No. 14/3 type SOW-A or STW-A cord. Housing color: gray or dark bronze.

- 3. **Ballast**

The integral ballast shall be high power factor (CWA) and completely wired to the terminal board and lamp socket. Ballasts will be multi-tap 120/208/240/277 volt and will be factory wired for 277 volts.

- 4. **Packaging**

The floodlight shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage. The package shall be marked with the floodlight's date of manufacture.

- 5. **Stock Unit:** EA

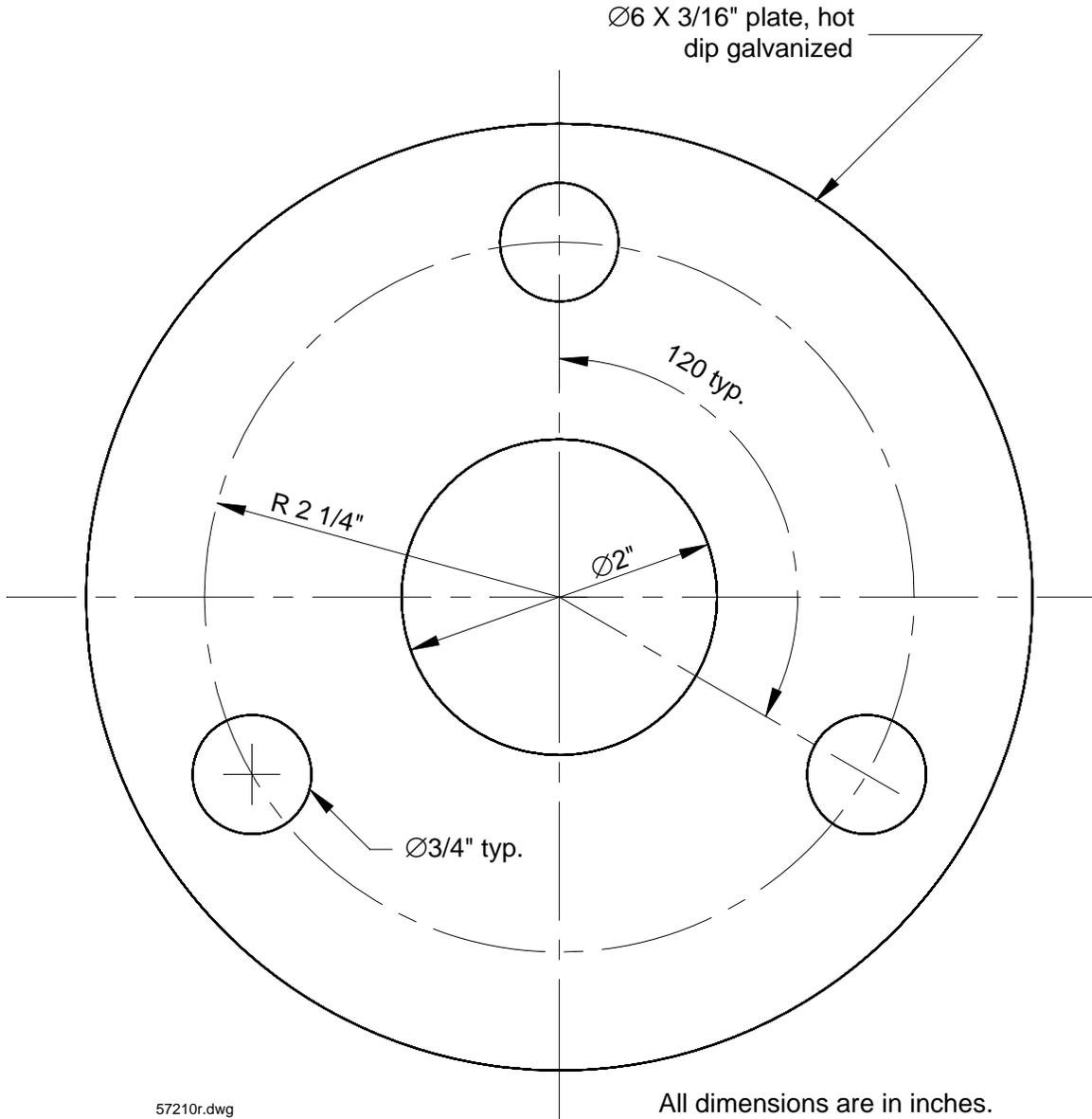
Stock Number	Lamp Watts	Primary Voltage	Approved Manufacturers and Catalog Numbers		
			American Electric	Cooper	General Electric
568166	400	multitap	S-510021	CFB40SWN65U0041	HLUF40SOA26X5DB
568168	250	multitap	S-510132	CFB25SWN65U0476	HLUF25SOA26X5DB

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Charles L. Shaffer</i>	<i>John Schinner</i>	<i>Harold Juy</i>

**MATERIAL STANDARD**

**COMPRESSION PLATE FOR  
THREE GLOBE LUMINAIRE**

This plate is used to adapt the three globe luminaire, Stock No. 572900 to fluted steel poles.



57210r.dwg

All dimensions are in inches.

Stock Unit: Each

Shop made

Plates shall be hot dip galvanized in conformance with ASTM A-153.

Stock No. 572902

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Betty Robini</i>

**MATERIAL STANDARD**

**LAMP, INCANDESCENT, MOGUL BASE**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for single-ended, incandescent streetlight lamps with mogul screw bases.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Wattage
730582	500
730584	1000

**1.2 Application**

Lamps are for installation in open or enclosed, incandescent streetlight luminaires with mogul screw base lamp holders. Lamps have no restriction on burning position.

**1.3 Industry Standards**

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.22-1995 (R2003)** – American National Standard for Electric Lamps – A, G, PS, and Similar Shapes with E39 Mogul Screw Bases

**2. Construction**

Lamps shall meet the applicable requirements of ANSI C78.22 and Table 1 of this material standard with the following clarifications:

Lamps shall be capable of operation in all positions.

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 Richard Kent

**MATERIAL STANDARD**

Lamp, Incandescent, Mogul Base

**2. Construction, continued**

Lamp bases shall be E39 mogul screw.

Lamp base connections shall be welded.

Lamps average rated life shall be defined as:

The total operation hours at which 50% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamps shall be compliant with the Toxicity Characteristic Leaching Procedure (TCLP) test specified in the Resource Conservation and Recovery Act (RCRA) of 1990.

**Table 1**

Stock Number	Wattage	ANSI Designation		Rated Voltage, volts	Average Rated Life, hours	Glass Bulb Finish
		Lamp	Bulb			
730582	500	none	PS-35 or PS-40	130	1000	clear
730584	1000	none	PS-52	130	-	clear

**3. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.22 and this material standard shall be provided upon request.

**4. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation. Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

**5. Shipping**

Lamps shall be shipped in whole cartons only.

Lamps shall be shipped to the address specified on the Purchase Order.

**6. Issuance**

EA

**7. Approved Manufacturers**

Stock Number	Wattage	General Electric		OSRAM/Sylvania		Phillips	
		Order Code	Description	Item Number	Ordering Abbreviation	Product Number	Ordering Code
730582	500	-	-	16034	500PS35/CL 130V	-	-
730584	1000	-	-	-	-	-	-

**MATERIAL STANDARD**

**LAMP, HIGH PRESSURE SODIUM, STANDARD LIFE, MEDIUM BASE**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for standard life, single-ended, single arc tube, high pressure sodium, streetlight lamps with medium screw bases. High pressure sodium (HPS) lamps are a subcategory of high intensity discharge (HID) lamps.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Wattage	Bulb Finish
572270	35	clear
572220	35	coated
572225	50	coated
572230	70	coated
572232	100	clear
572233	150	clear

**1.2 Application**

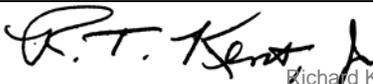
Lamps are for installation in open or enclosed, high pressure sodium streetlight luminaires with medium screw base lamp holders. Lamps have no restriction on burning position.

For similar lamps with mogul screw base, refer to Material Standard 5772.40.

**1.3 Industry Standards**

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.42-2004** – American National Standard for Electric Lamps: High-Pressure Sodium Lamps

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 Richard Kent

**MATERIAL STANDARD**

Lamp, High Pressure Sodium, Standard Life, Medium Base

**2. Construction**

Lamps shall meet the applicable requirements of ANSI C78.42 and Table 1 of this material standard with the following clarifications:

Lamps shall be of single arc tube design.

Lamps shall be capable of operation in all positions.

Lamp bases shall be E26 / 24 medium screw.

Average rated life is defined as:

The total operation hours at which 65% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamp color rendering index (CRI) shall be 21 or greater.

Lamps shall cycle at end-of-life.

**Table 1**

Stock Number	Wattage	ANSI Designation		Average Rated Life, hours	Minimum Output, lumens		Minimum Correlated Color Temp., K	Glass Bulb Finish
		Lamp	Bulb		Initial	Mean		
572270	35	S76/O-ZL	B17, BD-17, E17, ED-17	16000	2250	2025	1600	clear
572220	35	S76/O-ZL	B17, BD-17, E17, ED-17	16000	2100	1935	1900	coated
572225	50	S68/O-ZL	B17, BD-17, E17	24000	3700	3420	1900	coated
572230	70	S62/O-ZL	B17, BD-17, E17	24000	5800	4900	1900	coated
572232	100	S54/O-ZL	B17, BD-17, E17	24000	9500	8000	2000	clear
572233	150	S55/O-RV	B17, BD-17, E17	24000	15800	13400	2000	clear

**3. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.42 and this material standard shall be provided upon request.

**4. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation.

Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

**5. Shipping**

Lamps shall be shipped in whole cartons only.

Lamps shall be shipped to the address specified on the Purchase Order.

**6. Issuance**

EA

**MATERIAL STANDARD**

Lamp, High Pressure Sodium, Standard Life, Medium Base

PAGE: 3 of 3

SUPERSEDING: new

EFFECTIVE DATE: February 7, 2008

**7. Approved Manufacturers**

Stock Number	Wattage	General Electric (Lucalox)		OSRAM/Sylvania (Lumalux)		Phillips (Ceramalux)	
		Order Code	Description	Item Number	Ordering Abbreviation	Product Number	Ordering Code
572270	35	11668	LU35/MED	67500	LU35/MED	046677-30632-4	C35S76/M
572220	35	11669	LU35/D/MED	67501	LU35/D/MED	046677-30633-2	C35S76/D/M
572225	50	11347	LU50/D/MED	67503	LU50/D/MED	046677-30337-0	C50S68/D/M
572230	70	11340	LU70/D/MED	67505	LU70/D/MED	046677-33214-8	C70S62/D/M
572232	100	13250	LU100/MED	67506	LU100/MED	046677-34446-5	C100S54/M
572233	150	13252	LU150/MED	67508	LU150/55/MED	046677-30347-9	C150S55/M

**LAMP, HIGH PRESSURE SODIUM, 30,000 HOUR, MOGUL BASE**



**1. Scope**

This material standard covers the requirements for extended life, single-ended, single arc tube, high pressure sodium, streetlight lamps with mogul bases. High pressure sodium (HPS) lamps are a subcategory of high intensity discharge (HID) lamps.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Wattage
013014	50
013015	70
012743	100
013016	150
013017	200
012744	250
012745	400

**2. Application**

Lamps are for installation in open or enclosed, high pressure sodium streetlight luminaires with mogul lamp holders. Lamps have no restriction on burning position.

Extended life lamps are well-suited for group re-lamping.

Two-hundred watt lamps, Stock Number 013017, are used in the Battery Street Tunnel.

**3. Industry Standards**

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.42-2004** – American National Standard for Electric Lamps: High-Pressure Sodium Lamps

**4. Construction**

Lamps shall meet the applicable requirements of ANSI C78.42 and Table 4.1 of this material standard with the following clarifications:

Lamps shall be of single arc tube design.

Lamps shall be capable of operation in all positions.

Lamp bases shall be E39 mogul screw.

Lamp base connections shall be welded.

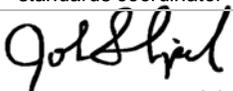
Lamps shall have an average rated life of 30,000 hours, where average rated life is defined as:

The total operation hours at which 65% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamp color rendering index (CRI) shall be 21 or greater.

Lamps shall be compliant with the Toxicity Characteristic Leaching Procedure (TCLP) test specified in the Resource Conservation and Recovery Act (RCRA) of 1990.

Lamps shall extinguish and remain off at end-of-life.

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

Lamp, High Pressure Sodium, 30,000 Hour, Mogul Base

standard number: **5722.45**

superseding: February 19, 2010  
 effective date: September 16, 2010  
 page: 2 of 3

**4. Construction, continued**

**Table 4.1**

Stock Number	Wattage	ANSI Designation		Minimum Lumen Output		Minimum Correlated Color Temp., K	Glass Blub Finish
		Lamp	Blub	Initial	Mean		
013014	50	S68	ED-23.5 or ET-23.5	4000	3600	1900	clear
013015	70	S62	ED-23.5 or ET-23.5	6300	5600	1900	clear
012743	100	S54/O-NV	ED-23.5 or ET-23.5	9400	8000	2000	clear
013016	150	S55	ED-23.5 or ET-23.5	16000	13500	2100	clear
013017	200	S66	ED-18 or ET-18	22000	19800	2100	clear
012744	250	S50/O-EJ	ED-18 or ET-18	27000	24300	2100	clear
012745	400	S51/O-EJ	ED-18 or ET-18	50000	45000	2100	clear

**5. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.42 and this material standard shall be provided upon request.

**6. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation.

Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

Lamps shall be shipped in whole cartons only.

**7. Issuance**

Stock Unit: EA

**8. Approved Manufacturers**

Stock Number	Wattage	OSRAM/Sylvania (Lumalux PLUS ECO)		Phillips (Ceramalux ALTO)	
		Product No.	Ordering Abbreviation	Product No.	Ordering Code
013014	50	67607	LU50/PLUS/ECO	na	na
013015	70	67497	LU70/PLUS/ECO	147397	C70S62/ALTO NC HPS
012743	100	67559	LU100/PLUS/ECO	147405	C100S54/ALTO NC HPS
013016	150	67949	LU150/PLUS/ECO	147413	C150S55/ALTO NC HPS
013017	200	67495	LU200/PLUS/ECO	157255	C200S66/ALTO NC HPS
012744	250	67572	LU250/PLUS/ECO	147421	C250S50/ALTO NC HPS
012745	400	67312	LU400/PLUS/ECO	147439	C400S51/ALTO NC HPS

## MATERIAL STANDARD

Lamp, High Pressure Sodium, 30,000 Hour, Mogul Base

standard number: **5722.45**

superseding: February 19, 2010  
effective date: September 16, 2010  
page: 3 of 3

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### 9. References

**5722.40** (canceled); "Lamp, High Pressure Sodium, 24,000 Hour, Mogul Base"; Material Standard; SCL

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 5722.45  
(john.shipek@seattle.gov)

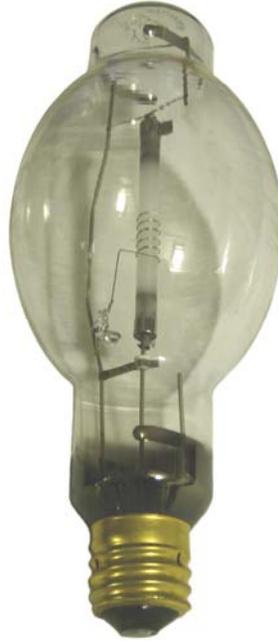
**Smalley, Ed**; SCL Standards Engineer, subject matter expert (ed.smalley@seattle.gov)

**Sylvania Lamp and Ballast Product Catalog 2004**  
(CATALOG04); Sylvania; 2004

**Sylvania PIB HID 018R12**; 11/09

# MATERIAL STANDARD

## LAMP, HIGH PRESSURE SODIUM, FOR MERCURY LUMINAIRES



### 1. Foreword

#### 1.1 Scope

This material standard covers the requirements for standard life, single-ended, single arc tube, high pressure sodium, streetlight lamps for use in mercury luminaires (only). High pressure sodium (HPS) lamps are a subcategory of high intensity discharge (HID) lamps.

This material standard applies to the following Seattle City Light Stock Number:

Stock Number	Wattage
572248	360

#### 1.2 Application

Lamps are intended for installation in open or enclosed, mercury luminaires where the efficiency of high pressure sodium lighting is desired, but it is not convenient or practical to replace the existing fixture. Lamps have no restriction on burning position.

**Special note:** Lamps may only be used in luminaires with 400 watt, mercury lag or reactor ballasts (ANSI mercury ballast No. H33).

#### 1.3 Industry Standards

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.42-2004** – American National Standard for Electric Lamps: High-Pressure Sodium Lamps

STANDARDS COORDINATOR

John Shipek

STANDARDS SUPERVISOR

John Barnett

UNIT DIRECTOR

John Nierenberg

**MATERIAL STANDARD**

Lamp, High Pressure Sodium, For Mercury Luminaires

**2. Construction**

Lamps shall meet the applicable requirements of ANSI C78.42 and Table 1 of this material standard with the following clarifications:

Lamps shall be of single arc tube design.

Lamps shall be capable of operation in all positions.

Lamp bases shall be E39 mogul screw.

Lamp base connections shall be welded.

Lamps shall have an average rated life of 16,000 hours, where average rated life is defined as:

The total operation hours at which 65% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamp color rendering index (CRI) shall be 20 or greater.

Lamps shall be compliant with the Toxicity Characteristic Leaching Procedure (TCLP) test specified in the Resource Conservation and Recovery Act (RCRA) of 1990.

Lamps shall extinguish and remain off at end-of-life.

**Table 1**

Stock Number	Wattage	ANSI Designation		Minimum Lumen Output		Minimum Correlated Color Tempature, K	Glass Bulb Finish
		Lamp	Bulb	Initial	Mean		
572248	360	S64	BT-37	36500	32800	2060	clear

**3. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.42 and this material standard shall be provided upon request.

**4. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation. Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

**5. Shipping**

Lamps shall be shipped in whole cartons only.

Lamps shall be shipped to the address specified on the Purchase Order.

**6. Issuance**

EA

**7. Approved Manufacturers**

Stock Number	Wattage	General Electric		OSRAM/ Sylvania (Unalux)		Phillips	
		Order Code	Description	Item No.	Ordering Abbreviation	Product No.	Ordering Code
572248	360	none	none	67531	ULX360	none	none

**MATERIAL STANDARD**

**LAMP, MERCURY**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for single-ended, mercury streetlight lamps with mogul screw bases. Mercury lamps are a subcategory of high intensity discharge (HID) lamps.

This material standard applies to the following Seattle City Light Stock Numbers:

<b>Stock Number</b>	<b>Wattage</b>
572205	175
572201	400

**1.2 Application**

Lamps are for installation in open or enclosed, mercury streetlight luminaires with mogul screw base lamp holders. Lamps have no restriction on burning position.

**1.3 Industry Standards**

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.40-1992 (R2003)** – American National Standard for Mercury Lamps – Specifications

**2. Construction**

Lamps shall meet the applicable requirements of ANSI C78.40 and Table 1 of this material standard with the following clarifications:

Lamps shall be capable of operation in all positions.

Lamp bases shall be E39 mogul screw.

STANDARDS COORDINATOR

*John Shipek*  
John Shipek

STANDARDS SUPERVISOR

*John Barnett*  
John Barnett

UNIT DIRECTOR

*Richard Kent*  
Richard Kent

**MATERIAL STANDARD**

Lamp, Mercury

**2. Construction, continued**

Lamps shall have an average rated life of 24,000 hours, where average rated life is defined as:

The total operation hours at which 50% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamp color rendering index (CRI) shall be 45 or greater.

Lamps shall be deluxe white.

**Table 1**

Stock Number	Wattage	ANSI Designation		Minimum Output, lumens		Minimum Correlated Color Temp., K	Glass Blub Finish
		Lamp	Bulb	Initial	Mean		
572205	175	H39KC-175/DX	BT-28, ED-28	7800	6800	3700	phosphor-coated
572201	400	H33GL-400/DX	BT-37, ED-37	22600	14400	3700	phosphor-coated

**3. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.40 and this material standard shall be provided upon request.

**4. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation. Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

**5. Shipping**

Lamps shall be shipped in whole cartons only.

Lamps shall be shipped to the address specified on the Purchase Order.

**6. Issuance**

EA

**7. Approved Manufacturers**

Stock Number	Wattage	General Electric		OSRAM/Sylvania (Mercury Vapor)		Phillips	
		Order Code	Description	Item Number	Ordering Abbreviation	Product Number	Ordering Code
572205	175	24062	HR175DX39	69445	H39KC-175/DX	248054	H39KC-175DX
572201	400	23998	HR400DX33	69450	H33GL-400/DX	248427	H33GL-400DX

# MATERIAL STANDARD

## LAMP, METAL HALIDE



### 1. Foreword

#### 1.1 Scope

This material standard covers the requirements for single-ended, metal halide streetlight lamps with mogul screw bases. Metal halide lamps are a subcategory of high intensity discharge (HID) lamps.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Wattage
572255	400

#### 1.2 Application

Lamps are for installation in open or enclosed, metal halide streetlight luminaires with mogul screw base lamp holders. Lamps have no restriction on burning position.

#### 1.3 Industry Standards

Lamps shall meet the applicable requirements of the following industry standards:

**ANSI C78.43-2005** – American National Standard for Electric Lamps – Single-Ended Metal Halide Lamps

### 2. Construction

Lamps shall meet the applicable requirements of ANSI C78.43 and Table 1 of this material standard with the following clarifications:

Lamps shall be capable of operation in all positions.

Lamp bases shall be E39 mogul screw.

STANDARDS COORDINATOR

John Shipek

STANDARDS SUPERVISOR

John Barnett

UNIT DIRECTOR

Richard Kent

**MATERIAL STANDARD**

Lamp, Metal Halide

**2. Construction, continued**

Lamps shall have an average rated life of 20,000 hours, where average rated life is defined as:

The total operation hours at which 50% of any group of lamps is still operating. The average life of a lamp shall be based on vertical operation (unless otherwise noted) of representative lamps operated under controlled conditions of up to 15 hours per start.

Lamp color rendering index (CRI) shall be 65 or greater.

Lamps shall be compliant with the Toxicity Characteristic Leaching Procedure (TCLP) test specified in the Resource Conservation and Recovery Act (RCRA) of 1990.

**Table 1**

Stock Number	Wattage	ANSI Designation		Minimum Output, lumens		Minimum Correlated Color Temp., K	Glass Bulb Finish
		Lamp	Bulb	Initial	Mean		
572255	400	M59PJ	BT-37, ED-37	36000	24400	4000	clear

**3. Tests and Test Reports**

Lamp test data that establishes compliance with the requirements of ANSI C78.43 and this material standard shall be provided upon request.

**4. Packaging**

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation. Quantity of lamps per shipping carton shall be as mutually agreed upon between supplier and Seattle City Light.

**5. Shipping**

Lamps shall be shipped in whole cartons only.

Lamps shall be shipped to the address specified on the Purchase Order.

**6. Issuance**

EA

**7. Approved Manufacturers**

Stock Number	Wattage	General Electric		OSRAM/Sylvania		Phillips (Protected MasterColor)	
		Order Code	Description	Item Number	Ordering Abbreviation	Product Number	Ordering Code
572255	400	-	-	-	-	MH400/U	34415-0

## Lamp, LED, Medium Base, White Light



### 1. Scope

This standard covers the requirements for white, single-ended, light-emitting diode (LED) lamps with medium screw (E26) bases.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Color	Incandescent Equivalent (W)
013673	2700K, warm white	60
013674	5000K, cool white	60
013675	2700K, warm white	100
013676	5000K, cool white	100

### 2. Application

White light LED lamps:

- Are instant-on.
- Are mercury-free.
- Have an omnidirectional beam spread.
- Are shatter resistant.
- Are UL Listed for installation in damp locations, but are not for use where exposed directly to weather or water.
- Are suitable for installation in open fixtures.
- Are dimmable.
- Are suitable for installation in 130 VDC lighting applications.

Installations in enclosed fixtures vary by manufacturer. See Section 9 for specific details regarding ratings for enclosed fixture installations.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

Handwritten signature of Yaochiem Chao.

Handwritten signature of John Shipek.

Handwritten signature of Darnell Cola.

### 3. Industry Standards

**ANSI C78.20-2003**; American National Standard for Electric Lamps – A, G, PS, and Similar Shapes with E26 Medium Screw Bases

**ANSI C78.377-2008**; American National Standard for Specifications for the Chromaticity of Solid State Lighting Products

### 4. Requirements

Lamps shall meet the applicable requirements of ANSI C78.20 and Table 4 of this standard with the following clarifications:

- Lamp bases shall be E26 medium screw.
- Lamp base connections shall be welded.

**Table 4. Requirements for White Light LED Lamps**

Stock No.	Color	Incandescent Equivalent (W)	Bulb Shape	Lumens	Input Voltage (V)	Nominal Input Power (W)
013673	2700K, warm white	60	A19	800	120	10
013674	5000K, cool white	60	A19	850	"	10
013675	2700K, warm white	100	A21	1600	"	18
013676	5000K, cool white	100	A21	1675	"	18

#### 4.1 Lamp Performance

Rated lamp life, minimum, hours	25,000
Operating temperature range	
°C	-30 to 40
°F	-13 to 104
Power factor, minimum	0.90
Color rendering index (CRI), minimum	80

### 5. Tests and Test Reports

Lamp test data that establishes compliance with the requirements of ANSI C78.20, ANSI C78.377, and this material standard shall be provided upon request.

### 6. Packaging

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation.

Quantity of lamps per shipping carton is specified in the catalog number. See Section 9 for details.

## 7. Shipping

Lamps shall be shipped in whole cartons only.

## 8. Issuance

EA

## 9. Approved Manufacturers

Stock No.	Color	Incandescent Equivalent (W)	Bulb Shape	Manufacturer	Catalog No.	Rated for Enclosed Fixture	Carton Qty
013673	2700K, warm white	60	A19	Cree, Inc.	A19-60W-27K-B1	Yes	6
				Cree, Inc.	A19P-60W-27K-B1	Yes	8
				TCP	LED-10-A19-D-OD-27K	Yes	12
013674	5000K, cool white	60	A19	Cree, Inc.	A19-60W-50K-B1	Yes	6
				Cree, Inc.	A19P-60W-50K-B1	Yes	8
				TCP	LED-10-A19-D-OD-50K	Yes	12
013675	2700K, warm white	100	A21	Cree, Inc.	A21-100W-27K-B1	No	5
				TCP	LED-18-A21-D-OD-27K	Yes	12
013676	5000K, cool white	100	A21	Cree, Inc.	A21-10W-27K-TB1	No	5
				TCP	LED-18-A21-D-OD-50K	Yes	12

## 10. Sources

**Byun, Robin**; SCL Standards Engineer and subject matter expert for 5722.81  
 (robin.byun@seattle.gov)

**Chao, Yaochiem**; SCL Standards Engineer and originator of 5722.81  
 (yaochiem.chao@seattle.gov)

**Cree, Inc.**; A19 LED Bulbs Specification Sheet; Version 5, Revision Date 10/28/2014

**Cree, Inc.**; A19P LED 4Flow Bulbs Specification Sheet; Revision Date 12/02/2014

**Cree, Inc.**; A21 LED Bulbs Specification Sheet; Version 4, Revision Date 1/29/2015

**TCP**; Specification Sheet 54031 Elite A19 A-Lamps Omni-Directional; Revision Date September 2014

**TCP**; Specification Sheet 54720 Elite High Output A-Lamps Omni-Directional; Revision Date January 2015

## Lamp, LED, Medium Base, Color Light



### 1. Scope

This standard covers the requirements for color, single-ended, light-emitting diode (LED) lamps with medium screw (E26) bases.

This standard applies to the following Seattle City Light stock numbers:

Stock No.	Incandescent Equivalent (W)	Color
013677	40	Red
013678	40	Green

### 2. Application

Color LED lamps are used as status indicators on vault-installed transformers.

Color LED lamps:

- Are instant-on.
- Are mercury-free.
- Have a minimum 200-degree beam spread.
- Are shatter resistant.
- Are UL Listed for installation in damp locations.
- Are suitable for installation in open and enclosed fixtures.
- Are dimmable.
- FCC and RoHS compliant.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



---

### 3. Industry Standards

**ANSI C78.20-2003** – American National Standard for Electric Lamps – A, G, PS, and Similar Shapes with E26 Medium Screw Bases

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### 4. Requirements

Lamps shall meet the applicable requirements of ANSI C78.20 and Table 4 of this standard with the following clarifications:

- Lamp bases shall be E26 medium screw.
- Lamp base connections shall be welded.

**Table 4. Requirements for Color LED Lamps**

Stock No.	Color	Incandescent Equivalent (W)	Input Voltage (V)	Nominal Power (W)
013677	Red	40	120	3
013678	Green	40	120	3

#### 4.1 Lamp Performance

Rated lamp life, minimum, hrs	25,000
Operating temperature range	
°C	-4 to 40
°F	-4 to 104
Power factor, minimum	0.90

---

### 5. Tests and Test Reports

Lamp test data that establishes compliance with the requirements of ANSI C78.20 and this standard shall be provided upon request.

---

### 6. Packaging

Lamps shall be individually packaged to prevent damage during shipping, storage, and casual handling prior to installation.

Quantity of lamps per shipping carton is detailed in the catalog number. See section 9 for details.

---

### 7. Shipping

Lamps shall be shipped in whole cartons only.

---

### 8. Issuance

EA

## 9. Approved Manufacturers

<b>Stock No.</b>	<b>Color</b>	<b>Incandescent Equivalent (W)</b>	<b>Manufacturer</b>	<b>Catalog No.</b>
013677	Red	40	FEIT Electric	A19/R/LED
013678	Green	40	FEIT Electric	A19/G/LED

---

## 10. Sources

**Byun, Robin**; SCL Standards Engineer and subject matter expert for 5722.91  
(robin.byun@seattle.gov)

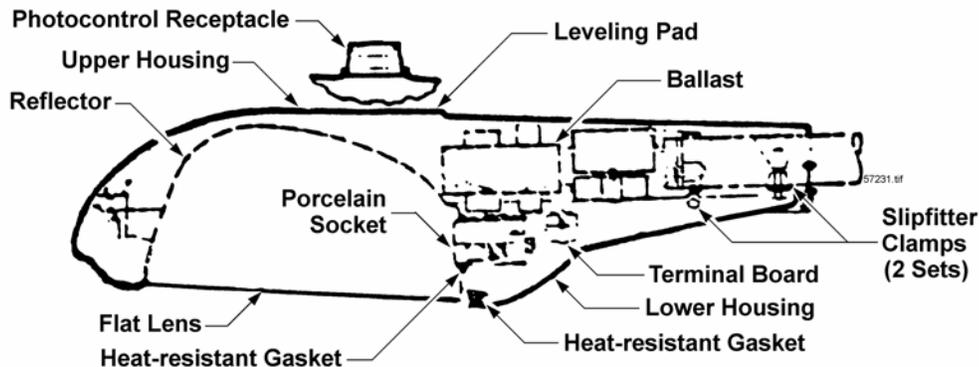
**Chao, Yaochiem**; SCL Standards Engineer and originator of 5722.91  
(yaochiem.chao@seattle.gov)

**FEIT Electric**; Green LED Lamp Specifications

**FEIT Electric**; Red LED Lamp Specifications

**MATERIAL STANDARD**

**CUTOFF LUMINAIRES, HIGH-PRESSURE SODIUM VAPOR WITH INTERNAL BALLAST**



**1. Scope**

**High-pressure Sodium Vapor Luminaires** shall be of the end-mounted type, utilizing lamps in the horizontal position and intended for operation on distribution voltages as specified in the purchase order.

**2. Industry Standards**

**ANSI C136.2;** Roadway Lighting Equipment - Luminaire Voltage Classification

**EEI TDJ-148;** Future Design of Luminaire Head to Receive External, Locking Type Unit Control (Except that the three-wire hookup referred to in TDJ-148 is not used; only the two-wire hookup is used.)

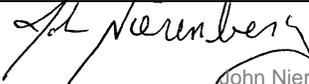
**IESNA LM-31;** Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge Lamps

**IESNA Lighting Handbook,** latest edition

**City of Seattle Standard Specifications 9-31.1(2);** Luminaires

**3. Luminaires**

Luminaires shall be "cobrahead" style and shall consist of a luminaire housing, lamp socket, ballast, and photoelectric cell receptacle. Luminaires shall have an ANSI-approved decal (three inches square) attached to the housing so as to be readily visible from the ground, indicating lamp type by color code (e.g., gold for "high-pressure sodium"), and lamp wattage by numerical code. Luminaire light distribution patterns shall conform to the IESNA classification system for Type III medium cutoff for less than 200 watts and Type II short cutoff for 200 watts and more. Reflectors shall be rigidly located so as not to vary light distribution after normal maintenance. Glare control shall be accomplished by use of a flat lens. Minimum streetside utilization shall be 39 percent at 1.5 transverse mounting height. Distribution shall be free from striations and hot spots. Photometric performance will be subject to testing by the Washington State Material Testing Laboratory to ensure conformance with these specifications and the photometric data submitted. A sample luminaire shall be submitted for testing when requested by the City Light Department.

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 John Nierenberg

**MATERIAL STANDARD**

Cutoff Luminaires, High –Preessure Sodium Vapor with Internal Ballast

**4. Construction**

The die cast housing shall have means for leveling, leveling clamps that are factory set for two-inch diameter pipe brackets (two sets of clamps are required equipped with lock washers on all four bolts), porcelain-enclosed lamp socket, heat-resistant sealing gaskets, grounding terminals on the terminal board, and prewired twist-lock photoelectric control receptacle. The reflector shall be aluminum with specular Alzak finish. Flat glass refractor shall be made of heat-resistant borosilicate glass. The lamp socket shall be adjustable in the horizontal and vertical axis and factory set to provide IESNA-approved distribution. Protective wire sleeves shall be provided in the high-temperature areas within the luminaire. A filter shall be positioned in such a manner that it shall allow circulation of air through the optical assembly and effectively filter out external contaminants. The luminaire shall have a nameplate identifying wattage, voltage, manufacturer, and date of manufacture.

**5. Ballast**

The integral ballast shall be multitap (120 / 208 / 240 / 277 volt) high-power factor, regulator-type, and completely wired at 277V to the terminal board and lamp socket. Windings shall be of copper wire.

**6. Packaging**

The luminaire shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage. The package shall be marked with the luminaire's date of manufacture.

**7. Stock Unit: EA**

**8. Approved Manufacturers**

Stock Number	Watts	American Electric	General Electric
572408	100	115 10S CA MT7 R3 FG 4B	MSCA10S0A22FMC3C(001)
572407	150	115 15S CA MT7 R3 FG 4B	MSCA15S0A22FMC3C(001)
572800	250	125 25S CA MT7 R2 FG	MSCA25S0A22FMC2C(001)
572801	400	125 40S CA MT7 R2 FG with copper ballast winding	MSCA40S0A22FMC2C(001)

## Pedestrian Luminaire, LED, Post-Top, Historic



### 1. Scope

This standard covers the requirements for light-emitting diode (LED), post-top, historic, pedestrian luminaires.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Color	Description
013679	Black	Serenade S56
013680	Dark green	Serenade S56
013681	Black	K56 Cleveland
013682	Red	K56 Cleveland

### 2. Application

Historic LED luminaires are:

- Installed in City-designated areas and SCL-designated streetlight districts.
- Post-top mounted on streetlight poles with a 4-in pole-top outer diameter.
- Equipped with a built-in slip-fitter with a tool-less door to house a standard, three-pin photocontrol.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Historic LED luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008**; Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.10–2010**; Locking-Type Photocontrol Devices and Mating Receptacles.

**ANSI C136.31–2010**; American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37–2011**; American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**ANSI C136.41–2013**; Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15–2011** (or latest); American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22–2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**Federal Trade Commission (FTC)**; Green Guides, 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of Protection Provided by Enclosures (IP Code), consolidated edition

**IEEE C62.41.2–2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11 (revised)**; Luminaire Classification System for Outdoor Luminaires

**RoHS** (European Union Directive 2002/95/EC for Restriction of Hazardous Substance)

**Title 47 of the Code of Federal Regulations (CFR)**, Part 15; Radio Frequency Devices

**UL 1598**; Luminaires; UL

## 4. Requirements

### 4.1 Luminaire Performance

Operating temperature, range	
°C	-40 to +55
°F	-40 to +130
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377	4000 ± 200
Color rendering index (CRI), minimum	70
L70 Lumen depreciation of LED light sources per IES LM-80, hours, minimum	100,000
Light distribution, IES	Type 5
Luminaire efficacy, lumens/watt, minimum, per IES LM-79, Section 11.0	102.6
Off-state power consumption, W, maximum	0.5

### 4.2 Power Supply/Driver

Input voltage, functional range, 60 Hz, Vac	120 to 277
Dimming control signal interface operative range, Vdc	0 to 10
Power factor, minimum	90

### 4.3 Construction

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to:

- Mounting provisions
- Latching and hinging
- Terminal blocks
- Dimming
- Ingress protection
- Wiring and grounding
- Photocontrol receptacle

Luminaire shall be RoHS compliant. Luminaire shall have less than the maximum concentration values of the following RoHS-restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb)

#### 4.4 Fixture Housing

Luminaire weight, lb, maximum	60
Effective projected area (EPA), ft <sup>2</sup> , maximum	2.2
External housing, ingress protection per IEC 60529	IP65
Optical chamber, ingress protection per IEC 60529	IP66

Luminaire housing shall be cast aluminum and allow for tool-less entry.

Photocontrol receptacle shall be located at the base of the luminaire and allow for tool-less entry.

Luminaire cooling system shall consist of passive heat sink without fans, pumps, or liquids.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

#### 4.5 Electrical

Power supply/driver shall be UL Recognized for dry and damp locations.

All other electrical components shall be UL Listed or Recognized for wet locations.

Luminaire photocontrol receptacle shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photocontrol, and shall be located at the base of the fixture.

Photocontrol receptacle shall have a minimum of five positions as defined in ANSI C136.41-2013. Two dimming contacts shall be connected to the 0-10 Vdc control signal interface on the power supply/driver with quick-disconnect connectors.

Rotational adjustment of the photocontrol shall be tool-less.

Luminaire circuitry shall include quick connect/disconnects to allow easy separation and removal of driver and power door.

A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

#### 4.6 Mounting

Luminaire shall be designed for post-top mounting onto a pole with a top diameter of 4 inches.

Tenon mounting area opening shall be limited to 1/4-in over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

#### 4.7 Lens

Lens shall be lightly diffused and resistant to ultraviolet light deterioration.

Lens shall be smooth on the exterior to discourage unwanted growth of moss and mold.

#### 4.8 Finish and Color

Finish on housing shall be a powder coating with a minimum thickness of 100 microns.

Finish shall meet salt spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

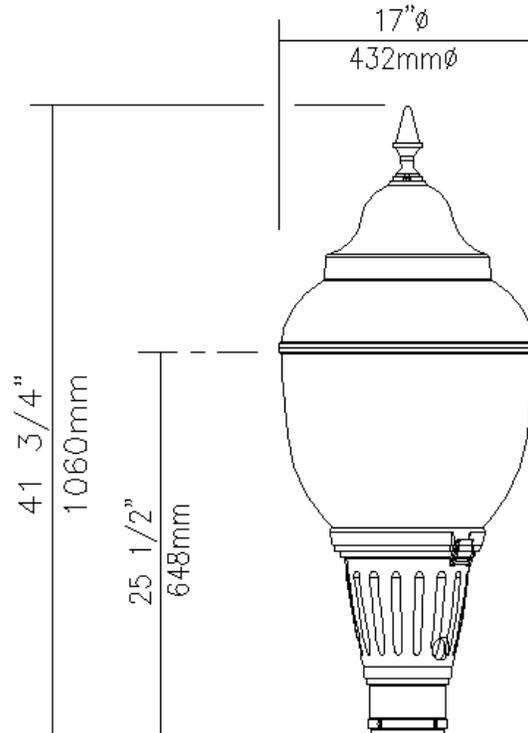
#### 4.9 Luminaire Requirements

Physical and electrical details for specific luminaires are provided below.

##### Stock Numbers 013679 and 013680 – Serenade S56

System power consumption, W	36
Weight, lb	60
EPA, ft <sup>2</sup>	2.17
Tenon mounting requirements, outside diameter by length, in	4"Ø by 4"
Dimensions, height by width, in	5" by 17"

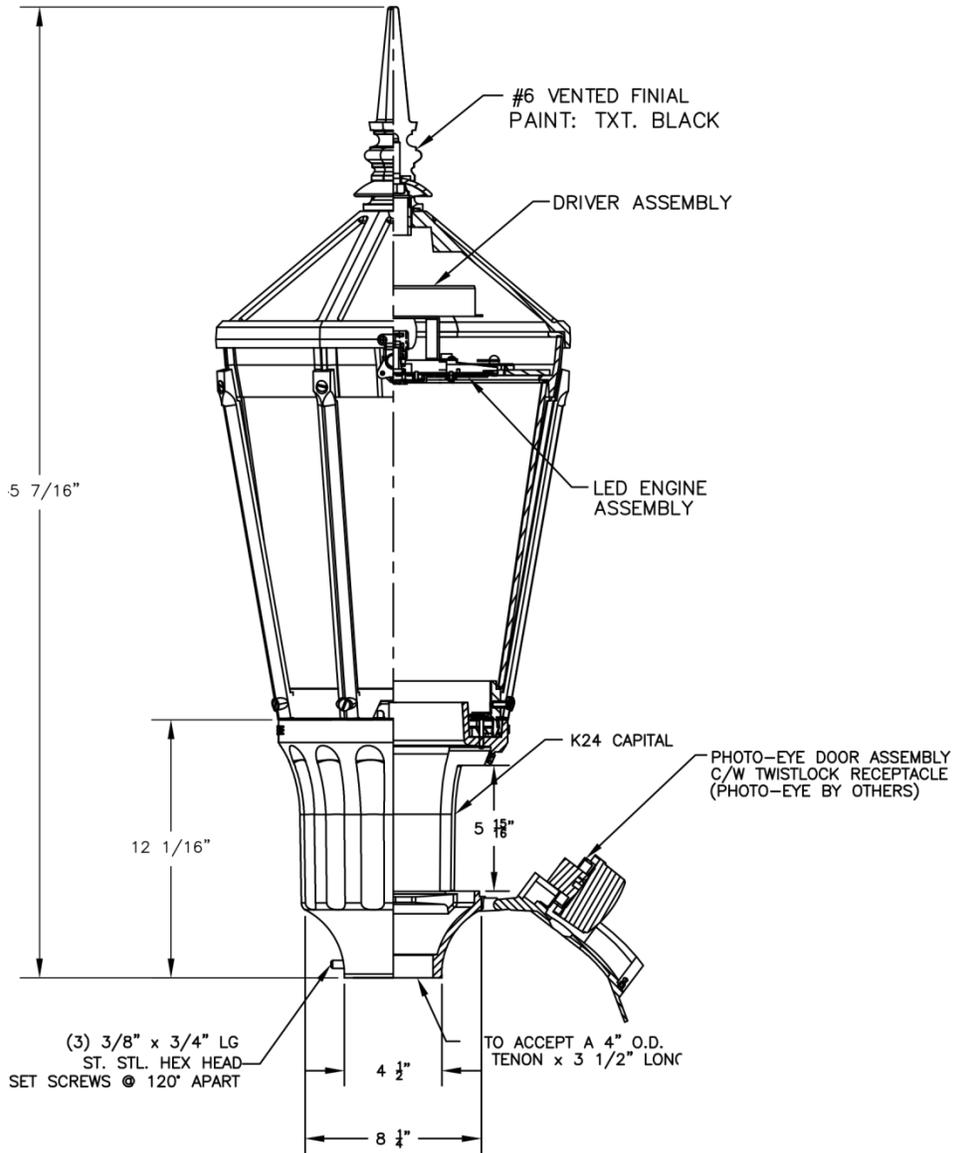
**Figure 4.9a. Serenade Luminaire Dimensions**



**Stock Numbers 013681 and 013682 – K56 Cleveland**

System power consumption, W	36
Weight, lb	60
EPA, ft <sup>2</sup>	2.17
Tenon mounting requirements, outside diameter by length, in	4"Ø by 4"
Dimensions, height by width, in	5" by 17"

**Figure 4.9b. Cleveland Luminaire Dimensions**



## 5. Testing

Manufacturers shall provide test data that establishes compliance with the requirements of this material standard upon request.

Certificate of RoHS compliance shall be provided upon request.

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## 6. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

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## 7. Marking

### 7.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 hertz
- Driver type, if applicable (may be on Driver if readily visible).
- Photocontrol voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on Driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photocontrol receptacle, lamp, and the like, as necessary.
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number

### 7.2 Barcode

A barcode label shall be provided as specified in the purchase order.

### 7.3 Compliant Identification

All UL Listed or Recognized components shall be labeled as such.

## 8. Packaging

Luminaires and accessories shall be separately packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each luminaire package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light stock number
- Seattle City Light purchase order number

Each package of accessories shall be legibly marked with:

- Product description
  - Seattle City Light stock number
- 

## 9. Issuance

EA

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## 10. Approved Manufacturers

### Stock No. 013679

**Manufacturer:** Philips Lumec

Catalog Number: **S56-35W-32LED-4K-R-ACDR-LE5-VOLT-SFX-FN10-PH8/RCD-BKTX**

*where:*

S56 =	model, S56
35W =	wattage, 35 W
32LED =	number of LEDs, 32
4K =	color temperature, 4000 K
R =	LED type, Philips Lumileds LUXEON R
ACDR =	hood and globe, seamless acrylic globe with inner prismatic surface
LE5 =	light distribution, type 5
VOLT =	voltage, 120-277 Vac
SFX =	options, slipfitter
FN10 =	options, F10 finial style
PH8/RCD =	options, 5-pin photocell receptacle, pre-wired
BKTX =	finish, textured black

**Stock No. 013680**

**Manufacturer:** Philips Lumec

Catalog No.: S56-35W-32LED-4K-R-ACDR-LE5-VOLT-SFX-FN10-PH8/RCD-GN8TX

where:

S56 = model, S56

35W = wattage, 35 W

32LED = number of LEDs, 32

4K = color temperature, 4000 K

R = LED type, Philips Lumileds LUXEON R

ACDR = hood and globe, seamless acrylic globe with inner prismatic surface

LE5 = light distribution, type 5

VOLT = voltage, 120-277 Vac

SFX = options, slipfitter

FN10 = options, F10 finial style

PH8/RCD = options, 5-pin photocell receptacle, pre-wired

GN8TX = finish, textured dark green

**Stock No. 013681**

**Manufacturer:** King Luminaire

Catalog No.: K56-C-K24-P4AR-V-40W-SSL-7030-120:277-PR-BK-4000K

where:

K56 = model, K56

C = style, Cleveland

K24 = pole adaptor, K24 capital

P4AR = optical system, P4 flat array acrylic rippled

V = light distribution, type 5

40W = wattage, 40 W

SSL = type, solid-state lighting

7030 = LED series, 7030

120:277 = voltage, 120-277 Vac

PR = options, 7-pin twist-lock photo receptacle

BK = finish, textured black

4000K = color temperature, 4000 K

**Stock No. 013682**

**Manufacturer:** King Luminaire

Catalog No.: K56-C-K24-P4AR-V-40W-SSL-7030-120:277-PR-RAL3000-4000K

where:

K56 = model, K56

C = style, Cleveland

K24 = pole adaptor, K24 capital

P4AR = optical system, P4 flat array acrylic rippled

V = light distribution, type 5

40W = wattage, 40 W

SSL = type, solid-state lighting

7030 = LED series, 7030

120:277 = voltage, 120-277 Vac

PR = options, 7-pin twist-lock photo receptacle

RAL3000 = finish, textured red

4000K = color temperature, 4000 K

## 11. Sources

**Aristo, Ed**; King Luminaire Lighting Manufacturer Representative with Sea-Tac Lighting and Controls, LLC, and subject matter expert for 5723.11

**Borek, Tom**; SCL Streetlight Engineer and subject matter expert for 5723.11  
(tom.borek@seattle.gov)

**Chao, Yaochiem**; SCL Standards Engineer and originator of 5723.11  
(yaochiem.chao@seattle.gov)

**King Luminaire**; Drawing no. SEATTLE CITY LIGHT-3; revision January 27, 2015

**King Luminaire**; Drawing no. SEATTLE CITY LIGHT-5; revision January 27, 2015

**Li, Jesse**; SCL Streetlight Engineer and subject matter expert for 5723.11  
(jesse.li@seattle.gov)

**Philips Lumec**; Drawing no. SPEC20150219\_131557\_74679\_2.doc; revision February 19, 2015

**Philips Lumec**; Drawing no. SPEC20150219\_131557\_74679\_3.doc; revision February 19, 2015

**Thomas, Greg**; Philips Lumec Lighting Manufacturer Representative with Sea-Tac Lighting and Controls, LLC, and subject matter expert for 5723.11

## Pedestrian Luminaires, LED, Post-top, Traditional



### 1. Scope

This standard covers the requirements for light-emitting diode (LED), post-top, traditional, pedestrian luminaires.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Color	Description
013672	Dark green	Marina post-top LED luminaire
013748	Jet black	Marina post-top LED luminaire

### 2. Application

Traditional, LED, pedestrian luminaires are:

- Installed in City-designated areas and City Light-designated streetlight districts.
- Post-top mounted on streetlight poles with a 4-in pole-top outer diameter.

Traditional, LED, pedestrian luminaires are equipped with a built-in slipfitter with tool-less door to house a standard, three-pin photocontrol.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Traditional, LED, pedestrian luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008**; Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.10-2010**; Locking-Type Photocontrol Devices and Mating Receptacles.

**ANSI C136.22**; American National Standard for Roadway Lighting Equipment – Internal Labeling of Luminaires

**ANSI C136.31-2010**; American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37-2011**; American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**ANSI C136.41-2013**; Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15-2011 (or latest)**; American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22-2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**Code of Federal Regulations (CFR), Title 47, Part 15**; Radio Frequency Devices

**Federal Trade Commission (FTC) Green Guides**; 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of protection provided by enclosures (IP Code), consolidated edition

**IEEE C62.41.2-2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11 (revised)**; Luminaire Classification System for Outdoor Luminaires

**Restriction of Hazardous Substances Directive 2002/95/EC, (RoHS 1)**

**UL 1598**; Luminaires; UL

## 4. Requirements

### 4.1 Luminaire Performance

Operating temperature, range	
°C	-20 to +50
°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377	4000 ± 300
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80, hours, minimum	60,000
Light distribution, IES	Type 5
Luminaire efficacy, lumens/watt, minimum, per IES LM-79, Section 11.0	57
Off-state power consumption, W, maximum	0.5

### 4.2 Power Supply/Driver

Input voltage, functional range, 60 Hz, Vac	120 to 277
Dimming control signal interface operative range, Vdc	0 to 10
Power factor, minimum	90

### 4.3 Construction

#### 4.3.1 General

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to the following: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photocontrol receptacle.

Luminaire shall be RoHS (European Union Directive 2002/95/ED for Restriction of Hazardous Substances) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS-restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated diphenyl ether (PBDE)
- Lead (Pb)

#### 4.3.2 Fixture Housing

Luminaire weight (lb), maximum	40
Effective projected area (EPA) (ft <sup>2</sup> ) maximum	2.6
External housing, ingress protection per IEC 60529	IP65
Optical chamber, ingress protection per IEC 60529	IP66

Luminaire housing shall be cast aluminum and allow for tool-less entry.

Photocontrol receptacle shall be located at the base of the luminaire and allow for tool-less entry.

Luminaire cooling system shall consist of a passive heat sink without fans, pumps, or liquids.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

#### 4.3.3 Electrical

Power supply/driver shall be UL Recognized for dry and damp locations.

All other electrical components shall be UL Listed or UL Recognized for wet locations.

Luminaire photocontrol receptacle shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photocontrol, and shall be located at the base of the fixture.

Photocontrol receptacle shall also be configured with two conductive pads as defined in ANSI C136.41-2013. The use of four conductive pads is optional.

The two conductive pads shall be connected to the 0-10 Vdc control signal interface on the power supply/driver with quick-disconnect connectors.

Rotational adjustment of the photocontrol shall be tool-less.

Luminaire circuitry shall include quick connect/disconnects to allow easy separation and removal of driver and power door.

A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

#### 4.3.4 Mounting

Luminaire shall be designed for post-top mounting onto a pole with a top diameter of 4 in.

Tenon mounting area opening shall be limited to 1/4-in over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

#### 4.3.5 Lens

Lens shall be one-piece and seamless.

Lens shall be lightly diffused and resistant to ultraviolet light deterioration.

Lens shall be smooth on the exterior to discourage unwanted growth.

#### 4.4 Finish and Color

Finish on housing shall be a powder coating with a minimum thickness of 100 microns and shall meet salt spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

Color choices for fixtures are standard. See Section 11.

### 5. Detailed Requirements

Physical and electrical details for specific luminaires are provided below.

System power consumption (W)	45
Weight (lb)	32
EPA (ft <sup>2</sup> )	2.12
Tenon mounting requirements, outside diameter by length (in)	4 x 3
Dimensions, height by width (in)	37.75 x 29.5



### 6. Testing

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substances) compliance shall be provided upon request.

### 7. Design Changes

The manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

### 8. Marking

#### 8.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

The internal label shall meet the requirements of ANSI C136.22.

The internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 Hz
- Driver type, if applicable (may be on driver if readily visible)
- Photocontrol voltage if different from line input voltage
- Lamp type, wattage, and voltage, if applicable (may be on driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photocontrol receptacle, lamp, and the like, as necessary
- Plant location
- Input power consumption

- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number

## 8.2 Barcode

A barcode label shall be provided as specified in the purchase order.

## 8.3 Component Identification

All UL Listed components shall be labeled or recognized as such.

---

## 9. Packaging

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description (including color)
- Date of manufacture (month and year)
- Seattle City Light stock number
- Seattle City Light purchase order number

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Product description
- Seattle City Light stock number

---

## 10. Issuance

EA

## 11. Approved Manufacturers

### 11.1 Stock No. 013672

<b>Manufacturer:</b>	<b>Cyclone Lighting</b>
Catalog Number:	<del>CN11T4-GCPP-5L-44W-4K-120-GCN04-PTDR-DIM-CP4306-RAL6012TX</del>
<i>where:</i>	
CN11T4 =	luminaire
GCPP =	globe, GCPP (partially obscured non-diffused polycarbonate 75% diffusing)
5L =	optic, type 5hot
44W =	watt, 44W (system wattage is 45W)
4K =	color temperature, 4K
120 =	voltage, 120-277 VAC
GCN04 =	guard, GCN04
PTDR =	option, twist-lock dimmable photocell receptacle with seven pins
DIM =	option, dimmable driver
CP4306 =	Cyclone project, 4306
RAL6012TX =	finish, textured dark green

### 11.2 Stock No. 013748

<b>Manufacturer:</b>	<b>Cyclone Lighting</b>
Catalog Number:	<del>CN11T4-GCPP-5L-44W-4K-120-GCN04-PTDR-DIM-CP4306- RAL9005TX</del>
<i>where:</i>	
CN11T4 =	luminaire
GCPP =	globe, GCPP (partially obscured non-diffused polycarbonate 75% diffusing)
5L =	optic, type 5hot
44W =	watt, 44W (system wattage is 45W)
4K =	color temperature, 4K
120 =	voltage, 120-277 VAC
GCN04 =	guard, GCN04
PTDR =	option, twist-lock dimmable photocell receptacle with seven pins
DIM =	option, dimmable driver
CP4306 =	Cyclone project, 4306
RAL9005TX =	finish, textured jet black

## 12. Sources

**Borek, Tom;** Seattle City Light Streetlight Engineer and subject matter expert of 5723.19 (tom.borek@seattle.gov)

**Chao, Yaochiem;** Seattle City Light Standards Engineer and originator of 5723.19 (yaochiem.chao@seattle.gov)

**Cyclone Lighting;** file CN11T4-CP4306-SQ\_015396-CITY OF SEATTLE REV2.DOC; February 5, 2015

**Freed, Ken;** Cyclone Lighting Manufacturer Representative with Lighting Group Northwest and subject matter expert for 5723.19

**Li, Jesse;** Seattle City Light Streetlight Engineer and subject matter expert of 5723.19 (jesse.li@seattle.gov)

**MATERIAL STANDARD**

**SHOEBOX TYPE LUMINAIRES  
HIGH PRESSURE SODIUM**

**1. Scope**

**High Pressure Sodium Vapor Luminaires** shall be of the end-mounted outdoor type, utilizing lamps in the horizontal position.

**2. Industry Standards**

- ANSI C136.2 American National Standard for Roadway Lighting Equipment - Luminaires Voltage Classification - Description
- EI TDJ-148 EEI-NEMA Suggested Standards for Future Design of Luminaire Head to Receive External Locking Type Unit Control (1959) (Use TDJ-148 except where the three-wire hookup is referenced. Only the two-wire hookup is used. The three-wire hookup is not used.)
- IESNA LM-31 Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge Lamps
- IESNA Lighting Handbook, latest edition

**3. Construction Requirements**

**Housing:** ..... Housing shall be one piece die cast aluminum suitable for wet locations. A solid barrier wall shall separate the optical and electrical compartments, with heat-resistant gasketed wire penetrations. A double-thick wall with gussets shall be provided on the support arm mounting end. Inset sections on each end shall cradle the mounting arm.

**Hardware**

**Material:** ..... All hardware and hinge pins shall be stainless steel or electro-zinc plated steel.

**Lens Frame:** ..... Lens Frame shall be a one piece die cast aluminum with a 1" minimum thickness around the heat-resistant gasket flange for rigidity. Mounting and removal from the housing shall be accomplished without the use of tools. Two stainless steel thumb-latches shall be recessed into the front corners, concealed from normal view. The lens frame shall seal against the housing by a one piece extruded heat-resistant silicone gasket with vulcanized end closure. Lens shall be clear 3/16" minimum thickness tempered heat-resistant borosilicate flat glass and retained in the frame by eight or more clips with full heat-resistant silicone gasketing around the perimeter.

**Sockets:** ..... All HPS sockets shall be porcelain mogul base pulse rated 4kV and have a spring loaded center contact. Sockets shall be factory prewired with a disconnect plug for the ballast module, with wires passing through a silicone heat-resistant gasket in the housing barrier wall.

**Reflector Module:** ..... Reflector shall be specular Alzak<sup>®</sup> optical segments which are rigidly mounted in an aluminum frame which attaches to the housing as a one piece module. Reflector module shall be field-rotatable in 90 degree increments.

**Electrical Module:** ..... All electrical components shall be UL listed for wet locations and mounted on a single plate and factory prewired with disconnect plugs. Electrical module shall be attached to housing with no-tool hinges and latches, accessible by opening the lens frame. Ballasts shall be 120 volt high power factor with a minimum starting temperature of - 40 degrees F. Ballasts shall be completely wired to the terminal board and lamp socket

**Support Arm:** ..... For mounting to square poles, shall be one piece extruded aluminum with internal bolt guides and a recessed step to match the housing. Luminaire-to-pole attachment shall be by internal draw bolts (included), and shall include a pole reinforcing plate with wire strain relief.

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Charles L. Shaffer</i>	<i>John Schinner</i>	<i>Hardee Juy</i>

**MATERIAL STANDARD**

**Finish:** ..... Color shall be as shown in the table on page 2 of this standard. The finish on housing, lens frame, arm and optional entablatures shall have a 2.5 mil minimum thickness and shall pass the 2500 hour salt spray test.

**Photocell Control:** ..... 250 watt luminaire shall be supplied with a fully gasketed receptacle above the electrical compartment for a NEMA three terminal base photocell. 100 watt luminaire shall be supplied with an internal photocell with the sensor on the fixture end facing the pole.

**Terminal Block:** ..... A terminal block shall be mounted to the housing inside the electrical compartment. The block shall accept #14 to #4 AWG wire and shall be factory prewired to electrical module disconnect plug.

**Air Filter:** ..... An air filter shall be positioned in such a manner that it shall allow circulation of air through the optical assembly and effectively filter out all air particles above 500 microns.

**Distribution**

**Patterns:** ..... Luminaire light distribution patterns shall conform to the IESNA classification system for Type II. Reflectors shall be rigidly located so as not to vary light distribution after normal maintenance. Glare control shall be accomplished by the use of a flat lens. Minimum street-side utilization shall be 39 percent at 1.5 transverse mounting height. Distribution shall be free from striations and hot spots. Photometric performance will be subject to testing by the Washington State Material Testing Laboratory to ensure conformance with these specifications and the photometric data submitted. A sample luminaire shall be submitted for testing when requested by the City Light Department.

**Entablatures:** ..... Provision shall be made for the mechanical attachment of optional entablatures to front and back of housing with no visible fasteners.

**Luminaire Marking:** .... Luminaires shall have an ANSI-approved decal (three inches square) attached to the housing so as to be readily visible from the ground, indicating lamp type by color code (e.g., gold for "high-pressure sodium"), and lamp wattage by numerical code.

**Nameplate:** ..... The luminaire shall have a nameplate identifying wattage, voltage, manufacturer, and date of manufacture.

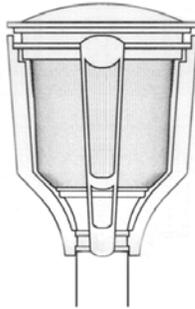
Stock No.	Lamp Watts	Color	Primary Voltage	Style	Approved Manufacturer
					Kim Lighting / Hubbell
572760	100	Light Gray	120	Entablature	1SA/SET3/100 HPS 120/LG-P/A-30/ANSI Label
572761	100	Dark Bronze	120	Entablature	1SA/SET3/100 HPS 120/DB-P/A-30/ANSI Label
012294	100	Light Gray	120	Archetype	1SA/SAR2/100 HPS 120/LG-P/TL/ANSI Label
012418	100	Dark Bronze	120	Archetype	1SA/SAR2/100 HPS 120/DB-P/TL/ANSI Label
572762	250	Light Gray	120	Entablature	1A/ET3/250 HPS 120/LG-P/A-25/ANSI Label
572763	250	Dark Bronze	120	Entablature	1A/ET3/250 HPS 120/DB-P/A-25/ANSI Label

**4. Packaging**

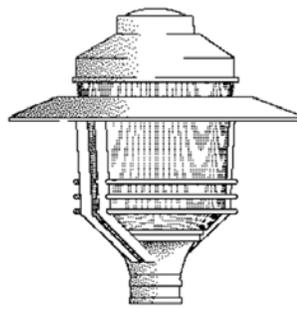
The luminaire shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage.

**5. Stock Unit: EA**

**Decorative Luminaires, High Pressure Sodium**



57233Z14.tif  
**Z14**



57233Z15.tif  
**Z15**



57233Z40.tif  
**Z40**



57233Z47A.tif  
**Z47A**

**1. Scope**

This standard covers the requirements for the high-pressure sodium (HPS), pedestrian walkway luminaires.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
012380	Zenith Z14 HPS Luminaire
011967	Zenith Z15 HPS Luminaire
010398	Nostalgia Z40 HPS Luminaire
010399	Nostalgia Z47A HPS Luminaire

**2. Application**

HPS pedestrian walkway luminaires are installed in City-designated areas and SCL-designated streetlight districts.

HPS pedestrian walkway luminaires are supported by the following decorative streetlight poles of matching finish:

Stock No.	Mounting Height (ft)	Shaft	Color
013422	14	Fluted	Black
013423	14	Fluted	Light gray
013424	14	Fluted	Dark green
013425	14	Round	Black
013426	14	Round	Light gray
013427	14	Round	Dark green

Standards Coordinator  
 Yaochiem Chao

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

### **3. Requirements**

#### **3.1 Luminaire Type**

HPS luminaires shall be of the post top outdoor type, utilizing lamps in the vertical position.

#### **3.2 Housing**

Housing shall be aluminum or polymer suitable for wet locations and resistant to ultraviolet light deterioration. The base shall be a cast aluminum tenon-adapter designed to mount on a pole with a 3-in diameter top.

#### **3.3 Lens**

Lens shall be acrylic and resistant to ultraviolet light deterioration.

#### **3.4 Hardware Fastening Material**

All visible hardware shall be stainless steel.

#### **3.5 Sockets**

All HPS sockets shall be porcelain medium base pulse rated 4 kV and have a spring-loaded center contact. Sockets shall be factory prewired with a disconnect plug for the ballast module.

#### **3.6 Electrical Module**

All electrical components shall be UL Recognized, for wet locations and shall be mounted on a single plate and factory prewired with disconnect plugs. Ballasts shall be 120 volt CWA type with a minimum starting temperature of -30 degrees F. Ballasts shall be completely wired to the terminal board and lamp socket.

#### **3.7 Photocell Control**

Luminaire shall be supplied with an internal photocell in the base of the fixture.

#### **3.8 Terminal Block**

A terminal block shall be mounted to the housing inside the electrical compartment. The block shall accept #14 to #4 AWG wire and shall be factory prewired to electrical module disconnect plug.

#### **3.9 Luminaire Light Distribution Patterns**

Luminaire light distribution patterns shall conform to the IESNA classification system for Type III. Distribution shall be free from striations and hot spots. Photometric performance will be subject to testing by the Washington State Material Testing Laboratory to ensure conformance with these specifications and the photometric data submitted. A sample luminaire shall be submitted for testing when requested by the SCL department.

#### **3.10 Luminaire Marking**

Luminaires shall have an ANSI-approved decal (three inches square) attached to the housing so as to be readily visible from the ground, indicating lamp type by color code (e.g., gold for "high-pressure sodium"), and lamp wattage by numerical code.

#### **3.11 Finish**

The finish on housing shall be a powder coating with a minimum thickness of 100 microns and shall meet salt spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

**3.12 Color**

The color of the pole shall be specified by the streetlight engineer and stated on the purchase order. Seattle City Light uses the following color choices:



**GN8TX**, Textured Dark Green



**GYTX**, Textured Grey



**BKTXT**, Textured Black



**BRTXT**, Textured Bronze

**3.13 Nameplate**

The luminaire shall have a nameplate identifying wattage, voltage, manufacturer, and date of manufacture.

**3.14 Packaging**

The luminaire shall be packaged in accordance with the manufacturer's commercial practice to ensure safe delivery without damage.

**4. Approved Manufacturers**

**4.1 Stock No. 012380**

<b>Manufacturer:</b>	<b>Lumec</b>
Catalog Number:	<b>Z14-70-HPS-3-120-SFPH4-PH8-xxxxx</b>
<i>where:</i>	
Z14 =	luminaire style, ZED Zenith Z14
70 =	wattage, 70 watts
HPS =	lamp, HPS
3 =	optical system, type III
120 =	voltage, 120 volts
SFPH4 =	adaptor, utility slip-fitter for photocell
PH8 =	photocell receptacle, twist-lock photocell
xxxxx =	finish (See Section 3.12):
GN8TX =	textured dark green
GYTX =	textured grey
BKTXT =	textured black
BRTXT =	textured bronze

**4.2 Stock No. 011967**

<b>Manufacturer:</b>	<b>Lumec</b>
Catalog Number:	Z15-70-HPS-3-120-SFPH4-PH8-xxxxx
<i>where:</i>	
Z15 =	luminaire style, ZED Zenith Z15
70 =	wattage, 70 watts
HPS =	lamp, HPS
3 =	optical system, type III
120 =	voltage, 120 volts
SFPH4 =	adaptor, utility slip-fitter for photocell
PH8 =	photocell receptacle, twist-lock photocell
xxxxx =	finish (See Section 3.12):
	GN8TX = textured dark green
	GYTX = textured grey
	BKTX = textured black
	BRTX = textured bronze

**4.3 Stock No. 010398**

<b>Manufacturer:</b>	<b>Lumec</b>
Catalog Number:	Z40-70-HPS-3-120-SFPH4-PH8-xxxxx
<i>where:</i>	
Z40 =	luminaire style, ZED Nostalgia Z40
70 =	wattage, 70 watts
HPS =	lamp, HPS
3 =	optical system, type III
120 =	voltage, 120 volts
SFPH4 =	adaptor, utility slip-fitter for photocell
PH8 =	photocell receptacle, twist-lock photocell
xxxxx =	finish (See Section 3.12):
	GN8TX = textured dark green
	GYTX = textured grey
	BKTX = textured black
	BRTX = textured bronze

#### 4.4 Stock No. 010399

<b>Manufacturer:</b>	<b>Lumec</b>
Catalog Number:	Z47A-70-HPS-3-120-SFPH4-PH8-xxxxx
<i>where:</i>	
	Z47A = luminaire style, ZED Nostalgia Z47A
	70 = wattage, 70 watts
	HPS = lamp, HPS
	3 = optical system, type III
	120 = voltage, 120 volts
	SFPH4 = adaptor, utility slip-fitter for photocell
	PH8 = photocell receptacle, twist-lock photocell
	xxxxx = finish (See Section 3.12)
	GN8TX = textured dark green
	GYTX = textured grey
	BKTX = textured black
	BRTX = textured bronze

#### 5. References

**American National Standards Institute (ANSI) standard C136.2;** "For Roadway and Area Lighting Equipment - Luminaire Voltage Classification," 2004

**American Society for Testing and Materials (ASTM) standard B 117;** "Standard Practice for Operating Salt Spray (Fog) Apparatus"

**American Society for Testing and Materials (ASTM) standard D 2247;** "Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity"

**Chao, Yaochiem;** SCL standards engineer and subject matter expert for 5723.30 (yaochiem.chao@seattle.gov)

**Edison Electric Institute (EEI) document TDJ 148** (Refers to two-wire hookup only; the three-wire hookup referred to in TDJ 148 is not used.)

**Illuminating Engineering Society of North America (IESNA) standard LM 31;** "Method for Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge Lamps," 1995

**IESNA Lighting Handbook, IES HB-10-11,** Tenth Edition, Illuminating Engineering Society, New York, NY, 2011

**Pompeo, Brenda;** SCL engineer and subject matter expert for 5723.30 (brenda.pompeo@seattle.gov)

**SCL Material Standard 5723.3** (canceled); "Decorative Luminaire, High Pressure Sodium," February 2014

## Streetlight Luminaire, LED, Pendant-mount, Boulevard



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### 1. Scope

This standard covers the material requirements for an 80-watt streetlight luminaire, LED, pendant-mount. LED luminaires are also known as solid state light (SSL) source fixtures.

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### 2. Application

LED, pendant-mount, boulevard streetlight luminaires are currently installed along Lake Washington Boulevard in the Washington Park Arboretum. For installation in the Arboretum, use steel pole Stock No. 013464 and steel arm Stock No. 013465. Reference SCL 5683.0, Steel Streetlight Pole and Arm Assemblies.

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Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

**ANSI C136.15-2011 (or latest)**; Roadway and Area Lighting Equipment– Internal Labeling of Luminaires

**ANSI C136.22-2004 (R2009)**; Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**ANSI C136.31**; Roadway Luminaire Vibration specifications for Bridge/overpass applications. (Tested for 3G over 100 000 cycles by an independent lab)

**ANSI C136.37 2011**; Solid State Light Sources Used in Roadway and Area Lighting

**ASTM B117-73**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D 2247**; Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

**IEEE C62.41.2-2002**; “Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits”

### 4. Requirements

Operating temperature, range	
°C	-40 to +55
°F	-40 to +130
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377	4000 (+/- 350K)
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80	LED module(s)/ array(s) shall deliver at least 70% of initial lumens (L <sub>70</sub> ), when installed for a minimum of 70,000 hours
Light distribution per IES Handbook, chapter 22	Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A	B2, U0, G1
Uplight per IESNA TM-15	UL & UH = 0 (full cutoff)
High and very high light per IES TM-15, maximum of luminaire lumens	BH = 5% BVH and FVH = 0.2%
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0	94.3
Off-state power consumption, W, maximum - Photocell	1
On-state power consumption, excluding control device, watt, maximum	79
Luminous flux distribution at median driver current, lumens, minimum	7454
Effective projected area (EPA), maximum, ft <sup>2</sup>	1.42
Total harmonics distortion at full power across specified voltage range, maximum	20%
Vibration withstand, minimum, per ANSI C136.31	Level 2.0

## 5. Construction

### 5.1 General

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photo-control receptacle.

Luminaire shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb).

### 5.2 Fixture Housing

Luminaire housing shall be cast aluminum.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e.; weep holes).

Luminaire door shall be securely hinged and incapable of involuntary separation from housing when accessed in field-installed position.

Luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

All fasteners shall be stainless steel.

Complete assembly weight shall not exceed 45 lb.

Luminaire design shall facilitate hose-down cleaning and discourage debris accumulation.

### 5.3 Electrical

Power supply/driver shall be provided with a control signal interface with operating range of 0 to 10 Vdc for dimming.

Rotational adjustment of the photo control shall be tool-less.

Luminaire circuitry shall include quick connect/disconnects to allow easy separation and removal of driver and power door.

Wire harnesses shall be protected with a spiral wrap to prevent damage to the wire insulation when operating the power door.

A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

#### 5.4 Mounting

Luminaire shall be 4 bolts and designed to mount on a 2-in nominal pipe size (NPS) tenon.

Luminaire shall be capable of  $\pm 5$  degrees of tilt, minimum, for leveling adjustment and labeled properly.

Tenon mounting area opening shall be limited to 1/4-in over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

Methods of limiting tenon mounting area shall provide safe access for temporary service feeds entering directly through the tenon opening without damaging service wires.

#### 5.5 Finish

Luminaire housing finish shall be powder-coated black, RAL9005.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per B117.

Painted or finished luminaire components exposed to the environment shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

#### 5.6 Certification and Listing

Power supply/driver shall be UL Recognized for dry and damp locations.

All other electrical components shall be UL Listed or recognized for wet locations.

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#### 6. Testing

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substances) compliance shall be provided upon request.

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#### 7. Product Approval

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for details:

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation.

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

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#### 8. Design Changes

Manufacturers shall inform SCL in writing of all design changes that may affect the product's understood or published capabilities.

## 9. Marking

### 9.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 Hz
- Driver type (if applicable) (may be on driver if readily visible)
- Photo control voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photo control receptacle, lamp, and other items, as necessary
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number.

### 9.2 External Marking

A readily visible marker shall be permanently affixed to the outside surface of the luminaire housing.

External marker shall meet the requirements of ANSI C136.15.

External marker type shall be large per ANSI C136.15.

### 9.3 Barcode

A barcode label shall be provided as specified in the purchase order.

### 9.4 Component Identification

All UL Listed components shall be labeled or recognized as such.

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## 10. Packaging

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light stock number
- Seattle City Light's purchase order number.

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

## 11. Issuance

EA

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## 12. Approved Manufacturers

Manufacturer: Domus

Catalog Number: **DMS50-80W-48LED-4K-LE2F-120-SMB-PH8-BK**

*where:*

DMS50 = luminaire, Domus, 50

80W = lamp wattage, 80 W

48LED = number of diodes (LED), 48

4K = color temperature, 4000 K

LE2 = optical system, Type 2 asymmetrical

F = lens, flat

120 = voltage, 120 V

SMB = adapter, SMB side-mounting, cast aluminum

PH8 = options, photoelectric cell

BK = finish, black RAL 9005

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## 13. References

**SCL Material Standard 5683.01**; "Steel Streetlight Pole and Arm Assemblies"

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## 14. Sources

**Chao, Yaochiem**; SCL Standards Engineer, originator and subject matter expert for 5723.33 (yaochiem.chao@seattle.gov)

**Philips Advance Electrical Specifications, Doc. No. LED-INTA-0530C-280-DO**;  
October 20, 2010

**Philips Lumec, Specification Sheet, Doc. No. SPEC20140808\_103052\_61615\_7.doc**,  
August 8, 2014

**Tilley, Kathy**; SCL Standards Support Specialist (Kathy.tilley@seattle.gov)

**Streetlight Luminaire, LED, Side-mount, Residential, 38-watt**



**1. Scope**

This standard covers the requirements for 38-watt, side-mount, outdoor type, light-emitting-diode (LED) streetlight luminaires and their accessories. LED luminaires are also known as solid state light (SSL) source fixtures.

This standard applies to the following Seattle City Light stock numbers:

Stock No.	Description
013469	Luminaire
013470	House side shield for Cree XSP1 luminaire

**2. Application**

38-watt LED streetlight luminaires are side-mounted on 2-inch nominal pipe size (NPS) tenons on poles to provide light to residential neighborhoods.

38-watt LED streetlights are not intended for installation in bridge and overpass applications.

38-watt LED streetlights are intended for installation at a 25-foot mounting height.

A 38-watt LED streetlight consumes approximately 72 percent less energy than a conventional 100-watt high-intensity discharge (HID) luminaire.

In 2013, 38-watt LED streetlight luminaires replaced less-efficient 52 watt units, Stock Number 013354, for new construction.

LED life is greater than 100,000 hours. LED streetlight luminaire is 100 percent mercury- and lead-free.

Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.

38-watt LED streetlights are intended to meet the performance criteria set forth in the latest revision of Seattle City Light's Specification for LED Roadway Luminaires.

Stock number 013469 contains a field adjustable output that is factory set at setting "D" to achieve the desired consumption of 38 watts and output of 3700 lumens. Any changes to luminaire settings must be approved for application by SCL Streetlight Engineering.

**3. Industry Standards**

LED streetlight luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008;** Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.31-2010;** American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37 2011;** American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**MATERIAL STANDARD**

Streetlight Luminaire, LED, Side-mount, Residential, 38-watt

Standard Number: **5723.47**  
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**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15-2011** (or latest); American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22-2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**Federal Trade Commission (FTC)**; Green Guides, 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of protection provided by enclosures (IP Code), consolidated edition

**IEEE C62.41.2-2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11 (revised)**; Luminaire Classification System for Outdoor Luminaires

**RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance)**

**Title 47** of the Code of Federal Regulations (CFR), Part 15; Radio Frequency Devices

**UL 1598**; Luminaires; UL

**4. Requirements****4.1 Luminaire Performance**

Operating temperature, range	
°C	-20 to +50
°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377	4000 ±300
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80	LED module(s)/ array(s) shall deliver at least 70% of initial lumens ( $L_{70}$ ), when installed for a minimum of 100,000 hours
Light distribution per IES Handbook, chapter 22	Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A	B1, U0, G1
Uplight per IESNA TM-15	UL & UH = 0 (full cutoff)
High and very high light per IES TM-15, maximum of luminaire lumens	BH = 5% BVH and FVH = 0.2%
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0	55
Off-state power consumption, W, maximum	0.5
On-state power consumption, excluding control device, watt, nominal	38
Luminous flux distribution at median driver current, lumens, minimum	3700
Effective projected area (EPA), maximum, ft <sup>2</sup>	0.9
Total harmonics distortion at full power across specified voltage range, maximum	20%
Vibration withstand, minimum, per ANSI C136.31	Level 1 (normal application)

**MATERIAL STANDARD**

Streetlight Luminaire, LED, Side-mount, Residential, 38-watt

Standard Number: **5723.47**  
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**4.2 Power Supply/Driver**

Input voltage, functional range, 60 Hz, Vac	120 to 277
Power factor, minimum	0.90
Driver output current, mA, range	variable
Surge protection, per ANSI C136.37 and ANSI/ IEEE C62.41.2	
High exposure	10 kV
Low exposure	6 kV
Interference	FCC 47 CFR part 15/18, Class A
Dimming signal, control range, Vdc	0 to 10

**4.3 Construction**

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photo-control receptacle.

Luminaire housing shall be cast aluminum.

Luminaire housing shall allow tool-less entry.

Luminaire housing shall be provided with level bubble to facilitate installation.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e.; weep holes).

Luminaire door shall be securely hinged and incapable of involuntary separation from housing when accessed in field-installed position.

Luminaire shall be designed to mount on a 2-inch nominal pipe size (NPS) tenon with  $\pm 5$  degrees of tilt.

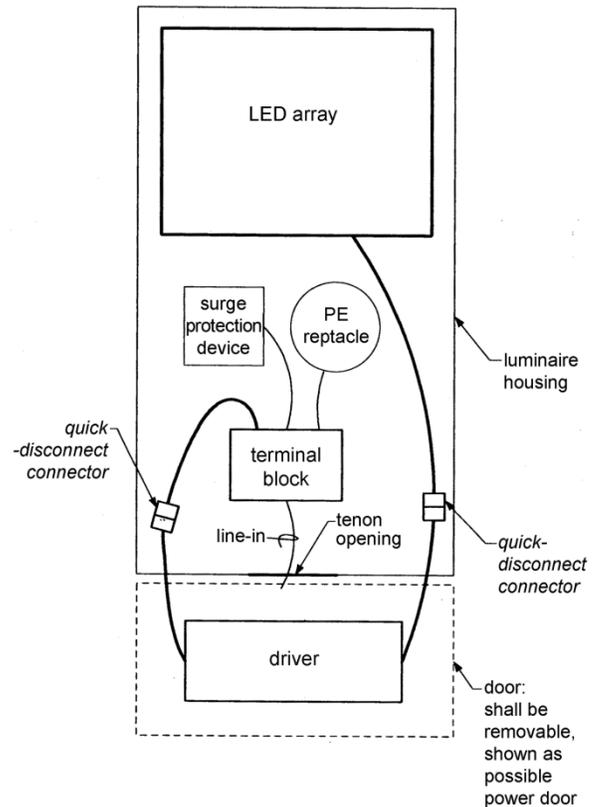
Tenon mounting area opening shall be limited to 1/4-inch over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

Methods of limiting tenon mounting area shall provide safe access for temporary service feeds entering directly through the tenon opening without damaging service wires.

Power supply/driver shall be provided with a control signal interface with operating range of 0 to 10 Vdc for dimming.

Luminaire circuitry shall include *quick connect/disconnects* to allow easy separation and removal of driver and power door. Refer to Figure 4.3.

**Figure 4.3.** Locations of Quick Disconnect Connectors



The luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

Luminaire shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photo control.

Rotational adjustment of the photo control shall be tool-less.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

**MATERIAL STANDARD**

Streetlight Luminaire, LED, Side-mount, Residential, 38-watt

A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall be provided with capability for optional backlight control.

Backlight control shall be installed using stainless steel fasteners. Screw drive type shall be slotted or Phillips.

Complete assembly weight shall not exceed 30 lbs.

Luminaire shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb)

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

Luminaire design shall facilitate hose-down cleaning and discourage debris accumulation.

**4.4 Finish**

Luminaire housing finish shall be powder-coated gray.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per B117.

Painted or finished luminaire components exposed to the environment shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

**4.5 Certification and Listing**

Power supply/driver shall be UL recognized for dry and damp locations.

All other electrical components shall be UL listed or recognized for wet locations.

**5. Testing**

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliance shall be provided upon request.

**6. Product Approval**

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for the details.

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

**7. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

**8. Marking****8.1 Internal Labeling**

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 hertz
- Driver type (if applicable)(may be on Driver if readily visible)
- Photo control voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on Driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photo control receptacle, lamp, and the like, as necessary
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number.

**MATERIAL STANDARD**

Streetlight Luminaire, LED, Side-mount, Residential, 38-watt

**8.2 External Marking**

A readily visible marker shall be permanently affixed to the outside surface of each luminaire housing.

External marker shall meet the requirements of ANSI C136.15.

External marker type shall be large per ANSI C136.15.

**8.3 Barcode**

A barcode label shall be provided as specified in the purchase order.

**8.4 Component Identification**

All UL listed components shall be labeled or recognized as such.

**9. Packaging**

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light's Stock Number
- Seattle City Light's Purchase Order Number.

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Product description
- Seattle City Light's Stock Number.

**10. Issuance**

EA

**11. Approved Manufacturers – Luminaires, Stock Number 013469**

**Manufacturer:** Cree

**Catalog No.:** BXSP-A-0-2-G-A-U-S-R-Q-SEA

where:

- BXSP = product
- A = version
- 0 = mounting, horizontal tenon
- 2 = optic, type II
- G = module, high-efficacy 4000K
- A = input power, 53W<sup>1</sup>
- U = voltage, universal 120-277V
- S = color options, silver
- R = options, NEMA photocell receptacle
- Q = options, field adjustable output
- SEA = special options:
  - field adjustable output factory preset at level 'D'. (D-setting on field adjustable output decreases input power to approximately 38W.)
  - full functionality of field adjustable output
  - external wattage label = '38'
  - 4-bolt mounting: two brackets--one with teeth and one smooth
  - internal labeling
  - output current guide
  - powder-coated splash-guard
  - special housing

**12. Approved Manufacturers – Accessories, Stock Number 013470**

**Manufacturer:** Cree

**Catalog No.:** XA-SP1BLS

**Description:** House side shield for Cree, type BXSP1, LED streetlight luminaires

**Application:** Installed on Cree, type BXSP1, LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.

## MATERIAL STANDARD

Streetlight Luminaire, LED, Side-mount, Residential, 38-watt

Standard Number: **5723.47**  
Superseding: July 1, 2013  
Effective Date: November 3, 2014  
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### 13. References

**SCL Material Standard 5723.49**; "Streetlight Luminaire, LED, Side-mount, Residential, 52-watt"

**SCL Material Standard 5723.51**; "Streetlight Luminaire, LED, Side-mount, Residential, 70-watt"

### 14. Sources

**Borek, Tom**; SCL Streetlight Engineer and subject matter expert for 5723.47; (tom.borek@seattle.gov)

**Cree XSP1**, XSP Series LED Streetlight, Cree Documentation, revision 09/14/12

**Chao, Yaochiem**; SCL Standards Engineer, originator and subject matter expert for 5723.47; (yaochiem.chao@seattle.gov)

**City of Seattle, Standard Specifications**, Section 9-31.1(2)-Luminaires

**Federal Communications Commission Title 47 CFT**; Part 15/18, revision 05/10/11; www.fcc.gov

**GE OLP-2858**, bulletin, LED Roadway; GE Lighting System, Inc.; 1/10

**IESNA Lighting Handbook**; Chapter 22,9th edition; Roadway Lighting

**IESNA Lighting Ready Reference**, A Compendium of Materials from the IESNA Lighting Handbook; 9th Edition, RR-03 Fourth Edition

**Li, Jesse**; SCL Streetlight Engineer and subject matter expert for 5723.47; (jesse.li@seattle.gov)

**Seattle City Light, Specification for LED Roadway Luminaires**, revised January 4, 2012

**UL 1012** - Power Units Other Than Class 2

**UL 1310** - Class 2 Power Units

**UL 2108** - Low Voltage Lighting Systems

**UL 8750** - Light-Emitting Diode (LED) Light Sources for Use in Lighting Products

## Streetlight Luminaire, LED, Side-mount, Residential, 52-watt



### 1. Scope

This standard covers the requirements for 52 watt, side-mount, outdoor type, light-emitting-diode (LED) streetlight luminaires and their accessories. LED luminaires are also known as solid state light (SSL) source fixtures,

This standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Description
013354	Luminaire
013355	House side shield for BetaLED luminaire
013356	House side shield for Leotek GC-1 luminaire

### 2. Application

52 watt LED streetlight luminaires are side-mounted on 2-inch nominal pipe size (NPS) tenons on poles to provide light to residential neighborhoods.

52 watt LED streetlights are not intended for installation in bridge and overpass applications.

52 watt LED streetlights are intended for installation at a 25-foot mounting height.

A 52 watt LED streetlight consumes approximately 62 percent less energy than a conventional 100 watt high-intensity discharge (HID) luminaire.

In 2012, 52 watt LED streetlight luminaires replaced less-efficient 70 watt units for new construction. In 2013, City Light transitioned to a new 38-watt unit, Stock Number 013469 for new construction.

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Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

LED life is greater than 50,000 hours. LED streetlight luminaire is 100 percent mercury- and lead-free.

Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.

52 watt LED streetlights are intended to meet the performance criteria set forth in the latest revision of Seattle City Light's Specification for LED Roadway Luminaires.

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### 3. Industry Standards

LED streetlight luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008**; Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.31-2010**; American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37 2011**; American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15-2011** (or latest); American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22-2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

Federal Trade Commission (FTC); Green Guides, 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of protection provided by enclosures (IP Code), consolidated edition

**IEEE C62.41.2-2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11** (revised); Luminaire Classification System for Outdoor Luminaires RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance)

Title 47 of the Code of Federal Regulations (CFR), Part 15; Radio Frequency Devices

**UL 1598**; Luminaires; UL

#### 4. Requirements

##### 4.1 Luminaire Performance

Operating temperature, range	°C	-20 to +50
	°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377		4000 ±300
Color rendering index (CRI), minimum		70
Lumen depreciation of LED light sources per IES LM-80		LED module(s)/ array(s) shall deliver at least 70% of initial lumens (L <sub>70</sub> ), when installed for a minimum of 50,000 hours
Light distribution per IES Handbook, chapter 22		Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A		B1, U0, G1
Uplight per IESNA TM-15		UL & UH = 0 (full cutoff)
High and very high light per IES TM-15, maximum of luminaire lumens		BH = 5% BVH and FVH = 0.2%
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0		55
Off-state power consumption, W, maximum		0.5
On-state power consumption, excluding control device, watt, maximum		50 +/- 5
Luminous flux distribution at median driver current, lumens, minimum		3900
Effective projected area (EPA), maximum, ft <sup>2</sup>		0.9
Total harmonics distortion at full power across specified voltage range, maximum		20%
Vibration withstand, minimum, per ANSI C136.31		Level 1 (normal application)

## 4.2 Power Supply/Driver

Input voltage, functional range, 60 Hz, Vac	120 to 277
Power factor, minimum	0.90
Driver output current, mA, range	300 - 725
Surge protection <sup>1</sup>	
High exposure	10 kV
Low exposure	6 kV
Interference	FCC 47 CFR part 15/18, Class A
Dimming signal, control range, Vdc	0 to 10

References:

1. ANSI C136.37 and ANSI/IEEE C62.41.2

## 4.3 Construction

Luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photo-control receptacle.

Luminaire housing shall be cast aluminum.

Luminaire housing shall allow tool-less entry.

Luminaire housing shall be provided with level bubble to facilitate installation.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e. weep holes).

Luminaire door shall be securely hinged and incapable of involuntary separation from housing when accessed in field-installed position.

Luminaire shall be designed to mount on a 2-inch nominal pipe size (NPS) tenon with  $\pm 5$  degrees of tilt.

Tenon mounting area opening shall be limited to 1/4-inch over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

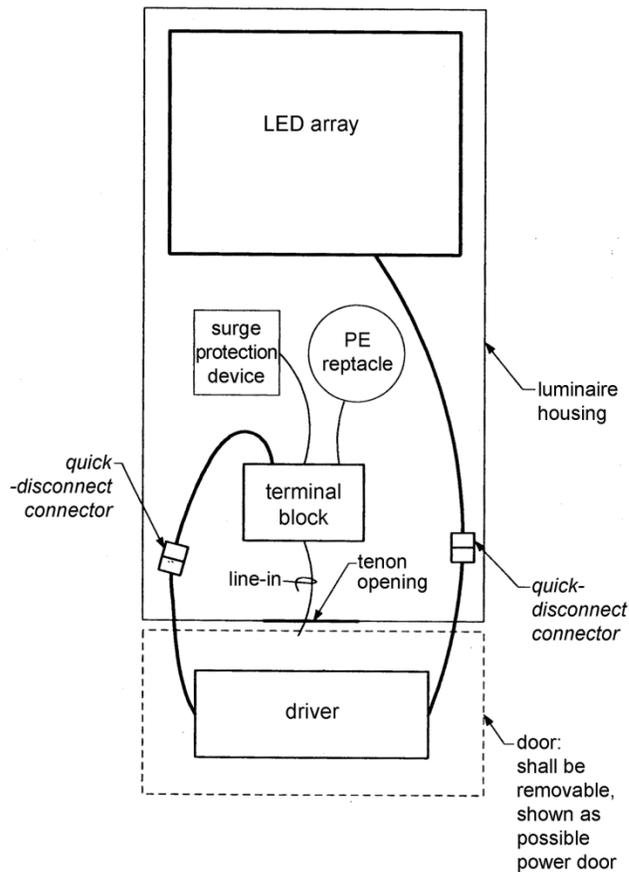
Methods of limiting tenon mounting area shall provide safe access for temporary service feeds entering directly through the tenon opening without damaging service wires.

Power supply/driver shall be field replaceable by means of quick-disconnect connectors and easy access mounting hardware.

Power supply/driver shall be provided with a control signal interface with operating range of 0 to 10 Vdc for dimming.

Luminaire circuitry shall include *quick connect/disconnects* to allow easy separation and removal of driver and power door. Refer to Figure 4.3

**Figure 4.3. Locations of Quick Disconnect Connectors**



The luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

Luminaire shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photo control.

Rotational adjustment of the photo control shall be tool-less.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall be provided with capability for optional backlight control.

Backlight control shall be installed using stainless steel fasteners. Screw drive type shall be slotted or Phillips.

Complete assembly weight shall not exceed 30 lb.

Luminaire shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb)

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

Luminaire design shall facilitate hose-down cleaning and discourage debris accumulation.

#### **4.4 Finish**

Luminaire housing finish shall be powder-coated gray.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117.

Painted or finished luminaire components exposed to the environment shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

#### **4.5 Certification and Listing**

Power supply/driver shall be UL recognized for dry and damp locations.

All other electrical components shall be UL listed or recognized for wet locations.

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### **5. Testing**

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliance shall be provided upon request.

#### **5.1 Product Approval**

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for the details:

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation.

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

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### **6. Design Changes**

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

## 7. Marking

### 7.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 hertz
- Driver type (if applicable)(may be on Driver if readily visible)
- Photo control voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on Driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photo control receptacle, lamp, and the like, as necessary
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number.

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## 8. Marking

### 8.1 External Marking

A readily visible marker shall be permanently affixed to the outside surface of each luminaire housing.

External marker shall meet the requirements of ANSI C136.15.

External marker type shall be large per ANSI C136.15.

### 8.2 Barcode

A barcode label shall be provided as specified in the purchase order.

### 8.3 Component Identification

All UL listed components shall be labeled or recognized as such.

## 9. Packaging

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light's stock number
- Seattle City Light's purchase order number.

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Product description
- Seattle City Light's stock number.

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## 10. Issuance

EA

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## 11. Approved Manufacturers – Luminaires, Stock No. 013354

**Manufacturer:** BetaLED

**Catalog No.:** STR-LWY-2M-HT-03-D-UL-SV-R-43K-PD

*where:*

STR = product

LWY = family

2M = IESNA type II medium distribution

HT = horizontal tenon mount

03 = thirty LEDs

D = LED series

UL = voltage, universal 120-277 Vac

SV = housing color, silver

R = NEMA photocell receptacle

43K = color temperature, 4300 K

PD = power door option consisting of quick disconnect devices that allow the driver and the LEDs to be disconnected so that the door with the driver can be completely removed from the fixture if desired

**Manufacturer:** Leotek  
**Catalog No.:** GC1-30E-MV-NW-2-GY

where:

GC1 = LED streetlight  
30E = thirty Cree XPG LEDs  
MV = voltage, 120-277 Vac  
NW = nominal color temperature, 4000 K  
2 = light distribution, type 2  
GY = finish, gray

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## 12. Approved Manufacturers – Accessories

### 12.1 BetaLED Shield

**Stock No.:** 013355  
**Description:** House side shield for BetaLED, LED streetlight luminaires  
**Application:** Installed on BetaLED LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.  
**Manufacturer:** BetaLED  
**Catalog Number:** *by description*

### 12.2 Leotek Shield

**Stock Number:** 013356  
**Description:** House side shield for Leotek, type GC-1, LED streetlight luminaires  
**Application:** Installed on Leotek, type GC-1, LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.  
**Manufacturer:** Leotek  
**Catalog Number:** HSS-GC1-40

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## 13. References

**SCL Material Standard 5723.51;** “Streetlight Luminaire, LED, Side-mount, Residential, 70-watt”

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## 14. Sources

**BetaLED STR-LWY-2M-HT,** LEDway Streetlight - Type II Medium, BetaLED bulletin; revision 01/27/11

**BetaLED STR-LWY-2M-HT,** LEDway Streetlight - Type II Medium, BetaLED bulletin; revision 02/15/10

**Chao, Yaochiem;** SCL Standards engineer and subject matter expert for 5723.49; (yaochiem.chao@seattle.gov)

**City of Seattle, Standard Specifications,** Section 9-31.1(2)-Luminaires

**Federal Communications Commission Title 47 CFT**; Part 15/18,  
revision 05/10/11; [www.fcc.gov](http://www.fcc.gov)

**GE OLP-2858**, bulletin, LED Roadway; GE Lighting System, Inc.; 1/10

**IESNA Lighting Handbook**; Chapter 22,9th edition; Roadway Lighting

**IESNA Lighting Ready Reference**, A Compendium of Materials from the IESNA Lighting  
Handbook; 9th Edition, RR-03 Fourth Edition

**Leotek CN-022411**, LED Street Lighting, Leotek bulletin, GCA1 Series

**Seattle City Light, Specification for LED Roadway Luminaires**, revision J  
January 4, 2012

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert for  
5723.49; ([john.shipek@seattle.gov](mailto:john.shipek@seattle.gov))

**Smalley, Edward**; SCL engineer and subject matter expert for 5723.49  
([edward.smalley@seattle.gov](mailto:edward.smalley@seattle.gov))

**UL 1012** - Power Units Other Than Class 2

**UL 1310** - Class 2 Power Units

**UL 2108** - Low Voltage Lighting Systems

**UL 8750** - Light-Emitting Diode (LED) Light Sources for Use in Lighting Products

## Streetlight Luminaire, LED, Side-mount, Residential, 70-watt



### 1. Scope

This standard covers the requirements for 70 watt, side-mount, outdoor type, light-emitting-diode (LED) streetlight luminaires. LED luminaires are also known as solid state luminaires.

This standard applies to Seattle City Light Stock Number 013078.

This Stock Number is to allow luminaires removed from service to be returned to inventory; not for new purchases. For new purchases, refer to Material Standard 5723.49.

### 2. Application

70 watt LED streetlight luminaires are mounted on 2-inch nominal pipe size (NPS) tenons on poles to provide light to residential neighborhoods.

A 70 watt, LED streetlight consumes approximately 48 percent less energy than a conventional 100 watt high-intensity discharge (HID) luminaire.

LED life is greater than 50,000 hours. LED streetlight luminaire is 100 percent mercury- and lead-free.

Refer to Standard 5323.49 for luminaire shields. Streetlight Engineering must pre-approve all

installations of luminaire shields. Contact Streetlight Engineering for details.

### 3. Industry Standards

LED streetlight luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008** - Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**IES LM-79-08** - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08** - Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IEEE C62.41.2-2002** - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IESNA TM-15-07 (revised)** - Luminaire Classification System for Outdoor Luminaires

**IESNA TM-15-07, Addendum A** - Backlight, Uplight, and Glare (BUG) Ratings

**IEC 60529** - Degrees of protection provided by enclosures (IP Code), consolidated edition

**UL 1598** - Luminaires; UL

#### 4. Requirements

##### 4.1 Luminaire Performance

Operating temperature, range	
°C	-20 to +50
°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSLG C78.377	4000 ±300
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80	LED module(s)/ array(s) shall deliver at least 70% of initial lumens (L <sub>70</sub> ), when installed for a minimum of 50,000 hours
Light distribution per IES Handbook, chapter 22	Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A	B1, U1, G1
Uplight per IESNA TM-15	UL & UH = 0 (full cutoff)
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0	55
Off-state power consumption, W, maximum	0.5
On-state power consumption, excluding control device, watt, maximum	75
Luminous flux distribution at median driver current, lumens, minimum	3900

##### 4.2 Power Supply/Driver

Power supply driver shall be dimmer compatible.

Input voltage, functional range, 60 Hz, Vac	120 to 277
Power factor, minimum	0.90
Driver output current, mA, range	300 - 725
Transient protection	10 kV
Interference	FCC 47 CFR part 15/18, Class A

##### 4.3 Construction

Luminaire housing shall be cast aluminum.

Luminaire housing shall allow tool-less entry.

Luminaire housing shall be provided with level bubble to facilitate installation.

Luminaire housing finish shall be powder-coated gray.

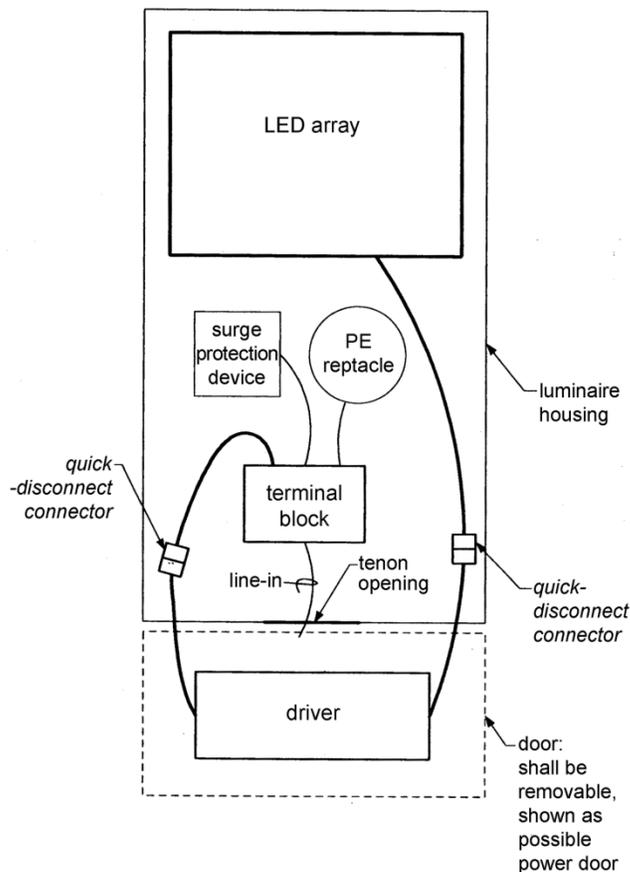
Luminaire shall be designed to mount on a schedule 40, 2-inch nominal pipe size (NPS) tenon with ±5 degrees of tilt.

Power supply/driver shall be field replaceable by means of quick-disconnect connectors and easy access mounting hardware.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e. weep holes).

Luminaire circuitry shall include *quick connect/disconnects* to allow easy separation and removal of driver and power door. Refer to Figure 4.3

**Figure 4.3, Locations of Quick Disconnect Connectors**



## 4. Requirements

### 4.3 Construction, continued

The luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

Luminaire shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photocontrol.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

A three-pole terminal block capable of accepting #14 to #10 AWG wire shall be mounted to the housing inside the electrical compartment.

Luminaire shall be provided with capability for optional backlight control.

Complete assembly weight shall not exceed 45 lbs.

### 4.4 Certification and Listing

Power supply/driver shall be UL recognized for dry and damp locations.

All other electrical components shall be UL listed or recognized for wet locations.

## 5. Testing

Test data that establishes compliance with the requirements of UL 1598 and the other industry standards listed in Section 3 of this material standard shall be provided upon request.

## 6. Product Approval

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for the details.

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

## 7. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

## 8. Marking

### 8.1 Nameplate

An easily-viewable nameplate shall be permanently affixed to the inside each luminaire housing.

Nameplate shall contain the following information:

- manufacturer's name
- manufacturer's catalog number
- date of manufacture (month and year)
- plant location
- input power consumption
- driver output current
- IEC IP Rating
- correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- serial number

A similar nameplate shall be permanently affixed to the exterior underside of each luminaire housing.

### 8.2 Barcode

A barcode label shall be as provided as specified in the purchase order.

### 8.3 Identification

All UL listed components shall be labeled or recognized as such.

## 9. Packaging

luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light's Stock Number
- Seattle City Light's Purchase Order Number

## 10. Issuance

EA

## 11. Approved Manufacturers – Luminaires, Stock Number 013078

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**Manufacturer:** BetaLED

**Catalog Number:** STR-LWY-2M-HT-04-C-UL-SV-R-43K-PD

*where:*

- STR** = product
- LWY** = family
- 2M** = IESNA type II medium distribution
- HT** = horizontal tenon mount
- 04** = forty LEDs
- C** = LED series
- UL** = voltage, universal 120-277 Vac
- SV** = housing color, silver
- R** = NEMA photocell receptacle
- 43K** = color temperature, 4300 K
- PD** = power door option consisting of quick disconnect devices that allow the driver and the LEDs to be disconnected so that the door with the driver can be completely removed from the fixture if desired

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**Manufacturer:** Leotek

**Catalog Number:** GC1-40C-MV-NW-2M-GY-530mA

*where:*

- GC1** = LED streetlight
- 40C** = forty type C LEDs
- MV** = voltage, 120-277 Vac
- NW** = nominal color temperature, 4000 K
- 2M** = light distribution, type 2 medium
- GY** = finish, gray
- 530mA** = fixed drive current, 530 mA

## 12. References

**SCL Material Standard 5723.49**; "Streetlight Luminaire, LED, Side-mount, Residential, 52-watt"

## 13. Sources

**BetaLED STR-LWY-2M-HT**, LEDway Streetlight - Type II Medium, BetaLED bulletin; revision 01/27/11

**BetaLED STR-LWY-2M-HT**, LEDway Streetlight - Type II Medium, BetaLED bulletin; revision 02/15/10

**City of Seattle, Standard Specifications**, Section 9-31.1(2)-Luminaires

**GE OLP-2858**, bulletin, LED Roadway; GE Lighting System, Inc.; 1/10

**IESNA Lighting Handbook**; Chapter 22,9th edition; Roadway Lighting

**IESNA Lighting Ready Reference**, A Compendium of Materials from the IESNA Lighting Handbook; 9th Edition, RR-03 Fourth Edition

**Leotek CN-022411**, LED Street Lighting, Leotek bulletin, GCA1 Series

**Leotek CN-031310**, LED Street Lighting, Leotek bulletin, GCA1 Series

**Marsten, Vicki**; SCL engineer and subject matter expert for 5723.51; (vicki.marsten@seattle.gov)

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert and for 5723.51; (john.shipek@seattle.gov)

**Smalley, Edward**; SCL engineer and subject matter expert for 5723.51; (edward.smalley@seattle.gov)

**UL 1012** - Power Units Other Than Class 2

**UL 1310** - Class 2 Power Units

**UL 2108** - Low Voltage Lighting Systems

**UL 8750** - Light-Emitting Diode (LED) Light Sources for Use in Lighting Products

## Streetlight Luminaire, LED, Side-mount, Collector Arterial-grade



### 1. Scope

This standard covers the requirements for collector arterial-grade, side-mount, outdoor type, light-emitting-diode (LED) streetlight luminaires and their accessories. LED luminaires are also known as solid state light (SSL) source fixtures.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
013492	Luminaire
013493	House side shield for Cree luminaire
013494	House side shield for Leotek luminaire

### 2. Application

Collector arterial-grade LED streetlight luminaires are side-mounted on 2-inch nominal pipe size (NPS) tenons on poles to provide light to collector-arterial roadways as defined by the Seattle Department of Transportation.

Collector arterial-grade LED streetlights are rated for installation in bridge and overpass applications.

Collector arterial-grade LED streetlights are intended for installation at a 35-ft mounting height.

LED life is greater than 100,000 hours. LED streetlight luminaire is 100 percent mercury- and lead-free.

Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

LED streetlight luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008**; Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.10-2010**; Locking-Type Photocontrol Devices and Mating Receptacles

**ANSI C136.31-2010**; American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37-2011**; American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**ANSI C136.41-2013**; Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15-2011 (or latest)**; American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22-2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**Federal Trade Commission (FTC)**; Green Guides, 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of protection provided by enclosures (IP Code), consolidated edition

**IEEE C62.41.2-2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11 (revised)**; Luminaire Classification System for Outdoor Luminaires

**RoHS** (European Union Directive 2002/95/EC for Restriction of Hazardous Substances)

**Title 47** of the Code of Federal Regulations (CFR), Part 15; Radio Frequency Devices

**UL 1598**; Luminaires; UL

## 4. Requirements

### 4.1 Luminaire Performance

Operating temperature, range	
°C	-20 to +50
°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSLG C78.377	4000 ± 300
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80	LED module(s)/ array(s) shall deliver at least 70% of initial lumens (L <sub>70</sub> ), when installed for a minimum of 100,000 hours
Light distribution per IES Handbook, chapter 22	Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A	B2, U0, G2
Zonal luminance distribution, of maintained lumen output, per IESNA TM-15	
FL + FM + FH	50–75%
FVH	1–3%
BL + BM	15–35%
BH + BVH	0–10%
UL + UH	0%
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0	70
Off-state power consumption, W, maximum	0.5
On-state power consumption, excluding control device, watt, nominal	135 ± 10
Luminous flux distribution at median driver current, lumens, minimum	9650
Effective projected area (EPA), maximum, ft <sup>2</sup>	0.9
Total harmonics distortion at full power across specified voltage range, maximum	20%
Vibration withstand, minimum, per ANSI C136.31	Level 2 (bridge/overpass application)

### 4.2 Power Supply/Driver

Input voltage, functional range, 60 Hz, Vac	120 to 277
Power factor, minimum	0.90
Driver output current, mA, range	350 to 700
Surge protection, per ANSI C136.37 and ANSI/ IEEE C62.41.2	
High exposure	10 kV
Low exposure	6 kV
Interference	FCC 47 CFR part 15/18, Class A
Dimming signal, control range, Vdc	0 to 10

## 4.3 Construction

### 4.3.1. General

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photo-control receptacle.

Luminaire shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb).

### 4.3.2. Fixture Housing

Luminaire housing shall be cast aluminum.

Luminaire housing shall allow tool-less entry.

Luminaire housing shall be provided with level bubble to facilitate installation.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e.; weep holes).

Luminaire door shall be securely hinged and incapable of involuntary separation from housing when accessed in field-installed position.

The luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

Complete assembly weight shall not exceed 30 lb.

Maximum estimated projected area shall not exceed 0.9 sq ft.

Luminaire design shall facilitate hose-down cleaning and discourage debris accumulation.

### 4.3.3. Electrical

Power supply/driver shall be provided with a control signal interface with operating range of 0 to 10 Vdc for dimming.

Luminaire photocontrol receptacle shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photo control. Photocontrol receptacle shall also be configured with the addition of a minimum of two conductive pads, as defined in ANSI C136.41-2013. Four conductive pads are optional.

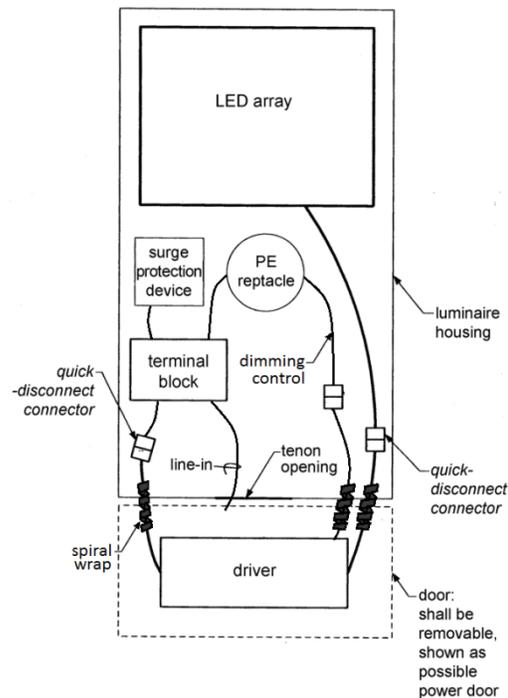
The two conductive pads shall be connected to the 0-10 Vdc control signal interface on the power supply/driver with quick-disconnect connectors.

Rotational adjustment of the photo control shall be tool-less.

Luminaire circuitry shall include *quick connect/disconnects* to allow easy separation and removal of driver and power door. Refer to Figure 4.3.3.

Wire harnesses shall be protected with a spiral wrap to prevent damage to the wire insulation when operating the power door.

**Figure 4.3.3 Locations of Quick Disconnect Connectors**



A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

#### 4.3.4. Mounting

Luminaire shall be 4 bolts and designed to mount on a 2-in nominal pipe size (NPS) tenon.

Luminaire shall be capable of  $\pm 5$  degrees of tilt, minimum, for leveling adjustment and labeled properly.

Tenon mounting area opening shall be limited to 1/4-inch over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

Methods of limiting tenon mounting area shall provide safe access for temporary service feeds entering directly through the tenon opening without damaging service wires.

#### 4.3.5. Backlight Control

Luminaire shall be provided with capability for optional, field-installed backlight control.

Backlight control shall be no more than two pieces.

Backlight control shall be installed using stainless steel fasteners and be provided by the manufacturer. Screw drive type shall be slotted or Phillips.

In addition to required amount, each backlight shield shall be supplied with two additional fasteners.

#### 4.4 Finish

Luminaire housing finish shall be powder-coated gray.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per B117.

Painted or finished luminaire components exposed to the environment shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

#### 4.5 Certification and Listing

Power supply/driver shall be UL recognized for dry and damp locations.

All other electrical components shall be UL listed or recognized for wet locations.

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### 5. Testing

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliance shall be provided upon request.

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### 6. Product Approval

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for the details.

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation.

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

## 7. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

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## 8. Marking

### 8.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 hertz
- Driver type (if applicable)(may be on Driver if readily visible)
- Photo control voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on Driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photo control receptacle, lamp, and the like, as necessary
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number.

### 8.2 External Marking

A readily visible marker shall be permanently affixed to the outside surface of each luminaire housing.

External marker shall meet the requirements of ANSI C136.15.

External marker type shall be large per ANSI C136.15.

### 8.3 Barcode

A barcode label shall be provided as specified in the purchase order.

### 8.4 Component Identification

All UL listed components shall be labeled or recognized as such.

## 9. Packaging

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light's stock number
- Seattle City Light's purchase order number.

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Product description
- Seattle City Light's stock number.

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## 10. Issuance

EA

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## 11. Approved Manufacturers – Luminaires, Stock Number 013492

**Manufacturer: Cree**

**Catalog No.:** **BXSP-A-0-2-H-N-USN-SEA-7PIN**

*where:*

BXSP = product

A = version

0 = mounting, horizontal tenon

2 = optic, type II

H = module, high-efficacy 4000K

N = input power, 134W

U = voltage, universal 120-277V

S = color options, silver

N = options, utility label and NEMA photocell receptacle

SEA = special options:

- field adjustable output factory
- preset at level 'N'. (N-setting on field adjustable output decreases input power to approximately 134W.)
- full functionality of field adjustable output
- external wattage label = '134'
- 4-bolt mounting: two brackets--one with teeth and one smooth internal labeling
- output current guide
- powder-coated splash-guard
- special housing

7PIN = photocontrol option, seven pins

**Manufacturer: Leotek**

**Catalog No.:** GC1-60E-MV-NW-2-GY-700-WL-PCR7

where:

- GC1 = product
- 60E = number/LED type, 60
- MV = voltage, 120-277V
- NW = nominal color temperature, 4300K
- 2 = light distribution, type II
- GY = finish, gray
- 700 = options, factory set 700mA
- WL = accessories, wattage label
- PCR7 = photocell option, seven pins

**12. Approved Manufacturers – Accessories, Stock Number**

**12.1 Cree Shield**

Stock No.:	013493
Description:	House side shield for Cree, type BXSP, LED streetlight luminaires
Application:	Installed on Cree, type BXSP, LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.
Manufacturer:	Cree
Catalog No.:	XA-SP2BLS

**12.2 Leotek Shield**

Stock No.:	013494
Description:	House side shield for Leotek, type GC1-60E, LED streetlight luminaires
Application:	Installed on Leotek, type GC1-60E, LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.
Manufacturer:	Leotek
Catalog No.:	HSS-GC1-60

### 13. Sources

**Chao, Yaochiem**; SCL Standards Engineer, originator and subject matter expert for 5723.61; (yaochiem.chao@seattle.gov)

**City of Seattle, Standard Specifications**; Section 9 -31.1(2)-Luminaires

**Cree XSP2**; XSP Series LED Street Light, Cree Documentation; revision 09/14/12

**Darrat, Ahmed**; SDOT Traffic Engineer, subject matter expert for 5723.61; (ahmed.darrat@seattle.gov)

**Federal Communications Commission Title 47 CFT**; Part 15/18, revision 05/10/11; www.fcc.gov

**IESNA Lighting Handbook**; Chapter 22,9th edition; Roadway Lighting

**IESNA Lighting Ready Reference**; A Compendium of Materials from the IESNA Lighting Handbook; 9th Edition, RR-03 Fourth Edition

**Leotek GC1, E-Series Spec Sheet**; Leotek Documentation; revision 05/14/13

**Seattle City Light, Specification for LED Roadway Luminaires**; revision January 4, 2012

**UL 1012** - Power Units Other Than Class 2

**UL 1310** - Class 2 Power Units

**UL 2108** - Low Voltage Lighting Systems

**UL 8750** - Light-Emitting Diode (LED) Light Sources for Use in Lighting Products

## Streetlight Luminaire, LED, Side-mount, Principal Arterial-grade



### 1. Scope

This standard covers the requirements for principal arterial-grade, side-mount, outdoor type, light-emitting-diode (LED) streetlight luminaires and their accessories. LED luminaires are also known as solid state light (SSL) source fixtures.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
013495	Luminaire
013496	House-side shield for Leotek GC2-120E luminaire

### 2. Application

Principal arterial-grade LED streetlight luminaires are side-mounted on 2-inch nominal pipe size (NPS) tenons on poles to provide light to arterial roadways as defined by the Seattle Department of Transportation.

Principal arterial-grade LED streetlights are rated for installation in bridge and overpass applications.

Principal arterial-grade LED streetlights are intended for installation at a 35-foot mounting height.

LED life is greater than 100,000 hours. LED streetlight luminaires are 100 percent mercury- and lead-free.

Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.

### 3. Industry Standards

LED streetlight luminaires shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA/ANSLG C78.377-2008**; Specifications for the Chromaticity of Solid State Lighting (SSL) Products

**ANSI C136.10–2010**; Locking-Type Photocontrol Devices and Mating Receptacles.

**ANSI C136.31–2010**; American National Standard for Roadway Lighting Equipment – Luminaire Vibration

**ANSI C136.37–2011**; American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

**ANSI C136.41–2013**; Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

**ASTM B117-09**; Standard Practice for Operating Salt Spray (Fog) Apparatus

**ASTM D1654-08**; Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

**ASTM D523-08**; Standard Test Method for Specular Gloss

**ASTM G154-06**; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

**C136.15–2011 (or latest)**; American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires

**C136.22–2004 (R2009)**; American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures

**Federal Trade Commission (FTC)**; Green Guides, 16 CFR Part 260; Guides for the Use of Environmental Marketing

**IEC 60529**; Degrees of protection provided by enclosures (IP Code), consolidated edition

**IEEE C62.41.2–2002**; IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits

**IES LM-79-08**; Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

**IES LM-80-08**; Approved Method: Measuring Lumen Maintenance of LED Lighting Sources

**IESNA TM-15-11 (revised)**; Luminaire Classification System for Outdoor Luminaires

**RoHS** (European Union Directive 2002/95/EC for Restriction of Hazardous Substance)

**Title 47 of the Code of Federal Regulations (CFR), Part 15**; Radio Frequency Devices

**UL 1598**; Luminaires; UL

#### 4. Requirements

##### 4.1 Luminaire Performance

Operating temperature, range	
°C	-20 to +50
°F	-4 to +122
Correlated Color Temperature (CCT), nominal, °K, per ANSI/NEMA/ANSI C78.377	4000 ± 300
Color rendering index (CRI), minimum	70
Lumen depreciation of LED light sources per IES LM-80	LED module(s)/ array(s) shall deliver at least 70% of initial lumens (L <sub>70</sub> ), when installed for a minimum of 100,000 hours
Light distribution per IES Handbook, chapter 22	Type II Medium
Backlight, Uplight and Glare (BUG) rating per IESNA TM-15, Addendum A	B3, U0, G3
Zonal luminance distribution, of maintained lumen output, per IESNA TM-15	
FL + FM + FH	50–75%
FVH	1–3%
BL + BM	15–35%
BH + BVH	0–10%
UL + UH	0%
Luminaire efficacy, type II distribution, lumens/watt, minimum, per IES LM-79, Section 11.0	70
Off-state power consumption, W, maximum	0.5
On-state power consumption, excluding control device, watt, nominal	270 ± 10
Luminous flux distribution at median driver current, lumens, minimum	18850
Effective projected area (EPA), maximum, ft <sup>2</sup>	1.0
Total harmonics distortion at full power across specified voltage range, maximum	20%
Vibration withstand, minimum, per ANSI C136.31	Level 2 (bridge/overpass application)

## 4.2 Power Supply/Driver

Input voltage, functional range, 60 Hz, VAC	120 to 277
Power factor, minimum	0.90
Surge protection, per ANSI C136.37 and ANSI/ IEEE C62.41.2	
High exposure	10 kV
Low exposure	6 kV
Interference	FCC 47 CFR part 15/18, Class A
Dimming signal, control range, VDC	0 to 10

## 4.3 Construction

### 4.3.1. General

The luminaire shall be designed and constructed to meet the requirements of ANSI C136.37.

Luminaire features conforming to ANSI C136.37 shall include, but not be limited to: mounting provisions, latching and hinging, terminal blocks, dimming, ingress protection, wiring and grounding, and photo-control receptacle.

Luminaire shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant. Luminaire shall have less than the maximum concentration values of the following RoHS restricted substances:

- Mercury (Hg)
- Cadmium (Cd)
- Chromium VI (Cr +6)
- Polybrominated biphenyl (PBB)
- Polybrominated biphenyl ether (PBDE)
- Lead (Pb).

### 4.3.2. Fixture Housing

Luminaire housing shall be cast aluminum.

Luminaire housing shall allow tool-less entry.

Luminaire housing shall be provided with level bubble to facilitate installation.

Luminaire external housing shall have a minimum rating of IP65 as specified in IEC 60529, with the ability to shed water from inside the housing (i.e.; weep holes).

Luminaire door shall be securely hinged and incapable of involuntary separation from housing when accessed in field-installed position.

The luminaire optical chamber shall have a minimum rating of IP66 as specified in IEC 60529.

Luminaire cooling system shall consist of a passive heat sink with no fans, pumps, or liquids.

All fasteners shall be stainless steel.

All polycarbonate components shall be UV stabilized.

Complete assembly weight shall not exceed 40 lb.

Maximum estimated projected area shall not exceed 0.9 sq ft.

Luminaire design shall facilitate hose-down cleaning and discourage debris accumulation.

### 4.3.3. Electrical

Power supply/driver shall be provided with a control signal interface with operating range of 0 to 10 Vdc for dimming.

Luminaire photocontrol receptacle shall be designed and constructed to accept a standard plug type, locking, three-pole, three-wire, streetlight photo control. Photocontrol receptacle shall also be configured with the addition of a minimum of two conductive pads, as defined in ANSI C136.41-2013. Four conductive pads are optional.

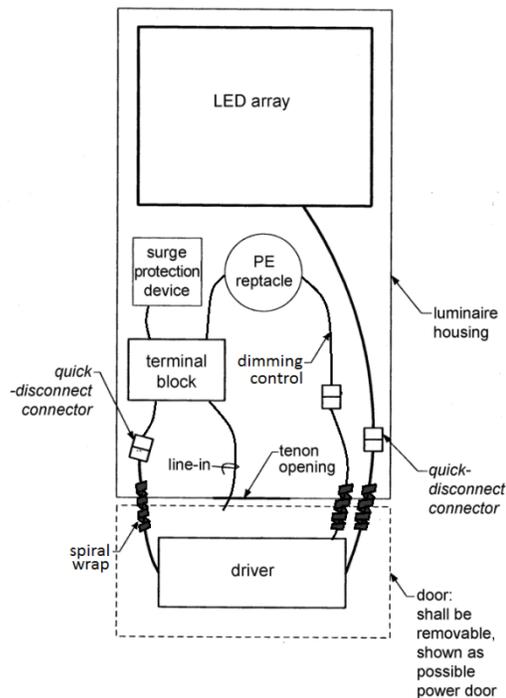
The two conductive pads shall be connected to the 0-10 Vdc control signal interface on the power supply/driver with quick-disconnect connectors.

Rotational adjustment of the photo control shall be tool-less.

Luminaire circuitry shall include *quick connect/disconnects* to allow easy separation and removal of driver and power door. Refer to Figure 4.3.3.

Wire harnesses shall be protected with a spiral wrap to prevent damage to the wire insulation when operating the power door.

**Figure 4.3.3. Luminaire Construction**



A three-pole terminal block capable of accepting #14 to #6 AWG wire shall be mounted to the housing inside the electrical compartment.

Terminal block shall be capable of operation with a standard #2 flat blade screwdriver.

Luminaire shall meet the requirements of Title 47 of the Code of Federal Regulations (CFR), Part 15 – Radio Frequency Devices.

#### 4.3.4. Mounting

Luminaire shall be 4 bolts and designed to mount on a 2-in nominal pipe size (NPS) tenon.

Luminaire shall be capable of  $\pm 5$  degrees of tilt, minimum, for leveling adjustment and labeled properly.

Tenon mounting area opening shall be limited to 1/4-inch over the range of tenon sizes and leveling adjustment to prevent entrance of wildlife as specified in ANSI C136.37.

Methods of limiting tenon mounting area shall provide safe access for temporary service feeds entering directly through the tenon opening without damaging service wires.

#### 4.3.5. Backlight Control

Luminaire shall be provided with capability for optional, field-installed backlight control.

Backlight control shall be no more than two pieces.

Backlight control shall be installed using stainless steel fasteners and be provided by the manufacturer. Screw drive type shall be slotted or Phillips.

In addition to required amount, each backlight shield shall be supplied with two additional fasteners.

#### 4.4 Finish

Luminaire housing finish shall be gray.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per B117.

Painted or finished luminaire components exposed to the environment shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

#### 4.5 Certification and Listing

Power supply/driver shall be UL recognized for dry and damp locations.

All other electrical components shall be UL listed or recognized for wet locations.

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### 5. Testing

Test data that establishes compliance with the requirements of this material standard shall be provided upon request.

Certificate of RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliance shall be provided upon request.

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### 6. Product Approval

Manufacturers interested in having their luminaire(s) approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Streetlight Engineering for the details.

- Review fixture test reports
- Computer modeling of fixture light distribution
- Laboratory testing of sample fixture and shield
- Field trial of sample fixture(s) and shield(s)
- Field trial review and evaluation

Manufacturers are encouraged to plan accordingly. The approval process can take up to six months to complete.

## 7. Design Changes

Manufacturer shall inform Seattle City Light in writing of all design changes that could affect the product's understood or published capabilities.

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## 8. Marking

### 8.1 Internal Labeling

A readily visible label shall be permanently affixed to the inside surface of each luminaire housing.

Internal label shall meet the requirements of ANSI C136.22.

Internal label shall include, but not be limited to, the following information:

- Manufacturer's name and catalog number
- Month and year of manufacture
- Line input voltage
- Frequency if other than 60 hertz
- Driver type (if applicable)(may be on Driver if readily visible)
- Photo control voltage if different from line input voltage
- Lamp type, wattage, and voltage (if applicable; may be on Driver if readily visible)
- Descriptive wiring diagram showing input terminals, ballast, capacitors, starting aid, photo control receptacle, lamp, and the like, as necessary
- Plant location
- Input power consumption
- Driver output current
- Driver output adjustment
- IEC IP rating
- Correlated color temperature (CCT)
- IES light distribution type
- IESNA TM-15 BUG ratings
- Serial number.

### 8.2 External Marking

A readily visible marker shall be permanently affixed to the outside surface of each luminaire housing.

External marker shall meet the requirements of ANSI C136.15.

External marker type shall be large per ANSI C136.15.

### 8.3 Barcode

A barcode label shall be provided as specified in the purchase order.

### 8.4 Component Identification

All UL listed components shall be labeled or recognized as such.

## 9. Packaging

Luminaires shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Date of manufacture (month and year)
- Seattle City Light's stock number
- Seattle City Light's purchase order number.

Accessories shall be individually packaged to prevent damage during shipping, inside storage, and casual handling prior to installation.

Each package shall be legibly marked with:

- Product description
  - Seattle City Light's stock number.
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## 10. Issuance

EA

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## 11. Approved Manufacturers – Luminaires, Stock Number 013495

**Manufacturer: Leotek**

**Catalog No.:** GC2-120E-MV-NW-2-GY-700-WL-PCR7

*where:*

- GC2 = product
- 120E = number/LED type, 120
- MV = voltage, 120-277V
- NW = nominal color temperature, 4300K
- 2 = light distribution, type II
- GY = finish, gray
- 700 = options, factory set 700mA
- WL = accessories, wattage label
- PCR7 = photocell option, seven pins

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## 12. Approved Manufacturers – Accessories, Stock No.

### 12.1 Leotek Shield

Stock No.:	013496
Description:	House-side shield for Leotek, type GC2-120E, LED streetlight luminaires
Application:	Installed on Leotek, type GC2-120E, LED streetlight luminaires to mitigate house side backlighting problems. Streetlight Engineering must pre-approve all installations of luminaire shields. Contact Streetlight Engineering for details.
Manufacturer:	Leotek Shield
Catalog No.:	HSS-GC2-120

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## 13. Sources

**Chao, Yaochiem**; SCL Standards Engineer, originator and subject matter expert for 5723.71; (yaochiem.chao@seattle.gov)

**Darrat, Ahmed**; SDOT Traffic Engineer and subject matter expert for 5723.71; (ahmed.darrat@seattle.gov)

**City of Seattle, Standard Specifications**; Section 9 -31.1(2)-Luminaires

**Federal Communications Commission Title 47 CFT**; Part 15/18, revision 05/10/11; www.fcc.gov

**IESNA Lighting Handbook**; Chapter 22,9th Edition; Roadway Lighting

**IESNA Lighting Ready Reference, A Compendium of Materials from the IESNA Lighting Handbook**; 9th Edition, RR-03 Fourth Edition

**Leotek GC2, E-Series Spec Sheet**; Leotek Documentation; revision 05/14/13

**Los Angeles Bureau of Street Lighting**; Credit for cover photo on page 1

**RW-ATB2; Autobahn Series ATB2 Roadway Lighting**; American Electric Lighting, revision 11/21/13

**Specification for LED Roadway Luminaires**; Seattle City Light, January 2012

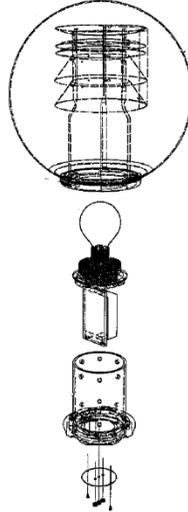
**UL 1012** - Power Units Other Than Class 2

**UL 1310** - Class 2 Power Units

**UL 2108** - Low Voltage Lighting Systems

**UL 8750** - Light-Emitting Diode (LED) Light Sources for Use in Lighting Products

## Induction Ball Globe Fixtures



### 1. Scope

This standard covers the requirements for induction ball globe fixtures and replacement parts.

An induction ball globe fixture is made up of a 22-inch globe with louver, an induction system, and a ballast housing.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
012664	Complete induction globe fixture
013545	Induction system replacement
013546	22-in globe with louver replacement

### 2. Application

Induction ball globe fixtures are installed on SCL Stock No. 572900, 3-ball globe fixtures located in Pioneer Square and other historical districts.

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Requirements

#### 3.1 Fixture Performance

System power consumption, maximum (W)	168
Lamp wattage (W)	168
Color temperature, nominal (°K) (per ANSI/NEMA/ANSLG C78.377)	3000
Input voltage (Vac)	120
Globe size, diameter (in)	22

#### 3.2 Luminaire Construction

Luminaires shall be designed using Philips QL Induction Lighting System components and shall comply with the criterion set out in the Philips OEM guidelines for QL luminaires. Luminaires shall be of modular design and consist of a custom cast capital that is an adapter base to fit existing Seattle City Light (SCL) poles with an 8-inch inside diameter neck. These shall have a single-piece generator and socket assembly, and a clear acrylic, acid etched globe with an internal louver optical chamber designed for an IES Type IV distribution classification. The globe shall be UV stabilized.

Fixtures shall be designed for tool-less installation and maintenance of all chambers. The globe and capital shall be attached by a rotational locking system for easy lamp replacement. The top half of the rotational locking system assembly shall be integrally bonded and sealed, and mechanically fastened to the globe. The bottom half shall be part of the custom cast capital adapter. The globe may be either locked onto or released from the lower section by a quarter turn of the globe. The rotational locking system shall be cast of grade 319 aluminum.

#### 3.3 Optical System – Globe Assembly

The louvered optical system shall be permanently attached to the globe to provide easy access to the lamp and generator assembly when the globe is removed. The optical assembly shall be so attached using stainless steel legs during manufacturing as to avoid any movement or change in optical performance. The rings and louvers of the reflector shall have an Alzak® finish, or SCL-approved substitute. The optical assembly shall limit the house-side glare and avoid light trespass by means of a house-side shield.

#### 3.4 Generator Chamber Assembly

The generator chamber assembly shall be composed of standard electrical components and shall be designed to provide a quick disconnect for ease of replacement or dry room repair. The unit shall sit on a modular plate which shall disconnect from the adapter plate by a single hand-twist fastener for easy maintenance. The generator chamber assembly shall have a three position quick disconnect cable connector.

#### 3.5 Generator Temperature and Design Life

The generator shall have a design life of 80,000 hours based on a nominal Tcase temperature of no greater than 60°C/140°F.

### 3.6 Testing

Unit testing shall be done with the lamp in the base-down position with status readings taken 30 minutes after startup and every two hours thereafter for 12 consecutive hours. This information shall be documented in a spreadsheet report showing the, the generator temperature, and the lamp base temp in consecutive columns. The positions of thermocouples shall be as set out in the Philips OEM guidelines. In subsequent columns, the electrical readings of the unit shall be shown: Input Voltage; Input Amperage; Input Watts; Operating Efficiency (Power Factor/Cos $\phi$ ). Ambient environment temperature shall be no less than 25°C/77°F. All testing shall be certified and attested to by an approved independent laboratory.

### 3.7 Finish

All external metal parts shall be powder coated, with color to match Parker-Marathon paint color Railroad Green, P25-4497. (This shall include capital if specified.) All fastening hardware shall be stainless steel.

### 3.8 Performance

The luminaire shall conform in all respects to the veiling luminance requirements per IES RP-8 2000 Section 2.4, for an R-3 surface. The luminaire shall have no more than 40% up light and no less than 44% down light. An independent photometric testing laboratory shall verify such performance factors.

### 3.9 Approvals

The luminaire shall be UL listed and/or CSA approved for wet locations and IEC IP54 approved. The luminaire shall meet all requirements set out in the Philips OEM guidelines for QL luminaires.

### 3.10 Submittals

Manufacturers shall submit testing, performance, and approval documentation along with a sample luminaire before being listed as an approved manufacturer. Listing on this standard as being approved shall not relieve the manufacturer from the obligation to furnish product in accordance with all requirements of this standard.

Regardless of prior listing as being approved, all bids must be accompanied by testing, performance, and approval documentation. The apparent successful bidder shall supply a sample luminaire prior to bid award.

### 3.11 Manufacturing Warranty

The luminaire assembly shall have no less than a 10-year warranty against parts defects and failure of generator and power coupler; and a five-year warranty against paint fade or peel. This warranty shall commence at the installation of the product.

Cost for replacements shall be borne as follows: Any failures of generator and/or power coupler within the first five years of the warranty period shall be replaced at the expense of the manufacturer; this includes materials, freight, and Seattle City Light labor. Any failures of generator and/or power coupler during the second five years of the warranty period shall be replaced at the expense of the manufacturer; this includes materials and freight.

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## 4. Issuance

Stock Unit: EA

**5. Approved Products**

**5.1 Complete Induction Globe Fixture**

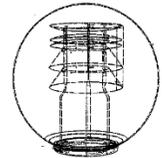
**Table 5.1. Complete Induction Globe Fixture**

<b>Stock No.:</b>	<b>012664</b>
Manufacturer:	King Luminaire Company Inc.
Catalog No.:	KG22-LAC(ETCHED)-III-165-IND-120-K4
Manufacturer:	Cyclone Luminaire
Catalog No.:	CP1138-PL3LAP-165QL-277-S5-RAL

**5.2 Induction Globe Fixture Components**

**Table 5.2. Induction Globe Fixture Components**

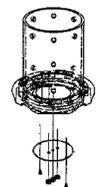
<b>Stock No.</b>	<b>013546</b>
Description:	22-in globe, ball, acrylic, etched, with louver, Type IV optics
Application:	For globe replacement of King Luminaire 22-in induction globe



<b>Stock No.</b>	<b>013545</b>
Description:	Generator Assembly, Induction, 120 V, 165 W, 120-208 Generator Operating Volts
Application:	For induction generator replacement of King Luminaire 22-in induction globe



<b>Stock. No.</b>	<b>Not stocked</b>
Description:	Ballast housing



## 6. Approved Products – Replacement Parts

### 6.1 Induction System

<b>Stock No.:</b>	<b>013545</b>
Description:	Induction system replacement for King 22-in, single globe luminaire
Application:	Replacement induction system for King 22-in induction globe fixture (Stock No. 012664)
Manufacturer:	King Luminaire Company Inc.
Catalog No.:	IND-165-208V/206A2892

### 6.2 Globe with Louver

<b>Stock No.:</b>	<b>013546</b>
Description:	Globe with louver replacement for King 22-in, single globe luminaire
Application:	Replacement globe with louver for King 22-in induction globe fixture (Stock No. 012664)
Manufacturer:	King Luminaire Company Inc.
Catalog No.:	KG22-LAC(ETCHED)-III/206A2892

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## 7. Sources

**Chao, Yaochiem;** SCL Standards Engineer, coordinator and subject matter expert for 5724.00; (yaochiem.chao@seattle.gov)

**King Luminaire; Drawing No. 205D0344;**  
Seattle KG22-LAC(ETCHED)-III-165IND-120, May 11, 2004

## Streetlight Poles, Roadway, Aluminum, Round, Anchor Base Type



### 1. Scope

This standard covers the requirements for round aluminum roadway streetlight poles.

This standard applies to the following Seattle City Light (SCL) stock numbers:

<b>Stock No.</b>	<b>Mounting Height (ft)</b>
573984	25
573986	35

### 2. Application

Round roadway streetlight poles are installed with a streetlight luminaire support bracket per SCL 5705.2. Support brackets have a 2-ft rise to achieve the desired luminaire mounting height.

SCL Stock No. 573984 is used to support cobra-head style, residential streetlight luminaires.

SCL Stock No. 573986 is used to support cobra-head style, arterial streetlight luminaires.

Round roadway streetlight poles are installed onto 4-bolt, 11-1/2-inch bolt circle streetlight pole foundations, SCL Stock No. 568027.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Round roadway streetlight poles shall meet the applicable requirements of the latest revision of the following industry standards:

**AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals**

**ASTM A 153**; Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM A 307**; Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

**ASTM B 117**; Standard Practice for Operating Salt Spray Apparatus

**ASTM D 2247**; Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

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### 4. Requirements

#### 4.1 General

Round roadway streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Round roadway streetlight poles shall consist of an aluminum shaft welded to an aluminum alloy base and be complete with pressure-mounted nut cover discs.

#### 4.2 Shaft

The aluminum shaft shall be made of high-strength, corrosion-resistant 6063 aluminum alloy.

**25-ft Mounting Height – Stock No. 573984**

Cross section	round
Mounting height, nominal	25 ft
Pole length	23 ± .5 ft
Pole-top diameter	4-1/2 ± 1/8 ft
Wall thickness, minimum	.250 in
Weight, maximum	150 lb

**35-ft Mounting Height – Stock No. 573986**

Cross section	round
Mounting height, nominal	35 ft
Pole length	33 ± .5 ft
Pole-top diameter	4-1/2 ± 1/8 in
Wall thickness, minimum	.250 in
Weight, maximum	205 lb

#### 4.3 Grounding

A tapped grounding pad equipped with either a 1/4-20 x 1/2 or 3/8-16 x 1 stainless steel screw shall be provided and located on the interior of the pole opposite the handhole or directly adjacent to the handhole.

#### 4.4 Handhole

**Table 4.4. Handhole Specifications**

Size, minimum	4 in W x 6 in H
Finish/Color	Match pole finish/color
Location	
nominal	Centered 18 in above base
maximum	Centered 30 in above base

The handhole shall be reinforced so as to result in no loss of shaft strength.

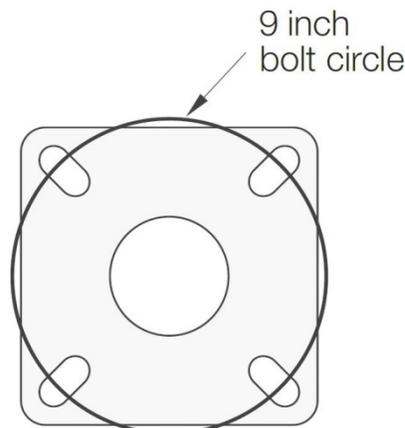
The handhole shall have a vandal-proof aluminum cover painted to match the pole color and attached with stainless steel screws. The aluminum cover shall be weatherproof.

#### 4.5 Anchor Base Plate

The base plate shall be fixed.

The base plate shall be sized to accommodate four one-inch anchor bolts spaced 90 degrees apart on an 11-1/2-inch bolt circle. Tamper resistant aluminum nut cover discs shall be included.

**Figure 4.5. Anchor Base Detail**



#### 4.6 Fixture Mounting

Round roadway streetlight poles shall be designed to support a single luminaire support bracket with luminaire. See SCL 5705.2 for luminaire support bracket requirements.

#### 4.7 Finish

The outer surface of the pole shall be satin finish aluminum. Finish shall meet spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

#### 4.8 Pole Top Cap

Pole top cap shall be cast aluminum.

Pole top cap shall be supplied with stainless steel screws.

#### 4.9 Anchor Bolts

None required.

## 5. Packaging

Round roadway streetlight poles shall be protected with a spiral wrapping of heavy waterproof material for protection during shipping and outside storage. A method shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light stock number

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## 6. Issuance

EA

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## 7. Approved Manufacturers

### 7.1 25 ft Round Roadway Streetlight Pole, Stock No. 573984

Manufacturer: Valmont Industries, Inc.

Catalog Number: **2408-45-80-8-T-4-SBF**

*where:*

2408 = nominal mounting height, 25 ft

45 = top diameter, 4-1/2 in

80 = butt diameter, 8 in

8 = wall thickness, .250 in

T = shape of shaft, round tapered

4 = base or mounting, 4-bolt anchor base

SBF = finish, satin brushed finish

Manufacturer: Hapco

Catalog Number: **RTA-25-F-8-B-4-01**

*where:*

RTA = pole, round-tapered aluminum

25 = nominal mounting height, 25 ft

F = wall thickness, .250 in

8 = butt diameter, 8 in

B = base diameter, 11.25 in

4 = base or mounting, 4-bolt anchor base

01 = finish, satin finish

**7.2 35 ft Round Roadway Streetlight Pole, Stock No. 573986**

Manufacturer: Valmont Industries, Inc.

Catalog Number: **3408-45-80-8-T-4-SBF**

*where:*

3408 = nominal mounting height, 35 ft

45 = top dimension, 4-1/2 in

80 = butt dimension, 8 in

8 = wall thickness, .250 in

T = shape of shaft, round tapered

4 = base or mounting, 4-bolt anchor base

SBF = finish, satin brushed finish

Manufacturer: Hapco

Catalog Number: **RTA-35-F-8-B-4-01**

*where:*

RTA = pole, round-tapered aluminum

35 = nominal mounting height, 35 ft

F = wall thickness, .250 in

8 = butt diameter, 8 in

B = base diameter, 11.25 in

4 = base or mounting, 4-bolt anchor base

01 = finish, satin finish

## 8. References

**SCL Material Standard 5705.2**; "Bracket, Aluminum Luminaire Support for Metal Poles"

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## 9. Sources

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5750.03  
(yaochiem.chao@seattle.gov)

**RTA25E8B4-**; Hapco 4 Bolt Base, Hapco specifications; dated 04/10/2013

**RTA35E8B4-**; Hapco 4 Bolt Base, Hapco specifications; dated 04/10/2013

**SPC7539**; Valmont 18' to 25' Round Tapered Aluminum Pole, 4-bolt Anchor Base; dated February 2012

**SPC7540**; Valmont 28' to 33' Round Tapered Aluminum Pole, 4-bolt Anchor Base; dated February 2012

**www.valmont.com**

## Streetlight Poles, Pedestrian, Aluminum, Round, Anchor Base Type



### 1. Scope

This standard covers the requirements for round aluminum pedestrian streetlight poles.

This standard applies to the following Seattle City Light stock numbers:

Stock No.	Mounting Height (ft)	Color	Base
013409	14	Satin Al	Fixed
013410	20	Satin Al	Fixed
013411	20	Dark bronze	Fixed
013412	14	Satin Al	Hinged

### 2. Application

Round pedestrian streetlight poles are used to support post-top style luminaires with a minimum inner diameter opening of 3 inches.

Round pedestrian streetlight poles are installed onto 4-bolt, 9-inch bolt-circle streetlight-pole foundations, Stock No. 568025.

Hinged-base poles, Stock No. 013412, are intended for installation on stairways with steep inclines.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Round pedestrian streetlight poles shall meet the applicable requirements of the latest revision of the following industry standards:

**AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals**

**ASTM A 153**; Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM A 307**; Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

**ASTM B 117**; Standard Practice for Operating Salt Spray Apparatus

**ASTM D 2247**; Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

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### 4. Requirements

#### 4.1 General

Round pedestrian streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Round pedestrian streetlight poles shall consist of an aluminum shaft welded to an aluminum alloy base and be complete with pressure-mounted nut cover discs.

#### 4.2 Shaft

The aluminum shaft shall be made of high-strength, corrosion-resistant 6063 aluminum alloy.

**14-ft Mounting Height** – stock numbers 013409 and 013412

Cross section	Round
Mounting height, nominal	14 ft
Pole-top diameter	3 ± 1/8 in
Base diameter	5 ± 1/8 in
Wall thickness, minimum	.125 in
Weight, nominal	31 lb

**20-ft Mounting Height** – stock numbers 013410 and 013411

Cross section	Round
Mounting height, nominal	20 ft
Pole-top diameter	3 ± 1/8 in
Base diameter	5 ± 1/8 in
Wall thickness, minimum	.188 in
Weight, nominal	60 lb

### 4.3 Grounding

A tapped grounding pad equipped with a 1/4-20 x 1/2 or 3/8-16 x 1 stainless-steel screw shall be provided and located on the interior of the pole opposite the handhole or directly adjacent to the handhole.

### 4.4 Handhole

Size, minimum	3 in W x 5 in H
Finish/Color	Match pole finish/color
Location	
nominal	Centered 18 in above base
maximum	Centered 30 in above base

The handhole shall be reinforced so as to result in no loss of shaft strength.

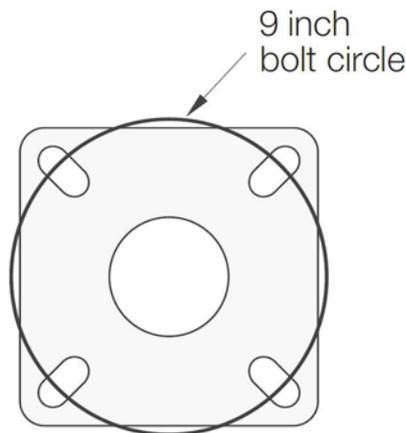
The handhole shall have a vandal-proof aluminum cover painted to match the pole color and attached with stainless-steel screws. The aluminum cover shall be weatherproof.

### 4.5 Anchor Base Plate

The anchor base plate shall be fixed, except for Stock No. 013412, which shall be hinged.

The anchor base plate shall be sized to accommodate four 3/4-in anchor bolts spaced 90 degrees apart on a 9-in bolt circle. Tamper-resistant aluminum nut covers shall be included.

**Figure 4.5. Anchor Base Detail**



### 4.6 Fixture Mounting

Round pedestrian streetlight poles shall be designed to support a pole-top mounted luminaries.

### 4.7 Finish

The pole's outer surface shall be satin finish aluminum or anodized dark bronze (Duranodic). Anodized finish shall meet ASTM B580-79 requirements. All finishes shall meet spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

#### 4.8 Pole Top Cap

None required.

#### 4.9 Anchor Bolts

None required.

---

### 5. Packaging

Round pedestrian streetlight poles shall be individually protected with a spiral wrapping of heavy waterproof material for protection during shipping and outside storage. A method shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light stock number

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### 6. Issuance

EA

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### 7. Approved Manufacturers

#### 7.1 14 ft Round, Satin Al Streetlight Pole, Stock No. 013409

Manufacturer: Valmont Industries, Inc.

Catalog Number: **R-1308-30-50-4-T4-SBF**

*where:*

R = cross section, round

1308 = nominal mounting height, 14 ft

30 = top outer diameter, 3 in

50 = base outer diameter, 5 in

4 = wall thickness, .125 in

T = shape of shaft, tapered

4 = base or mounting, 4-bolt anchor base

SBF = finish, satin brushed finish

Manufacturer: Union Metal

Catalog Number: **163-B26-Y1 Satin**

### 7.2 20 ft Round, Satin Al Streetlight Pole, Stock No. 013410

Manufacturer: Valmont Industries, Inc.

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Catalog Number: **R-1908-30-50-6-T4-SBF**

---

*where:*

R = cross section, round

---

1908 = nominal mounting height, 20 ft

---

30 = top outer diameter, 3 in

---

50 = base outer diameter, 5 in

---

6 = wall thickness, .188 in

---

T = shape of shaft, tapered

---

4 = base or mounting, 4-bolt anchor base

---

SBF = finish, satin brushed finish

---

Manufacturer: Union Metal

---

Catalog Number: **163-B26-Y2 Satin**

### 7.3 20 ft Round, Dark Bronze Anodized Streetlight Pole, Stock No. 013411

Manufacturer: Valmont Industries, Inc.

---

Catalog Number: **R-1908-30-50-6-T4- DDB**

---

*where:*

R = cross section, round

---

1908 = nominal mounting height, 20 ft

---

30 = top outer diameter, 3 in

---

50 = base outer diameter, 5 in

---

6 = wall thickness, .188 in

---

T = shape of shaft, tapered

---

4 = base or mounting, 4-bolt anchor base

---

DDB = finish, dark bronze anodized

---

Manufacturer: Union Metal

---

Catalog Number: **163-B26-Y3 Anodized Bronze**

#### 7.4 14 ft Round, Satin Al, Hinged-base Streetlight Pole, Stock No. 013412

Manufacturer: Valmont Industries, Inc.

Catalog Number: **R-1308-30-40-5-T-H-SBF**

*where:*

R = cross section, round

1308 = nominal mounting height, 14 ft

30 = top outer diameter, 3 in

50 = base outer diameter, 5 in

5 = wall thickness, .125 in

T = shape of shaft, tapered

H = base or mounting, hinged

SBF = finish, satin brushed finish

---

#### 8. Sources

**Borek, Tom**; SCL Engineer and subject matter expert for 5752.05  
(tom.borek@seattle.gov)

**Chao, Yaochiem**; SCL Engineer, originator and subject matter expert for 5752.05  
(yaochiem.chao@seattle.gov)

**DR4109**; Valmont; dated March 16, 2012

**Li, Jesse**; SCL Engineer and subject matter expert for 5752.05 (jessi.li@seattle.gov)

**SPC7083**; Valmont 8' to 20' Round Tapered Aluminum Pole, Hinged Base; August 2012

**SPC7539**; Valmont 18' to 25' Round Tapered Aluminum Pole, 4-bolt Anchor Base;  
August 2012

**www.valmont.com**

## Streetlight Poles, Pedestrian, Aluminum, Square, Anchor Base Type



### 1. Scope

This standard covers the requirements for 4-inch square aluminum pedestrian, streetlight poles.

This standard applies to the following Seattle City Light stock numbers:

Stock No.	Mounting Height (ft)	Color	Base
013417	16	Dark bronze	Fixed
013418	20	Dark bronze	Fixed
013419	14	Light gray	Fixed
013420	14	Dark bronze	Hinged

### 2. Application

Square pedestrian streetlight poles are used to mount entablature-style luminaires using a one-piece extruded support arm.

Square pedestrian streetlight poles are installed onto a 4-bolt, 9-inch bolt-circle streetlight pole foundation, SCL stock number 568025.

Hinged-base poles, SCL stock number 013420, are intended for installation on stairways with steep inclines.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Square pedestrian streetlight poles shall meet the applicable requirements of the latest revision of the following industry standards:

**AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals**

**ASTM A 153**; Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM A 307**; Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

**ASTM B 117**; Standard Practice for Operating Salt Spray Apparatus

**ASTM D 2247**; Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

---

### 4. Requirements

#### 4.1 General

Square pedestrian streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals.

Square pedestrian streetlight poles consist of an aluminum shaft welded to an aluminum alloy base with pressure-mounted nut cover discs.

#### 4.2 Shaft

The aluminum shaft shall be made of high-strength, corrosion-resistant 6061 aluminum alloy.

##### **16-ft Mounting Height, Stock Nos. 013417 and 013419**

Cross section	Square
Mounting height, nominal	16 ft
Pole-top	4 ± 1/8 in square
Base	4 ± 1/8 in square
Wall thickness, minimum	0.125 in

##### **20-ft Mounting Height, Stock No. 013418**

Cross section	Square
Mounting height	20 ft
Pole-top diameter	4 ± 1/8 in
Base diameter	4 ± 1/8 in
Wall thickness, minimum	0.166 in

**14-ft Mounting Height, Stock No. 013420**

Cross section	Square
Mounting height, nominal	14 ft
Pole-top diameter	4 ± 1/8 in
Base diameter	4 ± 1/8 in
Wall thickness, nominal	0.125 in

**4.3 Grounding**

A tapped grounding pad equipped with a 1/4-20 x 1/2 or 3/8-16 x 1 stainless-steel screw shall be provided and located on the interior of the pole opposite the handhole or directly adjacent to the handhole.

**4.4 Handhole**

**Table 4.4. Handhole Specifications**

Size, minimum	2 in W x 4 in H
Finish/Color	Match pole finish/color
Location	
nominal	Centered 18 in above base
maximum	Centered 30 in above base

The handhole shall be reinforced so as to result in no loss of shaft strength.

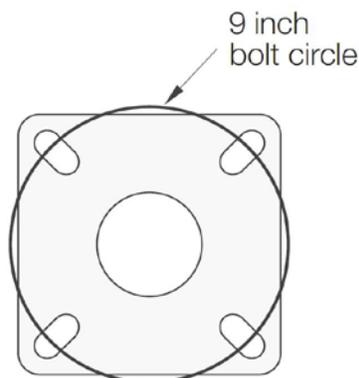
The handhole shall have a vandal-proof aluminum cover painted to match the pole color and attached with stainless-steel screws. The aluminum cover shall be weatherproof.

**4.5 Anchor Base Plate**

The anchor base plate shall be fixed, except for stock number 013420, which shall be hinged.

The anchor base plate shall be sized to accommodate four 3/4-in anchor bolts spaced 90 degrees apart on a 9-in bolt circle. Tamper-resistant aluminum nut cover discs shall be included.

**Figure 4.5. Anchor Base Detail**



#### 4.6 Fixture Mounting

Square pedestrian streetlight poles shall be designed to support end-mounted luminaries using one-piece extruded aluminum arm with internal bolt guides.

#### 4.7 Finish

The pole's outer surface shall be either a powder coated gray with a minimum thickness of 100 microns or anodized dark bronze (duranodic). Anodized finish shall meet ASTM B580-79 requirements. All finishes shall meet spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

#### 4.8 Pole Top Cap

Pole top cap shall be cast aluminum and supplied with stainless steel screws.

#### 4.9 Anchor Bolts

None required.

---

### 5. Packaging

Square pedestrian streetlight poles shall be protected with a spiral wrapping of heavy waterproof material for protection during shipping and outside storage. A method shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's stock number

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### 6. Issuance

EA

---

### 7. Approved Manufacturers

#### 7.1 16-ft Square, Dark Bronze Aluminum Streetlight Pole, Stock No. 013417

Manufacturer:	Valmont Industries, Inc.
Catalog Number:	<b>S-1600-40-40-6-Y-4-DDB</b>
<i>where:</i>	
S	= cross section, square
1600	= nominal mounting height, 16 ft
40	= top diameter, 4 in
40	= butt diameter, 4 in
6	= wall thickness, 0.188 in
Y	= shape of shaft, square straight
4	= base or mounting, 4-bolt anchor base
DDB	= finish, anodized dark bronze

**20-ft Square, Dark Bronze Aluminum Streetlight Pole, Stock No. 013418**

Manufacturer:	Valmont Industries, Inc.
Catalog Number:	<b>S-2000-40-40-6-Y-4-DDB</b>
<i>where:</i>	
S	= cross section, square
2000	= nominal mounting height, 20 ft
40	= top diameter, 4 in
40	= butt diameter, 4 in
6	= wall thickness, 0.188 in
Y	= shape of shaft, square straight
4	= base or mounting, 4-bolt anchor base
DDB	= finish, anodized dark bronze

**7.2 14-ft Square, Light Gray Aluminum Streetlight Pole, Stock No. 013419**

Manufacturer:	Valmont Industries, Inc.
Catalog Number:	<b>S-1400-40-40-4-Y-4-DCG</b>
<i>where:</i>	
S	= cross section, square
1400	= nominal mounting height, 14 ft
40	= top diameter, 4 in
40	= butt diameter, 4 in
4	= wall thickness, 0.125 in
Y	= shape of shaft, square straight
4	= base or mounting, 4-bolt anchor base
DCG	= finish, powder-coat light gray

**7.3 14-ft Square Dark Bronze Aluminum Streetlight Pole, Stock No. 013420**

Manufacturer:	Valmont Industries, Inc.
Catalog Number:	<b>S-1400-40-40-4-Y-H-DDB</b>
<i>where:</i>	
S	= cross section, square
1400	= nominal mounting height, 14 ft
40	= top diameter, 4 in
40	= butt diameter, 4 in
4	= wall thickness, 0.125 in
Y	= shape of shaft, square straight
H	= base or mounting, hinged
DDB	= finish, anodized dark bronze

## 8. Sources

**Borek, Tom**; SCL engineer, subject matter expert for 5754.07; (tom.borek@seattle.gov)

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5754.07;  
(yaochiem.chao@seattle.gov)

**DR4107**; Valmont; dated 02/06/12

**Li, Jesse**; SCL engineer and subject matter expert for 5754.07; (jesse.li@seattle.gov)

**SPC7077**; Valmont 8' to 18' Square Non-Tapered Aluminum Pole, 4-bolt Anchor Base;  
dated 12/11

**SPC7085**; Valmont 8' to 20' Square Straight Hinged Base Poles; dated 08/07

**www.valmont.com**

## Decorative Streetlight Poles, Aluminum, Anchor Base



### 1. Scope

This standard covers the requirements for 4-inch decorative aluminum anchor-base streetlight poles.

This standard applies to the following Seattle City Light stock numbers:

Stock No.	Mounting Height (ft)	Shaft	Color
013422	14	Fluted	Black
013423	14	Fluted	Light gray
013424	14	Fluted	Dark green
013425	14	Round	Black
013426	14	Round	Light gray
013427	14	Round	Dark green

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

## 2. Application

Decorative streetlight poles are used to support the following decorative streetlight luminaires:

<b>Stock No.</b>	<b>Name</b>	<b>Color</b>
012380	ZED Z14	Per P.O.
011967	ZED Z15	Per P.O.
010398	ZED Z40	Per P.O.
010399	ZED Z47A	Per P.O.

Decorative streetlight poles are powder-coated. The color is specified by the streetlight engineer to match the color of the streetlight luminaires, which varies by installation location.

Decorative streetlight poles are installed onto 4-bolt, 9-inch bolt-circle streetlight pole foundations, SCL Stock Number 568025.

Decorative streetlight poles are installed with a decorative base, SCL Stock Number 011974 or 011975.

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## 3. Industry Standards

Decorative streetlight poles shall meet the applicable requirements of the latest revision of the following industry standards:

**AASHTO** Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

**ASTM A 153**; Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM A 307**; Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

**ASTM B 117**; Standard Practice for Operating Salt Spray Apparatus

**ASTM D 2247**; Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

---

## 4. Requirements

### 4.1 General

Decorative streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

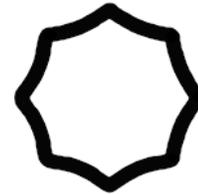
Decorative streetlight poles consist of an aluminum shaft welded to an aluminum alloy base with pressure-mounted nut cover discs.

## 4.2 Shaft

The aluminum shaft shall be made of high-strength, corrosion-resistant 6063 aluminum alloy.

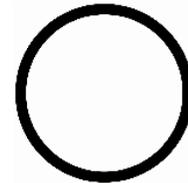
### Fluted Shaft - Stock No. 011969

Cross section	Fluted, 8 curved sections
Mounting height	14'
Pole-top diameter, outside	4" ± 1/8"
Base diameter, outside	4" ± 1/8"
Wall thickness	0.125"
Taper	None



### Round Shaft - Stock No. 011971

Cross section	Round
Mounting height	14'
Pole-top diameter, outside	4" ± 1/8"
Base diameter, outside	4" ± 1/8"
Wall thickness	0.125"
Taper	None



## 4.3 Grounding

A tapped grounding pad equipped with either a 1/4-20 x 1/2 or 3/8-16 x 1 stainless-steel screw shall be provided and located on the interior of the pole opposite the handhole or directly adjacent to the handhole.

## 4.4 Handhole

<b>Size, min</b>	3" w x 5" h
<b>Finish/color</b>	Match pole finish/color
<b>Location</b>	Centered 18" above base

The handhole shall be reinforced so as to result in no loss of shaft strength.

The handhole shall have a vandal-proof aluminum cover painted to match the pole color and attached with stainless-steel screws. The aluminum cover shall be weatherproof.

If locating the handhole 18 inches above the base would adversely affect the strength of the pole, the handhole may be centered at a maximum height of 30 inches above the base of the pole.

## 4.5 Pole Base Plate

Base plates shall not be hinged.

Base plate shall be sized to accommodate four 3/4-inch anchor bolts spaced 90 degrees apart on a 9-inch bolt circle. Tamper-resistant aluminum nut cover discs shall be included.

#### 4.6 Fixture Mounting

Decorative streetlight poles shall be designed to support pole-top-mounted luminaries.

#### 4.7 Finish

The finish shall be a powder coating with a minimum thickness of 100 microns and shall meet spray requirements of ASTM B 117 and the humidity resistance requirements of ASTM D 2247.

Seattle City Light uses the color choices shown in Figure 4.7:

##### Figure 4.7. Color Choices



Textured Black



Textured Grey



Textured Dark Green

#### 4.8 Pole-Top Cap

None required.

#### 4.9 Anchor Bolts

None required.

---

### 5. Packaging

Decorative streetlight poles shall be protected with a spiral wrapping of heavy waterproof paper for protection during shipping and installation. A rip cord shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's stock number.

---

### 6. Issuance

EA

## 7. Approved Manufacturers

### 7.1 14-foot Fluted, Black Streetlight Pole, Stock No. 013422

Manufacturer:	Lumec
Catalog Number:	P-134-C-001-14-BK-TX
<i>where:</i>	
P =	pole
134 =	type, fluted 4" outer diameter
C =	thickness, 0.167"
001 =	base cover, none
14 =	pole height, 14'
BK =	color, black
TX =	finish, powder coat textured
Manufacturer:	Union Metal
Catalog Number:	B99-B590-Y1

### 7.2 14-foot Fluted, Light Gray Streetlight Pole, Stock No. 013423

Manufacturer:	Lumec
Catalog Number:	P-134-C-001-14-SCRAL7035-TX
<i>where:</i>	
P =	pole
134 =	type, fluted 4" outer diameter
C =	thickness, 0.167"
001 =	base cover, none
14 =	pole height, 14'
SCRAL7035 =	color, light gray (RAL 7035)
TX =	finish, powder coat textured
Manufacturer:	Union Metal
Catalog Number:	B99-B590-Y2

**7.3 14-foot Fluted, Dark Green Streetlight Pole, Stock No. 013424**

Manufacturer:	Lumec
Catalog Number:	P-134-C-001-14-SCRAL6012-TX
<i>where:</i>	
P =	pole
134 =	type, fluted 4" outer diameter
C =	thickness, 0.167"
001 =	base cover, none
14 =	pole height, 14'
SCRAL6012 =	color, dark green (RAL 6012)
TX =	finish, powder coat textured

Manufacturer:	Union Metal
Catalog Number:	B99-B590-Y3

**7.4 14-foot Smooth, Black Streetlight Pole, Stock No. 013425**

Manufacturer:	Lumec
Catalog Number:	APR-4-F-001-14-BK-TX
<i>where:</i>	
APR =	Pole material, aluminum round
4 =	diameter, 4"
F =	wall thickness, 0.125"
001 =	base cover, none
14 =	nominal height, 14'
BK =	color, black
TX =	finish, powder coat textured

Manufacturer:	Union Metal
Catalog Number:	B99-B591-Y1

### 7.5 14-foot Smooth, Light Gray Streetlight Pole, Stock No. 013426

Manufacturer:	Lumec
Catalog Number:	APR-4-F-001-14-SCRAL7035-TX
<i>where:</i>	
APR =	pole, aluminum round
4 =	diameter, 4"
F =	wall thickness, 0.125"
001 =	base cover, none
14 =	nominal height, 14'
SCRAL7035 =	color, light gray (RAL 7035)
TX =	finish, powder coat textured

Manufacturer:	Union Metal
Catalog Number:	B99-B591-Y2

### 7.6 14-foot Smooth, Dark Green Streetlight Pole, Stock No. 013427

Manufacturer:	Lumec
Catalog Number:	APR-4-F-001-14-SCRAL6012-TX
<i>where:</i>	
APR =	pole, aluminum round
4 =	diameter, 4"
F =	wall thickness, 0.125"
001 =	base cover, none
14 =	nominal height, 14'
SCRAL6012 =	color, dark green (RAL 6012)
TX =	finish, powder coat textured

Manufacturer:	Union Metal
Catalog Number:	B99-B591-Y3

---

## 8. References

**Borek, Tom**; SCL engineer, subject matter expert for 5756.09; (tom.borek@seattle.gov)

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5756.09; (yaochiem.chao@seattle.gov)

**Li, Jesse**; SCL engineer, subject matter expert for 5756.09; (jessi.li@seattle.gov)

**Philips, LUMEC**; Pole Technical Information; revision 2010

## Streetlight Poles, Pedestrian, Concrete, Direct-Buried



### 1. Scope

This material standard covers the requirements for concrete pedestrian streetlight poles. This standard applies to the following Seattle City Light stock numbers:

Stock No.	Mounting Height	Color
574003	16 ft 5 in	Green natural
574004	20 ft	Gray natural
574010	16 ft 5 in	White

### 2. Application

Concrete pedestrian streetlight poles are used to support pedestrian streetlight luminaires with a minimum diameter opening of 3-1/2 inches.

Concrete streetlight poles are direct-buried in the ground.

Concrete streetlight poles are installed in designated locations. Contact Streetlight Engineering for details.

In 2013, stock number 574007 (22-ft gray concrete pole) was replaced by 574004 (20-ft gray concrete pole).

Standards Coordinator  
Yaochiem Chao

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Concrete streetlight poles shall meet the applicable requirements of the following industry standards:

**AASHTO Standard Specifications** for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

---

### 4. Requirements

#### 4.1 General

Concrete streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

#### 4.2 Shaft

The concrete pole shall be made of pre-stressed, spun-cast concrete with uniformly wrapped solid steel pre-stressing wire.

##### **16-ft 5-in Mounting Height – Stock Nos. 574003 & 574010**

Cross section	octagonal
Mounting height, nominal	16 ft 5 in
Pole length, nominal	20 ±0.5 ft
Pole-top diameter, nominal	3-1/2 in
Wall thickness, minimum (in)	n/a
Weight, maximum	380 lbs

##### **20-ft Mounting Height – Stock No. 574004**

Cross section	octagonal
Mounting height, nominal	20 ft
Pole length, nominal	23 ft 7 in
Pole-top diameter, nominal	3-1/2 in
Wall thickness, minimum (in)	n/a
Weight, maximum	470 lbs

#### 4.3 Grounding

All reinforcing steel, strand, wire, and stud bolts shall be electrically bonded.

A standard, copper grounding wire for ground connection shall be pre-installed and accessible at the hand-hole. Copper grounding wire shall be minimum 5-feet long.

#### 4.4 Handhole

**Table 4.4. Handhole Specifications**

Size, minimum (in)	1-3/8 in wide x 9 in high
Finish/color	Match pole finish/color
Location	
nominal	Centered 18 in above ground when installed
maximum	Centered 30 in above ground when installed

The handhole shall be reinforced so as to result in no loss of shaft strength.

The handhole shall have a vandal-proof aluminum cover, attached with stainless steel screws. The aluminum cover shall be weatherproof.

If locating the handhole 18 inches above the base would adversely affect the strength of the pole, the handhole may be centered at a maximum of 30 inches above the base of the pole.

#### 4.5 Pole Base Plate

None required.

#### 4.6 Fixture Mounting

Concrete streetlight poles shall be designed to support a single post-top luminaire with a minimum inner diameter opening of 3-1/2 inches.

#### 4.7 Finish

Concrete streetlight poles shall have an acrylic coating with the following finishes:

**Table 4.7. Streetlight Pole Finishes**

Stock No.	Finish	Color
574003	Exposed aggregate	Green natural
574004	Exposed aggregate	Gray natural
574010	Polished aggregate	White

#### 4.8 Pole Top Cap

None required.

#### 4.9 Anchor Bolts

None required.

---

## 5. Packaging

Concrete streetlight poles shall be protected with a spiral wrapping of heavy waterproof material for protection during shipping and outside storage. A method shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

---

## 6. Issuance

EA

---

## 7. Approved Manufacturers

### 7.1 16-ft-5-in Green Concrete Streetlight Pole, Stock No. 574003

Manufacturer	Ameron/Centrecon
Catalog No.	<b>S-E-O-5-413</b>
<i>where:</i>	
S	= series, S
E	= mounting, embedded (direct-buried)
O	= cross-section, octagonal
5	= mounting height, 16 ft 5 in
413	= finish, green natural exposed aggregate with acrylic coating

### 7.2 20-ft Gray Concrete Streetlight Pole, Stock No. 574004

Manufacturer:	Ameron/Centrecon
Catalog No.:	<b>S-E-O-6-113</b>
<i>where:</i>	
S	= series, S
E	= mounting, embedded (direct-buried)
O	= cross-section, octagonal
6	= mounting height, 19 ft 8 in
113	= finish, gray natural exposed aggregate with acrylic coating

**7.3 16-ft-5-in White Concrete Streetlight Pole, Stock No. 574010**

Manufacturer	Ameron/Centrecon
Catalog No.:	<b>S-E-O-5-222</b>
<i>where:</i>	
S	= series, S
E	= mounting, embedded (direct-buried)
O	= cross-section, octagonal
5	= mounting height, 16 ft 5 in
222	= finish, white polished aggregate with acrylic coating

---

**8. References**

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5758.11;  
(yaochiem.chao@seattle.gov)

**Centrecon & Victorian Series**; Ameron specification sheet; January 2012

**S-Series Octagonal Pole**; Ameron, Centrecon Series, January 2012

## Streetlight Poles, Pedestrian, Fiberglass, Anchor Base Type



### 1. Scope

This standard covers the requirements for 12-ft gray fiberglass pedestrian streetlight poles.

This standard applies to Seattle City Light stock number 574030.

### 2. Application

Fiberglass streetlight poles are only used to support stock number 572660, K56 Tudor luminaire in Thermal Red color.

Fiberglass streetlight poles are installed in the Chinatown-International District (CID), designated a historic district by the City of Seattle.

Fiberglass streetlight poles are installed onto 4-bolt, 9-inch bolt circle streetlight pole foundations, Stock No. 568025.

The post shall be designed with a minimum safety factor of 2:1 and have no more than a 10% deflection at full wind loading.

Fiberglass streetlight poles are supplied with an ornament base cover painted Thermal Red.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Fiberglass streetlight poles shall meet the applicable requirements of the latest revision of the following industry standard:

**AASHTO Standard Specifications** for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

---

### 4. Requirements

#### 4.1 General

Fiberglass streetlight poles shall be designed and fabricated to conform to the requirements of AASHTO standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Fiberglass streetlight poles shall consist of a fiberglass shaft factory bonded to an aluminum alloy or steel base plate.

#### 4.2 Shaft

Fiberglass shaft shall be constructed of continuous fiberglass filament combined with a thermosetting epoxy resin.

##### **12-ft Mounting Height Fiberglass Pole - Stock No. 574030**

Cross section	octagonal
Mounting height, nominal	12 ft
Pole length, nominal	12 ft
Pole-top diameter, nominal	4-1/2 in
Post-top tenon size	3 in O.D. x 3 in
Weight, maximum	380 lb

#### 4.3 Grounding

None required.

#### 4.4 Handhole

**Table 4.4. Handhole Specifications**

Size, minimum	2-in wide x 5-in high
Finish/Color	Match pole finish/color
Location, nominal	Centered 14 in above base

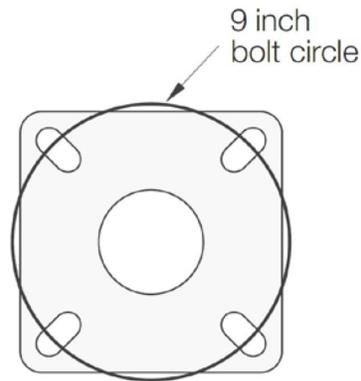
The handhole shall be reinforced so as to result in no loss of shaft strength.

The handhole shall have a vandal-proof, weatherproof aluminum cover painted to match the pole color and be attached with stainless steel screws.

#### 4.5 Pole Base Plate

Base plate shall be fixed and sized to accommodate four 3/4-in anchor bolts spaced 90 degrees apart on a 9-in bolt circle, as shown below.

**Figure 4.5. Anchor Base Plate**



#### 4.6 Fixture Mounting

Pedestrian round streetlight poles shall be designed to support a pole-top mounted luminaire with a 3-1/2-in inner diameter opening.

#### 4.7 Finish

The pole's outer surface shall be coated with a durable, chemical-resistant, UV-light-resistant protective finish.

#### 4.8 Pole Top Cap

None required.

#### 4.9 Anchor Bolts

None required.

#### 4.10 Base Cover

The ornamental base cover shall be two-piece and supplied with the pole.

The base cover shall be constructed from the same material as the shaft.

The base cover shall be painted Thermal Red and finished with the same material as the shaft.

---

### 5. Packaging

Fiberglass streetlight poles shall be individually protected with a spiral wrapping of waterproof material for protection during shipping and outside storage. A method shall be provided for easy removal of the wrapping.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light Stock Number

## 6. Issuance

EA

## 7. Approved Manufacturers

### 7.1 12-ft Fiberglass Streetlight Pole, Stock No. 574030

Manufacturer	Whatley
Catalog Number	<b>XO45-D10M-OCT-12-AB-GRY-30-30</b>
<i>where:</i>	
XO	= pole series, Xtreme Octagonal
45	= top diameter, 4.5 in
D10M	= base type, D10M
OCT	= base shape, octagonal
12	= above grade height, 12 ft
AB	= installation method, anchor base
GRY	= color, grey
30	= tenon outer diameter, 3 in
30	= tenon height, 3 in

---

## 8. Sources

**Chao, Yaochiem**; SCL engineer, originator and subject matter expert for 5760.13;  
(yaochiem.chao@seattle.gov)

**SPC7491**; Whatley Decorative Lamp Post, Pole X045, Decorative Base D10M-OCT,  
dated February 2011

**[www.whatley.com](http://www.whatley.com)**

## Footings, Precast Concrete for Residential Streetlight Poles



### 1. Scope

This standard covers the requirements for precast concrete footings used to support residential streetlight poles.

This standard applies to the following Seattle City Light Stock Numbers:

Stock No.	Bolt Circle, Diameter (in)	Bolt Projection (in)
568025	9	4

Precast concrete footings used to support *arterial* streetlight poles are outside the scope of this standard.

### 2. Application

Precast concrete residential streetlight pole footings are a cost-effective alternative to poured-in-place footings. Residential streetlight footings allow for an immediate foundation system for at-grade and above-grade applications.

Footing design includes convenient connection points to conduit systems.

Footing is set using lift plate secured to anchor bolt with nut (two places).

Requirements for footings used to support *arterial* streetlight poles are covered in SCL 5778.40.

Standards Coordinator  
Laura Vanderpool

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Footing manufacturer shall meet the applicable requirements of the following industry standard:

National Precast Concrete Association (NPCA) Quality Control Manual for Precast and Pre-stressed Concrete Plants, 9th Edition, January 2012.

---

### 4. Requirements

Concrete Finish	Flat float with machined edges
Footing Dimensions, Concrete Portion	
Height	4'-0" ±1/4"
Width	1'-6" ±1/4"
Depth	1'-6" ±1/4"
Concrete Chamfer, nominal	3/4 in
Footing weight, nominal	700 lb
Tolerances	
Bolt Circle Diameter	±1/8 in
Bolt Projection	±1/4 in

Provision for routing customer supplied conductor through footing shall be accomplished by means of two sections of 2-inch, PVC, flexible conduit.

A PVC conduit coupling shall be installed on each end of each flexible conduit section.

Anchor bolt details shall be as specified in Section 8.

---

### 5. Product Approval

Manufacturers and/or distributors interested in having their product approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Standards for the details.

1. Submit documentation that establishes the product meets the requirements of this standard.
  2. Provide one sample for evaluation.
- 

### 6. Packaging

Footings shall be packaged to prevent damage during shipping, handling, and storage.

Each shipping container shall be marked with:

- Seattle City Light purchase order number
  - Seattle City Light stock number
- 

### 7. Issuance

EA

## 8. Approved Manufacturer

Anchor Bolt Details						
Stock No.	Number	Length (in)	Diam (in)	Bolt Circle Diam (in)	Bolt Projection (in)	Oldcastle Precast Catalog No.
568025	4	36	3/4	9	4	4-LB-CL-4

Oldcastle Precast products were previously manufactured under the name Utility Vault.

---

## 9. References

**SCL Material Standard 5778.40**; Footings, Precast Concrete for Arterial Streetlight Poles”

---

## 10. Sources

**Chao, Yaochiem**; SCL Standards Engineer, subject matter expert, and originator of SCL Material Standard 5778.20; (yaochiem.chao@seattle.gov)

**Oldcastle Precast**; drawing no. 010-X949002-001; September 18, 2012

**SCL Material Standard 5678.20**; “Footings, Precast Concrete for Residential Streetlight Poles” (renumbered to 5778.20 in October 2015)

**FOOTINGS, PRECAST CONCRETE FOR ARTERIAL STREETLIGHT POLES**



**1. Scope**

This standard covers the requirements for precast concrete footings used to support arterial streetlight poles.

This standard applies to Seattle City Light Stock Number 568028.

Precast concrete footings used to support *residential* streetlight poles are outside the scope of this standard.

**2. Application**

Precast concrete arterial streetlight pole footings are a cost-effective alternative to poured-in-place footings.

Arterial streetlight footings allow for an immediate foundation system for at-grade and above-grade applications.

Footing design includes convenient connection points to conduit systems.

Footing is set using lift plate secured to anchor bolt with nut (two places).

Requirements for footings used to support *residential* streetlight poles are covered in SCL 5778.20.

**3. Industry Standards**

Footing manufacturer shall meet the applicable requirements of the following industry standard:

National Precast Concrete Association (NPCA) Quality Control Manual for Precast and Pre-stressed Concrete Plants, 9th Edition, January 2012.

**4. Requirements**

Concrete finish	Flat float with machined edges
Concrete chamfer (nominal, in)	3/4
Tolerances(in)	
Bolt circle diameter	±1/8
Bolt projection	±1/4

Standards Coordinator  
Laura Vanderpool

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

**MATERIAL STANDARD**

Superseding: March 6, 2015

Effective Date: October 27, 2015

Footings, Precast Concrete for Arterial Streetlight Poles

Page: 2 of 2

Provision for routing customer supplied conductor through footing shall be accomplished by means of two sections of 2-inch, PVC, flexible conduit.

A PVC conduit coupling shall be installed on each end of each flexible conduit section.

---

**Footing dimensions, concrete portion**

Height	5'-0" ±1/4"
Width	1'-2" ±1/4"
Depth	1'-2" ±1/4"
Footing weight, (nominal)	910 lb

---

**Anchor Bolt Details**

Number	4
Diameter	1"
Bolt Circle, Diameter	11-1/2"
Bolt Projection	4"

**5. Product Approval**

Manufacturers and/or distributors interested in having their product approved for purchase by Seattle City Light must participate in the stepped process summarized below. Contact Standards for the details.

1. Submit documentation that establishes the product meets the requirements of this standard
2. Provide one sample for evaluation.

**6. Packaging**

Footings shall be packaged to prevent damage during shipping, handling, and storage.

Each shipping container shall be marked with:

- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Issuance**

EA

**8. Approved Manufacturer**

Stock No.	Oldcastle Precast Catalog No.
568028	5-LB-CL-4

Oldcastle Precast products were previously manufactured under the name Utility Vault.

**9. Sources**

**Chao, Yaochiem**; SCL Standards Engineer and co-originator of SCL Material Standard 5778.40; (yaochiem.chao@seattle.gov)

**Shipek, John**; SCL Standards Supervisor and co-originator of SCL Material Standard 5778.40; (john.shipek@seattle.gov)

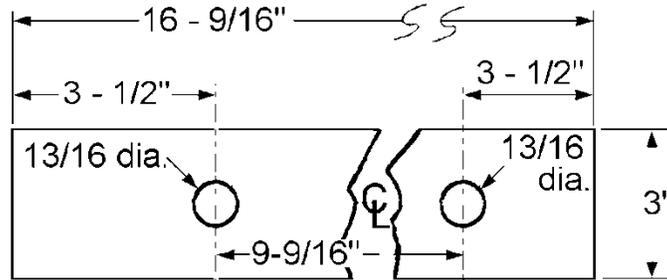
**SCL Material Standard 5678.40**; "Footings, Precast Concrete for Arterial Streetlight Poles" (renumbered to 5778.40 in October 2015)

**10. References**

**SCL Material Standard 5778.20**; "Footings, Precast Concrete for Residential Streetlight Poles"



**Brackets  
 Transformer and Rack Extension**



Hole Dimensions on Flat Bar

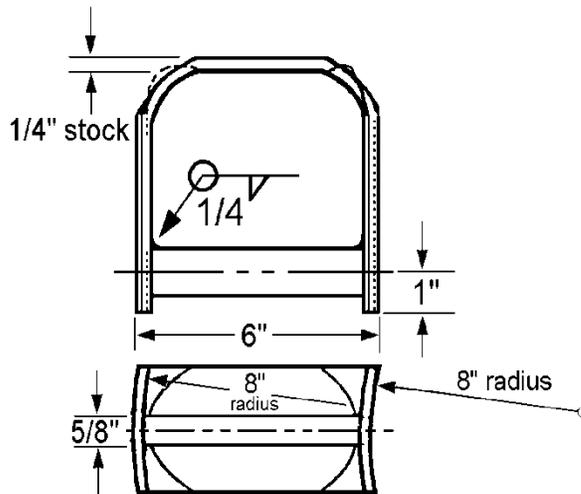
**Stock No.: 580505**

**EXTENSION BRACKETS** shall be of the configuration and dimensions shown. Extension brackets shall be manufactured from hot-rolled steel bars (ASTM A575) and hot-dip galvanized, after fabrication per ASTM A153.

**Reference Specification:**  
 ASTM A153 and A575  
**Stock No.:** 580505  
**Stock Unit:** EA

Approved Manufacturers	
Morfab	Wilcor
U41658	WAFM-2

For fabrication by Seattle City Light Shops, reference by stock number.



Standards Coordinator  
 Kathy Tilley

Standards Supervisor  
 John Shipek

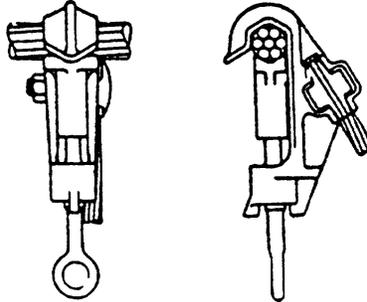
Unit Director  
 Darnell Cola

*Kathy Tilley*

*John Shipek*

*Darnell Cola*

**CLAMPS - COPPER HOT-LINE TAP**



**1. Scope**

Clamps are used to attach branch conductors to main conductors by means of an insulated hot-stick.

**2. Industry Standards**

ANSI C119.4; Electrical Connectors – Connectors to Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors

ASTM B154; Standard Test Method for Mercurous Nitrate Test for Copper and Copper Alloys

NEMA CC1; Power Connectors for Substations

**3. Requirements**

The clamps shall be made of high-strength cast bronze and be corrosive-resistant in accordance with ASTM B-154, Mercurous Nitrate Test for Copper and Copper Alloys. The eyescrew may be either stainless steel or bronze, as above. In addition, the clamps shall withstand a 20,000 ampere rms symmetrical fault current.

The electrical and mechanical characteristics of the clamps shall meet the performance requirements of NEMA CC1 and ANSI C119.4.

The threads of the eye stem shall be protected by being enclosed in the clamp body, and permanently lubricated with corrosion-inhibiting compound. The clamp jaws shall also be pre-filled with the compound.

**4. Packaging**

Hot-line clamps shall be individually packaged in sealed plastic bags.

**5. Approved Manufacturers**

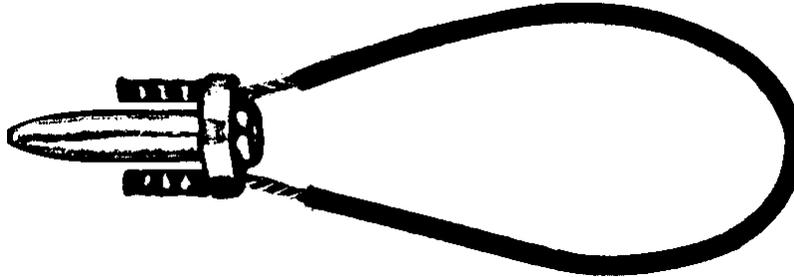
Stock No.	Main Conductor, Stranded - Solid	Tap Conductor, Stranded - Solid	Preferred Quality	Other			
			Richards	Anderson	Electric Motion Co.	Fargo	MacLean
580725	#2/0 - #8	#2/0 - #8	BHLC-100	BC-2/0-XB	–	–	C1520-9
580727	400 - #6	#4/0 - #6	BHLC-101-SCL	BH-4-XB	EMC HLC-101G	GH-101L	C1530-9

Stock Unit: EA

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
		
Yaochiem Chao	John Shipek	Darnell Cola

**MATERIAL STANDARD**

**DEAD ENDS, AUTOMATIC  
 WITH NEOPRENE COVERED BAIL**



**Automatic Dead Ends with Neoprene Covered Bail** shall be of the configuration shown. The automatic sleeve shall conform to the requirements of EEI Specification TD-72, Tentative Specification for Line Connectors and Splices. The gripping unit shall be machined from a silicon-bronze alloy and shall have four jaws with threaded contact surfaces.

The bail yoke shall be made of high-strength cast aluminum bronze.

The neoprene-covered bail shall be made of flexible stranded stainless steel or phosphorus bronze wires. Stainless steel sleeves shall be compressed on the ends of the bail wire with one end of the bail held captive in yoke and the other end removable.

**Reference Specification:** EEI TD-72, latest revision

**Stock Unit:** EA

Stock Number	Copper Wire Size		Bail Strand	Breaking Strength, lbs.	Approved Manufacturers	
	Solid	Stranded			Fargo	Reliable
581308	#4	#6	7 x 7	6,000	GD-112N	41 FDN
581310	#2	#3	7 x 7	6,000	GD-114N	21 FDN
581315	2/0	1/0	7 x 7	6,000	GD-117N	107 FDN
581320	3/0	2/0	7 x 7	7,400	GD-118N	207 FDN
012509	—	#4/0	7 x 7	12,600	GD-120N	407 FDN

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

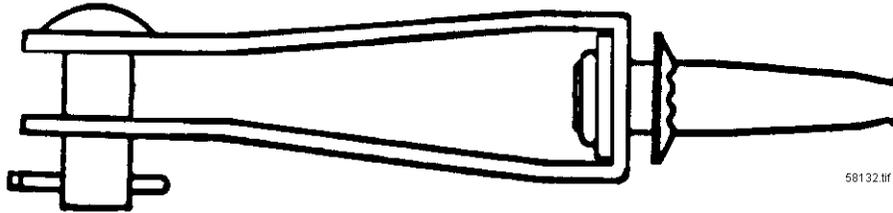
*John Chinner*

UNIT DIRECTOR

*Harold J. J.*

# MATERIAL STANDARD

## DEADENDS, AUTOMATIC, FEED-THROUGH COPPER CONDUCTOR



**Automatic Feed-Through Deadends for Copper Conductors**, of the configuration shown, are used to permit the extension of the conductor beyond the point of termination.

The gripping unit of the deadend shall meet all applicable requirements of EEI Specification TD-72, Tentative Specification for Line Connectors and Splices. The tube end shall be flared to facilitate insertion of the conductor when working energized lines.

The clevis shall be made of commercial-quality, hot-rolled steel strip conforming to ASTM Specification A 425, and shall be galvanized, after fabrication, in accordance with ASTM Specification A 123.

The deadend shall be an integral unit after assembly.

**Reference Specifications:** ASTM A 123, A 425; EEI TD-72 (Latest revisions)

**Stock Unit:** EA

Stock No.	Wire Size, AWG/kcmil		Approved Manufacturer
	Solid	Strand	Fargo/Hubbell
581332	#4	—	GD512
581333	#2	—	GD514
581334	—	2/0	GD518
581335	—	4/0	GD520
581337	—	300	GD523

standards coordinator

*John Shipek*  
John Shipek

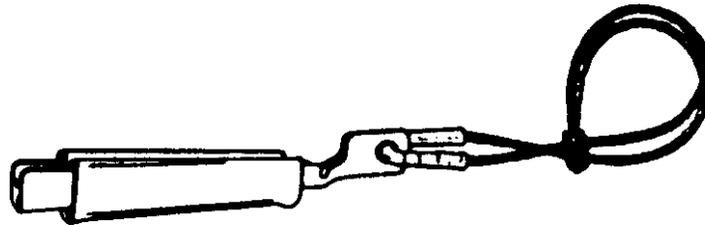
standards manager

*John Shipek*  
John Shipek

unit director

*Pamela S. Johnson*  
Pamela S. Johnson

**CLAMPS  
 NEUTRAL SERVICE WEDGE**



**Usage:** Neutral service wedge clamps are used to deadend the bare ACSR neutral messenger of service drop wire.

**Materials:** The wedge clamps shall be made of high-strength aluminum alloy with a chemical conversion coating as a protection against corrosion. The bail shall be made of aircraft cable covered with a nylon jacket.

**Requirements:** Neutral service wedge clamps shall be of the configuration shown. The clamps shall be serrated on the inner bottom of the shell to aid in holding the messenger. The bail shall be flexible, be looped with its ends secured, and be permanently attached to the wedge.

**Stock Unit:** EA

Stock Number	Wire Range		Bail Length, In	Approved Manufacturers	
	Max	Min		Blackburn	MacLean Power Systems
581340	2 ACSR	6 ACSR	12	W62-1BFC	7195 FLI
581342	1/0 ACSR	4 ACSR	12	W20-1BFC	7187 FLI
581344	4/0 ACSR	2/0 ACSR	12	W40-1BFC	7197 FLI

standards coordinator

John Shipek

standards supervisor

John Shipek

unit director

Darnell Cola

# MATERIAL STANDARD

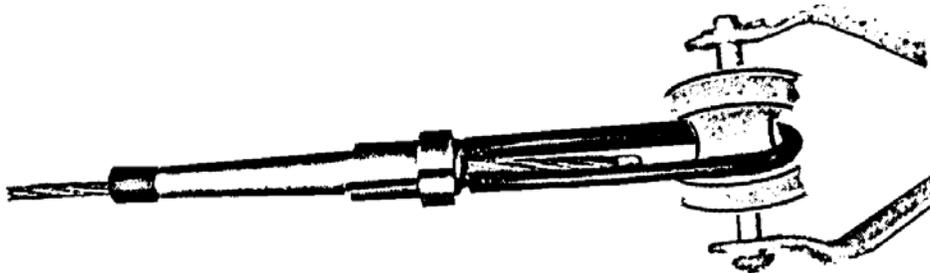
standard number: **5813.4**

superseding: June 12, 2008

effective date: November 18, 2010

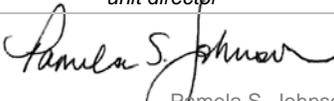
page: 1 of 1

## DEADENDS, AUTOMATIC FEED-THROUGH WITH INSULATED BAIL FOR ACSR

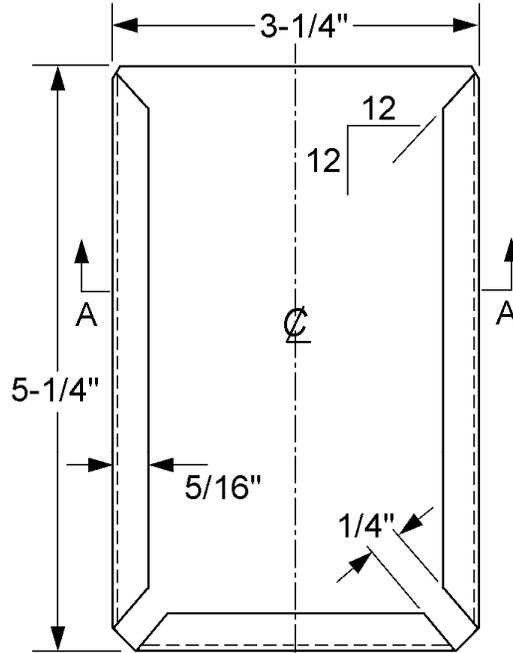


1. **Automatic Feed-Through Deadends for ACSR** are used to deadend the neutral messengers of triplex and quadruplex secondaries.
2. The **automatic sleeve** shall be made of high-strength aluminum alloy. The deadends shall develop a minimum of 90 percent of the rated conductor strength of standard ACSR without baring the steel core wire.
3. The **flexible bail** shall be made of stainless steel or stranded wire insulated with polyvinyl chloride or neoprene tubing.
4. A **strand guide and pilot cup** shall be provided to facilitate feeding the ACSR through the chuck, and help prevent misalignment of the ends of the messenger.
5. **Stock Unit:** EA
6. **Approved Manufacturers**

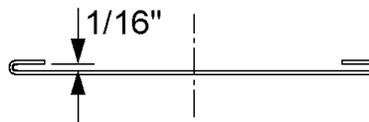
Stock Number	ACSR, AWG/kcmil	Bail Strand	Approved Manufacturers	
			MacLean Power Systems	Hubbell Power Systems (Fargo)
581301	2	7	7652AP-FDN	GD-4042AN
581302	1/0	19	7653-FDN	GD-406AN
581303	2/0	19	7654AP-FDN	GD-407N
581304	4/0	19	7656AP-FDN	GD-409AN
581305	336,400	19	7658AP-FDN	—

<i>standards coordinator</i>	<i>standards manager</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pamela S. Johnson

**SWITCH TAG HOLDER**



PLAN



SECT. "A-A"

**Material:** 24 gage stainless steel.  
**Stock Unit:** EA  
**Stock Number:** 581799

STANDARDS COORDINATOR

*Charles L. Shaffer*

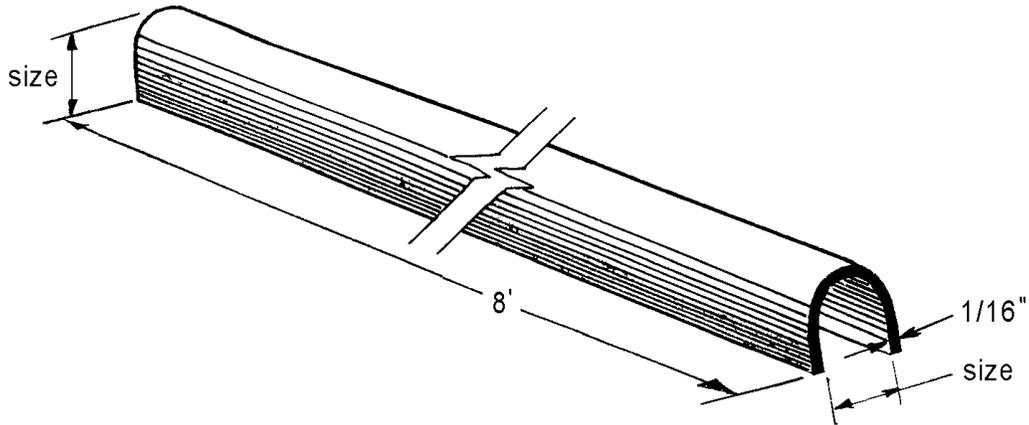
STANDARDS SUPERVISOR

*John Schinner*

UNIT DIRECTOR

*Harold Gray*

**MOLDING, PLASTIC GROUND WIRE**



**Plastic ground wire molding** shall be made of a polyvinyl chloride compound which will not support combustion, have excellent weathering characteristics, remain stable and retain its uniformity in varying temperature ranges from 0° F to 110° F.

Plastic Moulding shall have high inherent and dielectric strength, resistance to abrasion, and a low moisture absorption rate. Wall thickness shall be a minimum of 1/16".

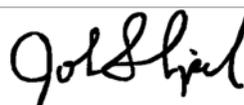
Plastic molding shall be furnished in 8' lengths and shipped in containers legibly marked with the type and quantity of the items, the City Purchase Order number, the name and address of the manufacturer, and the address of the City of Seattle receiving warehouse.

**Color:** Gray or Black

**Stock Unit:** EA

Stock Number	Size	Length	Approved Manufacturers				
			Osmose	Pexco	Preformed Line Products	Virginia Plastics	EMC
582060	1/2"	8'	OZ-26-50 PVC	7001301100	GWM-7100	VP-1/2GWM-B	PEGM 1/2GR
012980	3/4"	8'	70-050-003-108	-	GWM-7101	VP-3/4GWM-B	

Note: For staples for plastic 1/2" molding, see Stock Number 583200.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**COTTER PIN, HUMPBAC, STAINLESS STEEL**



**1. Scope**

This Material Standard covers the requirements for stainless steel, humpback cotter pins.

This Material Standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Width (C), Nominal, in
013060	1/8
582528	5/32

**2. Application**

Humpback cotter pins are used to secure a variety of spools and shackle pin assemblies. Stock Number 013060 is used in 3/16-inch diameter holes and has specific application replacing lost cotter pins cited in SCL Material Standard 6904.20, "Bracket, With Secondary Spool Insulator, Assembled". Stock Number 582528 is used in 7/32-inch diameter holes.

Humpback cotter pins are limited for use in pins 5/8 inch diameter and less.

**3. Industry Standards**

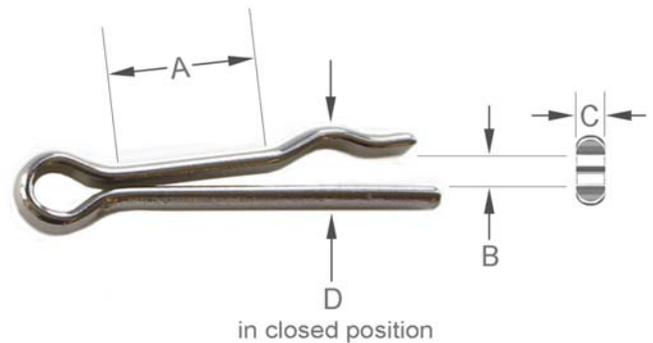
Humpback cotter pins shall meet the applicable requirements of the following industry standard:

**ANSI/ASME B18.8.1-1994(R2005)** - Clevis Pins and Cotter Pins

**4. Requirements**

Humpback cotter pins shall meet the applicable requirements of ANSI/ASME B18.8.1 with the following clarification: Cotter pins shall be of humpback design.

Humpback cotter pins shall be manufactured from 18-8 stainless steel.



Stock Number	Dimensions, nominal, in			
	A	B	C	D
013060	5/8	3/16	1/8	7/32
582528	5/8	3/16	5/32	7/32

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

## MATERIAL STANDARD

Cotter Pin, Humpback, Stainless Steel

standard number: **5825.90**  
superseding: September 23, 2002  
effective date: August 13, 2010  
page: 2 of 2

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### 5. Packaging

Humpback cotter pins shall be packaged to prevent damage during shipping, handling, and storage.

Individual packages shall contain 50 or 100 pieces and consist of a bag or a box.

Individual packages shall be legibly marked with:

- Manufacturer's name
- Manufacturer's part number
- Product description

Shipping containers shall be legibly marked with:

- Seattle City Light's Purchase Order Number

### 6. Issuance

**Stock Unit:** EA

### 7. Approved Manufacturers

Seattle City Light Material Control personnel may identify and approve distributors, and hence manufacturers, of humpback cotter pins.

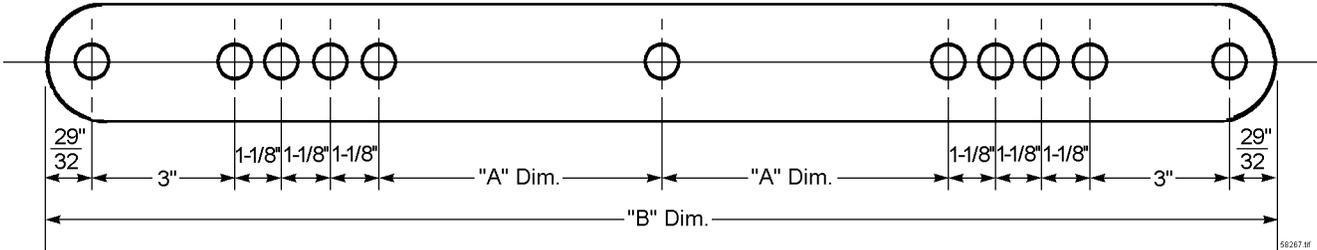
### 8. References

**6904.20;** "Bracket, With Secondary Spool Insulator, Assembled"; SCL Material Standard

**Shipek, John;** SCL Standards Engineer, subject matter expert and originator of 5825.90  
(john.shipek@seattle.gov)

# MATERIAL STANDARD

## PLATES GALVANIZED, DOUBLE & QUADRUPLE ARMING



**Galvanized, Double and Quadruple Arming Plates** shall be 1/2" x 2-1/2" with 13/16" dia. holes. The plates are used for dead-ending, executing angles, and turning corners in overhead line construction.

**Steel:** The plates shall be made of structural steel conforming to the requirements of ASTM Specification A 283.

**Galvanizing:** The plates shall be galvanized after fabrication in accordance with ASTM Specification A 123.

**Reference Specifications:** ASTM A283 and A123, latest revisions.

**Stock Unit:** EA

Plate	Stock Number	Dimensions - Inches	
		"A"	"B"
Double Arming	582665	5-3/8	25-5/16
Quadruple Arming	582680	7-7/8	30-5/16

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. J.</i>

## Staples - Galvanized and Copper Clad



### 1. Scope

This standard covers the requirements for cut point and diamond point round wire staples and cut point square barb staple.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
583180	1-1/2 in x 1/4 in - Hot Dipped Galvanized, Round Wire Staple
583200	2 in x 1/2 in - Hot Dipped Galvanized, Round Wire Staple
583261	2 in x 1/2 in - Copper Clad, Round Wire Staple
013517	2 in x 5/8 in - Hot Dipped Galvanized, Square Barb Staple

### 2. Application

Cut and diamond point staples are use in overhead line construction. Cut and diamond point staples are generally used to secure ground wire and ground wire molding to wood poles.

The square barb staple is stronger and resists bending better than traditional round wire staples. The barbed shank of the staple provides increased retention in wood fibers. The square barb staple is used to attach 1/2-inch conduits onto woods in the streetlight system.

Standards Coordinator  
Quan Wang



Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



### 3. Industry Standards

**ANSI C135.14 – 1979** - American National Standards Institute staples with rolled or slush points for overhead line construction

**ASTM A153/A153M-2004** - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM B227 – 10** - Standard Specification for Hard-Drawn Copper-Clad Steel Wire

### 4. Requirements

Cut and diamond point staples shall meet the applicable requirements of ANSI C135.14 with the clarifications described in Tables 4.1 and 4.2.

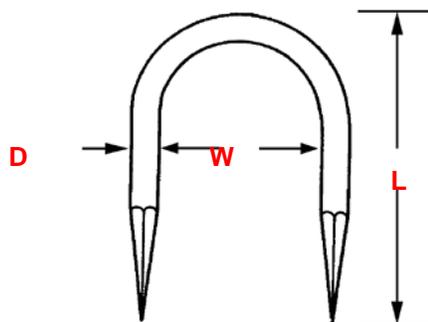
**Table 4.1. Common Requirements**

	Requirement	Reference
<b>Product Name</b>	Rolled or diamond point	ANSI C135.14,
	Slash or cut point	ANSI C135.14,
<b>Material</b>	Steel	ANSI C135.14, Section 3.1
	Copper clad	ASTM B227
<b>Dimension</b>	Per reference	ANSI C135.14, Data Sheet 2, Item No. 6
<b>Corrosion Protection</b>	Per reference	ANSI C135.14, Section 6.1.1 ASTM A153
<b>Point</b>	Cut or diamond	ANSI C135.14

**Table 4.2. Detailed Requirements**

Stock No.	Staple Dimension Nominal (in)			Corrosion Protection or Finish	Point	Material
	Length (L)	Inside Width (W)	Wire Dia. (D)			
<b>583180</b>	1-1/2	1/4	0.148	Hot-dipped galvanized	Cut	Round steel wire
<b>583200</b>	2	1/2	0.162	Hot-dipped galvanized	Diamond	Round steel wire
<b>583261</b>	2	1/2	0.162	Copper clad	Diamond	Round copper-clad wire
<b>013517</b>	2	5/8	0.165	Hot-dipped galvanized	Cut	Square wire, barb

**Figure 4. Cut and diamond point staple**



## 5. Packaging

Standard package quantity shall not exceed 500 per box.

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's stock number
- Quantity contained.

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
  - Product description
  - Seattle City Light's purchase order number
  - Seattle City Light's stock number.
- 

## 6. Issuance

Stock Unit: EA

---

## 7. Approved Manufacturers

<b>Stock No.</b>	<b>Hubbell Power Systems</b>	<b>MacLean Power Systems</b>	<b>L&amp;J Industries</b>
583180	C205-0247	J1672G	C1525148G
583200	C205-0216	J156	D2050162G
583261	9154	J6496	D2050162C
013517	C205-0463	J7672	--

Seattle City Light Material Control personnel may identify and approve alternate manufacturers.

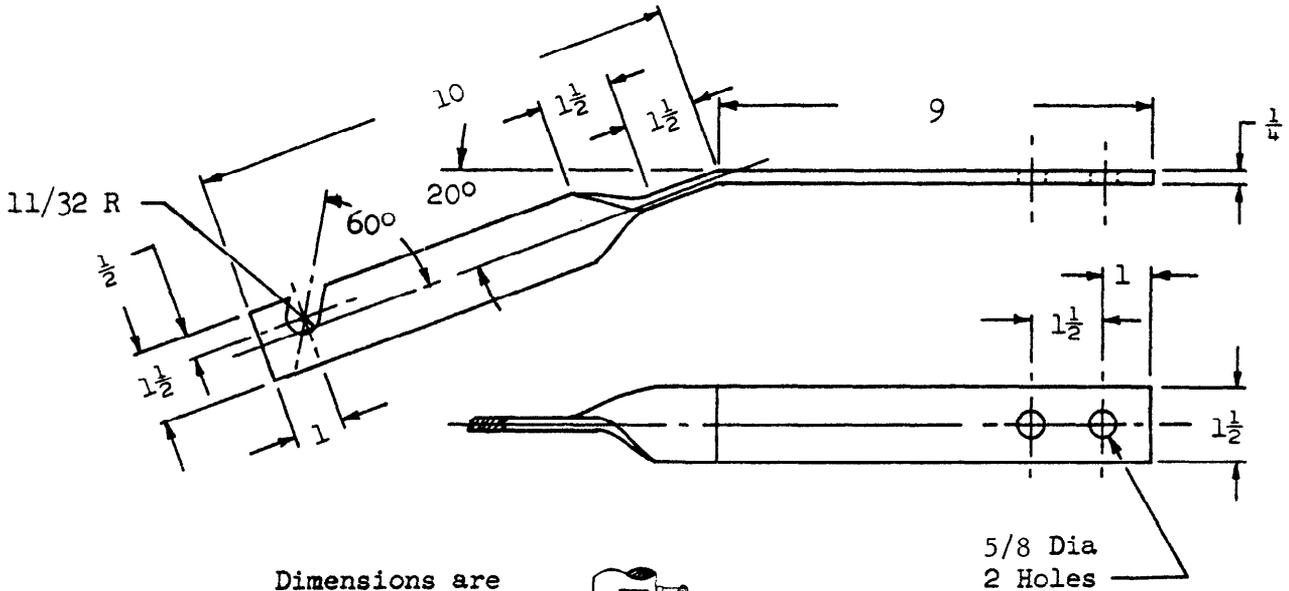
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## 8. References

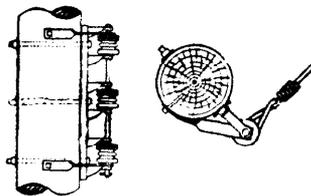
**Wang, Quan**, SCL Standards Engineer and subject matter expert for 5832.90  
([quan.wang@seattle.gov](mailto:quan.wang@seattle.gov))

STRAPS

SECONDARY RACK REINFORCING



Dimensions are  
in inches.



5/8 Dia  
2 Holes

SECONDARY RACK REINFORCING STRAPS shall be of the configuration and dimensions shown, and shall be made of hot-rolled bar steel conforming to ASTM specification A 107.

The straps shall be galvanized, after fabrication, in accordance with ASTM specification A 153.

Reference Specifications: ASTM A 107, A 153, latest revisions.

Stock Unit: Each

Stock Number: 583370

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>J E Perry</i>	<i>Charles J. Shaffer</i> 303	<i>John Skinner</i>	<i>D. DeVries</i>

**STEEL WASHERS, HELICAL SPRING LOCK**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for galvanized steel helical spring (split) lock washers.

**1.2 Application**

Helical spring (split) lock washers are for general use.

**1.3 Industry Standards**

Washers shall meet the applicable requirements of the following industry standards:

**ASME B18.21.1-1999** - Lock Washers (Inch Series)

**ASME B18.12-2001** - Glossary of Terms for Mechanical Fasteners

**ASTM A153/A153M-2004** - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

**ASTM B633-98e1** - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

**ASTM B695-2004** - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

**2. Fabrication**

**2.1 Common Requirements**

	<b>Requirements</b>	<b>Reference</b>
<b>Product Name</b>	helical spring lock washer	ASME B18.12, Section 3.3.1.10
<b>Material</b>	carbon steel	ASME B18.21.1, Section 2.3.1 (a)
<b>Dimensions</b>	per reference	ASME B18.21.1, Table 1 (for Regular) or Table 2 (for Heavy)
<b>Corrosion Protection</b>	nominal sizes 5/16" and smaller, per reference	ASTM B633
	nominal sizes 3/8" and larger, per reference	ASTM A153 or ASTM B695

STANDARDS COORDINATOR

John Shipek

STANDARDS SUPERVISOR

John Barnett

UNIT DIRECTOR

Hardev Juj

**MATERIAL STANDARD**

Steel Washers, Helical Spring Lock

STANDARD NUMBER: **5842.1**  
 PAGE: 2 of 2  
 SUPERSEDING: November 6, 2002  
 EFFECTIVE DATE: July 19, 2006

**2. Fabrication, continued****2.2 Detailed Requirements**

<b>Stock Number</b>	<b>Nominal Size, in.</b>	<b>Corrosion Protection</b>
584252	1/4	electrodeposited
584253	5/16	
584250	3/8	hot-dip or mechanical
584255	1/2	
584260	5/8	
584265	3/4	

**3. Packaging**

Helical spring washer standard packaging shall be as follows:

<b>Nominal Size, in.</b>	<b>Quantity per Box</b>
3/8 and smaller	100, 500 or 1000
1/2 and larger	100 or 500

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Stock Number
- Quantity contained

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Country of origin
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**4. Shipping**

Product shall be shipped to the address specified on the Purchase Order.

**5. Issuance**

Stock Unit: EA

**6. Approved Manufacturers:**

- A. B. Chance (Hubbell Power Systems)
- Hughes Brothers, Inc., Seward, NE
- Joslyn Manufacturing (MacLean Power Systems)
- Kortick, Hayward, CA
- Portland Bolt, Portland, OR

Seattle City Light Material Control personnel may identify and approve distributors, and hence manufacturers, for 5/16 inches and smaller hardware.

## Washers, Double Coil, Helical Spring Lock



### 1. Scope

This standard applies to heavy duty double coil helical spring lock washers with chamfered ends.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Size (in)
584257	1/2
584261	5/8
584267	3/4
012651	7/8

### 2. Application

Double coil helical spring lock washers are for general pole line use. Washers maintain pressure between wood components that may shrink or swell during varying weather conditions. Keeping components tight minimizes radio and television interference.

A 1/2-inch washer is sized for use with a nominal 1/2-in diameter bolt. Install nut and tighten normally. Important: Back off nut approximately 1/4 turn after closing coils.

### 3. Industry Standards

Double coil helical spring lock washers shall meet the applicable requirements of the following industry standards:

**American Society of Mechanical Engineers (ASME) B18.21.3**; Double Coil Helical Spring Lock Washers for Wood Structures

**American Society Testing and Materials (ASTM) B117**; Standard Practice for Operating Salt Spray (Fog) Apparatus.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



#### 4. Requirements

Material shall be spring grade carbon steel.

Washers shall meet the requirements of ASME B18.21.3.

Washer ends shall be chamfered.

Washer shall be exposed to at least 1500 hours of salt spray testing per ASTM B117.

Washers shall be mechanically plated. The final finish shall be a non-hexavalent chromate finish that adheres to ROHS regulations. ROHS restricts the use of lead, cadmium, mercury, and hexavalent chromium.

The finish shall provide both sacrificial and corrosive barrier resistance and shall not contribute to hydrogen embrittlement.

---

#### 5. Packaging

Each standard package shall be legibly marked with the following information:

- Manufacturer identification
- Product description
- SCL stock number
- Quantity contained (100)

Each shipping container shall be legibly marked with the following information:

- Manufacturer information
  - Product description
  - SCL purchase order number
  - SCL stock number
- 

#### 6. Issuance

Stock Unit: 100 per box

---

#### 7. Approved Manufacturers

Stock No.	Size (in)	Approximate Weight per 100 (lb)	Electrical Materials Company (Genoa City, WI) Catalog No.	Hughes Brothers, Inc. (Seward, NE) Catalog No.
584257	1/2	05	MW 1/2	—
584261	5/8	11	MW 5/8	SLW2-60EM
584267	3/4	12	MW 3/4	SLW2-70EM
012651	7/8	22	MW 7/8	SLW2-80EM

## 8. Sources

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 5842.50 (john.shipek@seattle.gov)

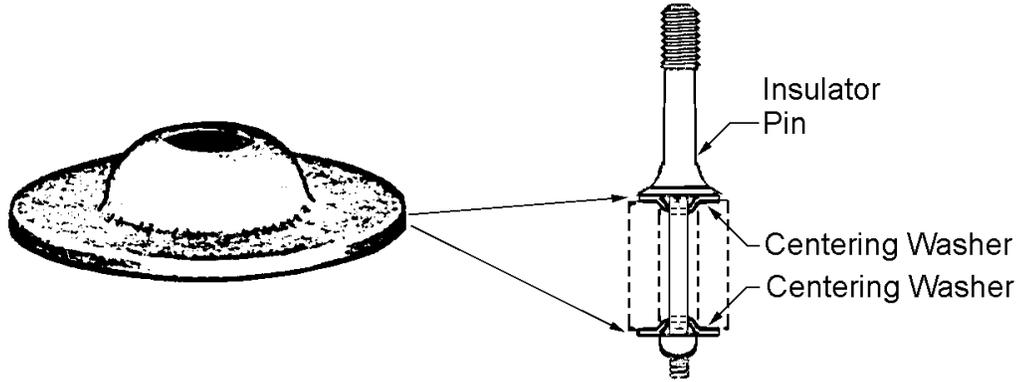
**Tilley, Kathy**; SCL Electrical Engineering Support Specialist and subject matter expert for 5842.50 (kathy.tilley@seattle.gov)

[www.electricalmaterialscompany.com](http://www.electricalmaterialscompany.com)

[www.hughesbros.com](http://www.hughesbros.com)

**MATERIAL STANDARD**

**WASHERS, CENTERING**



**Centering Washers** are used to adapt the shank of forged steel pins to pin-holes bored for wood pins in crossarms. Carbon steel washers shall be made of 1-gauge, hot-rolled steel strip meeting the requirements of ASTM A 425. Malleable iron shall conform to ASTM Specification A 47.

The washers shall be galvanized after fabrication, in accordance with ASTM A 153.

Packaging shall be in accordance with EEI Packaging Standards.

**Reference Specification:** ASTM A 425, A 47, A 153, EEI Packaging Standards, latest revisions

**Stock Unit:** EA

Stock Number	Washer Diameter, Inches	Hole Diameter, Inches	Approved Manufacturers	
			Joslyn	Kortick
584375	2-3/4	13/16	P140A	K1632

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. J...</i>

**MATERIAL STANDARD**

**WASHERS, GALVANIZED STEEL  
FLAT AND CURVED**

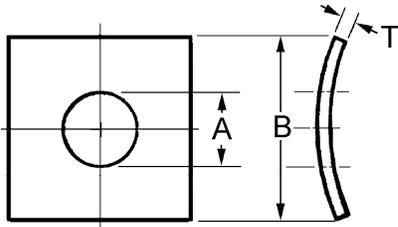


Figure 1

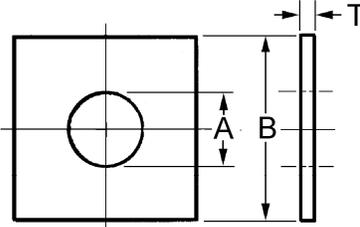


Figure 2

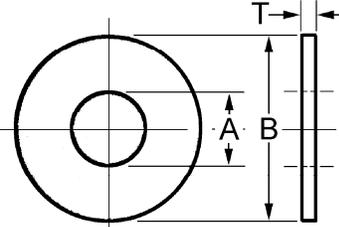


Figure 3

**Flat and Curved Galvanized Steel Washers** of the configurations shown shall meet the requirements of EEI-NEMA Pub. No. TDJ-10 "Standards for Washers Used in Overhead Line Construction."

**Zinc Coating:** Zinc coatings shall be by hot-dip galvanizing in accordance with ASTM Specification A153 or by mechanical galvanizing in accordance with ASTM Specification B695.

**Packaging:** The washers shall be packaged in accordance with EEI Packaging Standards (see table below).

**Reference Specifications** (latest revisions):

EEI-NEMA TDJ-10

EEI Packaging Standard (Latest Revision)

ASTM A153 Specification for Zinc Plating on Iron and Steel Hardware

ASTM B695, Standard Specifications for Coatings of Zinc Mechanically Deposited on Iron and Steel

**Stock Unit:** EA

Stock Number	Fig. No.	Bolt Dia., Inches	Dimensions, Inches			EEI NEMA Pkg.	
			B	A	T	Box	Lbs.
584775	1	5/8 to 7/8	4 x 4	15/16	1/4	50	58
584945	2	1/2	3 x 3	9/16	3/16	100	47
584947	2	5/8 to 3/4	3 x 3	13/16	3/16	100	46
584963	2	1	4 x 4	1-1/8	1/2	25	55
585135	2	5/8 to 3/4	2-1/4 x 2-1/4	13/16	3/16	250	56
585020	3	3/8	1	7/16	5/64	5000	75
585025	3	1/2	1-3/8	9/16	7/64	2500	93
585030	3	5/8	1-3/4	11/16	1/8	1000	85
585035	3	3/4	2	13/16	5/32	1000	92
585040	3	7/8	2-1/4	15/16	11/64	500	55
585045	3	1	2-1/2	1-1/16	11/64	500	60

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>James E. Perry</i>	<i>Charles L. Shaffer</i>	<i>John C. Himmer</i>	<i>Harold J. J...</i>

**MATERIAL STANDARD**

**WIRE, ACSR, BARE**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for bare, concentric-lay stranded aluminum conductor, steel reinforced (ACSR) wire. Aluminum strands are made from round 1350-H19 (extra hard) alloy wire. Steel, core strands are zinc coated.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock No.	Size, kcmil	Stranding, aluminum/steel	Code Word
600020	397.5	18/1	Chickadee
600021	397.5	26/7	Ibis
600040	795	26/7	Drake
600041	795	30/19	Mallard
600044	954	45/7	Rail

Wire identified by code word shall be consistent with the requirements of Aluminum Association Table 6. Code words define:

- Size (kcmil)
- Stranding (aluminum/steel)

**1.2 Application**

Wire is used as a bare, overhead, transmission or distribution conductor.

Wire with a high proportion of aluminum is better suited for applications requiring low electrical impedance. Wire with a high proportion of steel is better suited for long span applications.

For similar, all aluminum conductors, refer to Material Standard 6000.20.

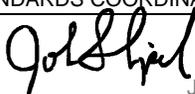
**1.3 Industry Standards**

Wire shall meet the applicable requirements of the following industry standards:

**Aluminum Association Code Words for Overhead Aluminum Electrical Conductors**, Seventh Edition (January 1999)

**ASTM B232-2001** - Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)

**NEMA WC-26-2000** - Binational Wire and Cable Packaging Standard

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 John Nierenberg

**MATERIAL STANDARD**

**Wire, ACSR, Bare**

**1.4 Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order
2. This Seattle City Light Material Standard
3. Aluminum Association
4. ASTM standards
5. Other industry standards

**2. Construction**

Wire shall meet the requirements of ASTM B232 and Table A with the following clarifications:

- Wire shall be Class AA.
- Wire shall be ACSR/GA using Class A zinc-coated steel wire.

**Table A**

Stock Number	Size, kcmil	Stranding, aluminum/steel	Code Word	Nominal Diameter, in.	Minimum Rated Strength, lbs.
600020	397.5	18/1	Chickadee	0.743	9,900
600021	397.5	26/7	Ibis	0.783	16,300
600040	795	26/7	Drake	1.108	31,500
600041	795	30/19	Mallard	1.140	38,400
600044	954	45/7	Rail	1.165	25,900

**3. Detailed Packaging Requirements**

Wire shall be packaged on reels according to the requirements of WC 26 and Table B or as specified otherwise on the request for quote or purchase order.

**Table B**

Stock Number	Size, kcmil	Reel Type	Maximum Outside Flange Diameter, in.	Maximum Outside Width, in.	Nominal Drum Diameter, in.	Length per Reel ± %, ft.	Approximate Weight per 100 ft., lbs.
600020	397.5	wood	66	38	36	9,630	43.1
600021	397.5	wood	60	33	28	6,945	54.6
600040	795	steel - RMT	84	43	42	6,940	109.3
600041	795	steel - RMT	84	52	42	7,980	123.4
600044	954	steel - RM	68	44	36	5,000	107.4

Reel gross weight shall not exceed 17,000 pounds.

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

Wood reels shall be either reusable type according to WC 26, Section 2.2, or nonreturnable type according to WC 26, Section 2.3.

**3. Detailed Packaging Requirements, continued**

Wood reels may be new or recycled.

Recycled wood reels (when provided) shall have the surface of both outside flanges painted over with a solid color.

Recycled wood reels (when provided) shall be equivalent to new in quality and strength.

Type RM steel reels shall be returnable, with fluted or corrugated flange and flat bar tires according to WC 26, Section 2.1.2.

Type RMT steel reels shall be returnable, with fluted or corrugated flange and I-beam tires according to WC 26, Section 2.1.2.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC 26, Section 4.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange.

Wood reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length of wire on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC 26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**4. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Wire shall be shipped to the address specified on the Purchase Order.

**5. Issuance**

FT

**6. Approved Manufacturers**

Alcan Cable

General/BICC

Nehring Electrical Works Company

Nexans Energy USA

Southwire Company

## Wire, ACSR/E3X, Bare



### 1. Scope

This standard covers the requirements for bare, concentric-lay stranded aluminum conductor, steel reinforced wire with special coating (ACSR/E3X). Aluminum strands are made from round 1350-H19 (extra hard) alloy wire. Steel, core strands are zinc coated.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Size (kcmil)	Stranding, aluminum/steel	Code Word
013766	795	30/19	Mallard/E3X
013767	954	45/7	Rail/E3X

Wire identified by code word shall be consistent with the requirements of Aluminum Association Table 6. Code words define:

- Size (kcmil)
- Stranding (aluminum/steel)

### 2. Application

Wire is used as a bare, overhead transmission conductor.

Wire with a high proportion of aluminum is better suited for applications requiring low electrical impedance. Wire with a high proportion of steel is better suited for long span applications.

E3X is a proprietary coating offered by General Cable that increase the ampacity of bare, ACSR by increasing emissivity and lowering absorptivity.

This product is installed the same and uses the same connectors as uncoated ACSR.

For uncoated ACSR, see SCL 6000.00.

### 3. Industry Standards

Wire shall meet the applicable requirements of the following industry standards:

**Aluminum Association Code Words for Overhead Aluminum Electrical Conductors**, Seventh Edition, January 1999

**ASTM B232-2001**; Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)

**NEMA WC-26-2000**; Binational Wire and Cable Packaging Standard

### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. SCL purchase order
2. This SCL standard
3. Aluminum Association
4. ASTM standards
5. Other industry standards

### 5. Requirements

Wire shall meet the requirements of ASTM B232 and Table A with the following clarifications:

- Wire shall be Class AA.
- Wire shall be ACSR/GA using Class A zinc-coated steel wire.
- The outer surface of the stranded wire shall be coated with a high emissivity, low absorptivity coating having a nominal emissivity of 0.9 and a nominal solar absorptivity of 0.2.

**Table A. Wire Requirements**

Stock No.	Size (kcmil)	Stranding, aluminum/steel	Code Word	Diameter, nominal (in)	Minimum Rated Strength (lb)
013766	795	30/19	Mallard/E3X	1.140	38,400
013767	954	45/7	Rail/E3X	1.165	25,900

### 6. Packaging Requirements

Wire shall be packaged on reels according to the requirements of WC 26 and Table B or as specified otherwise on the request for quote or purchase order.

**Table B. Packaging Requirements**

Stock No.	Size (kcmil)	Reel Type	Maximum Outside Flange Diameter (in)	Maximum Outside Width (in)	Nominal Drum Diameter (in)	Length per Reel ± %, (ft)	Approximate Weight per 100 ft (lb)
013766	795	Steel - RMT	84	52	42	7,980	123.5
013767	954	Steel - RM	68	44	36	5,000	107.8

Reel gross weight shall not exceed 17,000 pounds.

Actual quantity per reel may vary from the quantity stated on the purchase order by plus or minus 10%.

Type RM steel reels shall be returnable, with fluted or corrugated flange and flat bar tires according to WC 26, Section 2.1.2.

Type RMT steel reels shall be returnable, with fluted or corrugated flange and I-beam tires according to WC 26, Section 2.1.2.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC 26, Section 4.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange.

Each reel shall be legibly marked with the following information:

- Manufacturer identification
- Product description, including code word
- Shipping length of wire on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC 26, Section 5
- SCL purchase order number
- SCL stock number

---

## 7. Shipping

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

- Reels shall not be strapped or palleted.
- Wire shall be shipped to the address specified on the purchase order.

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## 8. Issuance

FT

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## 9. Approved Manufacturers

General Cable

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## 10. References

**SCL Material Standard 6000.00**; "Wire, ACSR, Bare"

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## 11. Sources

**Shipek, John**; Standards Supervisor, subject matter expert, and originator of 6000.05 (john.shipek@seattle.gov)

**MATERIAL STANDARD**

**WIRE, AAC, BARE**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for bare, concentric-lay stranded, all aluminum wire. Aluminum strands are made from round 1350-H19 (extra hard) alloy wire.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock No.	Size, kcmil	Code Word
600113	397.5	Canna
600121	795	Arbutus
600126	954	Goldenrod

Wire identified by code word shall be consistent with the requirements of Aluminum Association Table 1. Code words define:

- Size (kcmil)
- Number of strands

**1.2 Application**

Wire is used as a bare, overhead, transmission or distribution conductor.

For similar conductors with a steel component (more appropriate for long span applications) refer to Material Standard 6000.00.

**1.3 Industry Standards**

Wire shall meet the applicable requirements of the following industry standards:

**Aluminum Association Code Words for Overhead Aluminum Electrical Conductors**, Seventh Edition (January 1999)

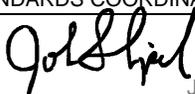
**ASTM B231-2004** - Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors

**NEMA WC-26-2000** - Binational Wire and Cable Packaging Standard

**1.4 Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order
2. This Seattle City Light Material Standard
3. Aluminum Association
4. ASTM standards
5. Other industry standards

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 John Nierenberg

**2. Construction**

Wire shall meet the requirements of ASTM B231 and Table A.

**Table A**

Stock Number	Size, kcmil	Class	Number of Strands	Code Word	Nominal Diameter, in.	Minimum Rated Strength, lbs.
600113	397.5	A, AA	19	Canna	0.724	7,110
600121	795	AA	37	Arbutus	1.026	13,900
600126	954	A	61	Goldenrod	1.126	16,900

**3. Detailed Packaging Requirements**

Wire shall be packaged on reels according to the requirements of WC 26 and Table B or as specified otherwise on the request for quote or purchase order.

**Table B**

Stock Number	Size, kcmil	Reel Type	Maximum Outside Flange Diameter, in.	Maximum Outside Width, in.	Nominal Drum Diameter, in.	Length per Reel ± %, ft.	Approximate Weight per 100 ft., lbs.
600113	397.5	wood	48	33	24	5,090	37.3
600121	795	steel - RM	66	38	36	4,690	74.5
600126	954	wood	48	33	24	2,100	89.5

Reel gross weight shall not exceed 17,000 pounds.

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

Wood reels shall be either reusable type according to WC 26, Section 2.2, or nonreturnable type according to WC 26, Section 2.3.

Wood reels may be new or recycled.

Recycled wood reels (when provided) shall have the surface of both outside flanges painted over with a solid color.

Recycled wood reels (when provided) shall be equivalent to new in quality and strength.

Type RM steel reels shall be returnable, with fluted or corrugated flange and flat bar tires according to WC 26, Section 2.1.2.

Type RMT steel reels shall be returnable, with fluted or corrugated flange and I-beam tires according to WC 26, Section 2.1.2.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC 26, Section 4.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange.

Wood reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**3. Detailed Packaging Requirements, continued**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length of wire on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC 26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**4. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Wire shall be shipped to the address specified on the Purchase Order.

**5. Issuance**

FT

**6. Approved Manufacturers**

Alcan Cable

General/BICC

Nehring Electrical Works Company

Nexans Energy USA

Southwire Company

## High Temperature, Low Sag Conductor



Note: Image is for illustrative purposes and does not necessarily represent the actual product.

### 1. Scope

This standard covers the requirements for high temperature, low sag (HTLS), overhead transmission line conductor.

The various HTLS conductor designs are proprietary and not exact equals to each other.

HTLS conductor may also be referred to as follows:

- High capacity
- Aluminum conductor composite reinforced (ACCR)
- Aluminum conductor composite core (ACCC)

This standard applies to Stock No. 013632.

HTLS conductor deadend and splice requirements are outside the scope of this standard.

HTLS conductor commission testing requirements prior to energization are outside the scope of this standard.

### 2. Application

HTLS is similar in construction and dimensions to Aluminum Conductor Steel Reinforced (ACSR); however, HTLS has a higher strength-to-weight ratio and lower thermal expansion than comparably-sized steel core conductors. Because it is lighter and sags less, even at higher operating temperatures, higher line ratings are possible at equivalent tensions and clearances. Note: Joule heating (line losses) increase linearly with operating temperature.

The first use of HTLS at Seattle City Light (SCL) will be in 2016 to re-conductor the Bothell to SnoKing #1 and #2 (BO-SK #1/#2) 230kV transmission lines.

Standards Coordinator  
John Shipek

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

HTLS conductor shall meet the applicable requirements of the following industry standards:

**ASTM B976-11**; Standard Specification for Fiber Reinforced Aluminum Matrix Composite (AMC) Core Wire for Aluminum Conductors, Composite Reinforced (ACCR)

**ASTM B978/B978M-14**; Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Composite Reinforced (ACCR)

**ASTM B987/B987M-14**; Standard Specification for Carbon Fiber Composite Core (CFCC/TS) for use in Overhead Electrical Conductors

**ASTM B857-14**; Standard Specification for Shaped Wire Compact Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Supported (ACSS/TW)

HTLS conductor design and correspondence shall use the methods, terms, and definitions cited in the following industry standard:

**IEEE Std 738-2012**; IEEE Standard for Calculating the Current-Temperature Relationship of Bare Overhead Conductors

HTLS conductor packaging shall meet the applicable requirements of the following industry standard:

**NEMA WC-26-2000**; Binational Wire and Cable Packaging Standard

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### 4. Requirements

For evaluation purposes, physical and electrical property performance requirements shall be based on the parameters cited in Appendix A.

#### 4.1 Physical Properties

**Table 4.1. High Temperature, Low Sag Conductor Physical Properties**

Description	Value
Diameter, total conductor, minimum	1.0 in
Total weight, maximum	1.25 lb/ft
Tensile strength, ultimate, minimum	32,000 lb

HTLS conductor shall be as follows:

- Corrosion resistant
- Creep resistant
- Fatigue resistant
- Thermally stable

#### 4.2 Electrical Properties

**Table 4.2. High Temperature, Low Sag Conductor Electrical Properties**

Rating	Value (A)
Winter	1950
Summer	1800

## 5. Packaging

### 5.1 General

HTLS conductor shall be packaged on reels according to the requirements of NEMA WC 26.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC 26, Section 4.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange.

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of wire on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC 26, Section 5
- SCL stock number

### 5.2 Supplemental Requirements

In addition to the general requirements cited in section 5.1, HTLS conductor intended for receipt, storage, and installation by SCL shall be packaged on reels conforming to the requirements of Table 5.2.

**Table 5.2. Supplemental Requirements**

Reel type	Steel RMT
Maximum outside flange diameter (in)	84
Maximum outside width (in)	52
Nominal drum diameter (in)	42
Length per reel, +/- 10% (ft)	7,980

Reel gross weight shall not exceed 17,000 pounds.

---

## 6. Shipping

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palletted.

---

## 7. Issuance

Stock unit: FT

---

## 8. Approved Manufacturers

- 3M
- CTC Global

## 9. Sources

**Lin, Jimmy**; SCL Electrical Engineering Associate and subject matter expert for 6001.25  
(jimmy.lin@seattle.gov)

**Ogi, Irving**; SCL Supervisor and subject matter expert for 6001.25  
(irving.ogi@seattle.gov)

**Risch, Bob**; SCL Manager and subject matter expert for 6001.25  
(bob.risch@seattle.gov)

**Shipek, John**; SCL Supervisor and originator of 6001.25 (john.shipek@seattle.gov)

[www.3M.com/accr](http://www.3M.com/accr)

[www.ctcglobal.com](http://www.ctcglobal.com)

**APPENDIX A**

For evaluation purposes, the physical and electrical property performance requirements specified in Section 4 shall be based on the parameters cited below:

Frequency (Hz)	60
Date	June 21
Time	Noon
Environmental Conditions	
Ambient (°C)	
Winter	0
Summer	30
Emissivity	0.50
Solar absorption	0.50
Elevation (ft)	0
Latitude	47°
Wind speed (ft/s)	2
Wind angle to conductor	90°
Atmosphere	Clear
Line azimuth	90°
Short-circuit withstand, 30 cycles, minimum (kA)	50
Load factor	50%
Other	
Operating voltage (kV)	230
Ruling span (ft)	1120
Working tension, maximum (lb)	14,500 (NESC medium)

SEATTLE CITY LIGHT  
**MATERIAL STANDARD**

STANDARD NUMBER: **6005.1**

PAGE: 1 of 4

SUPERSEDING: December 1, 2003

EFFECTIVE DATE: June 9, 2006

**WIRE, ALUMINUM, WEATHER-RESISTANT, POLYETHYLENE COVERED**



**1. Foreword**

**1.1 Scope**

This material standard covers the requirements for aluminum, weather-resistant, polyethylene covered, single conductor line wire.

This material standard applies to the following Seattle City Light Stock Number:

Stock No.	Size, AWG	Packaging	Code Word	Type
600318	4/0	reel	Olive	1/C

Aluminum Association code words are cited in this standard for the convenience of the reader. Cable assemblies identified by code word shall be consistent with the requirements of Aluminum Association Table 9.

**1.2 Application**

This product is used as an overhead, primary distribution system neutral conductor.

This product has no voltage rating and must be installed on insulators adequate for the service voltage.

**1.3 Industry Standards**

Covered conductor shall meet the applicable requirements of the following industry standards:

**ICEA S-70-547-2000** - Standard for Weather-Resistant Polyethylene Covered Conductors

**Aluminum Association Code Words for Overhead Aluminum Electrical Conductors**, Seventh Edition (January 1999)

**NEMA WC-26-2000** - Binational Wire and Cable Packaging Standard

**1.4 Conflict**

Where conflict exists, the following order of precedence shall apply:

1. This Seattle City Light Material Standard
2. ICEA standards
3. Aluminum Association
4. Other industry standards

STANDARDS COORDINATOR

John Shipek

STANDARDS SUPERVISOR

John Barnett

UNIT DIRECTOR

Hardev Singh

**MATERIAL STANDARD**

Wire, Aluminum, Weather-Resistant, Polyethylene Covered

**2. Construction****2.1 General**

Covered conductor identified by code word shall be consistent with the requirements of Aluminum Association.

Covered conductor shall meet the requirements of ICEA S-70-547, Part 1 for thermoplastic polyethylene.

Maximum conductor operating temperatures shall be according to **Table A**.

**Table A**

Covering Type	Normal Service	Emergency Overload	Short Circuit
Thermoplastic PE	75° C	95° C	150° C

**2.2 Conductor**

Conductor shall meet the requirements of ICEA S-70-547, Part 2.

Conductor shall be 1350-H19 aluminum.

Conductor stranding shall meet the requirements of **Table B**:

**Table B**

Conductor Size, AWG	Number of Strands
4/0	7

**2.3 Covering**

Covering shall meet the requirements of ICEA S-70-547, Part 3, with the following clarifications:

Covering shall be black.

Covering shall be low density or linear low density: ASTM D1248 Type I, Class C, Category 4 or 5, Grades E5 or J3.

Minimum and nominal covering thickness values shall meet the requirements of **Table C**:

**Table C**

Conductor Size, AWG	Minimum Thickness, mils	Nominal Thickness, mils
4/0	54	60

Covering shall be free stripping from the conductor. This may be accomplished by the manufacturing processes or by the addition of a Mylar separator.

**2.4 Identification**

The outer surface of the covering shall be durably and legibly marked throughout its length, at a maximum interval of 1 meter, with a print legend.

The print legend shall include, but not be limited to, the following information:

- Manufacturer's identification
- Plant symbol
- Type of covering
- Year of manufacturer

**MATERIAL STANDARD**

Wire, Aluminum, Weather-Resistant, Polyethylene Covered

**3. Packaging****3.1 Detailed Requirements**

Covered conductor shall be packaged according to the requirements of NEMA WC-26 and **Table D**.

**Table D**

Stock No.	Conductor Size, AWG	Packag-ing	Length per Package, $\pm 10\%$ , ft.	Outside Flange Diameter, Max., in.	Inside Traverse Width, Max., in.	Weight per 100 ft., Approx., lbs.	Weight per Package, Approx., lbs.	Code Word	Type
600318	4/0	reel	10,000	58	32	25	2,500	Olive	1/C

**3.2 Quantity**

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

**3.3 Reels**

Reels shall be nonreturnable type.

Reels may be new or recycled.

Recycled reels (when provided) shall be have the surface of both outside flanges painted over with a solid color.

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**3.4 Product for Shipping**

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

The inner end of the covered conductor shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples.

**3.5 Marking**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length of covered conductor on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**MATERIAL STANDARD**

Wire, Aluminum, Weather-Resistant, Polyethylene Covered

STANDARD NUMBER: **6005.1**

PAGE: 4 of 4

SUPERSEDING: December 1, 2003

EFFECTIVE DATE: June 9, 2006

**4. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palletted.

Product shall be shipped to the address specified on the Purchase Order.

**5. Issuance**

Stock Unit: FT

**6. Approved Manufacturers**

Alcan Cable

General Cable, BICC Brand

Nehring Electrical Works Company

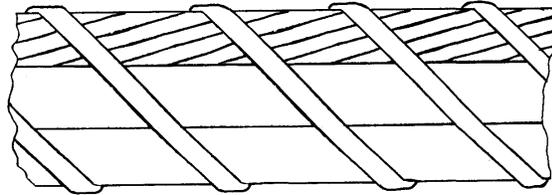
Nexans

Phoenix Wire and Cable Corp.

Prysmian

Southwire Company

**CABLE, PREASSEMBLED, PARALLEL LAY**



**1. Scope**

This specification covers cross-linked polyethylene-insulated aluminum conductors, prelashed to a bare aluminum AW/AAAC neutral messenger, for use on secondary distribution at 600 volts or less.

**2. Industry Standards**

ASTM B 230, Standard Specification for Aluminum 1350-H19 Wire for Electrical Purposes  
 ASTM B 398, Standard Specification for Aluminum-Alloy 6201-T81 Wire for Electrical Purposes  
 ICEA S-66-524 (NEMA WC 7), Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable  
 NEMA WC 26, Wire and Cable Packaging

**3. Requirements**

**Insulated Conductors** .... The 4/0, 19-strand conductors shall be Class B concentric, stranded, 1350 grade aluminum, meeting the requirements of ASTM B 230. The insulation shall be cross-linked, thermosetting polyethylene, meeting the requirements of ICEA S-66-524, Sec. 7.4.3.2. The average insulation thickness shall be 0.060". The minimum thickness at any point shall not be less than 90 percent of the average thickness. One insulated conductor shall have continuous, molded, longitudinal ridges for identifying purposes. The color of the insulation shall be black.

**Neutral Messenger** ..... The neutral messenger shall be equivalent to 1/0 AAAC conductor for current-carrying capacity, and shall consist of four 0.1490" diameter AAAC strands, and three 0.1490" diameter AW strands. Stranding shall be Class AA concentric. The AAAC strands shall be Type 6201 aluminum alloy, meeting the requirements of ASTM B 398. The AW strands shall be *Alumoweld* as manufactured by the Copperweld Steel Co. The neutral messenger shall have a minimum breaking strength of 11,000 lbs.

**Assembly** ..... The cable shall be assembled so that when installed the center line of all conductors shall be in a vertical plane with the neutral messenger on top. The cable shall be lashed together with either:

1. A single 1350-H19 grade aluminum ribbon having a minimum cross-sectional area of 0.0075 sq. in. and a minimum thickness of 0.050" and the width to vary accordingly; or
2. Single #10 AWG 1350-H19 grade wire.

The lay of the lashing shall be 4" - 6".

**4. Packaging:**

The cable shall be wound in 3000 ft. lengths on non-returnable reels of NEMA Standard WC 26 dimension. Both ends of the cable shall be securely fastened to the reel. The cable shall be adequately protected to ensure delivery without damage. Each reel shall be legibly marked with the type, weight, and length of the cable, the name and address of the manufacturer, and City of Seattle purchase order number and receiving warehouse.

**5. Approved Manufacturers:**

Alcan, Alcoa, BICC/General, Copperweld, Kaiser, Pirelli, Southwire

**Stock Unit:** FT

**Stock Number:** 600612

**Special Order by Engineering Only – minimum 24-week lead time.**

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
Charles L. Shaffer	John Schinner	Hardee Juy

**600 V, ALUMINUM, OVERHEAD, TRIPLEX AND QUAD SERVICE DROP CABLE**



**1. Scope**

This material standard covers the requirements for neutral-supported, 600 V, aluminum, cross-linked polyethylene (XLPE) insulated, multiplex cable used for the distribution of electric energy.

This material standard applies to the following Seattle City Light Stock Numbers:

Stock No.	Phase Conductor Size	Pack-aging	Code Word	Type
013271	#6 AWG	coil	Voluta-XLP	triplex
600672	#2 AWG	reel	Cockle-XLP	triplex
600673	#2 AWG	coil	Cockle-XLP	triplex
600664	1/0 AWG	reel	Janthina-XLP	triplex
012580	1/0 AWG	coil	Janthina-XLP	triplex
600669	4/0 AWG	reel	Cerapus-XLP	triplex
600734	#2 AWG	reel	Palomino-XLP	quadruplex
600735	1/0 AWG	reel	Costena-XLP	quadruplex
600738	4/0 AWG	reel	Appaloosa-XLP	quadruplex
600741	350 kcmil	reel	none	quadruplex

Aluminum Association code words are cited in this standard for the convenience of the reader. Cable assemblies identified by code word shall be consistent with the requirements of Aluminum Association Tables 30 and 41 as appropriate. Code words define:

- Type of construction
- Type of phase conductor insulation
- Thickness of phase conductor insulation
- Conductor alloy and temper
- Type of neutral
- Neutral rating
- Neutral covering
- Pertinent industry standard
- Insulation rating

**2. Application**

Cable assemblies are for single-phase, 3-wire, and three-phase, 4-wire secondary and service drops nominally rated up to 480 V phase-to-phase, 60 Hz.

Cable assembly is for overhead application. Support is provided by the bare, neutral messenger.

Stock Number 013271 has a special application as an overhead conductor for temporary streetlight services.

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**Material Standard**

600 V, Aluminum, Overhead, Triplex And Quad Service Drop Cable

standard number: **6007.50**

superseding: June 8, 2011  
 effective date: November 18, 2011  
 page: 2 of 4

**3. Industry Standards**

Cables shall meet the requirements of the following industry standard:

- ICEA S-76-474-2004** - Standard for Neutral Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation Rated 600 Volts
- Aluminum Association Code Words for Overhead Aluminum Electrical Conductors**, Seventh Edition (January 1999)
- ASTM B232-2001** - Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated-Steel Reinforced (ACSR)
- NEMA WC-26-2000** - Binational Wire and Cable Packaging Standard

**4. Conflict**

Where conflict exists, the following order of precedence shall apply:

1. This Seattle City Light Material Standard
2. ICEA standards
3. Aluminum Association
4. Other industry standards

**5. Construction**

**5.1 General**

Cable shall meet the requirements of ICEA S-76-474, Section 1, for cross-linked polyethylene insulation. Maximum conductor operating temperatures shall be according to **Table 5.1**.

**Table 5.1**

Insulation Type	Normal Service	Emergency Overload	Short Circuit
XLPE	90° C	130° C	250° C

**5.2 Conductors - Phase**

Phase conductors shall meet the requirements of ICEA S-76-474, Sections 2.2 and 2.2.1, with the following clarifications:

Phase conductor alloy shall be 1350-H19 aluminum.

**5.3 Conductors - Neutral**

Neutral conductors shall meet the requirements of ICEA S-76-474, Sections 2.3 and 2.3.3, with the following clarifications:

- Neutral conductors shall be bare.
- Neutral conductors shall be (full or reduced) according to **Table 5.3**.
- Neutral conductors shall be aluminum conductor coated-steel reinforced (ACSR/GA) according to the requirements of ASTM B232 and **Table 5.3**.
- Neutral conductor strength shall meet the requirements of **Table 5.3**.

**Table 5.3**

Phase Conductor Size	Neutral Conductor Size	Neutral Conductor Type	Code Word	Type	Neutral Conductor Rated Strength, Minimum, lbs
#6 AWG	#6 AWG	6/1 ACSR	Voluta-XLP	triplex	1,180
#2 AWG	#4 AWG	6/1 ACSR	Cockle-XLP	triplex	1,860
1/0 AWG	#2 AWG	6/1 ACSR	Janthina-XLP	triplex	2,850
4/0 AWG	2/0 AWG	6/1 ACSR	Cerapus-XLP	triplex	5,300
#2 AWG	#2 AWG	6/1 ACSR	Palomino-XLP	quadruplex	2,850
1/0 AWG	1/0 AWG	6/1 ACSR	Costena-XLP	quadruplex	4,380
4/0 AWG	4/0 AWG	6/1 ACSR	Appaloosa-XLP	quadruplex	8,350
350 kcmil	4/0 AWG	6/1 ACSR	none	quadruplex	8,350

**Material Standard**

600 V, Aluminum, Overhead, Triplex And Quad Service Drop Cable

standard number: **6007.50**

superseding: June 8, 2011  
 effective date: November 18, 2011  
 page: 3 of 4

**5. Construction, continued**

**5.4 Insulation**

Insulation shall meet the requirements of ICEA S-76-474, Sections 3.1, 3.1.2, 3.4, and 3.6.1.1 with the following clarifications: Insulation shall be cross-linked polyethylene.

Minimum and nominal insulation thickness values shall meet the requirements of **Table 5.4**:

**Table 5.4**

Conductor Size	Minimum Thickness, mils	Nominal Thickness, mils
#6 AWG	41	45
#4 AWG	41	45
#2 AWG	41	45
1/0 AWG	54	60
4/0 AWG	54	60
350 kcmil	72	80

Insulation shall be free stripping from the conductor. This may be accomplished by the manufacturing processes or by the addition of a Mylar separator.

**5.5 Assembly and Identification**

Multiplex cable assemblies shall be twisted according to the requirements of ICEA S-76-474, Section 4.1.1.

Cable shall be marked according to the requirements of ICEA S-76-474, Section 4.2, with the following clarifications:

The outer surface of one or more of the phase conductors shall be durably and legibly marked throughout its length, at a maximum interval of 1 meter, with a print legend.

The print legend shall include, but not be limited to, the following information:

- Manufacturer's plant name
- Type of insulation
- Year of manufacturer

Each phase conductor of a quadruplex cable assembly shall be individually identified.

Phase identification shall be accomplished by means of zero, one, or two raised ridges.

Triplex cable assemblies do not require phase conductor identification.

**6. Packaging**

**6.1 Detailed Requirements**

Cable shall be packaged according to the requirements of NEMA WC-26 and **Table 6.1**.

**Table 6.1**

Stock No.	Phase Conductor Size	Packaging	Length per Package ± 10%, ft	Outside Flange Diameter, Max., in	Inside Traverse Width, Max., in	Weight per 100 ft., Approx., lbs	Weight per Package, Approx., lbs	Code Word	Type
<b>013271</b>	#6 AWG	coil	0,500	–	–	12	60	Voluta-XLP	triplex
<b>600672</b>	#2 AWG	reel	1,800	36	24	24	432	Cockle-XLP	triplex
<b>600673</b>	#2 AWG	coil	400	–	–	24	96	Cockle-XLP	triplex
<b>600664</b>	1/0 AWG	reel	1,200	36	24	39	468	Janthina-XLP	triplex
<b>012580</b>	1/0 AWG	coil	250	–	–	39	98	Janthina-XLP	triplex
<b>600669</b>	4/0 AWG	reel	1,000	42	26	73	730	Cerapus-XLP	triplex
<b>600734</b>	#2 AWG	reel	1,800	42	26	37	666	Palomino-XLP	quad
<b>600735</b>	1/0 AWG	reel	1,200	42	26	58	696	Costena-XLP	quad
<b>600738</b>	4/0 AWG	reel	1,000	50	32	109	1,090	Appaloosa-XLP	quad
<b>600741</b>	350 kcmil	reel	1,000	58	32	159	1,590	none	quad

**Material Standard**

600 V, Aluminum, Overhead, Triplex And Quad Service Drop Cable

standard number: **6007.50**superseding: June 8, 2011  
effective date: November 18, 2011  
page: 4 of 4**6. Packaging, continued****6.2 Quantity**

Actual quantity per package may vary from the quantity stated on the Purchase Order by plus or minus 10%.

**6.3 Reels**

Reels shall be reusable wood type, Class 1 or 2.

Reels may be new or recycled.

Recycled reels (when provided) shall have the surface of both outside flanges painted over with a solid color.

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**6.4 Cable for Shipping**

Phase conductors shall be dry when shipped.

Phase conductor ends shall be sealed to prevent the entrance of moisture.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

**6.5 Marking**

Each **coil** shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length
- Weight
- Date of manufacture

Each **pallet** loaded with wire coils shall be legibly marked with Seattle City Light's Stock Number.

Each **reel** shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length of cable on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Cable shall be shipped to the address specified on the Purchase Order.

**8. Issuance**

**Stock Unit:** FT

**9. Approved Manufacturers**

Alcan Cable

General Cable, BICC Brand

Nehring Electrical Works Company

Nexans

Phoenix Wire and Cable Corp.

Prysmian

Southwire Company

**10. References**

**ACPC Inc.;** "Data Handbook, Aluminum Conductor, T&D Conductors, Overhead, Underground"; ACPC Inc.; Summer 1994

**Shipek, John;** SCL Standards Engineer, subject matter expert and originator of 6007.50 (john.shipek@seattle.gov)

**600 V, ALUMINUM, UNDERGROUND, 1/C, TYPE XHHW-2 CABLE**



**1. Scope**

This standard covers the requirements for 600 V, aluminum, cross-linked polyethylene (XLPE) insulated, single conductor cable used for the distribution of electric energy.

This material standard applies to the following Seattle City Light stock numbers:

Stock Number	Size, kcmil	Packaging	Type
601018	750	reel	1/C

**2. Application**

Cable is for network secondary applications, nominally rated up to 480 V phase-to-phase, 60 Hz, where increased flexibility and reduced overall diameter are required.

Cable shall be suitable for wet or dry installation in ducts.

Cable is **not** appropriate for direct burial.

**3. Industry Standards**

Cable shall meet the applicable requirements of the following industry standards:

**ASTM B801-1999** - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation.

**NEMA WC-26-2000** - Binational Wire and Cable Packaging Standard

**UL Standard 44** - Underwriters Laboratories Inc. Standard for Safety - Thermoset-Insulated Wires and Cables

**UL Standard 1581** - Underwriters Laboratories Inc. Standard for Safety - Reference Standard for Electrical Wires, Cables, and Flexible Cords

**4. Guidance in Case of Conflict**

Where conflict exists, the following order of precedence shall apply:

1. This Seattle City Light Material Standard
2. UL standards
3. Other industry standards

**5. Construction**

**5.1 General**

Cable shall meet the requirements of UL 44 for type XHHW-2.

Maximum conductor operating temperatures shall be according to UL 44, Section 5, and **Table A**.

**Table A**

Normal Service	Emergency Overload	Short Circuit
90° C	130° C	250° C

**5.2 Conductor**

Conductor shall meet the requirements of UL 44, Sections 6 through 12, with the following clarifications:

- Conductor alloy shall be 8000 series aluminum.
- Conductor stranding shall be compact.
- Conductor shall consist of at least 58 strands (or a lesser number as qualified by UL 44).

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**5.3 Insulation**

Insulation shall meet the requirements of UL 44, Sections 13 through 15, with the following clarifications:

- Insulation shall be cross-linked polyethylene.
- Insulation shall be free stripping from the conductor. This may be accomplished by the manufacturing processes or by the addition of a Mylar separator.

Minimum and nominal insulation thickness values shall meet the requirements of Table B:

**Table B**

Conductor Size, kcmil	Minimum Thickness, mils	Nominal Thickness, mils
750	72	80

Cable outside diameter shall not exceed 1.09 inches.

**5.4 Assembly and Identification**

Cable shall be marked according to the requirements UL 44, Section 60, with the following clarifications:

The outer surface of the cable shall be durably and legibly marked throughout its length, at a maximum interval of 1 meter, with a print legend.

The print legend shall include, but not be limited to, the following information:

- Manufacturer's identification
- Conductor size
- Conductor metal
- Type of insulation
- Rated voltage
- Year of manufacture
- TYPE XHHW-2

**6. Testing**

Cable shall be tested according to the requirements of UL 44.

Test results shall be provided upon request.

**Table C**

Stock Number	Conductor Size, kcmil	Packaging	Length per Reel, ft	Outside Flange Diameter, Maximum, in	Inside Traverse Width, Maximum, in	Weight per 100 ft., approx., lbs	Weight per reel, approx., lbs	Type
601018	750	Reel	3,000	66	28	83	2,490	1/C

**7. Packaging**

**7.1 Detailed Requirements**

Cable shall be packaged according to the requirements of NEMA WC-26 and Table C.

**7.2 Quantity**

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

**7.3 Reels**

Reels shall be reusable wood type, Class 1 or 2.

Reels may be new or recycled.

Recycled reels (when provided) shall be have the surface of both outside flanges painted over with a solid color.

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**7.4 Cable for Shipping**

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

**Seattle City Light**  
**MATERIAL STANDARD**

600 V, Aluminum, Underground, 1/C, Type XHHW-2 Cable

standard number: **6009.0**  
superseding: September 26, 2006  
effective date: February 15, 2013  
page: 3 of 3

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**7.5 Cable for Shipping**

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

**7.6 Marking**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of cable on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's purchase order number
- Seattle City Light's stock number

**8. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Cable shall be shipped to the address specified on the Purchase Order.

**9. Issuance**

FT

**10. Approved Manufacturers**

Alcan  
Nexans  
Phoenix  
Southwire

## 600 V, Copper, Underground, Single-Conductor Cable



### 1. Scope

This standard covers the requirements for 600 V, copper, cross-linked polyethylene (XLPE) insulated, single conductor cable used for the distribution of electric energy.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Size	Packaging	Type
613730	#2 AWG	Reel	1/C
613732	1/0 AWG	Reel	1/C
613733	2/0 AWG	Reel	1/C
613734	3/0 AWG	Reel	1/C
613735	4/0 AWG	Reel	1/C
613736	250 kcmil	Reel	1/C
613737	300 kcmil	Reel	1/C
613738	350 kcmil	Reel	1/C
613740	500 kcmil	Reel	1/C
613743	750 kcmil	Reel	1/C

### 2. Application

Cable is for looped radial or network secondary systems nominally rated up to 480 V phase-to-phase, 60 Hz.

Cable may be installed in single or parallel conductor runs.

Cable is suitable for installation in ducts and direct burial in wet or dry locations.

Smaller AWG sizes are also used to make up secondary leads for overhead transformers (bug legs).

Standards Coordinator  
John Shipek



Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



### 3. Industry Standards

Cable shall meet the applicable requirements of the following industry standards:

**ICEA S-95-658-1999** — Standard for Nonshielded Power Cable Rated 2000 Volts or Less for the Distribution of Electrical Energy

**UL Standard 44** — Underwriters Laboratories Inc. Standard for Safety — Thermoset-Insulated Wires and Cables

**UL Standard 854** — Underwriters Laboratories Inc. Standard for Safety — Service-Entrance Cables

**NEMA WC-26-2000** — Binational Wire and Cable Packaging Standard

### 4. Guidance in Case of Conflict

Where conflict exists, the following order of precedence shall apply:

1. This standard
2. UL standards
3. ICEA standards
4. Other industry standards.

### 5. Construction

#### 5.1 General

Cable shall meet the requirements of UL Standard 44 for type RHH-RHW-2 and UL Standard 854 for type USE-2.

#### 5.2 Conductor

Conductor shall meet the requirements of ICEA S-95-658, Section 2 and Table 2-3, with the following clarifications:

Conductor alloy shall be soft or annealed, uncoated copper.

#### 5.3 Insulation

Insulation shall meet the requirements of ICEA S-95-658, Section 3 and Tables 3-1, 3-4, and 3-7, with the following clarifications:

Insulation shall be cross-linked polyethylene.

Insulation level shall be 100%.

Maximum conductor operating temperatures shall be according to Table A.

**Table A. Operating Temperatures**

Insulation Type	Normal Service	Emergency Overload	Short Circuit
XLPE	90°C	130°C	250°C

Insulation shall comply with Class X-1, X-2, or X-3.

Minimum and nominal insulation thickness values shall meet the requirements of Table B:

**Table B. Insulation Thicknesses**

<b>Conductor Size</b>	<b>Minimum Thickness (mils)</b>	<b>Nominal Thickness (mils)</b>
#2 AWG	54	60
1/0 AWG	72	80
2/0 AWG	72	80
3/0 AWG	72	80
4/0 AWG	72	80
250 kcmil	86	95
300 kcmil	86	95
350 kcmil	86	95
500 kcmil	86	95
750 kcmil	99	110

Insulation shall be free stripping from the conductor. This may be accomplished by the manufacturing processes or by the addition of a Mylar separator.

#### **5.4 Assembly and Identification**

The cable's outer surface shall be black. The outer surface shall be durably and legibly marked with a print legend throughout its length at a maximum interval of 1 meter.

The print legend shall include, but not be limited to, the following information:

- Conductor size
- Conductor metal (if other than copper)
- Rated voltage
- Type USE-2 or RHH or RHW-2
- Manufacturer's identification (see the next paragraph)

Manufacturer's identification may consist of a written out name or UL Certification Number. UL Certification Numbers, appearing in the form E123456, can be deciphered by calling Underwriters Laboratories Inc. at 877-854-3577 or by going to [www.ul.com](http://www.ul.com) and following the path to Certifications.

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## **6. Testing**

Cable shall be tested according to the requirements of UL 44.

Test results shall be provided upon request.

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## **7. Packaging**

### **7.1 Detailed Requirements**

Cable shall be packaged according to the requirements of NEMA WC-26 and Table C.

**Table C. Packaging**

Stock No.	Phase Conductor Size	Packaging	Length per Reel, ±10% (ft)	Outside Flange Diameter, Maximum (in)	Inside Traverse Width, Maximum (in)	Weight per 100 ft., approx., (lb)	Weight per reel, approx., (lb)	Type
613730	#2 AWG	Reel	5,000	36	24	24	1,215	1/C
613732	1/0 AWG	Reel	3,000	32	24	39	1,161	1/C
613733	2/0 AWG	Reel	3,000	36	24	49	1,475	1/C
613734	3/0 AWG	Reel	2,000	32	24	61	1,222	1/C
613735	4/0 AWG	Reel	2,000	36	24	74	1,480	1/C
613736	250 kcmil	Reel	1,000	32	24	88	1,882	1/C
613737	300 kcmil	Reel	1,000	32	24	104	1,040	1/C
613738	350 kcmil	Reel	1,000	40	24	121	1,213	1/C
613740	500 kcmil	Reel	1,000	45	28	170	1,702	1/C
613743	750 kcmil	Reel	1,000	45	28	254	2,536	1/C

**7.2 Quantity**

Actual quantity per reel may vary from the standard package quantity stated on the purchase order by plus or minus 10%.

**7.3 Reels**

Reels shall be reusable wood type, Class 1 or 2.

Reels may be new or recycled.

Recycled reels (when provided) shall have the surface of both outside flanges painted over with a solid color.

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**7.4 Marking**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of cable on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's purchase order number
- Seattle City Light's stock number

## 8. Shipping

### 8.1 Cable

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

### 8.2 Reels

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Cable shall be shipped to the address specified on the purchase order.

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## 9. Issuance

FT

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## 10. Approved Manufacturers

Digital Cable

Encore Wire

General Cable, BICC Brand

Nehring Electrical Works Company

Nexans

Phoenix Wire and Cable Corp.

Prysmian

Service Wire Company

Southwire Company

# MATERIAL STANDARD

## 600 V, ALUMINUM, UNDERGROUND 1/C, TRIPLEX AND QUAD SECONDARY CABLE



### 1. Scope

This standard covers the requirements for 600 V, aluminum, cross-linked polyethylene (XLPE) insulated, single and multiplex cable used for the distribution of electric energy.

This standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Size	Pack-aging	Code Word(s)	Type
601011	4/0 AWG	reel	Beloit-XLP-AA8000, except triple rated USE-2 RHH RHW-2	1/C
601014	350 kcmil	reel	Rutgers-XLP-AA8000, except triple rated USE-2 RHH RHW-2	1/C
601015	500 kcmil	reel	Emory-XLP-AA8000, except triple rated USE-2 RHH RHW-2	1/C
601016	750 kcmil	reel	Sewanee-XLP-AA8000, except triple rated USE-2 RHH RHW-2	1/C
605040	4/0 AWG	reel	Sweetbriar-XLP-YES-USE-2	triplex
			Regis-XLP-USE-2	triplex
605076	350 kcmil	reel	Wesleyan-XLP-YES-USE-2	triplex
			Concordia-XLP-USE-2	triplex
605084	500 kcmil	reel	Rider-XLP-YES-USE-2	triplex
			Brooklyn-XLP-USE-2	triplex
605142	4/0 AWG	reel	Wake Forest-XLP-YES-USE-2	quad
			Lander-XLP-USE-2	quad
605176	350 kcmil	reel	Slippery Rock-XLP-YES-USE-2	quad
			Susquehanna-XLP-USE-2	quad
605186	500 kcmil	reel	Page-XLP-YES-USE-2	quad
			Valparaiso-XLP-USE-2	quad
			Wofford-XLP-USE-2	quad

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

600 V, Aluminum, Underground, 1/C, Triplex and Quad  
Secondary Cable

standard number: **6010.10**

superseding: May 30, 2012

effective date: February 15, 2013

page: 2 of 5

**1. Scope, continued**

Aluminum Association code words are cited in this standard for the convenience of the reader. Cable assemblies identified by code word shall be consistent with the requirements of Aluminum Association Tables A, F1, F2, H1, and H2 as appropriate. For brevity, the suffix -YES also represents -YS and -EYS. Single conductor cable shall be triple rated USE-2 RHH RHW-2. Code words define:

- Type of construction
- Conductor alloy and temper
- Thickness of phase conductor insulation
- Type of phase conductor insulation
- Neutral construction
- Neutral identification

**2. Application**

Single conductor cable is for network secondary applications nominally rated up to 480 V phase-to-phase, 60 Hz.

Multiplex cable is for URD secondary applications consisting of single-phase, 3-wire, and three-phase, 4-wire systems nominally rated up to 480 V phase-to-phases, 60 Hz.

Cable shall be suitable for installation in ducts and direct burial in wet or dry locations.

**3. Industry Standards**

Cable shall meet the applicable requirements of the following industry standards:

**ICEA S-105-692-2011** - Standard for 600 Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables

**Aluminum Association Code Words for Underground Distribution (UD) Cables**, Third Edition (January 1999)

**UL Standard 44** - Underwriters Laboratories Inc. Standard for Safety - Thermoset-Insulated Wires and Cables

**UL Standard 854** - Underwriters Laboratories Inc. Standard for Safety - Service-Entrance Cables

**NEMA WC-26-2008** - Binational Wire and Cable Packaging Standard

**4. Conflict**

Where conflict exists, the following order of precedence shall apply:

1. This Seattle City Light Material Standard
2. UL standards
3. ICEA standards
4. Aluminum Association
5. Other industry standards

**5. Construction****5.1 General**

Single conductor cable shall meet the requirements of UL Standard 44 for type RHH-RHW-2 and UL Standard 854 for type USE-2.

Multiplex cable shall meet the requirements of UL Standard 854 for type USE-2.

Cable shall meet the requirements of ICEA S-105-692, Part 1. Maximum conductor operating temperatures shall be according to Table A.

**Table A**

Insulation Type	Normal Service	Emergency Overload	Short Circuit
XLPE	90° C	130° C	250° C

**5.2 Conductors - Phase**

Phase conductors shall meet the requirements of ICEA S-105-692, Part 2, with the following clarifications:

- Single conductor cable phase conductor alloy shall be 8000 series aluminum.
- Multiplex cable phase conductor alloy shall be either 1350-H19 or 8000 series aluminum.

**5.3 Conductors - Neutral**

Neutral conductors shall meet the requirements of ICEA S-105-692, Part 2, with the following clarifications:

- Neutral conductors shall be of the same basic construction as the phase conductors, except they shall be reduced according to Table B.

**MATERIAL STANDARD**

600 V, Aluminum, Underground, 1/C, Triplex and Quad Secondary Cable

standard number: **6010.10**  
 superseding: May 30, 2012  
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**5. Construction, continued****5.3 Conductors – Neutral, continued****Table B**

Phase Conductor Size	Neutral Conductor Size (Reduced)
4/0 AWG	2/0 AWG
350 kcmil	4/0 AWG
500 kcmil	350 kcmil

**5.4 Insulation**

Insulation shall meet the requirements of ICEA S-105-692, Part 3, with the following clarifications:

- Insulation shall be cross-linked polyethylene.
- Minimum and nominal insulation thickness values shall meet the requirements of Table C:

**Table C**

Conductor Size	Minimum Thickness, mils	Nominal Thickness, mils
2/0 AWG	72	80
4/0 AWG	72	80
350 kcmil	86	95
500 kcmil	86	95
750 kcmil	99	110

Insulation shall be free stripping from the conductor. This may be accomplished by the manufacturing processes or by the addition of a Mylar separator.

**5.5 Assembly and Identification**

Multiplex cable assembly shall be twisted according to the requirements of ICEA S-105-692, Section 4.1.

Cable shall be marked according to the requirements of ICEA S-105-692, Sections 4.2.1 and 4.2.2, with the following clarification: the outer surface of one or more of the phase conductors shall be durably and legibly marked throughout its length, at a maximum interval of 1 meter, with a print legend.

The print legend shall include, but not be limited to, the following information:

- Manufacturer's identification
- Conductor size
- Conductor metal
- Type of insulation
- Rated voltage
- Year of manufacture
- **TYPE USE-2 OR RHH OR RHW-2** (single conductor cables)
- **TYPE USE-2** (multiplex cables)

Each phase conductor of a quadruplex cable assembly shall be identifiable.

Single conductor cable and triplex cable assemblies do not require phase conductor identification.

Phase conductor jacket shall be black.

Neutral identification shall be accomplished by one of the following means:

- A solid black jacket with one, two, or three yellow painted or extruded stripes
- A solid black jacket with one, two, or three white painted or extruded stripes
- A solid yellow jacket
- A solid light gray jacket

**6. Testing**

Cable shall be tested according to the requirements of UL 44.

Test results shall be provided upon request.

**MATERIAL STANDARD**

600 V, Aluminum, Underground, 1/C, Triplex and Quad Secondary Cable

standard number: **6010.10**  
 superseding: May 30, 2012  
 effective date: February 15, 2013  
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**7. Packaging****7.1 Detailed Requirements**

Cable shall be packaged according to the requirements of NEMA WC-26 and Table D.

Stock Number	Phase Conductor Size	Packaging	Length per Reel ± 10%, ft	Outside Flange Diameter, Maximum, in	Inside Traverse Width, Maximum, in	Weight per 100 ft Approx., lbs	Weight per Reel, Approx., lbs	Type
601011	4/0 AWG	reel	2,000	36	24	26	520	1/C
601014	350 kcmil	reel	1,500	40	24	42	630	1/C
601015	500 kcmil	reel	1,000	45	28	59	590	1/C
601016	750 kcmil	reel	3,000	66	28	86	2,580	1/C
605040	4/0 AWG	reel	1,000	45	28	73	730	triplex
605076	350 kcmil	reel	1,000	66	28	116	1,160	triplex
605084	500 kcmil	reel	1,000	66	28	170	1,700	triplex
605142	4/0 AWG	reel	1,000	58	32	102	1,020	quad
605176	350 kcmil	reel	1,000	66	28	164	1,640	quad
605186	500 kcmil	reel	1,000	66	28	240	2,400	quad

**7.2 Quantity**

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

**7.3 Reels**

Reels shall be reusable wood type, Class 1 or 2.

Reels may be new or recycled.

Recycled reels (when provided) shall have the surface of both outside flanges painted over with a solid color.

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**7.4 Cable for Shipping**

Phase and neutral conductors shall be dry when shipped.

Phase and neutral conductor ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples or securely fastened to the inner side of a flange with appropriately sized steel staples.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange.

**7.5 Marking**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description, including code word
- Shipping length of cable on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

## MATERIAL STANDARD

600 V, Aluminum, Underground, 1/C, Triplex and Quad Secondary Cable

standard number: **6010.10**  
superseding: May 30, 2012  
effective date: February 15, 2013  
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### 8. Shipping

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palletted.

Cable shall be shipped to the address specified on the Purchase Order.

### 9. Issuance

FT

### 10. Approved Manufacturers

Alcan Cable

General Cable, BICC Brand

Nexans

Phoenix Wire and Cable Corp.

Prysmian

Southwire Company

### 11. References

**Shipek, John**; Standards Engineer; originator and subject matter expert for 6010.10  
([john.shipek@seattle.gov](mailto:john.shipek@seattle.gov))

**SCL 6010.1** (renumbered to 6010.10); Aluminum, Underground, 1/C, Triplex and Quad Secondary Cable"; Material Standard

# MATERIAL STANDARD

## 5 kV, 1/C, TRXLPE INSULATED, TAPE SHIELDED CABLE



### 1. Scope

This standard covers the detailed requirements for 5 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable used for the distribution of electric energy.

Industry designation: **1/C**

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock Number	613212	613222
Size	#6 AWG	350 kcmil

### 2. Application

Cable is intended for use on a nominal 4.3 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz, power system.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standard:

**ICEA S-97-682-2013**; "Utility Shielded Power Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

standards coordinator	standards supervisor	unit director
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**MATERIAL STANDARD**

5 kV, 1/C, TRXLPE Insulated, Tape Shielded Cable

standard number: **6010.20**superseding: August 30, 2011  
effective date: October 30, 2015  
page: 2 of 5**5. Construction, continued****5.2 Conductor**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Diameter</b>	minimum	0.174 in	0.648 in	ICEA S-97-682, Section 2.5
	nominal	0.178 in	0.661 in	ASTM B8
	maximum	0.182 in	0.674 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		copper		ASTM B49
<b>Stranding type</b>		concentric-lay		ASTM B8
<b>Class</b>		B		ASTM B8
<b>Stranding subtype</b>		compressed		ASTM B8
<b>Number of strands</b>		7	37	ASTM B8
<b>Temper</b>		soft drawn, annealed prior to stranding		ASTM B3
<b>Lay, outer layer</b>		left hand		ASTM B3, Section 5.5.1
<b>Lay, successive layers</b>		reversed		ASTM B3, Section 5.5.1
<b>Sealant for stranded conductors</b>		not required		ICEA S-97-682, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Thickness, minimum point</b>		12 mil	16 mil	ICEA S-97-682, Part 3, Table 3.1

**5.4 Insulation**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Material</b>		unfilled tree retardant cross-linked polyethylene (TRXLPE)		ICEA S-97-682, Section 4.1
<b>Approved material formulations</b>		specified in general material standard		SCL 6015.00
<b>Thickness</b>	minimum point	85 mil		ICEA S-97-682, Section 4.2, Table 4-11
	nominal	90 mil		ICEA S-97-682, Table 8-1
	maximum point	120 mil		ICEA S-97-682, Section 4.2, Table 4-11
<b>Insulation level</b>		100%		ICEA S-97-682, Section 4.2, Table 4-11
<b>Basic impulse level (BIL)</b>		60 kV crest		ICEA S-97-682, Section 4.3, Table 4-10

**MATERIAL STANDARD**

5 kV, 1/C, TRXLPE Insulated, Tape Shielded Cable

standard number: **6010.20**

superseding: August 30, 2011

effective date: October 30, 2015

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**5. Construction, continued****5.5 Extruded Insulation Shield**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Material</b>		discharge-free (thermosetting material)		ICEA S-97-682, Section 5.1 to 5.5.1.5
<b>Thickness</b>	minimum point	24 mil		ICEA S-97-682, Section 5.2, Table 5-1
	maximum point	60 mil		ICEA S-97-682, Section 5.2, Table 5-1

**5.6 Metallic Shield**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Metal</b>		copper, uncoated		ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>		helically applied tape ▲		ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>		not required		ICEA S-97-682, Section 6.7

**5.7 Jacket**

		Requirements		Reference
<b>Stock Number</b>		<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>		#6 AWG	350 kcmil	various
<b>Material</b>		linear low density polyethylene (LLDPE)		ICEA S-97-682, Section 7.1.1
<b>Color</b>		black		ICEA S-97-682, Section 7.1.1
<b>Type</b>		overlying		ICEA S-97-682, Section 7.2.1
<b>Thickness</b>	minimum point	55 mil	70 mil	ICEA S-97-682, Section 7.2.1, Table 7-10
	maximum point	90 mil	105 mil	ICEA S-97-682, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>		0.67 in ▲	1.20 in ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**MATERIAL STANDARD**

5 kV, 1/C, TRXLPE Insulated, Tape Shielded Cable

standard number: **6010.20**superseding: August 30, 2011  
effective date: October 30, 2015  
page: 4 of 5**5. Construction, continued****5.9 Assembly and Identification**

	Requirements		Reference
<b>Stock Number</b>	<b>613212</b>	<b>613222</b>	SCL
<b>Size</b>	#6 AWG	350 kcmil	various
<b>Red stripe identification</b>	required ▲		ICEA S-97-682, Section 8.2.1.1

**6. Packaging**

	Requirements		Reference	
<b>Stock Number</b>	<b>613212</b>	<b>613222</b>	SCL	
<b>Size</b>	#6 AWG	350 kcmil	various	
<b>Reel type</b>	steel, fluted		WC 26, Section 2.1.2	
<b>Reel dimension</b>	flange diameter, maximum	78 in ▲	96 in ▲	SCL preference
	outside width, maximum	45 in ▲	54 in ▲	SCL preference
	drum diameter, minimum	28 in ▲	29 in ▲	SCL preference
	length per reel ± 10%	2,000 ft ▲		SCL preference
	gross weight, maximum	17,000 lb ▲		SCL preference

**7. Issuance**

	Requirements	
<b>Stock Number</b>	<b>613212</b>	<b>613222</b>
<b>Size</b>	#6 AWG	350 kcmil
<b>Stock unit</b>	FT	

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

## **MATERIAL STANDARD**

5 kV, 1/C, TRXLPE Insulated, Tape Shielded Cable

standard number: **6010.20**

superseding: August 30, 2011

effective date: October 30, 2015

page: 5 of 5

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### **9. References**

**SCL Material Standard 6015.00**, "Medium Voltage Cable – General"

### **10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6010.20  
(john.shipek@seattle.gov)

## Medium Voltage Cable - General



### 1. Scope

This standard covers the general requirements for medium voltage (5–46 kV) cable, single- and three-conductor.

Specific requirements shall be according to the detailed material standard and purchase order issued subsequent to competitive solicitations.

### 2. Application

Cable is intended for use on the following three-phase, 60 Hz, systems:

- **13.8 kV**, 3-wire, delta
- **26.4 kV**, 4-wire, solidly-grounded, wye-connected

### 3. Industry Standards

Cable shall meet the applicable requirements of the following industry standards as referenced in this and the detailed material standard:

**ANSI/ICEA S-97-682-2013** – Standard for Utility Shielded Power Cables  
Rated 5 through 46 kV.

**ASTM B231-04** – Standard Specification for Concentric-Lay-Stranded Aluminum  
1350 Conductors

**ASTM B233-03** – Standard Specification for Aluminum 1350 Drawing Stock for  
Electrical Purposes

**ASTM B3-01** – Standard Specification for Soft or Annealed Copper Wire

Standards Coordinator  
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Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

- ASTM B400-04** – Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors
- ASTM B49-04** – Standard Specification for Copper Redraw Rod for Electrical Purposes
- ASTM B496-04** – Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
- ASTM B609-04** – Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
- ASTM B8-04** – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ICEA S-93-639-2000 (NEMA WC 74-2000)** – 5-46 kV Shielded Power Cable for Use in the Transmission & Distribution of Electric Energy (utilized only for its section on metallic and associated coverings)
- ANSI/ICEA S-94-649-2013** – Standard for Concentric Neutral Cables Rated 5,000-46,000 Volts
- NEMA WC 26-2008 (EEMAC 201-2008)** – Binational Wire and Cable Packaging Standard
- 

#### 4. Conflict

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light (SCL) purchase order
  2. SCL General Terms and Conditions
  3. SCL detailed material standard
  4. This standard
  5. ANSI/ICEA publications
  6. ICEA publications
  7. ASTM publications
  8. Other industry standards
- 

#### 5. Purchase Order Information

Purchase order will state the following minimum information:

- Cable description
  - SCL general material standard number including revision date
  - SCL detailed material standard number including revision date
  - SCL stock number
  - Total order quantity
  - Price
  - Delivery date
  - Quantity per reel
- 

#### 6. Construction and Ratings

##### 6.1 General

Cable shall be suitable for aerial installations, direct burial, underground ducts, conduit risers, and wet or dry locations.

The manufacturer shall be responsible for ensuring the compatibility of all components used to assemble the cable.

Cable shall be manufactured in a continuous triple-extrusion process. The conductor shield, insulation, and insulation shield layers shall be extruded over the core conductor in one continuous pass using true triple or triple tandem extruders.

Cable shall be capable of being safely handled and installed if not subjected to temperatures lower than minus 10° C in the preceding twenty four hours.

In-plant repairs of the cable core are prohibited unless specifically agreed to by the purchaser.

Failure to meet any of the requirements of this and referenced standards shall be cause for rejection.

Cable shall be designed and constructed to operate at conductor temperatures not exceeding those shown in Table 6.

**Table 6. Insulation Material and Conductor Temperature Limits**

Insulation Material	Normal Operation	Emergency Overload	Short Circuit
TRXLPE	90° C	130° C	250° C
EPR/EAM Class III	105° C	140° C	250° C

## 6.2 Conductor

If the detailed material standard requires sealant for stranded conductors the following clarifications apply: The requirements of ANSI/ICEA S-97-682, Section 2.2 or ANSI/ICEA S-94-649, Section 2.2 shall apply as appropriate.

## 6.3 Conductor Shield

ANSI/ICEA S-97-682, Part 3 shall apply to cable with a tape metallic shield.

ANSI/ICEA S-94-649, Part 3 shall apply to cable with a flat strap metallic shield or concentric neutral.

## 6.4 Insulation

Cable insulation material that may be specified in the detailed material standard includes:

- Tree retardant crosslinked polyethylene (TRXLPE)
- Ethylene propylene rubber (EPR) or ethylene alkene copolymer (EAM)

If **TRXLPE** is specified the following clarifications shall apply:

- Approved material formulations (no exceptions) include:
  - Dow HFDB-4202 NT EC
  - Dow HFDC-4202 EC
  - Borealis LE4212.
- Cable shall be dry cured. Steam curing is expressly prohibited.

If **EPR/EAM** is specified, the following clarifications shall apply:

- Material shall be Class III thermosetting type (for discharge-free designs).
- Cable may be steam cured or dry cured.

## 6.5 Extruded Insulation Shield

Extruded insulation shield shall be conspicuously marked "semiconducting."

## 6.6 Concentric Neutral Conductor and Metallic Shielding

ANSI/ICEA S-97-682 shall apply to cable with a tape metallic shield with the following clarifications:

- If single tape design, tape shall be helically applied and be uncoated copper at least 4.5 mils thick. Tape shall be overlapped at least 25%.
- If two tape design, tapes shall be overlapped, helically applied and intercalated. Individual tape shall be uncoated copper at least 3.0 mils thick. Tape shall be overlapped at least 25%.

ANSI/ICEA S-94-649 shall apply to cable with a flat strap metallic shield or a concentric neutral with the following clarifications - if the detailed material standard requires flat strap construction:

- Flat strap thickness shall be 19 mil +7, -0 mil
- Flat strap width shall be 175 mil +10, -35 mil

Suppliers please take note - in some cases, an SCL material standard will make reference to ANSI/ICEA S-94-649 (written for concentric neutral cable) even though the cable being manufactured is metallic shield type.

Refer to detailed material standard to determine if cable is metallic shield or concentric neutral type.

Suppliers should correctly apply the terms “metallic shield” or “concentric neutral” in all correspondence, bids, invoices, packing slips, and certified test reports to minimize confusion.

If the detailed material standard requires the option of water blocking components for the metallic shield or concentric neutral the following clarifications apply:

- The requirements of ANSI/ICEA S-97-682, Section 6.7 or ANSI/ICEA S-94-649, Section 6.6 shall apply as appropriate.
- The water blocking type shall be water swellable powder.

## 6.7 Jacket (Non-Metallic Covering)

If a jacket is required, the detailed material standard will identify it as one of the following types:

- Extruded-to-fill (encapsulated), or
- Overlaying (sleeved).

Cable jacket shall be free stripping.

## 6.8 Sheath (Continuous Metallic Covering)

Sheath, if required, shall not contain lead.

## 6.9 Assembly and Identification

Cable jacket (or extruded insulation shield, as appropriate) shall be manufactured with sequential length marking according to the requirements of ANSI/ICEA S-97-682, Section 8.2.4 or ANSI/ICEA S-94-649, Section 8.2.4 as appropriate, with the following clarification: Sequential length marking numbers shall be non-repeating and extend the entire core extruder run.

If the detailed material standard requires the option of red stripe (three stripes) identification, the following clarifications apply: The requirements of ANSI/ICEA S-97-682, Section 8.2.1.1 or ANSI/ICEA S-94-649, Section 8.2.1.1 shall apply as appropriate.

For 3/C and 3-1/C type cable, at least two of the three conductors shall be uniquely identifiable throughout their length.

For 3/C cable, fillers shall be applied to the interstices of the cable to attain a substantially circular cross section.

For 3/C cable, filler material shall be jute or polypropylene rove. Alternate filler materials may be considered.

---

## 7. Packaging

Reels shall be returnable, fluted type steel.

Reels and their corresponding capacities shall be according to the requirements of NEMA WC 26.

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be securely fastened to the reel drum or inner flange surface. This method of securement shall be designed and constructed to withstand long-term, outside storage.

The inner end of the cable shall not extend beyond the outside plane of the reel flange.

The outer end shall be securely fastened to the inner side of the flange.

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of cable on reel
- Outer and inner end sequence length marking numbers
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- SCL purchase order number
- SCL stock number.

Reels shall be protected for shipment according to WC 26, Section 4, and Table 7 of this standard.

**Table 7. Reel Covering**

<b>Plant Location</b>	<b>WC 26 Reel Covering</b>
US	Level 2 (Weather Protector)
Canada	
Mexico	
All other	Level 5 (Export)

## 8. Testing and Test Methods

Testing and test methods shall be performed according to the requirements ANSI/ICEA S-97-682, Part 9 or ANSI/ICEA S-94-649, Part 9 as appropriate.

Cable shall not be tested with high voltage DC.

## 9. Terminology

This section defines certain terms unique to SCL for the purpose of reducing confusion between customer and supplier.

**Table 9. Definition of Terms**

Term	Definition
<b>Two-conductor cable</b>	A single-conductor cable with a full concentric neutral, abbreviated 2/C. Common industry convention abbreviates this cable type as 1/C+1N.
<b>CR</b>	Any compressed (-3%) class B concentric round conductor as defined by ASTM B8, Section 6.3.
<b>CCR</b>	Stands for compact concentric round. Any compact (-9%) concentric round conductor as defined by ASTM B496 for copper or ASTM B400 for aluminum.
<b>CS</b>	Stands for compact sector, a very rare 3/C cable that is outside the scope of this material standard.

## 10. Documentation

### 10.1 General

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

### 10.2 Bidder's Data

Bidder shall identify all exceptions to SCL requirements with reference to the requirement to which exception is taken; indicate if no exceptions taken.

### 10.3 Certified (Production) Test Reports

For each shipment a certified production test report (CTR) shall be emailed to: [standards.scl@seattle.gov](mailto:standards.scl@seattle.gov)

Certified production test report shall include:

- A unique certified test report number
- SCL purchase order number
- Manufacturer's name
- Manufacturing plant location
- Basic cable description
- Manufacturer's order number
- Shipping reel information or serial numbers and shipment footage
- Conductor metal, stranding type, class, stranding subtype, number of strands, temper, and lay
- Conductor shield manufacturer and compound number
- Insulation compound and manufacturer
- Extruded insulation shield manufacturer and compound number
- Metallic insulation shield dimensional information
- Nominal dimensions and number of flat straps, if specified
- Filler material description and properties, if specified

- Jacket compound and manufacturer
- Bedding material description and properties, if specified
- Armor and band serving details, if specified
- Red stripe compound and manufacturer, if specified
- Results of the testing required under Section 8 of this material standard
- Cable core extruder line identification
- Jacket extruder line identification
- List of shipping reels in the sequential order in which they came off the core extruder
- The sequential order of the shipping reels in which they came off the jacket extruder
- Outside (top) and inside (bottom) jacket sequential footage numbers for each shipping reel.

Certified production test reports shall not contain information for more than one cable order or more than one stock number at a time.

Supplier shall provide certified production test report according to Table 12 of this material standard.

#### **10.4 Certified Qualification Test Reports**

Cable shall meet the qualification test requirements of ANSI/ICEA S-97-682, Part 10 or ANSI/ICEA S-94-649, Part 10 as appropriate.

Upon request, supplier shall provide copies of ICEA certified qualification test reports.

#### **10.5 Plant QA Processes**

Upon request, supplier shall provide information describing their plant's quality assurance processes.

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### **11. Cable Samples**

For each shipment, manufacturer shall provide cable samples for SCL to evaluate for compliance according to Tables 11 and 12 of this material standard.

Cable samples shall be taken from the top of each shipping reel.

Each cable sample shall include at least one complete identification string and at least one sequential length marking number.

For each shipment, cable samples shall be express mailed to:

Seattle City Light  
3613 – 4th Avenue South  
Seattle, WA 98134  
Attention: Quality Assurance

Each cable sample shall be marked at one end with the following information:

- Manufacturer's name
- Shipping reel number
- Reel length
- CTR number
- SCL purchase order number
- SCL stock number

**Table 11. Sample Requirements by Cable Type**

Cable Type	Sample Requirements
1/C	One 2-ft sample per shipping reel
1/C + 1 N	One 2-ft sample per shipping reel
3/C	One 2-ft sample per shipping reel
3/C + 3 N	One 2-ft sample per shipping reel
3-1/C	One 2-ft sample per phase per shipping reel
3-1/C + 2 N	One 2-ft sample per phase per shipping reel

**12. Product Evaluation**

SCL Quality Assurance and Standards will evaluate the certified production test report and cable samples for compliance.

Following the internal evaluation, SCL Material Control will inform the supplier if cable shipment is in compliance, or not.

SCL Material Control will release reels for shipment and receive cable according to Table 12.

**Table 12. Cable Release Process**

	Plant Location	
	US and Canada	All Other
<b>Certified Test Reports (CTR)</b>	Email as soon as available.	Email as soon as available.
<b>Cable Samples</b>	Express mail as soon as available. Cable samples may be shipped with the reels, if the address is the same as in Section 11.	Express mail as soon as available.
<b>Release Reels for Shipment</b>	As soon as available	Following verification of compliance by SCL
<b>Receive Cable</b>	Following verification of compliance by SCL	Following matching of reels with CTR and check for visible shipping damage

**13. Plant Inspections**

Upon request, supplier shall provide sufficient notice for SCL or an SCL representative to inspect the cable during any stage of manufacture or testing.

**14. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift. Reels shall not be strapped or palletted.

**15. Approved Manufacturers**

Approved manufacturers and plant locations are identified in the detailed material standard.

## 16. Sources

**ANSI/ICEA P-45-482-2007**; “Short Circuit Performance of Metallic Shields and Sheaths on Insulated Cables”; Insulated Cable Engineers Association, Inc.; 2007

**General Cable, MTC Report No. 09-111-Q**; Revision 2 Core Qualification Report on 5–46 kV Rated Power Cable, LS-571-E/EI-4000-LF/LS-766-B, May 9, 2011

**Oki, Todd**; SCL Quality Inspector and subject matter expert for 6015.00  
(todd.oki@seattle.gov)

**SCL Design Standard 9660.04**, “Properties of Medium Voltage Cables”

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6015.00  
(john.shipek@seattle.gov)

**Wang, Quan**; SCL Standards Engineer and subject matter expert for 6015.00  
(quan.wang@seattle.gov)

**15 kV, 3/C, TRXLPE INSULATED, TAPE SHIELDED CABLE****1. Scope**

This standard covers the detailed requirements for 15 kV, tree retardant, cross-linked polyethylene (TRXLPE), three conductor cable used for the distribution of electric energy.

Industry designation: **3/C**

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock Number	613523	613526	613530
Size	#1 AWG	3/0 AWG	350 kcmil

**2. Application**

Cable is intended for use on a nominal 13.8 kV, three-phase, three-wire, delta, 60 Hz, power system.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

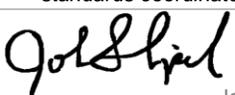
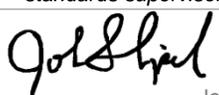
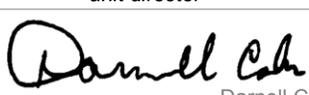
Cable shall meet the requirements of the following industry standards:

**ICEA S-97-682-2013**; "Utility Shielded Power Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction****5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

5. Construction, continued

5.2 Conductor

		Requirements			Reference
<b>Stock Number</b>		<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>		#1 AWG	3/0 AWG	350 kcmil	various
<b>Diameter</b>	minimum	0.316 in	0.447 in		ICEA S-97-682, Part 2
	nominal	0.322 in	0.456 in		ASTM B8
	maximum	0.328 in	0.465 in		ICEA S-97-682, Part 2
<b>Metal</b>		copper			ASTM B49
<b>Stranding type</b>		concentric-lay			ASTM B8
<b>Class</b>		B			ASTM B8
<b>Stranding subtype</b>		compressed			ASTM B8
<b>Number of strands</b>		19			ASTM B8
<b>Temper</b>		soft drawn, annealed prior to stranding			ASTM B3
<b>Lay, outer layer</b>		left hand			ASTM B3, Section 5.5.1
<b>Lay, successive layers</b>		reversed			ASTM B3, Section 5.5.1
<b>Sealant for stranded conductors</b>		required ▲			ICEA S-97-682, Part 2
<b>Diameter</b>	minimum			0.604 in	ICEA S-97-682, Part 2
	nominal			0.616 in	ASTM B496
	maximum			0.628 in	ICEA S-97-682, Part 2
<b>Metal</b>				copper	ASTM B49
<b>Stranding type</b>				concentric-lay	ASTM B496
<b>Class</b>				none	none
<b>Stranding subtype</b>				compact	ASTM B496
<b>Number of strands</b>				35-37	ASTM B496, Table 1
<b>Temper</b>				soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>				left hand	ASTM B496, Section 5
<b>Lay, successive layers</b>				reversed	ASTM B496, Section 5
<b>Sealant for stranded conductors</b>				required ▲	ICEA S-97-682, Part 2

**MATERIAL STANDARD**

15 kV, 3/C, TRXLPE Insulated, Tape Shielded Cable

standard number: **6020.01**page: 3 of 5  
superseding: August 30, 2011  
effective date: October 30, 2015**5. Construction, continued****5.3 Conductor Shield (Stress Control Layer)**

	Requirements			Reference
<b>Stock Number</b>	<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>	#1 AWG	3/0 AWG	350 kcmil	various
<b>Thickness, minimum point</b>	12 mil	12 mil	16 mil	ICEA S-97-682, Part 3, Table 3-1

**5.4 Insulation**

	Requirements			Reference
<b>Stock Number</b>	<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>	#1 AWG	3/0 AWG	350 kcmil	various
<b>Material</b>	unfilled tree retardant cross-linked polyethylene (TRXLPE)			ICEA S-97-682, Part 4
<b>Approved material formulations</b>	specified in general material standard			SCL 6015.00
<b>Thickness</b>	minimum point	165 mil		ICEA S-97-682, Part 4, Table 4-7
	nominal	175 mil		ICEA S-97-682, Part 8, Table 8-1
	maximum point	205 mil		ICEA S-97-682, Part 4, Table 4-7
<b>Insulation level</b>	100%			ICEA S-97-682, Part 4, Table 4-7
<b>Basic impulse level (BIL)</b>	110 kV crest			ICEA S-97-682, Part 4, Table 4-6

**5.5 Extruded Insulation Shield**

	Requirements			Reference
<b>Stock Number</b>	<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>	#1 AWG	3/0 AWG	350 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)			ICEA S-97-682, Part 5
<b>Thickness</b>	minimum point	24 mil		ICEA S-97-682, Part 5, Table 5-1
	maximum point	60 mil		ICEA S-97-682, Part 5, Table 5-1

**5.6 Metallic Shield**

	Requirements			Reference
<b>Stock Number</b>	<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>	#1 AWG	3/0 AWG	350 kcmil	various
<b>Metal</b>	copper, uncoated			ICEA S-97-682, Part 6
<b>Type</b>	helically applied tape ▲			ICEA S-97-682, Part 6 and SCL 6015.00
<b>Water blocking components for metallic shield</b>	not required			ICEA S-97-682, Part 6

**5. Construction, continued**

**5.7 Jacket (Non-Metallic Covering)**

Jacket shall be applied over three conductor assembly.

		Requirements			Reference
<b>Stock Number</b>		<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>		#1 AWG	3/0 AWG	350 kcmil	various
<b>Material</b>		linear low density polyethylene (LLDPE)			ICEA S-97-682, Part 7
<b>Color</b>		black			ICEA S-97-682, Part 7
<b>Type</b>		overlying			ICEA S-97-682, Part 7
<b>Thickness</b>	minimum point	100 mil ▲			ICEA S-97-682, Part 7, Table 7-10
	maximum point	150 mil ▲			ICEA S-97-682, Part 7, Table 7-10
<b>Maximum diameter over jacket</b>		2.25 in ▲	2.45 in ▲	2.85 in ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

		Requirements			Reference
<b>Stock Number</b>		<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>		#1 AWG	3/0 AWG	350 kcmil	various
<b>Red stripe identification</b>		not required			ICEA S-97-682, Part 8

**6. Packaging**

		Requirements			Reference
<b>Stock Number</b>		<b>613523</b>	<b>613526</b>	<b>613530</b>	SCL
<b>Size</b>		#1 AWG	3/0 AWG	350 kcmil	various
<b>Reel type</b>		steel, fluted			WC 26, Section 2
<b>Reel dimension</b>	flange diameter, maximum	96 in ▲			SCL preference
	outside width, maximum	56 in ▲	56 in ▲	60 in ▲	SCL preference
	drum diameter, minimum	32 in ▲	36 in ▲	40 in ▲	SCL preference
	length per reel ± 10%	3,000 ft ▲	2,500 ft ▲	-	SCL preference
	length per reel ± 15%	-	-	2,200 ft ▲	SCL preference
	gross weight, maximum	17,000 lb ▲			SCL preference

**7. Issuance**

Stock Number	Requirements		
	613523	613526	613530
Size	#1 AWG	3/0 AWG	350 kcmil
Stock unit	FT		

**8. Approved Manufacturing Plants**

Manufacturer	Location
General Cable	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
Prysmian	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
Southwire	Carrollton, GA
	Heflin, AL
	Starkville, MS

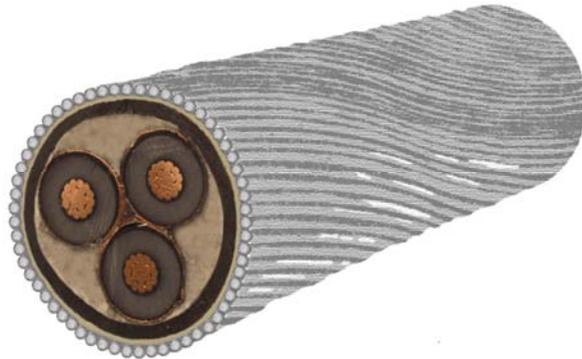
**9. References**

SCL Material Standard 6015.00, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6020.01  
 (john.shipek@seattle.gov)

**15 KV, 3/C, ARMORED, TRXLPE INSULATED, TAPE SHIELDED CABLE**



**1. Foreword**

**1.1 Scope**

This material standard covers the detailed requirements for 15 kV, armored, tree retardant, cross-linked polyethylene (TRXLPE), three conductor cable used for the distribution of electric energy.

Industry designation: **3/C**

This material standard applies to the following Seattle City Light Stock Numbers:

Stock Number	613522	613521
Size	#1 AWG	3/0 AWG

**1.2 Application**

Cable is intended for use on a nominal 13.8 kV, three-phase, three-wire, delta, 60 Hz, power system.

ICEA standards refer to this type of cable as “vertical riser cable”. It is intended for installation within high-rise buildings and suspended from one end. The function of the armor is to hold the cable components together while suspended in lengths up to 800 feet long.

This cable is no longer manufactured. Refer to Material Standard 6025.02 for and alternate.

**1.3 General Requirements**

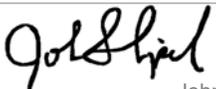
This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6015.00, “Medium Voltage Cable – General.”

**1.4 Industry Standards**

Cable shall meet the requirements of the following industry standards:

- ICEA S-97-682-2006
- ICEA S-93-639-2000 (Utilized only for its section on metallic and associated coverings.)

Refer to Material Standard 6015.00 to obtain the appropriate revision date for other referenced industry standards.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

superseding: January 27, 2010

effective date: August 30, 2011

15 kV, 3/C, Armored, TRXLPE Insulated, Tape Shielded Cable

page: 2 of 5

**2. Construction****2.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6015.00.

**2.2 Conductor**

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Diameter</b>	minimum	0.316 in	0.447 in	ICEA S-97-682, Section 2.5
	nominal	0.322 in	0.456 in	ASTM B8
	maximum	0.328 in	0.465 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		copper		ASTM B49
<b>Stranding type</b>		concentric-lay		ASTM B8
<b>Class</b>		B		ASTM B8
<b>Stranding subtype</b>		compressed		ASTM B8
<b>Number of strands</b>		19		ASTM B8
<b>Temper</b>		soft drawn, annealed prior to stranding		ASTM B3
<b>Lay, outer layer</b>		left hand		ASTM B3, Section 5.5.1
<b>Lay, successive layers</b>		reversed		ASTM B3, Section 5.5.1
<b>Sealant for stranded conductors</b>		option required ▲		ICEA S-97-682, Section 2.2

**2.3 Conductor Shield (Stress Control Layer)**

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Thickness, minimum point</b>		12 mil		ICEA S-97-682, Part 3, Table 3-1

**MATERIAL STANDARD**

15 kV, 3/C, Armored, TRXLPE Insulated, Tape Shielded Cable

standard number: **6020.02**

superseding: January 27, 2010

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**2. Construction, continued****2.4 Insulation**

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Material</b>		unfilled tree retardant crosslinked polyethylene (TRXLPE)		ICEA S-97-682, Section 4.1
<b>Approved material formulations</b>		specified in General Material Standard		SCL 6015.00
<b>Thickness</b>	minimum point	165 mil		ICEA S-97-682, Section 4.2, Table 4-11
	nominal	175 mil		ICEA S-97-682, Table 8-1
	maximum point	205 mil		ICEA S-97-682, Section 4.2, Table 4-11
<b>Insulation level</b>		100%		ICEA S-97-682, Section 4.2, Table 4-11
<b>Basic impulse level (BIL)</b>		110 kV crest		ICEA S-97-682, Section 4.3, Table 4-10

**2.5 Extruded Insulation Shield**

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Material</b>		discharge-free (thermosetting material)		ICEA S-97-682, Section 5.1 to 5.5.1.5
<b>Thickness</b>	minimum point	24 mil		ICEA S-97-682, Section 5.2, Table 5-1
	maximum point	60 mil		ICEA S-97-682, Section 5.2, Table 5-1

**2.6 Metallic Shield**

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Metal</b>		copper, uncoated		ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>		helically applied tape ▲		ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>		option not required		ICEA S-97-682, Section 6.7

**MATERIAL STANDARD**

15 kV, 3/C, Armored, TRXLPE Insulated, Tape Shielded Cable

standard number: **6020.02**

superseding: January 27, 2010

effective date: August 30, 2011

page: 4 of 5

**2. Construction, continued**

**2.7 Jacket (Non-Metallic Covering)**

Jacket shall be applied over 3/C assembly.

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Material</b>		linear low density polyethylene (LLDPE)		ICEA S-97-682, Section 7.1.1
<b>Color</b>		black		ICEA S-97-682, Section 7.1.1
<b>Type</b>		overlying		ICEA S-97-682, Section 7.2.1
<b>Thickness</b>	minimum point	70 mil		ICEA S-97-682, Section 7.2.1, Table 7-10
	maximum point	105 mil		ICEA S-97-682, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>		2.25 in ▲	2.55 in ▲	SCL preference

**2.8 Sheath (Continuous Metallic Covering)**

Cable shall be sheathed for the purpose of armor according to the requirements of ICEA S-93-639, Division II, Section 7.4.4 - Vertical Riser Cable.

Sheath shall be applied over jacket.

Wire band servings shall be according to the requirements of ICEA S-93-639, Division II, Section 7.4.1.2 – Wire Band Serving and Table 7-26, with the following clarification:

- Maximum band spacing shall be 25 feet.

Alternative methods of securing the armor wire may be considered.

		Requirements		Reference
<b>Stock Number</b>		<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>		#1 AWG	3/0 AWG	various
<b>Armor composition</b>		galvanized round steel wire		ICEA S-93-639, Section 7.4.3.2, Table 7-25
<b>Armor wire</b>	size	#8 BWG		ICEA S-93-639, Section 7.4.3.2, Table 7-25 and Birmingham Wire Gage
	thickness/diameter	165 mil		ICEA S-93-639, Section 7.4.3.2, Table 7-25
<b>Maximum diameter over sheath</b>		2.50 in ▲	2.80 in ▲	SCL preference

**MATERIAL STANDARD**

superseding: January 27, 2010

effective date: August 30, 2011

15 kV, 3/C, Armored, TRXLPE Insulated, Tape Shielded Cable

page: 5 of 5

**2. Construction, continued**

**2.9 Assembly and Identification**

Bedding shall be applied over the jacket and under the armor sheath.

Alternate bedding methods or materials may be considered.

An asphalt coating over the bedding and/or armor is expressly prohibited.

	Requirements		Reference
	<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Stock Number</b>	<b>613522</b>	<b>613521</b>	<b>SCL</b>
<b>Size</b>	#1 AWG	3/0 AWG	various
<b>Bedding material</b>	jute or polypropylene rove ▲		ICEA S-93-639, Section 7.3.6.2
<b>Thickness, nominal</b>	110 mil		ICEA S-93-639, Section 7.3.6.2, Table 7-18
<b>Red stripe identification</b>	option not required		ICEA S-97-682, Section 8.2.1.1

**3. Packaging**

	Requirements		Reference	
	<b>613522</b>	<b>613521</b>	<b>SCL</b>	
<b>Stock Number</b>	<b>613522</b>	<b>613521</b>	<b>SCL</b>	
<b>Size</b>	#1 AWG	3/0 AWG	various	
<b>Reel type</b>	steel, fluted		WC 26, Section 2.1.2	
<b>Reel dimension</b>	<b>flange diameter, maximum</b>	108 in ▲		
	<b>outside width, maximum</b>	72 in ▲		
	<b>drum diameter, minimum</b>	50 in ▲		
	<b>length per reel ± 10%</b>	2,500 ft ▲	2,000 ft ▲	SCL preference
	<b>gross weight, maximum</b>	17,000 lb ▲		SCL preference

**4. Issuance**

	Requirements	
	<b>613522</b>	<b>613521</b>
<b>Stock Number</b>	<b>613522</b>	<b>613521</b>
<b>Size</b>	#1 AWG	3/0 AWG
<b>Stock unit</b>	FT	

**5. Approved Manufacturing Plants**

Manufacturer	Location

**28 kV, 1/C, TRXLPE INSULATED, BARE CN CABLE**



**1. Scope**

This standard covers the detailed requirements for 28 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable with full neutral used for the distribution of electric energy.

Industry designation: **1/C +1N**

This standard applies to Seattle City Light (SCL) Stock No. 602025.

**2. Application**

Cable is intended for use on a nominal 26.4 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz, power system.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standard:

**ICEA S-94-649-2013**; "Standard for Concentric Neutral Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction**

**5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Bare CN Cable

standard number: **6020.03**superseding: April 1, 2015  
effective date: October 30, 2015  
page: 2 of 4**5. Construction, continued****5.2 Conductor**

		Requirements	Reference
<b>Diameter</b>	minimum	0.318 in	ICEA S-94-649, Section 2.5
	nominal	0.325 in	ICEA S-94-649, Section 2.5, Table 2.4
	maximum	0.331 in	ICEA S-94-649, Section 2.5
<b>Metal</b>		1350 aluminum	ASTM B233
<b>Stranding type</b>		solid	ASTM B233
<b>Class</b>		none	none
<b>Stranding subtype</b>		none	none
<b>Number of strands</b>		none	none
<b>Temper</b>		H14 (1/2 hard) ▲	ASTM B609
<b>Lay, outer layer</b>		none	none
<b>Lay, successive layers</b>		none	none
<b>Sealant for stranded conductors</b>		not required	ICEA S-94-649, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
<b>Thickness</b> , minimum point		12 mil	ICEA S-94-649, Part 3, Table 3-1

**5.4 Insulation**

		Requirements	Reference
<b>Material</b>		unfilled tree retardant cross-linked polyethylene (TRXLPE)	ICEA S-94-649, Section 4.1
<b>Approved material formulations</b>		specified in general material standard	SCL 6015.00
<b>Thickness</b>	minimum point	265 mil	ICEA S-94-649, Section 4.2, Table 4-7
	nominal	280 mil	ICEA S-94-649, Table 8-1
	maximum point	310 mil	ICEA S-94-649, Section 4.2, Table 4-7
<b>Insulation level</b>		100%	ICEA S-94-649, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		150 kV crest	ICEA S-94-649, Section 4.3, Table 4-6

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Bare CN Cable

**5. Construction, continued**

**5.5 Extruded Insulation Shield**

		Requirements	Reference
<b>Material</b>		discharge-free (thermosetting material)	ICEA S-94-649, Section 5.1 to 5.4.1.5
<b>Thickness</b>	minimum point	30 mil	ICEA S-94-649, Section 5.2, Table 5-1
	maximum point	60 mil	ICEA S-94-649, Section 5.2, Table 5-1

**5.6 Concentric Neutral Conductor / Metallic Shield**

Concentric neutral conductor shall be full rated.

		Requirements	Reference
<b>Metal</b>		copper, uncoated	ICEA S-94-649, Section 6.1
<b>Type</b>		round annealed wire, #14 AWG, helically applied	ICEA S-94-649, Section 6.4
<b>Number of wires</b> , minimum		16	ICEA S-94-649, Section 6.4, Table 6-2
<b>Cross-sectional area</b> , nominal		65,760 cmil	ICEA S-94-649, Section 6.4
<b>Water blocking components for metallic shield</b>		not required	ICEA S-94-649, Section 6.6
<b>Maximum diameter over CN</b>		1.30 in ▲	SCL preference

**5.7 Jacket (Non-Metallic Covering)**

Cable shall not be provided with a jacket.

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

		Requirements	Reference
<b>Red stripe identification</b>		not required	ICEA S-94-649, Section 8.2.1.1

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Bare CN Cable

standard number: **6020.03**

superseding: April 1, 2015  
 effective date: October 30, 2015  
 page: 4 of 4

**6. Packaging**

		Requirements	Reference
<b>Reel type</b>		steel, fluted	WC 26, Section 2.1.2
<b>Reel dimension</b>	flange diameter, maximum	72 in ▲	SCL preference
	outside width, maximum	45 in ▲	SCL preference
	drum diameter, minimum	19 in ▲	SCL preference
	length per reel ± 10%	3,400 ft ▲	SCL preference
	gross weight, maximum	3,500 lb ▲	SCL preference

**7. Issuance**

Stock unit: FT

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Hendrix</b>	Milford, NH
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

**9. References**

SCL Material Standard 6015.00, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6020.03  
 (john.shipek@seattle.gov)

## 28 kV, 3/C, TRXLPE Insulated, Tape Shielded Cable with Ground Conductors



### 1. Scope

This standard covers the detailed requirements for 28 kV, tree retardant, cross-linked polyethylene (TRXLPE), three conductor cable used for the distribution of electric energy.

Industry designation: **3/C + 3G**

This standard applies to the following Seattle City Light (SCL) stock numbers:

<b>Stock No.</b>	<b>Size</b>
613540	#1 AWG
613543	350 kcmil

### 2. Application

This cable is intended for use on a nominal 26.4 kV, three-phase, three-wire, delta, 60 Hz power system.

### 3. General Requirements

Use this detailed material standard in conjunction with the latest revision SCL 6015.00, "Medium Voltage Cable – General."

### 4. Industry Standards

This cable shall meet the requirements of the following industry standard:

**ICEA S-97-682-2013**; "Utility Shielded Power Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

Standards Coordinator  
John Shipek

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola



## 5. Construction

### 5.1 General

Unless indicated otherwise, all values in the following tables are consistent with industry standards. They are repeated here for the convenience of the reader.

The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

### 5.2 Conductor

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	various
<b>Diameter (in): minimum</b>	0.316	0.604	ICEA S-97-682, Section 2.5
<b>nominal</b>	0.322	0.616	ASTM B8/ASTM B496
<b>maximum</b>	0.328	0.628	ICEA S-97-682, Section 2.5
<b>Metal</b>	copper	copper	ASTM B49
<b>Stranding type</b>	concentric-lay	concentric-lay	ASTM B8/ASTM B496
<b>Class</b>	B	none	ASTM B8
<b>Stranding subtype</b>	compressed	compact	ASTM B8/ASTM B496
<b>Number of strands</b>	19	35-37	ASTM B8/ASTM B496, Table 1
<b>Temper</b>	SD, annealed prior to stranding	SD, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>	left hand	left hand	ASTM B3, Section 5.5.1/ASTM B496, Section 5
<b>Lay, successive layers</b>	reversed	reversed	ASTM B3, Section 5.5.1/ASTM B496, Section 5
<b>Sealant for stranded conductors</b>	required ▲	required ▲	ICEA S-97-682, Section 2.2

### 5.3 Conductor Shield (Stress Control Layer)

Stock No.	Size <sup>a</sup> (AWG/kcmil)	Thickness, minimum point <sup>b</sup> (mil)
613540	#1	12 mil
613543	350	16 mil

**Notes:**

- a. Various references
- b. ICEA S-97-682, Part 3, Table 3-1

#### 5.4 Insulation

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	various
<b>Material</b>	unfilled tree retardant cross-linked polyethylene (TRXLPE)		ICEA S-97-682, Section 4.1
<b>Approved material formulations</b>	specified in general material standard		SCL 6015.00
<b>Thickness (mil): minimum</b>	265		ICEA S-97-682, Section 4.2, Table 4-11
<b>nominal</b>	280		ICEA S-97-682, Table 8-1
<b>maximum</b>	310		ICEA S-97-682, Section 4.2, Table 4-11
<b>Insulation level</b>	100%		ICEA S-97-682, Section 4.2, Table 4-11
<b>Basic impulse level (BIL)</b>	150 kV crest		ICEA S-97-682, Section 4.3, Table 4-10

#### 5.5 Extruded Insulation Shield

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)		ICEA S-97-682, Section 5.1 to 5.5.1.5
<b>Thickness (mil): minimum</b>	24		ICEA S-97-682, Section 5.2, Table 5-1
<b>maximum</b>	60		ICEA S-97-682, Section 5.2, Table 5-1

#### 5.6 Metallic Shield

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	various
<b>Metal</b>	copper, uncoated		ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>	helically applied tape ▲		ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>	not required		ICEA S-97-682, Section 6.7

**5.7 Jacket (Non-Metallic Covering)**

Jacket shall be applied over 3/C + 3/ground assembly.

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	Various
<b>Material</b>	linear low density polyethylene (LLDPE)		ICEA S-97-682, Section 7.1.1
<b>Color</b>	black		ICEA S-97-682, Section 7.1.1
<b>Type</b>	overlying		ICEA S-97-682, Section 7.2
<b>Thickness (mil): minimum</b>	100		ICEA S-97-682, Section 7.2.1, Table 7-10 and SCL preference
<b>maximum</b>	150		
<b>Maximum diameter over jacket (in)</b>	2.65 ▲	3.45 ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification ▲**

Three separate ground conductors shall be provided under the jacket of the 3/C assembly.

Each ground conductor shall be located at an interstice of the 3/C assembly.

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	various
<b>Ground Conductor Quantity</b>	3 ▲		SCL preference
<b>Size</b>	#4 AWG ▲	2/0 AWG ▲	SCL preference
<b>Diameter (in), nominal</b>	0.232	0.419	ASTM B8
<b>Metal</b>	copper, bare		ASTM B49
<b>Stranding type</b>	concentric-lay		ASTM B8
<b>Class</b>	B		ASTM B8
<b>Stranding subtype</b>	concentric round		ASTM B8
<b>Number of strands</b>	7	19	ASTM B8
<b>Temper</b>	SD, annealed prior to stranding		ASTM B3
<b>Lay, outer layer</b>	left hand		ASTM B3, Section 5.5.1
<b>Lay, successive layers</b>	reversed		ASTM B3, Section 5.5.1
<b>Sealant for stranded conductors</b>	not required		ICEA S-97-682, Section 2.2
<b>Jacket</b>	not required		ICEA S-97-682, Section 8.2.1.1
<b>Red stripe identification</b>			

**6. Packaging**

	Stock No.		Reference
	613540	613543	
<b>Size</b>	#1 AWG	350 kcmil	Various
Reel type	steel, fluted	steel, fluted	WC 26, Section 2.1.2
Reel dimension: Flange diameter, maximum:	108 in ▲	96 in ▲	SCL preference
Outside width, maximum	56 in ▲	64 in ▲	SCL preference
Drum diameter, minimum	38 in ▲	56 in ▲	SCL preference
Length per reel ± 10%	2300 ft ▲	1500 ft ▲	SCL preference
Gross weight, maximum	17,000 lb ▲		SCL preference

**7. Issuance**

Stock unit: FT

**8. Approved Manufacturing Plants**

Manufacturer	Location
General Cable	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
Prysmian	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
Southwire	Heflin, AL
	Starkville, MS

**9. References**

**SCL Material Standard 6015.00**, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6020.05 (john.shipek@seattle.gov)

**28 kV, 1/C, TRXLPE INSULATED, JACKETED CN CABLE**



**1. Scope**

This standard covers the detailed requirements for 28 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable with full neutral used for the distribution of electric energy.

Industry designation: **1/C +1N**

This standard applies to Seattle City Light (SCL) Stock No. 012098.

**2. Application**

Cable is intended for use on a nominal 26.4 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz power system.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standard:

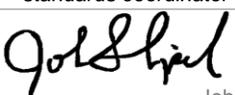
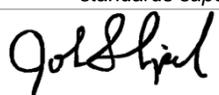
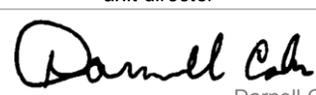
**ICEA S-94-649-2013**; "Concentric Neutral Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction**

**5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Jacketed CN Cable

standard number: **6020.06**superseding: April 6, 2015  
effective date: October 30, 2015  
page: 2 of 4**5. Construction, continued****5.2 Conductor**

		Requirements	Reference
<b>Diameter</b>	minimum	0.318 in	ICEA S-94-649, Section 2.5
	nominal	0.325 in	ICEA S-94-649, Section 2.5, Table 2.4
	maximum	0.331 in	ICEA S-94-649, Section 2.5
<b>Metal</b>		1350 aluminum	ASTM B233
<b>Stranding type</b>		solid	ASTM B233
<b>Class</b>		none	none
<b>Stranding subtype</b>		none	none
<b>Number of strands</b>		1	none
<b>Temper</b>		H14 (1/2 hard) ▲	ASTM B609
<b>Lay, outer layer</b>		none	none
<b>Lay, successive layers</b>		none	none
<b>Sealant for stranded conductors</b>		not required	ICEA S-94-649, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
<b>Thickness, minimum point</b>		12 mil	ICEA S-94-649, Part 3, Table 3-1

**5.4 Insulation**

		Requirements	Reference
<b>Material</b>		unfilled tree retardant cross-linked polyethylene (TRXLPE)	ICEA S-94-649, Section 4.1
<b>Approved material formulations</b>		specified in general material standard	SCL 6015.00
<b>Thickness</b>	minimum point	265 mil	ICEA S-94-649, Section 4.2, Table 4-7
	nominal	280 mil	ICEA S-94-649, Table 8-1
	maximum point	310 mil	ICEA S-94-649, Section 4.2, Table 4-7
<b>Insulation level</b>		100%	ICEA S-94-649, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		150 kV crest	ICEA S-94-649, Section 4.3, Table 4-6

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Jacketed CN Cable

standard number: **6020.06**superseding: April 6, 2015  
effective date: October 30, 2015  
page: 3 of 4**5. Construction, continued****5.5 Extruded Insulation Shield**

		Requirements	Reference
<b>Material</b>		discharge-free (thermosetting material)	ICEA S-94-649, Section 5.1 to 5.4.1.5
<b>Thickness</b>	minimum point	30 mil	ICEA S-94-649, Section 5.2, Table 5-1
	maximum point	60 mil	ICEA S-94-649, Section 5.2, Table 5-1

**5.6 Concentric Neutral Conductor / Metallic Shield**

Concentric neutral conductor shall be full rated.

		Requirements	Reference
<b>Metal</b>		copper, uncoated	ICEA S-94-649, Section 6.1
<b>Type</b>		round annealed wire, #14 AWG, helically applied	ICEA S-94-649, Section 6.4
<b>Number of wires, minimum</b>		16	ICEA S-94-649, Section 6.4, Table 6-2
<b>Cross-sectional area, nominal</b>		65,760 cmil	ICEA S-94-649, Section 6.4
<b>Water blocking components for metallic shield</b>		not required	ICEA S-94-649, Section 6.6

**5.7 Jacket (Non-Metallic Covering)**

		Requirements	Reference
<b>Material</b>		linear low density polyethylene (LLDPE)	ICEA S-94-649, Section 7.1.1
<b>Color</b>		black	ICEA S-94-649, Section 7.1.1
<b>Type</b>		extruded-to-fill	ICEA S-94-649, Section 7.2.1
<b>Thickness</b>	minimum point	45 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
	maximum point	80 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>		1.35 in ▲	SCL preference

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Jacketed CN Cable

standard number: **6020.06**

superseding: April 6, 2015  
 effective date: October 30, 2015  
 page: 4 of 4

**5. Construction, continued**

**5.8 Sheath (Continuous Metallic Covering)**  
 Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

	Requirements	Reference
<b>Red stripe identification</b>	required ▲	ICEA S-94-649, Section 8.2.1.1

**6. Packaging**

	Requirements	Reference	
<b>Reel type</b>	steel, fluted	WC 26, Section 2.1.2	
<b>Reel dimension</b>	flange diameter, maximum	72 in ▲	SCL preference
	outside width, maximum	45 in ▲	SCL preference
	drum diameter, minimum	19 in ▲	SCL preference
	length per reel ± 10%	3400 ft ▲	SCL preference
	gross weight, maximum	3500 lb ▲	SCL preference

**7. Issuance**

Stock Unit: FT

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Hendrix</b>	Milford, NH
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

**9. References**

**SCL Material Standard 6015.00, "Medium Voltage Cable – General"**

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6020.06  
 (john.shipek@seattle.gov)

# MATERIAL STANDARD

## 28 kV, 1/C, TRXLPE INSULATED, FLAT STRAP SHIELDED CABLE



### 1. Scope

This standard covers the detailed requirements for 28 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable used for the distribution of electric energy.

Industry designation: **1/C**

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock Number	012099	012100	012101	012102
Size	350 kcmil	500 kcmil	750 kcmil	1000 kcmil

### 2. Application

Cable is intended for use on a nominal 26.4 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz, power system.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standard:

**ICEA S-94-649-2013**; "Concentric Neutral Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable

standard number: **6020.07**

superseding: April 6, 2015

effective date: October 30, 2015

page: 2 of 5

**5. Construction, continued****5.2 Conductor**

		Requirements				Reference
<b>Stock Number</b>		<b>012099</b>	<b>012100</b>	<b>012101</b>	<b>012102</b>	SCL
<b>Size</b>		350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Diameter</b>	minimum	0.604 in				ICEA S-94-649, Section 2.5
	nominal	0.616 in				ASTM B400
	maximum	0.628 in				ICEA S-94-649, Section 2.5
<b>Metal</b>		1350 aluminum				ASTM B233
<b>Stranding type</b>		concentric-lay				ASTM B400
<b>Class</b>		B				ASTM B400
<b>Stranding subtype</b>		compact				ASTM B400
<b>Number of strands</b>		35-37				ASTM B400, Table 1
<b>Temper</b>		H16 (3/4 hard)				ASTM B609
<b>Lay, outer layer</b>		left hand				ASTM B400, Section 6.4
<b>Lay, successive layers</b>		reversed				ASTM B400, Section 6.4
<b>Sealant for stranded conductors</b>		required ▲				ICEA S-94-649, Section 2.2
<b>Diameter</b>	minimum		0.721 in	0.890 in	1.039 in	ICEA S-94-649, Section 2.5
	nominal		0.736 in	0.908 in	1.060 in	ASTM B496
	maximum		0.751 in	0.926 in	1.081 in	ICEA S-94-649, Section 2.5
<b>Metal</b>			copper	copper	copper	ASTM B49
<b>Stranding type</b>			concentric-lay	concentric-lay	concentric-lay	ASTM B496
<b>Class</b>			none	none	none	none
<b>Stranding subtype</b>			compact	compact	compact	ASTM B496
<b>Number of strands</b>			35-37	58-61	58-61	ASTM B496, Table 1
<b>Temper</b>			soft drawn, annealed prior to stranding			ASTM B3
<b>Lay, outer layer</b>			left hand	left hand	left hand	ASTM B496, Section 5
<b>Lay, successive layers</b>			reversed	reversed	reversed	ASTM B496, Section 5
<b>Sealant for stranded conductors</b>			required ▲			ICEA S-94-649, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements				Reference
<b>Stock Number</b>		<b>012099</b>	<b>012100</b>	<b>012101</b>	<b>012102</b>	SCL
<b>Size</b>		350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Thickness, minimum point</b>		16 mil	16 mil	20 mil	20 mil	ICEA S-94-649, Part 3, Table 3.1

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable

standard number: **6020.07**

superseding: April 6, 2015

effective date: October 30, 2015

page: 3 of 5

**5. Construction, continued****5.4 Insulation**

	Requirements				Reference
	012099	012100	012101	012102	
<b>Stock Number</b>	012099	012100	012101	012102	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Material</b>	unfilled tree retardant cross-linked polyethylene (TRXLPE)				ICEA S-94-649, Section 4.1
<b>Approved material formulations</b>	specified in general material standard				SCL 6015.00
<b>Thickness</b>					
minimum point	265 mil				ICEA S-94-649, Section 4.2, Table 4-7
nominal point	280 mil				ICEA S-94-649, Table 8-1
maximum point	310 mil				ICEA S-94-649, Section 4.2, Table 4-7
<b>Insulation level</b>	100%				ICEA S-94-649, Section 4.2, Table 4-7
<b>Basic Impulse Level (BIL)</b>	150 kV crest				ICEA S-94-649, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

	Requirements				Reference
	012099	012100	012101	012102	
<b>Stock Number</b>	012099	012100	012101	012102	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)				ICEA S-94-649, Section 5.1-5.4.1.5
<b>Thickness</b>					
minimum point	24 mil				ICEA S-94-649, Section 5.2
maximum point	60 mil				ICEA S-94-649, Section 5.2

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable

standard number: **6020.07**superseding: April 6, 2015  
effective date: October 30, 2015

page: 4 of 5

**5. Construction, continued****5.6 Metallic Shield**

Flat strap conductors are for metallic shielding only.

	Requirements				Reference
<b>Stock Number</b>	<b>012099</b>	<b>012100</b>	<b>012101</b>	<b>012102</b>	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Metal</b>	copper, uncoated or tin coated				ICEA S-94-649, Section 6
<b>Type</b>	flat strap, helically applied ▲				ICEA S-94-649, Section 6
<b>Number of straps</b>	17 +1, -1 ▲	19 +4, -3 ▲	21 +4, -3 ▲	23 +3, -3 ▲	SCL preference
<b>Cross-sectional area, minimum</b>	71,000 cmil ▲	89,000 cmil ▲	98,000 cmil ▲	106,000 cmil ▲	SCL preference
<b>Water blocking components for metallic shield</b>	required ▲				ICEA S-94-649, Section 6.6

**5.7 Jacket (Non-Metallic Covering)**

	Requirements				Reference
<b>Stock Number</b>	<b>012099</b>	<b>012100</b>	<b>012101</b>	<b>012102</b>	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Material</b>	linear low density polyethylene (LLDPE)				ICEA S-94-649, Section 7.1.1
<b>Color</b>	black				ICEA S-94-649, Section 7.1.1
<b>Type</b>	extruded-to-fill				ICEA S-94-649, Section 7.2.1
<b>Thickness</b>					
minimum point	45 mil	45 mil	70 mil	70 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
maximum point	80 mil	80 mil	120 mil	120 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>	1.57 in ▲	1.70 in ▲	2.00 in ▲	2.10 in ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

	Requirements				Reference
<b>Stock Number</b>	<b>012099</b>	<b>012100</b>	<b>012101</b>	<b>012102</b>	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Red stripe identification</b>	required ▲				ICEA S-94-649, Section 8.2.1.1

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable

standard number: **6020.07**

superseding: April 6, 2015

effective date: October 30, 2015

page: 5 of 5

**6. Packaging**

	Requirements				Reference
	012099	012100	012101	012102	
<b>Stock Number</b>	012099	012100	012101	012102	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Reel Type</b>	steel, fluted				WC 26, Section 2.1.2
<b>Flange diameter, maximum</b>	78 in ▲	84 in ▲	84 in ▲	108 in ▲	SCL preference
<b>Outside width, maximum</b>	45 in ▲	50 in ▲	50 in ▲	56 in ▲	SCL preference
<b>Drum diameter, minimum</b>	26 in ▲	26 in ▲	29 in ▲	31 in ▲	SCL preference
<b>Length per reel, +/- 10%</b>	2300 ft ▲	3000 ft ▲	2400 ft ▲	2400 ft ▲	SCL preference
<b>Gross weight, maximum</b>	3500 lb ▲	17,000 lb ▲	17,000 lb ▲	17,000 lb ▲	SCL preference

**7. Issuance**

	Requirements				Reference
	012099	012100	012101	012102	
<b>Stock Number</b>	012099	012100	012101	012102	SCL
<b>Size</b>	350 kcmil	500 kcmil	750 kcmil	1000 kcmil	various
<b>Stock unit</b>	FT				SCL

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

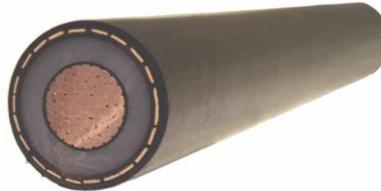
**9. References**

SCL Material Standard 6015.00, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6020.07  
(john.shipek@seattle.gov)

**28 kV, 1/C, TRXLPE INSULATED, FLAT STRAP SHIELDED CABLE, COMPRESSED STRANDING**



**1. Scope**

This standard covers the detailed requirements for 28 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable used for the distribution of electric energy.

Industry designation: **1/C**

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock Number	613645	613655
Size	500 kcmil	1000 kcmil

**2. Application**

Cable is intended for use on a nominal 26.4 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz power system.

At one time, this cable was designated for use as the preferred and alternate feeds to the West Point Sewer Treatment plant. This cable is no longer purchased. SCL engineers are encouraged to work with Material Control to coordinate depleting existing inventory. Stock numbers 012100 and 012102 are approved for use in replacement situations after 613645 and 613655 are used up.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standard:

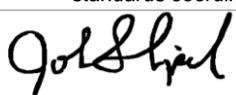
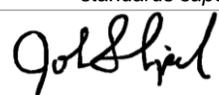
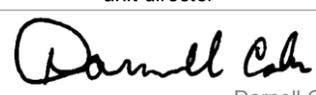
**ICEA S-94-649-2013**; "Concentric Neutral Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction**

**5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable,  
Compressed Strandingstandard number: **6020.14**superseding: August 30, 2011  
effective date: October 30, 2015  
page: 2 of 5**5.2 Conductor**

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Diameter</b>	minimum	0.773 in	1.095 in	ICEA S-94-649, Section 2.5
	nominal	0.789 in	1.117 in	ASTM B8
	maximum	0.805 in	1.139 in	ICEA S-94-649, Section 2.5
<b>Metal</b>		copper		ASTM B49
<b>Stranding type</b>		concentric-lay		ASTM B8
<b>Class</b>		B		ASTM B8
<b>Stranding subtype</b>		compressed		ASTM B8
<b>Number of strands</b>		37	61	ASTM B8
<b>Temper</b>		soft drawn, annealed prior to stranding		ASTM B3
<b>Lay, outer layer</b>		left hand		ASTM B3, Section 5.5.1
<b>Lay, successive layers</b>		reversed		ASTM B3, Section 5.5.1
<b>Sealant for stranded conductors</b>		required ▲		ICEA S-94-649, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Thickness, minimum point</b>		16 mil	20 mil	ICEA S-94-649, Part 3, Table 3-1

**5.4 Insulation**

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Material</b>		unfilled tree retardant crosslinked polyethylene (TRXLPE)		ICEA S-94-649, Section 4.1
<b>Approved material formulations</b>		specified in general material standard		SCL 6015.00
<b>Thickness</b>	minimum point	265 mil		ICEA S-94-649, Section 4.2, Table 4-7
	nominal	280 mil		ICEA S-94-649, Table 8-1
	maximum point	310 mil		ICEA S-94-649, Section 4.2, Table 4-7
<b>Insulation level</b>		100%		ICEA S-94-649, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		150 kV crest		ICEA S-94-649, Section 4.3, Table 4-6

**MATERIAL STANDARD**28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable,  
Compressed Strandingstandard number: **6020.14**superseding: August 30, 2011  
effective date: October 30, 2015  
page: 3 of 5**5.5 Extruded Insulation Shield**

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Material</b>		discharge-free (thermosetting material)		ICEA S-94-649, Section 5.1 to 5.4.1.5
<b>Thickness</b>	minimum point	24 mil		ICEA S-94-649, Section 5.2
	maximum point	60 mil		ICEA S-94-649, Section 5.2

**5.6 Metallic Shield**

Flat strap conductors are for metallic shielding only.

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Metal</b>		copper, uncoated or tin coated		ICEA S-94-649, Section 6
<b>Type</b>		flat strap helically applied ▲		ICEA S-94-649, Section 6
<b>Number of straps</b>		19+4, -3 ▲	23+3, -3 ▲	SCL preference
<b>Cross-sectional area, minimum</b>		89,000 cmil ▲	106,000 cmil ▲	SCL preference
<b>Water blocking components for metallic shield</b>		required ▲		ICEA S-94-649, Section 6.6

**5.7 Jacket**

		Requirements		Reference
<b>Stock Number</b>		<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>		500 kcmil	1000 kcmil	various
<b>Material</b>		linear low density polyethylene (LLDPE)		ICEA S-94-649, Section 7.1.1
<b>Color</b>		black		ICEA S-94-649, Section 7.1.1
<b>Type</b>		extruded to fill		ICEA S-94-649, Section 7.2.1
<b>Thickness</b>	minimum point	64 mil ▲		ICEA S-94-649, Section 7.2.1, Table 7-10 and SCL preference
	maximum point	120 mil		ICEA S-94-649, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>		1.95 in ▲	2.40 in ▲	SCL preference

**MATERIAL STANDARD**28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable,  
Compressed Strandingstandard number: **6020.14**

superseding: August 30, 2011

effective date: October 30, 2015

page: 4 of 5

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification ▲**

	Requirements		Reference
<b>Stock Number</b>	<b>613645</b>	<b>613655</b>	SCL
<b>Size</b>	500 kcmil	1000 kcmil	various
<b>Red stripe identification</b>	required ▲		ICEA S-94-649, Section 8.2.1.1

**6. Packaging**

	Requirements		Reference	
<b>Stock Number</b>	<b>613645</b>	<b>613655</b>	SCL	
<b>Size</b>	500 kcmil	1000 kcmil	various	
<b>Reel type</b>	steel, fluted		WC 26, Section 2.1.2	
<b>Reel dimension</b>	flange diameter, maximum	96 in ▲	SCL preference	
	outside width, maximum	54 in ▲	SCL preference	
	drum diameter, minimum	29 in ▲	31 in ▲	SCL preference
	length per reel ± 10%	2,100 ft ▲		SCL preference
	gross weight, maximum	17,000 lb ▲		SCL preference

**7. Issuance**

	Requirements	
<b>Stock Number</b>	<b>613645</b>	<b>613655</b>
<b>Size</b>	500 kcmil	1000 kcmil
<b>Stock unit</b>	FT	

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

**MATERIAL STANDARD**

28 kV, 1/C, TRXLPE Insulated, Flat Strap Shielded Cable,  
Compressed Stranding

standard number: **6020.14**

superseding: August 30, 2011

effective date: October 30, 2015

page: 5 of 5

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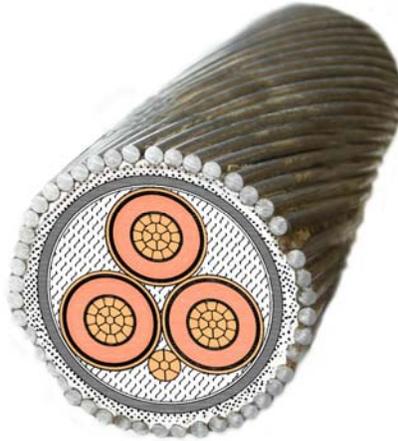
**9. References**

**SCL Material Standard 6015.00**; "Medium Voltage Cable - General"

**10. Sources**

**Shipek, John**; Standards Supervisor, subject matter expert, and originator of 6020.14 (john.shipek@seattle.gov)

**15 KV, 3/C, ARMORED, EPR INSULATED, TAPE SHIELDED CABLE**



**1. Scope**

This standard covers the detailed requirements for 15 kV, armored, ethylene propylene rubber (EPR) insulated, three conductor cable (with one bare ground wire) used for the distribution of electric energy.

Industry designation: **3/C +1G**

This standard applies to the following Seattle City Light Stock Number:

<b>Stock Number</b>	<b>013306</b>
<b>Size</b>	4/0 AWG

**2. Application**

Cable is intended for use on a nominal 13.8 kV, three-phase, three-wire, delta, 60 Hz, power system. This product has particular application as a vertical riser cable. Cable will be installed within high-rise buildings and suspended from one end.

Users should be aware that this cable has 220 mil of insulation – a less common value for 15 kV cable at Seattle City Light.

Cable length requirements are site specific. Engineers and Material Control shall plan for minimum order runs of 1,000 feet. Cable shall be shipped only in combinations of the options cited in Table 2.

**Table 2**

Cable Cut Length, ft	Reel Size and Type	Cable Net Weight, lb	Reel Tare Weight, lb	Total Gross Weight, lb
300	78 x 36 x 48 RT	2,523	890	3,413
600	78 x 41 x 48 RT	5,047	925	5,972
900	84 x 48 x 48 RT	7,570	1,030	8,600

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standards:

- ICEA S-97-682-2006
- ICEA S-93-639-2000 (Utilized only for its section on metallic and associated coverings.)

Refer to Material Standard 6015.00 to obtain the appropriate revision date for other referenced industry standards.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

15 kV, 3/C, Armored, EPR Insulated, Tape Shielded Cable

superseding: new  
effective date: September 16, 2011  
page: 2 of 5**5. Construction****5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6015.00.

**5.2 Conductor**

		Requirements	Reference
<b>Stock Number</b>		<b>013306</b>	<b>SCL</b>
<b>Size</b>		4/0 AWG	various
<b>Diameter</b>	minimum	0.466 in	ICEA S-97-682, Section 2.5
	nominal	0.475 in	ASTM B496
	maximum	0.485 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		uncoated copper	ASTM B49
<b>Stranding type</b>		concentric-lay	ASTM B496
<b>Class</b>		B	ASTM B496
<b>Stranding subtype</b>		compact	ASTM B496
<b>Number of strands</b>		19	ASTM B496
<b>Temper</b>		soft drawn, annealed prior to stranding	ASTM B496
<b>Lay, outer layer</b>		left hand	ASTM B3, Section 5.5.2
<b>Lay, successive layers</b>		reversed	ASTM B3, Section 5.5.2
<b>Sealant for stranded conductors</b>		not required	ICEA S-97-682, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
<b>Stock Number</b>		<b>013306</b>	<b>SCL</b>
<b>Size</b>		4/0 AWG	various
<b>Thickness, minimum point</b>		12 mil	ICEA S-97-682, Part 3, Table 3-1

**5.4 Insulation**

		Requirements	Reference
<b>Stock Number</b>		<b>013306</b>	<b>SCL</b>
<b>Size</b>		4/0 AWG	various
<b>Material</b>		ethylene propylene rubber (EPR), Class III	ICEA S-97-682, Section 4.1
<b>Thickness</b>	minimum point	210 mil	ICEA S-97-682, Section 4.2, Table 4-7
	nominal	220 mil	ICEA S-97-682, Table 8-1
	maximum point	250 mil	ICEA S-97-682, Section 4.2, Table 4-7
<b>Insulation level</b>		133%	ICEA S-97-682, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		110 kV crest	ICEA S-97-682, Section 4.3, Table 4-6

**MATERIAL STANDARD**

15 kV, 3/C, Armored, EPR Insulated, Tape Shielded Cable

superseding: new  
effective date: September 16, 2011  
page: 3 of 5**5. Construction, continued****5.5 Extruded Insulation Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Material</b>	discharge-free (thermosetting material)	ICEA S-97-682, Section 5.1 to 5.5.1.5
<b>Thickness</b>	minimum point	ICEA S-97-682, Section 5.2, Table 5-1
	maximum point	ICEA S-97-682, Section 5.2, Table 5-1

**5.6 Metallic Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Metal</b>	copper, uncoated	ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>	helically applied tape with 12.5% nominal overlap	ICEA S-97-682, Section 6.1 to 6.2
<b>Water blocking components for metallic shield</b>	not required	ICEA S-97-682, Section 6.7

**5.7 Jacket (Non-Metallic Covering)**

Jacket shall be applied over 3/C assembly.

	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Material</b>	polyvinyl chloride (PVC)	ICEA S-97-682, Section 7.1.6
<b>Color</b>	black	ICEA S-97-682, Section 7.1.6
<b>Type</b>	overlying	ICEA S-97-682, Section 7.2.1
<b>Thickness</b>	minimum point	ICEA S-97-682, Section 7.2.1, Table 7-10
	maximum point	ICEA S-97-682, Section 7.2.1, Table 7-10
<b>Maximum diameter over jacket</b>	2.73 in ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall be sheathed for the purpose of armor according to the requirements of ICEA S-93-639, Division II, Section 7.4.4 - Vertical Riser Cable.

Sheath shall be applied over jacket.

Wire band servings shall be according to the requirements of ICEA S-93-639, Division II, Section 7.4.1.2 – Wire Band Serving and Table 7-26, with the following clarification:

- Maximum band spacing shall be 25 feet.

Alternative methods of securing the armor wire may be considered.

**MATERIAL STANDARD**

15 kV, 3/C, Armored, EPR Insulated, Tape Shielded Cable

standard number: **6025.02**

superseding: new  
 effective date: September 16, 2011  
 page: 4 of 5

**5. Construction, continued**

**5.8 Sheath (Continuous Metallic Covering), continued**

	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Armor composition</b>	galvanized round steel wire	ICEA S-93-639, Section 7.4.3.2, Table 7-25
<b>Armor wire size</b>	#8 BWG	ICEA S-93-639, Section 7.4.3.2, Table 7-25 and Birmingham Wire Gage
thickness/diameter	165 mil	ICEA S-93-639, Section 7.4.3.2, Table 7-25
<b>Maximum diameter over sheath</b>	3.27 in ▲	SCL preference

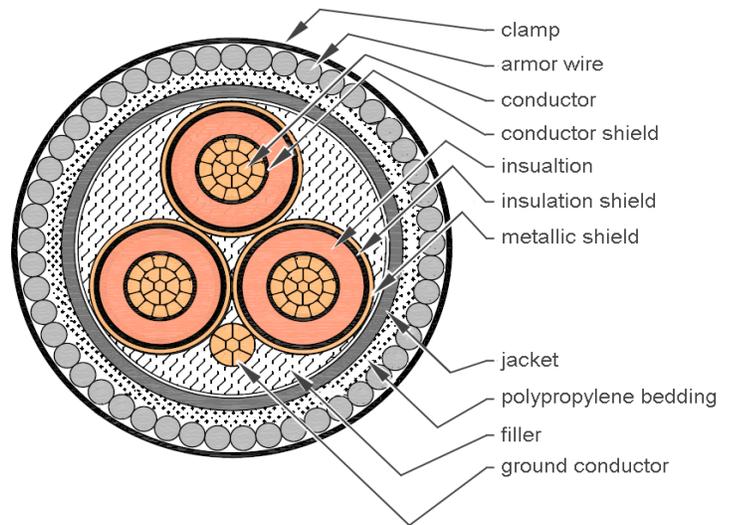
**5.9 Assembly and Identification**

One bare ground conductor shall be provided under the jacket of the 3/C assembly. The ground conductor shall be located at the interstice of the 3/C assembly.

Bedding shall be applied over the jacket and under the armor sheath.

Alternate bedding methods or materials may be considered.

An asphalt coating over the bedding and/or armor is expressly prohibited.



	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Ground conductor</b>		
quantity	1 ▲	SCL preference
size	#3 AWG ▲	SCL preference
diameter, nominal	0.24 in	calculation
metal	copper, bare	ASTM B49
stranding type	compact	ASTM B496
stranding subtype	concentric round	ASTM B496
number of strands	7	ASTM B496
temper	soft drawn	ASTM B3
lay, outer layer	left hand	ASTM B3, Section 5.5.1
lay, successive layers	reversed	ASTM B3, Section 5.5.1
<b>Bedding material</b>	jute or polypropylene rove ▲	ICEA S-93-639, Section 7.3.6.2
<b>Thickness, nominal</b>	110 mil	ICEA S-93-639, Section 7.3.6.2, Table 7-18
<b>Red stripe identification</b>	not required	ICEA S-97-682, Section 8.2.1.1

**MATERIAL STANDARD**

15 kV, 3/C, Armored, EPR Insulated, Tape Shielded Cable

standard number: **6025.02**

superseding: new  
 effective date: September 16, 2011  
 page: 5 of 5

**6. Packaging**

	Requirements	Reference
<b>Stock Number</b>	<b>013306</b>	<b>SCL</b>
<b>Size</b>	4/0 AWG	various
<b>Reel type</b>	*	SCL preference
<b>Reel dimension</b>		
flange diameter, maximum	*	SCL preference
outside width, maximum	*	SCL preference
drum diameter, minimum	*	SCL preference
length per reel +10%, - 0%	*	SCL preference
gross weight, maximum	*	SCL preference

\* to be determined at the time of order, refer to Section 2, Application

**7. Issuance**

	Requirements
<b>Stock Number</b>	<b>013306</b>
<b>Size</b>	4/0 AWG
<b>Stock unit</b>	FT

**8. Approved Manufacturing Plants**

Manufacturer	Location
<b>Okonite</b>	Orangeburg, SC
	Paterson, NJ
	Richmond, KY
	Santa Maria, CA

**9. References**

**CS-17783**; Okonite Drawing No.; September 7, 2011

**Okoguard Okoseal type MV-105**; Product Data Section 2, Sheet 20

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator for 6025.02 (john.shipek@seattle.gov)

**15 KV, 3/C, EPR/EAM INSULATED, TAPE SHIELDED CABLE**



**1. Scope**

This standard covers the detailed requirements for 15 kV, ethylene propylene rubber (EPR) and ethylene alkene copolymer (EAM), three conductor cable used for the distribution of electric energy.

Industry designation: **3/C**

This standard applies to Seattle City Light (SCL) Stock No. 010128.

**2. Application**

Cable is intended for use on a nominal 13.8 kV, three-phase, three-wire, delta, 60 Hz, power system. This product has particular application in 3-1/2 inch square, clay tile duct banks.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standard:

**ICEA S-97-682-2013**; "Utility Shielded Power Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction**

**5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

15 kV, 3/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.10**

superseding: August 30, 2011

effective date: October 30, 2015

page: 2 of 4

**5. Construction, continued****5.2 Conductor**

		Requirements	Reference
<b>Diameter</b>	minimum	0.721 in	ICEA S-97-682, Section 2.5
	nominal	0.736 in	ASTM B496
	maximum	0.751 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		copper	ASTM B49
<b>Stranding type</b>		concentric-lay	ASTM B496
<b>Class</b>		none	none
<b>Stranding subtype</b>		compact	ASTM B496
<b>Number of strands</b>		35-37	ASTM B496, Table 1
<b>Temper</b>		soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>		left hand	ASTM B496, Section 5
<b>Lay, successive layers</b>		reversed	ASTM B496, Section 5
<b>Sealant for stranded conductors</b>		option required ▲	ICEA S-97-682, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
<b>Thickness, minimum point</b>		16 mil	ICEA S-97-682, Part 3, Table 3-1

**5.4 Insulation**

		Requirements	Reference
<b>Material</b>		ethylene propylene rubber (EPR)/ ethylene alkene copolymer (EAM), Class III	ICEA S-97-682, Section 4.1
<b>Thickness</b>	minimum point	165 mil	ICEA S-97-682, Section 4.2, Table 4-7
	nominal	175 mil	ICEA S-97-682, Table 8-1
	maximum point	205 mil	ICEA S-97-682, Section 4.2, Table 4-7
<b>Insulation level</b>		100%	ICEA S-97-682, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		110 kV crest	ICEA S-97-682, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

		Requirements	Reference
<b>Material</b>		discharge-free (thermosetting material)	ICEA S-97-682, Section 5.1 to 5.5.1
<b>Thickness</b>	minimum point	24 mil	ICEA S-97-682, Section 5.2, Table 5-1
	maximum point	60 mil	ICEA S-97-682, Section 5.2, Table 5-1

**MATERIAL STANDARD**

15 kV, 3/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.10**

superseding: August 30, 2011

effective date: October 30, 2015

page: 3 of 4

**5. Construction, continued****5.6 Metallic Shield**

	Requirements	Reference
<b>Metal</b>	copper, uncoated	ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>	helically applied tape ▲	ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>	option not required	ICEA S-97-682, Section 6.7

**5.7 Jacket (Non-Metallic Covering)**

Jacket shall be applied over 3/C assembly.

	Requirements	Reference
<b>Material</b>	linear low density polyethylene (LLDPE)	ICEA S-97-682, Section 7.1.1
<b>Color</b>	black	ICEA S-97-682, Section 7.1.1
<b>Type</b>	overlying	ICEA S-97-682, Section 7.2
<b>Thickness</b>	minimum point	100 mil ▲
	maximum point	150 mil ▲
<b>Maximum diameter over jacket</b>	2.92 in ▲	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

	Requirements	Reference
<b>Red stripe identification</b>	not required	ICEA S-97-682, Section 8.2.1.1

**6. Packaging**

	Requirements	Reference
<b>Reel type</b>	steel, fluted	WC 26, Section 2.1.2
<b>Reel dimension</b>	flange diameter, maximum	96 in ▲
	outside width, maximum	71 in ▲
	drum diameter, minimum	42 in ▲
	length per reel ± 10%	2,000 ft ▲
	gross weight, maximum	17,000 lb ▲

**MATERIAL STANDARD**

15 kV, 3/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.10**

superseding: August 30, 2011

effective date: October 30, 2015

page: 4 of 4

**7. Issuance****Stock Unit:** FT**8. Approved Manufacturing Plants**

<b>Manufacturer</b>	<b>Location</b>
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Okonite</b>	Orangeburg, SC
	Richmond, KY
	Santa Maria, CA
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL
	Starkville, MS

**9. References****SCL Material Standard 6015.00**, "Medium Voltage Cable – General"**10. Sources****Shipek, John**; SCL Standards Supervisor, subject matter expert and originator of 6025.10 (john.shipek@seattle.gov)

**15 kV, 3-1/C, EPR/EAM INSULATED, FLAT STRAP SHIELDED CABLE**



**1. Scope**

This standard covers the detailed requirements for 15 kV, ethylene propylene rubber (EPR) and ethylene alkene copolymer (EAM), three conductor triplexed cable used for the distribution of electric energy.

Industry designation: 3-1/C

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock Number	Size
012735	500 kcmil
623670	1000 kcmil

**2. Application**

Cable is intended for use on a nominal 13.8 kV, three-phase, three-wire, delta, 60 Hz, power system.

For a cable fault occurring between two vaults, full fault current flows in the metallic shield from the fault location to the first splice vault nearest the source. Because the phases of a 3-1/C cable are individually jacketed, adjacent metallic shields (or separately-pulled, bare ground conductors) cannot be counted upon to dissipate fault current.

**3. General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

**4. Industry Standards**

Cable shall meet the requirements of the following industry standard: ICEA S-94-649-2013.

Refer to SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**5. Construction**

**5.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special SCL requirements, some of which are detailed in SCL 6015.00.

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**Seattle City Light**  
**MATERIAL STANDARD**

15 kV, 3-1/C, EPR/EAM Insulated, Flat Strap Shielded Cable

standard number: **6025.60**  
 superseding: July 9, 2013  
 effective date: October 23, 2015  
 page: 2 of 5

**5.2 Conductor**

Requirement	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Diameter			
minimum	1.095 in	1.095 in	ICEA S-94-649, Section 2.5
nominal	1.117 in	1.117 in	ASTM B8
maximum	1.139 in	1.139 in	ICEA S-94-649, Section 2.5
Metal	copper	copper	ASTM B49
Stranding type	concentric-lay	concentric-lay	ASTM B496
Class	B	B	ASTM B8
Stranding subtype	compressed	compressed	ASTM B8
Number of strands	37	61	ASTM B8
Temper	soft drawn, annealed prior to stranding	soft drawn, annealed prior to stranding	ASTM B3
Lay, outer layer	left hand	left hand	ASTM B3, Section 5.5.1
Lay, successive layers	reversed	reversed	ASTM B3, Section 5.5.1
Sealant for stranded conductors	required ▲	required ▲	ICEA S-94-649, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Thickness, minimum point	16 mil	20 mil	ICEA S-94-649, Part 3

**5.4 Insulation**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Material	ethylene propylene rubber (EPR)/ethylene alkene copolymer (EAM), Class III	ethylene propylene rubber (EPR)/ethylene alkene copolymer (EAM), Class III	ICEA S-94-649, Section 4.1
Thickness			ICEA S-94-649, Section 4.2, Table 4-7
minimum point	165 mil	165 mil	
nominal	175 mil	175 mil	"
maximum point	205 mil	205 mil	"
Insulation level	100%	100%	ICEA S-94-649, Section 4.3, Table 4-7
Basic impulse level (BIL)	110 kV crest	110 kV crest	ICEA S-94-649, Section 4.3, Table 4-6

Seattle City Light  
**MATERIAL STANDARD**

15 kV, 3-1/C, EPR/EAM Insulated, Flat Strap Shielded Cable

standard number: **6025.60**  
 superseding: July 9, 2013  
 effective date: October 23, 2015  
 page: 3 of 5

**5.5 Extruded Insulation Shield**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Material	discharge-free (thermosetting material)	discharge-free (thermosetting material)	ICEA S-94-649, Section 5.1 to 5.4.1.5
Thickness			
minimum point	24 mil	24 mil	ICEA S-94-649, Section 5.2, Table 5-2
nominal	60 mil	60 mil	ICEA S-94-649, Section 5.2, Table 5-2

**5.6 Metallic Shield**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Metal	copper, uncoated or tin coated	copper, uncoated or tin coated	ICEA S-94-649, Section 6
Type	flat strap, helically applied ▲	flat strap, helically applied ▲	ICEA S-94-649, Section 6
Number of straps	13 + 3, - 2 ▲	23 + 3, - 3 ▲	SCL preference
Cross-sectional area, minimum	48,000 cmil ▲	106,000 cmil ▲	SCL preference
Water blocking components for metallic shield	required ▲	required ▲	ICEA S-94-649, Section 6.6

**5.7 Jacket**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Material	linear low density polyethylene (LLDPE)	linear low density polyethylene (LLDPE)	ICEA S-94-649, Section 7.1.1
Color	black	black	ICEA S-94-649, Section 7.1.1
Type	extruded-to-fill	extruded-to-fill	ICEA S-94-649, Section 7.2.1
Thickness			
minimum point	45 mil	70 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
maximum point	80 mil	120 mil	ICEA S-94-649, Section 7.2.1, Table 7-10
Maximum diameter over jacket	1.55 in ▲	1.99 in ▲	SCL preference

**Seattle City Light**  
**MATERIAL STANDARD**

15 kV, 3-1/C, EPR/EAM Insulated, Flat Strap Shielded Cable

standard number: **6025.60**  
 superseding: July 9, 2013  
 effective date: October 23, 2015  
 page: 4 of 5

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Red stripe identification	required ▲	required ▲	ICEA S-94-649, Section 8.2.1.1

**6. Packaging**

Requirements	Stock Number		Reference
	501273	623670	
Size	500 kcmil	1000 kcmil	
Reel type	steel, fluted	steel, fluted	WC 26, Section 2.1.2
Reel dimension			
flange diameter, maximum	96 in ▲	96 in ▲	SCL preference
outside width, maximum	68.00 in ▲	68.00 in ▲	Due to maximum arm width of equipment at Seattle City Light, reels greater than 68.00 inches cannot be accepted.
drum diameter, minimum	42 in ▲	42 in ▲	SCL preference
length per reel +10%, - 0%	1800 ft ▲		SCL preference
length per reel +0%, - 10%	1,200 ft ▲	1,200 ft ▲	SCL preference
gross weight, maximum	17,000 lb ▲	17,000 lb ▲	SCL preference

**7. Issuance**

Requirements	Stock Number		Reference
	012735	623670	
Size	500 kcmil	1000 kcmil	
Stock unit	FT	FT	

**8. Approved Manufacturing Plants - Manufacturers and Plant Locations**

General Cable	Okonite	Prysmian (formerly Pirelli)	Southwire
DuQuoin, IL	Orangeburg, SC	Abbeville, SC	Carrollton, GA
Malvern, AR	Richmond, KY	Prescott, ON, Canada	Heflin, AL
Marshall, TX	Santa Maria, CA	St. Jean Sur Richielieu, QC, Canada	
St. Jerome, QC, Canada			

**9. References**

**SCL Material Standard 6015.00**, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert and originator of 6025.60 ([john.shipek@seattle.gov](mailto:john.shipek@seattle.gov))

# MATERIAL STANDARD

## 15 kV, 1/C, EPR/EAM INSULATED, TAPE SHIELDED CABLE



### 1. Scope

This standard covers the detailed requirements for 15 kV, ethylene propylene rubber (EPR) and ethylene alkene copolymer (EAM), single conductor cable used for the distribution of electric energy. Cable is specified to have 220 mil insulation (nominal).

Industry designation: **1/C**

This standard applies to Seattle City Light (SCL) Stock No. 623640.

### 2. Application

Cable is for connecting the secondary terminals of 26-13 kV transformers to customer switchgear, or where maximum flexibility is needed in a 15 kV rated cable.

Users should be aware that this cable has 220 mil of insulation—a non-standard value for 15 kV cable at Seattle City Light.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of SCL 6015.00, "Medium Voltage Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standard:

**ICEA S-97-682-2013**; "Utility Shielded Power Cables Rated 5 Through 46 kV"

See SCL 6015.00 to obtain the appropriate revision date for other referenced industry standards.

### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards. They are repeated here for the convenience of the reader. The ▲ symbol indicates special City Light requirements, some which are detailed in SCL 6015.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

15 kV, 1/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.70**

superseding: August 30, 2011

effective date: October 30, 2015

page: 2 of 4

**5. Construction**, continued**5.2 Conductor**

		Requirements	Reference
<b>Diameter</b>	minimum	0.721 in	ICEA S-97-682, Section 2.5
	nominal	0.736 in	ASTM B496
	maximum	0.750 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		copper	ASTM B49
<b>Stranding type</b>		concentric-lay	ASTM B496
<b>Class</b>		none	none
<b>Stranding subtype</b>		compact	ASTM B496
<b>Number of strands</b>		35-37	ASTM B496, Table 1
<b>Temper</b>		soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>		left hand	ASTM B496, Section 5
<b>Lay, successive layers</b>		reversed	ASTM B496, Section 5
<b>Sealant for stranded conductors</b>		option not required	ICEA S-97-682, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
Thickness, minimum point		16 mil	ICEA S-97-682, Part 3, Table 3-1

**5.4 Insulation**

		Requirements	Reference
<b>Material</b>		ethylene propylene rubber (EPR)/ ethylene alkene copolymer (EAM), Class III	ICEA S-97-682, Section 4.1
<b>Thickness</b>	minimum point	210 mil	ICEA S-97-682, Section 4.2, Table 4-7
	nominal	220 mil	ICEA S-97-682, Table 8-1
	maximum point	250 mil	ICEA S-97-682, Section 4.2, Table 4-7
<b>Insulation level</b>		133%	ICEA S-97-682, Section 4.2, Table 4-7
<b>Basic impulse level (BIL)</b>		110 kV	ICEA S-97-682, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

		Requirements	Reference
<b>Material</b>		discharge-free (thermosetting material)	ICEA S-97-682, Section 5.1 to 5.5.1
<b>Thickness</b>	minimum point	24 mil	ICEA S-97-682, Section 5.2, Table 5-1
	maximum point	60 mil	ICEA S-97-682, Section 5.2, Table 5-1

**MATERIAL STANDARD**

15 kV, 1/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.70**

superseding: August 30, 2011

effective date: October 30, 2015

page: 3 of 4

**5. Construction**, continued**5.6 Metallic Shield**

	Requirements	Reference
<b>Metal</b>	copper, uncoated	ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>	helically applied tape ▲	ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>	option not required	ICEA S-97-682, Section 6.7

**5.7 Jacket (Non-Metallic Covering)**

	Requirements	Reference
<b>Material</b>	polyvinyl chloride (PVC)	ICEA S-97-682, Section 7.1.6
<b>Color</b>	black	ICEA S-97-682, Section 7.1.6
<b>Type</b>	overlying	ICEA S-97-682, Section 7.2
<b>Thickness</b>	minimum point	70 mil
	maximum point	105 mil
<b>Maximum diameter over jacket</b>	1.63 in	SCL preference

**5.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**5.9 Assembly and Identification**

	Requirements	Reference
<b>Red stripe identification</b>	not required	ICEA S-97-682, Section 8.2.1.1

**6. Packaging**

	Requirements	Reference
<b>Reel type</b>	steel, fluted	WC 26, Section 2.1.2
<b>Reel dimension</b>	flange diameter, maximum	78 in ▲
	outside width, maximum	45 in ▲
	drum diameter, minimum	20 in ▲
	length per reel ± 10%	1,000 ft ▲
	gross weight, maximum	17,000 lb ▲

**7. Issuance****Stock unit:** FT

**MATERIAL STANDARD**

15 kV, 1/C, EPR/EAM Insulated, Tape Shielded Cable

standard number: **6025.70**

superseding: August 30, 2011

effective date: October 30, 2015

page: 4 of 4

**8. Approved Manufacturing Plants**

<b>Manufacturer</b>	<b>Location</b>
<b>Aetna Insulated Wire Company</b>	Virginia Beach, VA
<b>General Cable</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Okonite</b>	Orangeburg, SC
	Richmond, KY
	Santa Maria, CA
<b>Prysmian</b>	Abbeville, SC
	Prescott, ON, Canada
	Saint-Jean-sur-Richelieu, QC, Canada
<b>Southwire</b>	Carrollton, GA
	Heflin, AL

**9. References**

**SCL Material Standard 6015.00**, "Medium Voltage Cable – General"

**10. Sources**

**Shipek, John**; SCL Standards Supervisor, subject matter expert, and originator of 6025.70  
(john.shipek@seattle.gov)

**HIGH VOLTAGE, XLPE INSULATED CABLE - GENERAL**

**1. Scope**

This Material Standard covers the general requirements for 69-138 kV, cross-linked polyethylene (XLPE) insulated, single-conductor high voltage cable used for the distribution and transmission of electric energy.

Cable joint and termination requirements are outside the scope of this Material Standard.

Commission testing requirements of installed cable prior to energization are outside the scope of this Material Standard.

**2. Application**

Cable is intended for use on three-phase, 60 Hz, grounded, wye-connected systems.

**3. Specific Requirements**

Specific requirements shall be according to the detailed Material Standard and Purchase Order issued subsequent to competitive solicitations.

**4. Industry Standards**

Cable shall meet the requirements of the following industry standards as referenced in this and the detailed Material Standard:

**AEIC CS9-2006** – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46 kV Through 345 kVac

**ASTM B3-01** – Standard Specification for Soft or Annealed Copper Wire

**ASTM B8-04** – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

**ASTM B49-04** – Standard Specification for Copper Redraw Rod for Electrical Purposes

**ICEA S-108-720-2004** – Standard for Extruded Insulation Power Cables Rated Above 46 Through 345 kV

**NEMA WC 26-2000** (EEMAC 201-2000) – Binational Wire and Cable Packaging Standard

**5. Conflict**

Where conflict exists, the following order of precedence shall apply:

1. Seattle City Light Purchase Order (PO)
2. Seattle City Light General Terms and Conditions
3. Seattle City Light detailed Material Standard
4. This Material Standard
5. AEIC CS9
6. ICEA S-108-720

**6. Purchase Order Information**

Purchase Order will state the following minimum information:

- Cable description
- Seattle City Light General Material Standard number including revision date
- Seattle City Light detailed Material Standard number including revision date
- Seattle City Light Stock Number
- Total order quantity
- Price
- Delivery date
- Quantity per reel

**7. Alternative Proposals**

Alternative proposals will be accepted according to the requirements of AEIC CS9, Section 1.4.2.

**8. Construction and Ratings**

**8.1 General**

Cable shall be suitable for underground ducts, conduit risers, and wet or dry locations.

The manufacturer shall be responsible for ensuring the compatibility of all components used to assemble the cable.

Cable shall be manufactured in a continuous triple-extrusion process. The conductor shield, insulation, and insulation shield layers shall be extruded over the core conductor in one continuous pass using true triple or triple tandem extruders.

<i>standards coordinator</i>	<i>standards manager</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pam S. Johnson

**MATERIAL STANDARD**

High Voltage, XLPE Insulated Cable - General

standard number: **6050.00**

superseding: June 12, 2008

effective date: May 14, 2010

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**8. Construction and Ratings****8.1 General, continued**

Cable shall be capable of being safely handled and installed if not subjected to temperatures lower than minus 10° C in the preceding twenty four hours.

Completed cable assembly shall not contain lead.

In-plant repairs of the cable core are prohibited unless specifically agreed to by the purchaser.

Failure to meet any of the requirements of this and referenced standards shall be cause for rejection.

Cable shall be designed and constructed to operate at conductor temperatures according to the requirements of AEIC CS9, Section 1.9 and not exceeding those shown in Table 8.1.

**Table 8.1**

Insulation Material	Normal Operation	Emergency Overload	Short Circuit
XLPE	90° C	105° C	250° C

**8.2 Conductor**

Conductor shall meet the requirements of AEIC CS9, Section 2.1.

**8.3 Conductor Shield**

Conductor shield shall meet the requirements of AEIC CS9, Section 2.2.

Conductor shield shall be super smooth grade.

**8.4 Insulation**

Insulation shall meet the requirements of AEIC CS9, Section 2.3.

Insulation shall be with no mineral fillers crosslinked polyethylene (XLPE).

Insulation shall be super clean grade.

Approved insulation providers:

- Dow
- Borealis

Cable shall be dry cured. Steam curing is expressly prohibited.

**8.5 Extruded Insulation Shield**

Extruded insulation shield shall meet the requirements of AEIC CS9, Section 2.4.

Extruded insulation shield shall be conspicuously marked "semiconducting."

Extruded insulation shield shall be bonded.

**8.6 Metallic Shield/Sheath**

Metallic shield/sheath shall meet the requirements of AEIC CS9, Section 2.5.

If the Detailed Material Standard requires the option of water blocking components for the metallic shield the following clarifications apply:

- The requirements of ICEA S-108-720, Section 6.5 shall apply.
- The water blocking type shall be water swellable tape.

**8.7 Jacket (Non-Metallic Covering)**

Jacket shall meet the requirements of AEIC CS9, Section 2.6.

Cable jacket or jacket laminate combination shall be free stripping from the fault handling layer.

**8.8 Assembly and Identification**

Cable shall be assembled and identified according to the requirements of AEIC CS9, Section 9.

**9. Packaging**

Cable shall be placed on reels according to the requirements of AEIC CS9, Section 10.0.

Reels shall be returnable steel.

Reels and their corresponding capacities shall be according to the requirements of NEMA WC 26.

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange.

One cable per reel shall be provided with a cable eye.

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Reel identification number
- Shipping length of cable on reel
- Outer and inner end sequence length marking numbers
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**MATERIAL STANDARD**

High Voltage, XLPE Insulated Cable - General

standard number: **6050.00**

superseding: June 12, 2008

effective date: May 14, 2010

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**9. Packaging, continued**

Reels shall be protected for shipment according to WC 26, Section 4, and Table 9.1 of this Material Standard.

**Table 9.1**

Plant Location	WC 26 Reel Covering
US	Level 2 (Weather Protector)
Canada	
Mexico	
All other	Level 6 (Export)

**10. Testing and Test Methods**

Testing and test methods shall be performed according to the requirements ICEA S-108-720, Part 9 and AEIC CS9, Section 2.7.

Cable insulation shall not be tested with high voltage DC.

**11. Documentation****11.1 General**

Documentation shall be in English and use customary inch-pound units.

Documentation shall utilize common industry terminology and well-understood abbreviations.

**11.2 Bidder's Data**

Bidder shall return the following technical information with their bids clearly indicating to which Stock Number it applies:

- Manufacturer's name
- Manufacturing plant location(s) (all possible)
- Basic cable description
- Information specified in ICEA S-108-720, Section 1.4
- Reel designation (RM or RMT) and class (1 or 2)
- Reel flange diameter
- Reel inside traverse and overall outside width
- Reel drum diameter
- Alternate packaging (if any, at supplier's option; this shall supplement standard packaging information, not replace it)
- Length per reel
- Reel gross, net, and tare weight
- Approximate weight per foot of cable
- Manufacturer's warranty
- All exceptions to Seattle City Light requirements with reference to the requirement to which exception is taken; indicate if no exceptions taken

**11.2 Bidder's Data, continued**

Bid information shall be presented in a clear and consolidated manner for ease of review.

**11.3 Exceptions to Bidder's Data**

The requirements of Section 11.2 may be waived provided the following conditions are met:

- Manufacturer has submitted the requested technical information by means of a formal bid within the previous twelve months.
- Requested information has not changed since the last submission.
- Manufacturer confirms in their bid that no exceptions are taken to Seattle City Light's requirements.

**11.4 Certified (Production) Test Reports**

For each shipment a certified production test report (CTR) shall be emailed to:

standards.scl@seattle.gov

Certified production test report shall include:

- A unique certified test report number
- Plant location
- Seattle City Light Purchase Order number
- Manufacturer's order number
- Shipping reel information or serial numbers and shipment footage
- All information listed under Bidder's Data
- Conductor metal, stranding type, class, stranding subtype, number of strands, temper, and lay
- Conductor shield manufacturer and compound number
- Extruded insulation shield manufacturer and compound number
- Metallic insulation shield dimensional information
- Results of the testing required under Section 10 of this Material Standard
- Cable core extruder line identification
- Jacket extruder line identification
- List of shipping reels in the sequential order in which they came off the core extruder
- The sequential order of the shipping reels in which they came off the jacket extruder
- Outside (top) and inside (bottom) jacket sequential footage numbers for each shipping reel

Certified production test report shall include a statement that all data in the report is true and complete.

Certified production test reports shall not contain information for more than one cable order or more than one Stock Number at a time.

**MATERIAL STANDARD**

High Voltage, XLPE Insulated Cable - General

standard number: **6050.00**

superseding: June 12, 2008

effective date: May 14, 2010

page: 4 of 4

**11. Documentation**

**11.4 Certified (Production) Test Reports, continued**

Supplier shall provide certified production test report according to Table 13.1 of this Material Standard.

**11.5 Certified Qualification Test Reports**

Cable shall meet the qualification test requirements of ICEA S-108-720, Part 10.

Upon request, supplier shall provide copies of ICEA certified qualification test reports.

**11.6 Plant QA Processes**

Upon request, supplier shall provide information describing their plant's quality assurance processes.

**12. Cable Samples**

For each shipment, manufacturer shall provide cable samples for Seattle City Light to evaluate for compliance according to Tables 12.1 and 13.1 of this Material Standard.

Cable samples shall be taken from the top of each shipping reel.

Each cable sample shall include at least one complete identification string and at least one sequential length marking number.

For each shipment, cable samples shall be express mailed to:

Seattle City Light  
3613 – 4th Avenue South  
Seattle, WA 98134

Attention: Quality Assurance

Each cable sample shall be marked at one end with corresponding:

- Manufacturer's Name
- Shipping Reel Number
- Reel Length
- CTR Number
- Seattle City Light Purchase Order Number
- Seattle City Light Stock Number

**Table 12.1**

Cable Type	Sample Requirements
1/C	One 2-foot sample per shipping reel

**13. Product Evaluation**

Seattle City Light Quality Assurance and Standards will evaluate the certified production test report and cable samples for compliance.

Following the internal evaluation, Seattle City Light Material Control will inform the supplier if cable shipment is in compliance, or not.

Seattle City Light Material Control will release reels for shipment and receive cable according to Table 13.1.

**Table 13.1**

Subject/Event	Action
Certified test reports	Email as soon as available
Cable samples	Express mail as soon as available
Release reels for shipment	Following verification of compliance by Seattle City Light
Receive cable	Following matching of reels with CTR and check for visible shipping damage

**14. Plant Inspections**

Upon request, supplier shall provide sufficient notice for Seattle City Light or Seattle City Light's representative to inspect the cable during any stage of manufacture or testing.

**15. Shipping**

Reels shall be shipped according to the requirements of AEIC CS9, Section 10.0.

**16. Approved Manufacturers**

Approved manufacturers are identified in the detailed Material Standard.

**17. References**

**Cunningham, Bob**; SCL Engineer, subject matter expert (bob.cunningham@seattle.gov)

**IEC 60840**; *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test Methods and Requirements*; International Electrotechnical Commission; April 2004 (Edition 3)

**Risch, Bob**; SCL Engineer, subject matter expert (bob.risch@seattle.gov)

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6050.00 (john.shipek@seattle.gov)

# MATERIAL STANDARD

## 115 kV, 1000 KCMIL, 1/C, XLPE INSULATED CABLE

### 1. Scope

This material standard covers the detailed requirements for 115 kV, 1000 kcmil, cross-linked polyethylene (XLPE), single conductor cable used for the transmission of electric energy.

Industry designation: **1/C**

This material standard applies to the following Seattle City Light Stock Number:

<b>Stock Number</b>	<b>012799</b>
<b>Size</b>	1000 kcmil

Cable joint and termination requirements are outside the scope of this Material Standard.

Commission testing requirements of installed cable prior to energization are outside the scope of this Material Standard.

### 2. Application

Cable is intended for use on a nominal 115 kV, three-phase, grounded, wye-connected power system.

	<b>System Characteristics and Design Criteria</b>	<b>Reference</b>
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Frequency</b>	60 Hz	SCL
<b>Operating voltage, ph-ph</b>		
Nominal	115 kV	SCL
Maximum	121 kV	SCL
<b>Basic Impulse Voltage (BIL)</b>	550 kV crest	SCL
<b>Fault current</b>		
Symmetrical	35 kA	SCL
Duration	30 cycles	SCL
<b>Location</b>	wet	SCL

### 2. Application, continued

Seattle City Light assumes responsibility for determining the normal ampacity rating of cable.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6050.00, "High Voltage, XLPE Insulated Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standards:

**AEIC CS9-2006** – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46kV through 345 Kvac

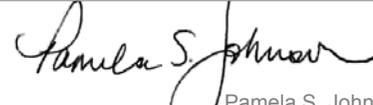
**ICEA S-108-720-2004** – Standard for Extruded Insulation Power Cables Rated Above 46 through 345 kV

Refer to Material Standard 6050.00 to obtain the appropriate revision date for other referenced industry standards.

### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6050.00.

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Barnett	 Pamela S. Johnson

**MATERIAL STANDARD**

115 kV, 1000 kcmil, 1/C, XLPE Insulated Cable

standard number: **6050.10**

superseding: June 12, 2008

effective date: July 3, 2008

page: 2 of 3

**5. Construction, continued****5.2 Conductor**

	Requirements	Reference
<b>Stock Number</b>	012799	SCL
<b>Size</b>	1000 kcmil	various
<b>Diameter</b>		
minimum	1.095 in	ICEA S-108-720, Section 2.5
nominal	1.117 in	ASTM B8
maximum	1.139 in	ICEA S-108-720, Section 2.5
<b>Metal</b>	copper	ASTM B49
<b>Stranding type</b>	concentric-lay	ASTM B8
<b>Class</b>	B	ASTM B8
<b>Stranding subtype</b>	compressed	ASTM B8
<b>Number of strands</b>	61	ASTM B8, Table 1
<b>Temper</b>	soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>	left hand	ASTM B8, Section 5.5.1
<b>Sealant for stranded conductors</b>	not required or desired	ICEA S-108-720, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

	Requirements	Reference
<b>Stock Number</b>	012799	SCL
<b>Size</b>	1000 kcmil	various
<b>Thickness, minimum point</b>	20 mil	ICEA S-108-720, Part 3, Table 3.1
<b>Material</b>	formulated with acetylene black ▲	SCL and AEIC CS9, Section 2.2.2

**5.4 Insulation**

	Requirements	Reference
<b>Stock Number</b>	012799	SCL
<b>Size</b>	1000 kcmil	various
<b>Material</b>	crosslinked polyethylene (XLPE) with no mineral fillers	ICEA S-108-720, Section 4.1
<b>Approved material formulations</b>	specified in general Material Standard	SCL 6050.00
<b>Thickness</b>		
minimum	760 mil	SCL
nominal	800 mil	ICEA S-108-720, Appendix F, Table F-1
maximum	840 mil	SCL
<b>Basic Impulse Level (BIL)</b>	550 kV crest	ICEA S-108-720, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

	Requirements	Reference
<b>Stock Number</b>	012799	SCL
<b>Size</b>	1000 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)	SCL
<b>Thickness</b>		
minimum point	40 mil	ICEA S-108-720, Section 5.2, Table 5-1
maximum point	100 mil	ICEA S-108-720, Section 5.2, Table 5-1

**MATERIAL STANDARD**

superseding: June 12, 2008

effective date: July 3, 2008

115 kV, 1000 kcmil, 1/C, XLPE Insulated Cable

page: 3 of 3

**5. Construction, continued****5.6 Metallic Shield/Sheath**

	Requirements	Reference
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Metal and type</b>	welded corrugated copper or laminated copper foil longitudinally folded and bonded to the jacket	ICEA S-108-720, Part 6
<b>Radial moisture barrier</b>	required ▲	ICEA S-108-720, Section 6.4
<b>Water blocking components for metallic shield</b>	required ▲	ICEA S-108-720, Section 6.5

**5.7 Jacket (Non-Metallic Covering)**

	Requirements	Reference
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Material</b>	linear low density polyethylene (LLDPE)	ICEA S-108-720, Section 7.1.1
<b>Color</b>	black	ICEA S-108-720, Section 7.1.1
<b>Thickness</b>		
minimum point	100 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
maximum point	160 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
<b>Semi-conducting coating</b>	required	AEIC CS9, Section 2.6.3
<b>Maximum diameter over jacket</b>	3.70 in ▲	SCL preference

**5.8 Assembly and Identification**

	Requirements	Reference
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Center strand identification</b>	not required	ICEA S-108-720, Section 8.1.1
<b>Sequential length marking</b>	required ▲	ICEA S-108-720, Section 8.1.2

**6. Packaging**

	Requirements	Reference
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Reel type</b>	steel fluted	WC 26, Section 2.1.2
<b>Flange diameter, maximum</b>	as specified on purchase order	SCL preference
<b>Outside width, maximum</b>	as specified on purchase order	SCL preference
<b>Drum diameter, minimum</b>	as specified on purchase order	SCL preference
<b>Length per reel, +1.5, -0%</b>	as specified on purchase order	SCL preference

**7. Issuance**

	Requirements	Reference
<b>Stock Number</b>	<b>012799</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Stock Unit</b>	FT	SCL

**8. Approved Manufacturers**

Brugg Cables, LLC

General Cable / SILEC

J-Power Systems (JPS)

Prysmian

Southwire Company/Forte Power Systems

**9. References****Cunningham, Bob**; SCL Engineer, subject matter expert (bob.cunningham@seattle.gov)**IEC 60840**; *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test Methods and Requirements*; International Electrotechnical Commission; April 2004 (Edition 3)**Risch, Bob**; SCL Engineer, subject matter expert (bob.risch@seattle.gov)**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6050.10 (john.shipek@seattle.gov)

# MATERIAL STANDARD

## 115 KV, 2500 KCMIL, 1/C, XLPE INSULATED CABLE

### 1. Scope

This material standard covers the detailed requirements for 115 kV, 2500 kcmil, cross-linked polyethylene (XLPE), single conductor cable used for the transmission of electric energy.

Industry designation: 1/C

This material standard applies to the following Seattle City Light Stock Number:

<b>Stock Number</b>	<b>012801</b>
<b>Size</b>	2500 kcmil

Cable joint and termination requirements are outside the scope of this Material Standard.

Commission testing requirements of installed cable prior to energization are outside the scope of this Material Standard.

### 2. Application

Cable is intended for use on a nominal 115 kV, three-phase, grounded, wye-connected power system.

	System Characteristics and Design Criteria	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Frequency</b>	60 Hz	SCL
<b>Operating voltage, ph-ph</b>		
nominal	115 kV	SCL
maximum	121 kV	SCL
<b>Basic impulse voltage (BIL)</b>	550 kV crest	SCL
<b>Fault current</b>		
symmetrical	35 kA	SCL
duration	30 cycles	SCL
<b>Location</b>	wet	SCL

Seattle City Light assumes responsibility for determining the normal ampacity rating of cable.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6050.00, "High Voltage, XLPE Insulated Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standards:

**AEIC CS9-2006** – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46kV through 345 kVAC

**ICEA S-108-720-2004** – Standard for Extruded Insulation Power Cables Rated Above 46 through 345 kV

Refer to Material Standard 6050.00 to obtain the appropriate revision date for other referenced industry standards.

### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6050.00.

#### 5.2 Conductor

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Diameter</b>		
minimum	1.788 in	ICEA S-108-720, Section 2.5
nominal	1.824 in	ASTM B8
maximum	1.860 in	ICEA S-108-720, Section 2.5
<b>Metal</b>	copper	ASTM B49

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

115 kV, 2500 kcmil, 1/C, XLPE Insulated Cable

standard number: **6050.25**

superseding: new  
 effective date: May 12, 2011  
 page: 2 of 3

**5. Construction, continued**

**5.2 Conductor, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Stranding type</b>	concentric-lay	ASTM B8
<b>Class</b>	B	ASTM B8
<b>Number of strands</b>	127	ASTM B8, Table 1
<b>Temper</b>	soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>	left hand	ASTM B8, Section 5.5.1
<b>Sealant for stranded conductors</b>	not required or desired	ICEA S-108-720, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Thickness, minimum point</b>	30 mil	ICEA S-108-720, Part 3, Table 3.1
<b>Material</b>	formulated with acetylene black ▲	SCL and AEIC CS9, Section 2.2.2

**5.4 Insulation**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Material</b>	crosslinked polyethylene (XLPE) with no mineral fillers	ICEA S-108-720, Section 4.1
<b>Approved material formulations</b>	specified in general Material Standard	SCL 6050.00

**5.4 Insulation, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Thickness</b>		
minimum	760 mil	SCL
nominal	800 mil	ICEA S-108-720, Appendix F, Table F-1
maximum	840 mil	SCL
<b>Basic Impulse Level (BIL)</b>	550 kV crest	ICEA S-108-720, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)	SCL
<b>Thickness</b>		
minimum point	40 mil	ICEA S-108-720, Section 5.2, Table 5-1
maximum point	100 mil	ICEA S-108-720, Section 5.2, Table 5-1

**5.6 Metallic Shield/Sheath**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Metal and type</b>	welded corrugated copper or laminated copper foil longitudinally folded and bonded to the jacket	ICEA S-108-720, Part 6

**MATERIAL STANDARD**

superseding: new  
effective date: May 12, 2011  
page: 3 of 3

115 kV, 2500 kcmil, 1/C, XLPE Insulated Cable

**5. Construction, continued**

**5.6 Metallic Shield/Sheath, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Radial moisture barrier</b>	required ▲	ICEA S-108-720, Section 6.4
<b>Water blocking components for metallic shield</b>	required ▲	ICEA S-108-720, Section 6.5

**5.7 Jacket (Non-Metallic Covering)**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Material</b>	linear low density polyethylene (LLDPE)	ICEA S-108-720, Section 7.1.1
<b>Color</b>	black	ICEA S-108-720, Section 7.1.1
<b>Thickness</b>		
minimum point	100 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
maximum point	160 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
<b>Semi-conducting coating</b>	required	AEIC CS9, Section 2.6.3
<b>Maximum diameter over jacket</b>	4.32 in ▲	SCL preference

**5.8 Assembly and Identification**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Center strand identification</b>	not required	ICEA S-108-720, Section 8.1.1
<b>Sequential length marking</b>	required ▲	ICEA S-108-720, Section 8.1.2

**6. Packaging**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Reel type</b>	steel fluted	WC 26, Section 2.1.2
<b>Flange diameter, maximum</b>	as specified on purchase order	SCL preference
<b>Outside width, maximum</b>	as specified on purchase order	SCL preference
<b>Drum diameter, minimum</b>	as specified on purchase order	SCL preference
<b>Length per reel, +1.5, -0%</b>	as specified on purchase order	SCL preference

**7. Issuance**

	Requirements	Reference
<b>Stock Number</b>	<b>012801</b>	SCL
<b>Size</b>	2500 kcmil	various
<b>Stock Unit</b>	FT	SCL

**8. Approved Manufacturers**

- Brugg Cables, LLC
- General Cable / SILEC
- J-Power Systems (JPS)
- Prismian
- Southwire Company/Forte Power Systems

**9. References**

- 6050.00**; "High Voltage, XLPE Insulated Cable – General"; SCL Material Standard
- IEC 60840**; *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test Methods and Requirements*; International Electrotechnical Commission; April 2004 (Edition 3)
- Risch, Bob**; SCL Engineer, subject matter expert (bob.risch@seattle.gov)
- Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6050.25 (john.shipek@seattle.gov)

# MATERIAL STANDARD

## 115 KV, 3000 KCMIL, 1/C, XLPE INSULATED CABLE

### 1. Scope

This material standard covers the detailed requirements for 115 kV, 3000 kcmil, cross-linked polyethylene (XLPE), single conductor cable used for the transmission of electric energy.

Industry designation: 1/C

This material standard applies to the following Seattle City Light Stock Number:

<b>Stock Number</b>	<b>012958</b>
<b>Size</b>	3000 kcmil

Cable joint and termination requirements are outside the scope of this Material Standard.

Commission testing requirements of installed cable prior to energization are outside the scope of this Material Standard.

### 2. Application

Cable is intended for use on a nominal 115 kV, three-phase, grounded, wye-connected power system.

	System Characteristics and Design Criteria	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Frequency</b>	60 Hz	SCL
<b>Operating voltage, ph-ph</b>		
nominal	115 kV	SCL
maximum	121 kV	SCL
<b>Basic impulse voltage (BIL)</b>	550 kV crest	SCL
<b>Fault current</b>		
symmetrical	35 kA	SCL
duration	30 cycles	SCL
<b>Location</b>	wet	SCL

Seattle City Light assumes responsibility for determining the normal ampacity rating of cable.

### 3. General Requirements

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6050.00, "High Voltage, XLPE Insulated Cable – General."

### 4. Industry Standards

Cable shall meet the requirements of the following industry standards:

**AEIC CS9-2006** – Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46kV through 345 kVAC

**ICEA S-108-720-2004** – Standard for Extruded Insulation Power Cables Rated Above 46 through 345 kV

Refer to Material Standard 6050.00 to obtain the appropriate revision date for other referenced industry standards.

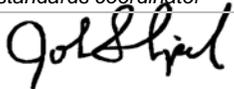
### 5. Construction

#### 5.1 General

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6050.00.

#### 5.2 Conductor

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Diameter</b>		
minimum	1.958 in	ICEA S-108-720, Section 2.5
nominal	1.998 in	ASTM B8
maximum	2.038 in	ICEA S-108-720, Section 2.5
<b>Metal</b>	copper	ASTM B49

standards coordinator	standards manager	unit director
 John Shipek	 John Shipek	 Pam S. Johnson

**MATERIAL STANDARD**

115 kV, 3000 kcmil, 1/C, XLPE Insulated Cable

standard number: **6050.30**

superseding: new  
effective date: May 12, 2010  
page: 2 of 3

**5. Construction, continued**

**5.2 Conductor, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Stranding type</b>	concentric-lay	ASTM B8
<b>Class</b>	B	ASTM B8
<b>Number of strands</b>	169	ASTM B8, Table 1
<b>Temper</b>	soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>	left hand	ASTM B8, Section 5.5.1
<b>Sealant for stranded conductors</b>	not required or desired	ICEA S-108-720, Section 2.2

**5.3 Conductor Shield (Stress Control Layer)**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Thickness, minimum point</b>	30 mil	ICEA S-108-720, Part 3, Table 3.1
<b>Material</b>	formulated with acetylene black ▲	SCL and AEIC CS9, Section 2.2.2

**5.4 Insulation**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Material</b>	crosslinked polyethylene (XLPE) with no mineral fillers	ICEA S-108-720, Section 4.1
<b>Approved material formulations</b>	specified in general Material Standard	SCL 6050.00

**5.4 Insulation, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Thickness</b>		
minimum	760 mil	SCL
nominal	800 mil	ICEA S-108-720, Appendix F, Table F-1
maximum	840 mil	SCL
<b>Basic Impulse Level (BIL)</b>	550 kV crest	ICEA S-108-720, Section 4.3, Table 4-6

**5.5 Extruded Insulation Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)	SCL
<b>Thickness</b>		
minimum point	40 mil	ICEA S-108-720, Section 5.2, Table 5-1
maximum point	100 mil	ICEA S-108-720, Section 5.2, Table 5-1

**5.6 Metallic Shield/Sheath**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Metal and type</b>	welded corrugated copper or laminated copper foil longitudinally folded and bonded to the jacket	ICEA S-108-720, Part 6

**MATERIAL STANDARD**

115 kV, 3000 kcmil, 1/C, XLPE Insulated Cable

standard number: **6050.30**

superseding: new  
effective date: May 12, 2010  
page: 3 of 3

**5. Construction, continued**

**5.6 Metallic Shield/Sheath, continued**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Radial moisture barrier</b>	required ▲	ICEA S-108-720, Section 6.4
<b>Water blocking components for metallic shield</b>	required ▲	ICEA S-108-720, Section 6.5

**5.7 Jacket (Non-Metallic Covering)**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Material</b>	linear low density polyethylene (LLDPE)	ICEA S-108-720, Section 7.1.1
<b>Color</b>	black	ICEA S-108-720, Section 7.1.1
<b>Thickness</b>		
minimum point	100 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
maximum point	160 mil	ICEA S-108-720, Section 7.2.1, Table 7-5
<b>Semi-conducting coating</b>	required	AEIC CS9, Section 2.6.3
<b>Maximum diameter over jacket</b>	4.86 in ▲	SCL preference

**5.8 Assembly and Identification**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Center strand identification</b>	not required	ICEA S-108-720, Section 8.1.1
<b>Sequential length marking</b>	required ▲	ICEA S-108-720, Section 8.1.2

**6. Packaging**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Reel type</b>	steel fluted	WC 26, Section 2.1.2
<b>Flange diameter, maximum</b>	as specified on purchase order	SCL preference
<b>Outside width, maximum</b>	as specified on purchase order	SCL preference
<b>Drum diameter, minimum</b>	as specified on purchase order	SCL preference
<b>Length per reel, +1.5, -0%</b>	as specified on purchase order	SCL preference

**7. Issuance**

	Requirements	Reference
<b>Stock Number</b>	<b>012958</b>	SCL
<b>Size</b>	3000 kcmil	various
<b>Stock Unit</b>	FT	SCL

**8. Approved Manufacturers**

- Brugg Cables, LLC
- General Cable / SILEC
- J-Power Systems (JPS)
- Prismian
- Southwire Company/Forte Power Systems

**9. References**

- 6050.00**; "High Voltage, XLPE Insulated Cable – General"; SCL Material Standard
- IEC 60840**; *Power Cables with Extruded Insulation and Their Accessories for Rated Voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) - Test Methods and Requirements*; International Electrotechnical Commission; April 2004 (Edition 3)
- Risch, Bob**; SCL Engineer, subject matter expert (bob.risch@seattle.gov)
- Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6050.30 (john.shipek@seattle.gov)

**WIRE, COPPER-CLAD STEEL, COATED**



**.1. Scope**

This standard covers the requirements for coated, round, copper-clad steel wire.

This standard applies to Seattle City Light Stock Number 012702.

**2. Application**

Wire is used to fabricate pole grounds and in other applications where theft is a concern. Unlike solid copper wire, conductor is very difficult to cut and has little value as salvage.

In 2013, this standard was revised to require the wire's outer surface be treated to resemble steel. City Light's stock number remained the same.

One half second (30 cycle) fusing current is approximately 5,650 amperes.

Refer to ASTM B910 for tensile strength and resistance per unit length values.

**3. Industry Standards**

Wire shall meet the applicable requirements of the following industry standard:

**ASTM B910-2007** – Standard Specification for Annealed Copper-Clad Steel Wire

**4. Requirements**

Wire shall meet the requirements of ASTM B910.

Size	#4 AWG, solid
Temper	annealed
Diameter	
Minimum, in	0.2012
Nominal, in	0.2043
Maximum, in	0.2073
Conductivity, % IACS, nominal	40

Wire will not be used for redraw.

Outer surface of wire shall be treated to resemble steel.

**5. Packaging**

Packaging	coil
Diameter, coil	
Outside Coil Diameter, Nominal, in	025
Inside Coil Diameter, Nominal, in	021
Weight per 100 ft., Approx., lbs	011.7
Weight per Package, Approx., lbs	050
Length per Package +/-10%, ft	431

Actual quantity per standard package may vary from the quantity stated on the Purchase Order by plus or minus 10 percent.

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Package length of product
- Package weight (gross or net)
- Date of manufacture
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**6. Issuance**

FT

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

## MATERIAL STANDARD

Wire, Copper-Clad Steel, Coated

standard number: **6100.00**

superseding: April 4, 2012

effective date: August 22, 2013

page 2 of 2

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### 7. Approved Manufacturers

Manufacturer	Product ID
Fushi Copperweld, Inc.	CCS01044D-CAMO

### 8. References

**ED5278 REV 04/13**, CAMO Anti-Theft  
Copperweld CCS Coated Grounding Wire,  
Fushi Copperweld

**IEEE 80-2000**; IEEE Guide for Safety in AC  
Substation Grounding

**Shipek, John**; SCL Standards Engineer, subject  
matter expert and originator of 6100.00  
(john.shipek@seattle.gov)

[www.fushicopperweld.com](http://www.fushicopperweld.com)

# MATERIAL STANDARD

## WIRE, BARE COPPER SOLID, HARD-DRAWN

**Requirements:** Bare solid hard-drawn copper wire shall meet the requirements of ASTM Specification B 1.

**Reels:** The wire shall be shipped on 36" x 24" x 17" or 40" x 24" x 17" non-returnable reels meeting the requirements of NEMA Standard WC-26, Table 1-5, except that each reel shall have two each 1½" diameter drive pin holes on each side on a minimum 6-inch radius.

**Packaging:** The wire shall be tightly wound on shipping reels by machines equipped with functional level wind capability.

The wire shall be adequately protected to ensure safe delivery without damage. The inner end of the wire shall be brought to the outside of the reel flange and securely fastened with steel staples appropriate to the wire size. The inner end shall not be brought out through the reel arbor. The outer end shall be fastened to the inner side of the flange with steel staples appropriate to the wire size.

Preference will be given to bid proposals that include steel arbor collars on the shipping reels. Supplier shall state whether or not reels are equipped with steel arbor collars.

**Marking:** The reels shall be legibly marked with the type, weight, length of wire (actual footage contained), and the name and address of the manufacturer. Tare weight shall be printed on all reels.

**Shipping:** Reels must be delivered in upright position suitable for side unloading by forklift, and not strapped or palletted.

**Reference Specifications:** ASTM B 1, NEMA WC 26, latest revisions

**Approved Manufacturers:** Nehring, Republic, Service Wire, Southwire

**Stock Unit:** FT

Stock Number	Wire Size		Weight per 1,000 Ft.	Wire on Reel*	
	AWG	Dia.-In.		Ft.	Lbs.
610006	2	0.258	200.9	1,000	201
610008	4	0.204	126.4	10,000	1264

\* Approximate

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. J...</i>

## Wire, Solid Bare Copper, Dead-Soft-Annealed



### 1. Scope

This standard covers the requirements for dead-soft-annealed, solid bare copper wire.

This standard applies to the following Seattle City Light (SCL) stock numbers:

<u>Stock No.</u>	<u>Size (AWG)</u>
610208	4
610210	6
610218	14
610222	18

### 2. Application

The larger sizes of dead-soft-annealed wire are used for hand tying copper primary conductor to pin insulators and making jumpers.

Dead-soft-annealed wire falls between soft-drawn and dead-soft-drawn in hardness.

The hardness of copper wire is determined by stretching a ten-inch-long sample until it breaks and then measuring the length of the sample. The percent of stretch is called elongation. Dead-soft-drawn has an elongation of 40%. Dead-soft-annealed (this standard) has an elongation of 35%. The elongation of soft-drawn ranges between 15 and 35%. The elongation of medium- and hard-drawn ranges between 1.0 and 1.9%. The practical, upper limit of softness for copper wire is about 48%. Annealing past this point significantly compromises tensile strength.

### 3. Industry Standard

Wire shall meet the applicable requirements of the following industry standard:

**ASTM B3-2001 (2007)** - Standard Specification for Soft or Annealed Copper Wire

#### 4. Requirements

Wire shall meet the applicable requirements of ASTM B3 and this standard with the following clarification: elongation shall be 35% or greater (dead-soft-annealed).

**Table 4. Requirements**

Stock No.	Size (AWG)	Diameter (in)	Weight, (lb per 100 ft)
610208	4	0.2043	12.64
610210	6	0.1620	7.95
610218	14	0.0641	1.24
610222	18	0.0403	0.492

#### 5. Packaging

Wire shall be packaged to prevent damage during shipping, handling, and storage.

Wire shall be packaged according to Table 5.

**Table 5. Packaging**

Stock No.	Size (AWG)	Standard Package	Length, Nominal (ft per standard package)	Weight, Nominal (lb per standard package)
610208	4	Spool	200	25.0
610210	6	Spool	315	25.0
610218	14	Spool	100	1.3
610222	18	Spool	100	0.5

Each package shall be marked with:

- Length of wire
- Manufacturer's name and address
- Seattle City Light's stock number.

Each shipping container shall be marked with:

- Seattle City Light's purchase order number.

#### 6. Issuance

Stock Unit: FT

#### 7. Approved Manufacturers

Nehring Electrical Works Company

Service Wire Company

Southwire

#### 8. References

**SCL Material Standard 6102.2**; "Wire, Soft, Round, Bare Copper" (renumbered)

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6102.20 (john.shipek@seattle.gov)

**Standard Handbook for Electrical Engineers**; 8<sup>th</sup> Edition; A.E. Knowlton, McGraw Hill Book Company, Inc., 1949

**WIRE, COPPER, BARE, SOFT-DRAWN**



**1. Scope**

This standard covers the requirements for bare, copper, soft-drawn, stranded wire.

This standard applies to the following Seattle City Light Stock Numbers:

Stock Number	Size, AWG/kcmil	Packaging
610434	#2	reel
610425	2/0	reel
610414	4/0	reel
610412	250	reel
610397	500	reel

**2. Application**

For grounding, jumpers, and other general use.

**3. Industry Standards**

Cable shall meet the applicable requirements of the following industry standards:

**ASTM B3-01** – Standard Specification for Soft or Annealed Copper Wire, 2001

**ASTM B8-04** – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, 2004

**NEMA WC 26-2000** (EEMAC 201-2000) Binational Wire and Cable Packaging Standard

**4. Construction**

Wire shall meet the requirements of ASTM B8 and **Table A** with the following clarifications:

Conductor alloy shall be soft or annealed, uncoated copper.

**Table A**

Stock Number	Size, AWG/kcmil	Number of Strands	Class
610434	#2	7	B
610425	2/0	7	A
610414	4/0	19	B
610412	250	37	B
610397	500	37	B

**5. Packaging**

**5.1 Quantity**

Actual quantity per reel may vary from the quantity stated on the Purchase Order by plus or minus 10%.

**5.2 Reels**

Reels shall be reusable wood type, Class 1 or 2.

Reels may be new or recycled.

Recycled reels (when provided) shall be have the surface of both outside flanges painted over with a solid color.

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Wire, Copper, Bare, Soft-Drawn

standard number: **6103.90**

superseding: June 11, 2010  
 effective date: December 8, 2011  
 page: 2 of 2

**5. Packaging, continued**

**5.2 Reels, continued**

Recycled reels (when provided) shall be equivalent to new in quality and strength.

Reels shall be protected for shipment with coverings consistent with the recommendations of NEMA WC-26, Section 4.

Reels shall be provided with metal bushings if the gross weight of the reel exceeds 1,000 pounds.

**5.3 Securing of Cable Ends**

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened with appropriately sized steel staples.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened with appropriately sized steel staples to the inner side of the flange or tied off and secured as with plastic wrap.

**5.4 Marking**

Each reel shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Shipping length of cable on reel
- Gross weight
- Tare weight
- Net weight
- Date of manufacture
- Reel identification according to NEMA WC-26, Section 5
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**5.5 Detailed Requirements**

Wire shall be packaged on reels according to the requirements of NEMA WC-26 and **Table B**.

**Table B**

Stock Number	Size, AWG/ kcmil	Length per Reel ± 10%, ft	Outside Flange Diameter, Maximum, in	Inside Traverse Width, Maximum, in	Weight per 100 ft., Approx., lbs	Weight per Reel, Approx., lbs
610434	#2	5,280	40	24	021	1,108
610425	2/0	5,280	40	24	041	2,165
610414	4/0	3,450	40	24	65	2,243
610412	250	3,000	40	24	77	2,310
610397	500	1,500	40	24	154	2,310

**6. Shipping**

Reels shall be shipped and delivered in the upright position (on the flange edges) on open flatbed trucks suitable for side unloading by forklift.

Reels shall not be strapped or palleted.

Wire shall be shipped to the address specified on the Purchase Order.

**7. Issuance**

FT

**8. Approved Manufacturers**

Nehring Electrical Works Company  
 Service Wire  
 Southwire

SEATTLE CITY LIGHT  
**MATERIAL STANDARD**

STANDARD NUMBER: **6104.5**  
 PAGE: 1 of 1  
 DATE: October 30, 1963  
 REV: August 5, 1996

**WIRE, BARE COPPER  
 MEDIUM-HARD-DRAWN, CONCENTRIC-STRANDED**

**Description**

Medium-hard-drawn, concentric-stranded, bare copper wire shall meet the requirements of ASTM Specification B8.

**Packaging**

The wire shall be shipped on nonreturnable reels of NEMA Standard WC 26 dimensions. The inner end of the wire shall be brought to the outside of the reel flange and securely fastened with steel staples appropriate to the wire size. The inner end shall not be brought out through the reel arbor. The outer end shall be fastened with steel staples, appropriate to the wire size, to the inner side of the flange. The reel arbor hole shall have a diameter of 2-3/4 inches.

**Marking**

The reels shall be legibly marked with the type, weight, length of wire, and the name and address of the manufacturer. The wire shall be adequately protected to ensure safe delivery without damage. Reels must be delivered in the upright position suitable for side unloading by forklift, and not strapped or palleted. Tare weight shall be printed on all reels.

**Reference Specifications:** ASTM B8, NEMA WC 26, latest revisions.

**Stock Unit:** Foot.

Stock Number	Wire Size AWG-kcmil	Wire Dia. Inch	Wire Strand	Weight Lbs. Per M Ft.	Wire on Reel		NEMA Reel Code No.
					❖Ft.	Lbs.	
610524	4/0	0.522	7	653.3	4615	3000	4226

❖ Plus or minus 10 percent.

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John Chinner</i>	<i>Betty Robin</i>

## Flat, Tinned-Copper Braid



### 1. Scope

This standard covers the requirements for flat, tinned-copper braid for use in grounding cables and forming jumpers on submersible, single-phase transformers.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Flat width, nominal (in)	Thickness, nominal (in)
618614	0.250	0.046
618625	0.625	0.046
618624	0.625	0.093
013491	1.375	0.120
618615	1.750	0.130

### 2. Application

Flat, tinned-copper braid is used by crews for grounding cables and by the Transformer Shop when forming jumpers on submersible, single-phase transformer secondary terminals.

### 3. Properties (nominal)

Individual strands must meet ASTM B33-10 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.

Standards Coordinator  
Brett Hanson



Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



Manufactured flat, tinned-copper braid shall meet the requirements of Section 1 and the following:

<b>Stock No.</b>	<b>Approximate AWG Equivalent</b>	<b>Circular mil area</b>	<b>Stranding (Number of strands x AWG per strand)</b>
618614	12	6,000	240 x #36
618625	9	13,200	528 x #36
618624	5	36,180	360 x #30
013491	1/0	105,600	1056 x #30
618615	2/0	124,800	1248 x #30

#### 4. Packaging

Each reel shall be individually protected with plastic and legibly marked with the following information:

- Manufacturer's name
- Manufacturer's catalog number
- Product description.

Each shipping container shall be marked with SCL's purchase order number.

#### 5. Issuance

FT

#### 6. Approved Manufacturers

<b>Stock No.</b>	<b>Continental Cordage</b>	<b>Electric Motion Company</b>
618614	231/1	EM241036
618625	233/1	EM481136
618624	242	EM241530
013491	278	EMFB482230
618615	279	EM482730

#### 8. References

**ASTM B33-10**; "Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes"

**Hanson, Brett**; SCL Standards Engineer, subject matter expert and originator of 6104.75 (brett.hanson@seattle.gov)

[www.electricmotioncompany.com](http://www.electricmotioncompany.com)

[www.iwgcontinentalcordage.com](http://www.iwgcontinentalcordage.com)

**MATERIAL STANDARD**

**WIRE, COPPER  
5,000-VOLT  
POLYETHYLENE-INSULATED**



**High-Density, Polyethylene-Insulated Wire** shall meet the applicable requirements of ANSI C8.35, Weather-Resistant Wire and Cable, Polyethylene Type, and ICEA S-61-402, (NEMA WC 5), Standards for Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, except as modified herein.

**Insulation and Jacket:** The insulation shall consist of 6/64ths of an inch of high molecular weight polyethylene, meeting the requirements of ASTM D1248 for Type I, Grade 5, Class C.

A jacket consisting of 4/64ths of an inch of high density polyethylene meeting the requirements of ASTM D1248 for Type III, Grade 4, Class C shall be extruded over the insulation. The minimum thickness of the insulation and jacket shall not be less than 90 percent of the nominal thickness listed in the table below.

**Conductor:** Medium-hard-drawn copper conductor shall meet the requirements of ASTM B2. Stranding shall be in accordance with ASTM B8.

**Reels:** The wire shall be shipped on nonreturnable reels of NEMA Standard WC 26 dimensions. The diameter of the arbor hole shall be 2-3/4 inches. The inner end of the wire shall be brought to the outside of the reel flange and securely fastened with steel staples appropriate to the wire size. The inner end shall not be brought out through the reel arbor. The outer end shall be fastened with steel staples, appropriate to the wire size, to the inner side of the flange.

**Marking:** Each reel shall be legibly marked with the type, weight, length of wire, and the name and address of the manufacturer. Reels must be delivered in the upright position suitable for side unloading by forklift, and not strapped or palleted. Tare weight shall be printed on all reels.

**Reference Specifications:** ANSI C8.35; ASTM B2, B3, B8, D1248; ICEA S-61-402, NEMA WC 5 & WC 26 (latest revisions).

**Approved Manufacturers:** Alcoa, Alcan, BICC/General, Hendrix Wire & Cable, Kaiser, Pirelli, Southwire

**Stock Unit:** FT

Stock Number	Size, AWG	Conductor			Reel Data		
		Type	Temper	Approx. Overall Dia., In.	Designation	Length, Ft.	Weight, Lbs.
610833	6	Solid	MHD	0.478	NR 40.24	5,000	650

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>J. Pierenberg</i>	<i>Harold J. J.</i>

**MATERIAL STANDARD**

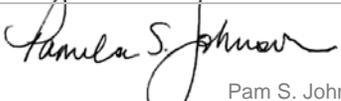
**WIRE, COPPER  
 WEATHER-RESISTANT, POLYETHYLENE-TYPE**



1. **Polyethylene-Insulated Copper Wire** shall meet the applicable requirements of ANSI Specification C8.35 for Weather-Resistant Wire and Cable, Polyethylene Type and NEMA WC-5, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. **Packaging**
  - 2.1 **Coils**  
 Coils shall be shrink-wrapped to pallets. The minimum inside diameter of the coils shall be 18 inches, and the maximum inside diameter shall be 20 inches. The maximum outside diameter of the coils shall not exceed 30 inches. The maximum height of the coils shall not exceed 7 inches. These coil dimensions do not apply to AWG 6 wire (SCL Stock No. 611444). The coil shall be wound in such a manner as to permit easy payoff of the entire coil from the payoff reel.
  - 2.2 **Reels**  
 The wire shall be shipped on non-returnable reels of NEMA standard WC 26 type and dimensions. The inner end of the wire shall be brought to the outside of the reel flange and securely fastened with steel staples appropriate to the wire size. The inner end shall not be brought out through the reel arbor. The outer end shall be fastened to the inner side of the flange with steel staples, appropriate to the wire size, to the inner side of the reel flange.. The reel arbor hole shall have a diameter of 2-3/4 inches. Reels must be delivered in the upright position suitable for side unloading by forklift, and not strapped or palleted. Tare weight shall be printed on all reels.
3. **Reference Specifications:** ANSI C8.35, NEMA WC-5, and NEMA WC 26, latest revisions
4. **Approved Manufacturers:** Nehring, Republic, Service Wire, Southwire
5. **Stock Unit:** FT

Stock No.	Conductor			Insulation Thickness, mils	Approximate Weight, lbs.			Nominal Length, ft.	
	AWG	Strand	Temper		per 100 ft.	Coil	Reel	Coil	Reel
611444	6	solid	soft	30	9	150	–	1,700	–
611442	4	solid	soft	30	14	150	–	1,100	–
611392	4	solid	MHD	30	14	150	–	1,100	–
611390	2	solid	MHD	45	22	250	1,000	1,100	4,545*
611393	4	solid	MHD	30	14	–	1,430	–	10,000

\*NEMA reel no. 32-24

<i>standards coordinator</i>	<i>standards manager</i>	<i>unit director</i>
 Quan Wang	 John Shipek	 Pam S. Johnson

**MATERIAL STANDARD**

**COPPER WIRE  
TYPE THWN THERMOPLASTIC POLYVINYL CHLORIDE**



**Thermoplastic Insulated Type THWN Building Wire** shall bear Underwriters Laboratories label of approval and shall meet all requirements of UL 83, Thermoplastic-Insulated Wires, and ASTM D2220, Vinyl Chloride Plastic Insulation for Wire and Cable, 75 C Operation.

**Conductors** shall be soft annealed copper meeting the requirements of ASTM B3.

**Polyvinyl Chloride Insulating Compound** shall be free from pores, splinters, and other inhomogeneities visible to the unaided eye.

**Packaging.** Type *THWN* wire shall be packaged in 500-foot spools unless otherwise specified on the purchase request.

**Reference Specifications:** UL 83; ASTM D2220, ASTM B3, latest revisions

**Stock Unit:** FT

Stock Number	Size	Strand	Color
612215	14	Solid	Black
612217	14	Solid	White
612218	14	Solid	Green
612219	12	Solid	Gray with Black Tracer
612220	12	Solid	Black
612221	12	Solid	Brown
612222	12	Solid	White
010382	12	Solid	White with Black Tracer
612223	12	Solid	Gray
612224	12	Solid	Red
612225	12	Solid	Blue
612226	12	Solid	Green
612227	12	Solid	Yellow
612228	12	Solid	Orange
612229	12	Solid	Purple
612230	12	19-Str.	Black
612232	12	19-Str.	White
612233	12	19-Str.	Red
612234	12	19-Str.	Blue
612250	10	Solid	Black
612252	10	Solid	White
612272	10	19-Str.	White

Stock Number	Size	Strand	Color
612254	10	Solid	Red
612255	10	Solid	Blue
612256	10	Solid	Green
612260	10	19-Str.	Black
612274	10	19-Str.	Red
612275	10	19-Str.	Blue
612276	8	19-Str.	Black
612277	8	19-Str.	Green
612278	8	19-Str.	White
612279	8	19-Str.	Red
612280	8	19-Str.	Blue
612282	6	19-Str.	Black
612284	6	19-Str.	White
612286	6	19-Str.	Red
612287	6	19-Str.	Blue
612288	6	19-Str.	Green
612298	4	19-Str.	Black
612300	4	19-Str.	White
612302	4	19-Str.	Red
612304	4	19-Str.	Blue
612306	4	19-Str.	Green

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>A. Verenberg</i>	<i>Harold J. J...</i>

**MATERIAL STANDARD**

**WIRE, PORTABLE CORD**



**1. Scope**

This material standard covers flexible, multi-conductor, portable cord used for making extension cords or repairing small electric hand tools.

Voltage rating is typically used to denote hardness of service. Yellow, 600 volt cord is for hard service and is good for making up highly visible extension cords. Black, 300 volt, cord is known as junior hard and is good for repairing hand tools.

**2. Industry Standards**

Portable cord shall meet the applicable requirements of:  
 UL 62 - FLEXIBLE CORD AND FIXTURE WIRE (1997)

**3. Conductor**

Conductor shall be stranded, annealed bare copper.

**4. Insulation**

Insulation shall be oil resistant.

**5. Color Identification**

Color identification of inner conductors shall follow North American convention.

Individual conductors of 2/C assemblies shall be permanently identified black/white.

Individual conductors of 3/C assemblies shall be permanently identified black/white/green.

**6. Filler and Separator**

Portable cord shall be assembled with high-grade filler for roundness and strength and a separator for firmness and reinforcement.

**7. Jacket**

Jacket shall be free-stripping.

Jacket shall be oil and weather resistant.

Jacket color shall be according to **Table 1**.

**8. Completed Assembly**

Portable cord shall remain flexible and not crack or deform at temperatures between -40 to +90 degrees Centigrade.

No component of the completed portable cord assembly shall contain polyvinyl chloride (PVC).

**9. Marking**

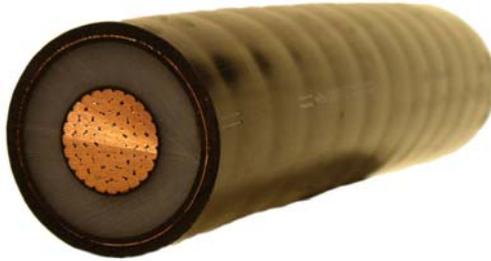
Jacket shall be permanently marked with manufacturer, conductor size, number of conductors, code type, and UL.

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 Hardev Juj

**MATERIAL STANDARD****10. Stock Unit: FT****Table 1**

<b>Stock Number</b>	<b>Number of Conductors</b>	<b>Conductor Size, AWG</b>	<b>Voltage Rating (Volts)</b>	<b>Outside Diameter, in.</b>	<b>Approved Codes</b>	<b>Approved Colors</b>
615776	2	16	300	0.33	SJOOW	Black
					SJEOOW	Yellow
615777	2	14	300	0.38	SJOOW	Black
					SJEOOW	Yellow
615853	3	16	300	0.36	SJOOW	Black
					SJEOOW	Yellow
616090	3	14	300	0.41	SJOOW	Black
					SJEOOW	Yellow
615828	3	16	600	0.43	SEOOW	Yellow
615829	3	14	600	0.56	SEOOW	Yellow

**35 kV, 1/C, TRXLPE INSULATED, TAPE SHIELDED CABLE**



**1. Foreword**

**1.1 Scope**

This material standard covers the detailed requirements for 35 kV, tree retardant, cross-linked polyethylene (TRXLPE), single conductor cable used for the distribution of electric energy.

Industry designation: **1/C**

This material standard applies to the following Seattle City Light Stock Numbers:

<b>Stock Number</b>	<b>623655</b>
<b>Size</b>	1000 kcmil

**1.2 Application**

Cable is intended for use on a nominal 34.5 kV, three-phase, 4-wire, solidly-grounded, wye-connected, 60 Hz, power system.

**1.3 General Requirements**

This detailed material standard is to be used in conjunction with the latest revision of Seattle City Light Material Standard 6015.00, "Medium Voltage Cable – General."

**1.4 Industry Standards**

Cable shall meet the requirements of the following industry standards: ICEA S-97-682-2006

Refer to Material Standard 6015.00 to obtain the appropriate revision date for other referenced industry standards.

**2. Construction**

**2.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards - they are repeated here for the convenience of the reader. Values or requirements different from industry standards are identified with the symbol ▲. In some situations, the ▲ symbol offers warning that special requirements are located in Material Standard 6015.00.

<i>standards coordinator</i>	<i>standards manager</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pam S. Johnson

**MATERIAL STANDARD****2. Construction, continued****2.2 Conductor**

		Requirements	Reference
<b>Stock Number</b>		<b>623655</b>	SCL
<b>Size</b>		1000 kcmil	various
<b>Diameter</b>	minimum	1.039 in	ICEA S-97-682, Section 2.5
	nominal	1.060 in	ASTM B496
	maximum	1.081 in	ICEA S-97-682, Section 2.5
<b>Metal</b>		copper	ASTM B49
<b>Stranding type</b>		concentric-lay	ASTM B496
<b>Class</b>		none	none
<b>Stranding subtype</b>		compact	ASTM B496
<b>Number of strands</b>		58-61	ASTM B496, Table 1
<b>Temper</b>		soft drawn, annealed prior to stranding	ASTM B3
<b>Lay, outer layer</b>		left hand	ASTM B496, Section 5
<b>Lay, successive layers</b>		reversed	ASTM B496, Section 5
<b>Sealant for stranded conductors</b>		option required ▲	ICEA S-97-682, Section 2.2

**2.3 Conductor Shield (Stress Control Layer)**

		Requirements	Reference
<b>Stock Number</b>		<b>623655</b>	SCL
<b>Size</b>		1000 kcmil	various
<b>Thickness, minimum point</b>		20 mil	ICEA S-97-682, Part 3, Table 3-1

**2.4 Insulation**

		Requirements	Reference
<b>Stock Number</b>		<b>623655</b>	SCL
<b>Size</b>		1000 kcmil	various
<b>Material</b>		unfilled tree retardant crosslinked polyethylene (TRXLPE)	ICEA S-97-682, Section 4.1
<b>Approved material formulations</b>		specified in General Material Standard	SCL 6015.00
<b>Thickness</b>	minimum point	400 mil	ICEA S-97-682, Section 4.2, Table 4-11
	nominal	420 mil	ICEA S-97-682, Table 8-1
	maximum point	450 mil	ICEA S-97-682, Section 4.2, Table 4-11
<b>Insulation level</b>		133%	ICEA S-97-682, Section 4.2, Table 4-11
<b>Basic impulse level (BIL)</b>		200 kV crest	ICEA S-97-682, Section 4.3, Table 4-10

**MATERIAL STANDARD**

superseding: November 28, 2007

effective date: January 27, 2010

35 kV, 1/C, TRXLP Insulated, Tape Shielded Cable

page: 3 of 4

**2. Construction, continued****2.5 Extruded Insulation Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>623655</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Material</b>	discharge-free (thermosetting material)	ICEA S-97-682, Section 5.1 to 5.5.1
<b>Thickness</b>	minimum point	24 mil
	maximum point	60 mil

**2.6 Metallic Shield**

	Requirements	Reference
<b>Stock Number</b>	<b>623655</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Metal</b>	copper, uncoated	ICEA S-97-682, Section 6.1 to 6.2
<b>Type</b>	helically applied tape ▲	ICEA S-97-682, Section 6.1 to 6.2 and SCL 6015.00
<b>Water blocking components for metallic shield</b>	option not required	ICEA S-97-682, Section 6.7

**2.7 Jacket (Non-Metallic Covering)**

	Requirements	Reference
<b>Stock Number</b>	<b>623655</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Material</b>	linear low density polyethylene (LLDPE)	ICEA S-97-682, Section 7.1.1
<b>Color</b>	black	ICEA S-97-682, Section 7.1.1
<b>Type</b>	overlying	ICEA S-97-682, Section 7.2
<b>Thickness</b>	minimum point	100 mil
	maximum point	150 mil
<b>Maximum diameter over jacket</b>	2.45 in ▲	SCL preference

**2.8 Sheath (Continuous Metallic Covering)**

Cable shall not be provided with a sheath.

**2.9 Assembly and Identification ▲**

	Requirements	Reference
<b>Stock Number</b>	<b>623655</b>	SCL
<b>Size</b>	1000 kcmil	various
<b>Red stripe identification</b>	option not required	ICEA S-97-682, Section 8.2.1.1

**MATERIAL STANDARD**

35 kV, 1/C, TRXLP Insulated, Tape Shielded Cable

standard number: **6236.60**

superseding: November 28, 2007

effective date: January 27, 2010

page: 4 of 4

**3. Packaging**

		Requirements	Reference
<b>Stock Number</b>		<b>623655</b>	SCL
<b>Size</b>		1000 kcmil	various
<b>Reel type</b>		steel, fluted	WC 26, Section 2.1.2
<b>Reel dimension</b>	flange diameter, maximum	84 in ▲	SCL preference
	outside width, maximum	45 in ▲	SCL preference
	drum diameter, minimum	42 in ▲	SCL preference
	length per reel ± 10%	2,000 ft ▲	SCL preference
	gross weight, maximum	17,000 lb ▲	SCL preference

**4. Issuance**

		Requirements
<b>Stock Number</b>		<b>623655</b>
<b>Size</b>		1000 kcmil
<b>Stock unit</b>		FT

**5. Approved Manufacturing Plants**

Manufacturer	Location
<b>General Cable/BICC</b>	DuQuoin, IL
	Malvern, AR
	Marshall, TX
	Moose Jaw, SK, Canada
	St. Jerome, QC, Canada
<b>Prysmian (formerly Pirelli)</b>	Abbeville, SC
	Prescott, ON, Canada
	St. Jean Sur Richelieu, QC, Canada

**MATERIAL STANDARD****BUS BAR, COPPER  
HARD TEMPERED****Hard Tempered Copper Bus Bar, Rectangular**

Minimum conductivity shall be 97.4 percent IACS. Corners shall be Commercially square. Normally purchased in 12-foot lengths.

**Reference Specifications:**

ASTM B187 "Specification for Bus Bar, Rod, & Shapes," latest revision.

Stock Unit: Foot

**STANDARD COPPER BUS BAR**

Stock Number	Thickness In.	Width In.	Nominal Lb./Ft.
630025	1/4	2	1.94
630026❖	1/4	2-1/2	2.42
630027	1/4	3	2.91
630029	1/4	4	3.88
630030❖	1/4	5	4.84
630031❖	1/4	6	5.81

❖ Not normally stocked

ORIGINATOR

*Jim S. Horn*

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

*John Chinner*

UNIT DIRECTOR

*Betty Robin*

## Bus Bar, Copper, Half Hard Tempered



### 1. Scope

This standard covers the material requirements for copper, half hard tempered bus bar.  
This material is purchased in 12-ft lengths.

Stock No.	Width (in)
630025	2
630026	2-1/2
630027	3
630029	4
630030	5
630031	6

### 2. Application

Copper bus bar is used in Seattle City Light's (SCL's) Network system to connect transformers. The bus bar is cut to length on the job as needed. Copper is the preferred material for use by crews for this application due to its high ampacity as well as ability to resist corrosion, which is prevalent in our region's commercial building vault environments.

Bus bar widths of 2-1/2 in, 5 in and 6 in are special order and not normally stocked in the warehouse.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

  
645

Unit Director  
Darnell Cola

### 3. Industry Standards

Copper bus bar shall meet the applicable requirements of the following industry standard:  
**ASTM B187/B187M**; Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes, 2011 edition.

### 4. Requirements

#### 4.1 General

**Table 4.1. Bus Bar Requirements**

Attribute	Requirement
Composition	Copper
Shape	Rectangular
Corners	Commercially square
Temper	H02 (Half Hard)
Chemical Requirements	As detailed in Table 1 of ASTM B187/B187M

#### 4.2 Detailed

**Table 4.2. Copper Bus Bar, Dimensions and Weight**

Stock No.	Thickness (in)	Thickness Tolerance (in)	Width (in)	Width Tolerance (in)	Weight (lb/ft)
630025	0.25	±(.003)	2	+-(.008)	1.93
630026	0.25	±(.004)	2-1/2	+-(.012)	2.42
630027	0.25	±(.006)	3	+-(.012)	2.90
630029	0.25	±(.004)	4	+-(.012)	3.86
630030	0.25	±(.0045)	5	+-(.015)	4.83
630031	0.25	n/a	6	n/a	5.80

### 5. Approved Manufacturers

Stock No	Width (in)	Thyssen Krupp Part No.
630025	2	CURECO1230
630026	2-1/2	CURECO0118
630027	3	CURECO1227
630029	4	CURECO0201
630030	5	CURECO1183
630031	6	CURECO1231

### 6. Issuance

Stock Unit: FT

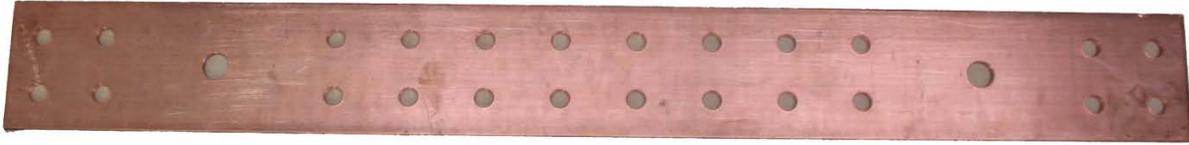
### 7. Sources

**Byun, Robin**; SCL Standards Engineer and subject matter expert for 6300.07  
 (robin.byun@seattle.gov)

**Thyssen Krupp Materials Catalog**; tkmna.com

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist and originator of 6300.07  
 (kathy.tilley@seattle.gov)

## Bus Bar, Drilled Copper, for Underground Vaults



### 1. Scope

This standard covers the requirements for drilled rectangular copper bar.

Stock No.	Size (in)
679762	28 x 4
679757	36 x 4
679760	48 x 4
679763	51 x 6
679764	62-1/2 x 6

### 2. Application

Rectangular copper bar is used to construct secondary bus and ground bus in underground Network vaults.

### 3. Industry Standards

Copper bus bar shall meet the applicable requirements of the following industry standard:

**ASTM B187/B187M-11**; Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes, 2011 Edition

Standards Coordinator  
Brett Hanson



Standards Supervisor  
John Shipek



Unit Director  
Darnell Cola



## 4. Requirements

### 4.1 General

Drilled bus bars shall be free of burrs, slivers, sharp edges, or other imperfections.

**Table 4.1. Bus Bar Requirements**

Attribute	Requirement	ASTM B187 Reference
Copper UNS No.	C11000	Table 1
Shape	Rectangular	Section 3.2.1
Corners	Commercially square	Section 13.7.2
Temper	H02 Temper (formerly H04)	Section 8 and Appendix, Note 5
Thickness (in)	1/4	

### 4.2 Detailed

Bus Bars shall be drilled and dimensioned as shown in Table 4.2 and Figures 4.2a – 4.2e.

**Table 4.2. Copper Bus Bar, Dimensions and Types**

Stock No.	Figure	Width (in)	Length (in)	Bus Bar Type
679762	4.2a	4	28	Light density
679757	4.2b	4	36	Light density
679760	4.2c	4	48	Heavy density
679763	4.2d	6	51	Spot network
679764	4.2e	6	62-1/2	Spot network

### 4.3 Tolerances

Attribute	Requirement	ASTM B187 Reference
Spacing between holes (in)	+/-0.020	–
Width tolerance (in)	+/-0.008	Table 6
Length tolerance (in)	+1/8, -0	Table 8
Thickness (in)	+/-0.004	Table 4

Some applications of these parts require two pieces to be overlapped for increased current capacity. Hole location is therefore very important. All holes in any two pieces must align well enough to allow free insertion of 1/2 in x 13 in bolts in all holes.

Figure 4.2a. 28-in Light Density Bus Bar, Stock No. 679762

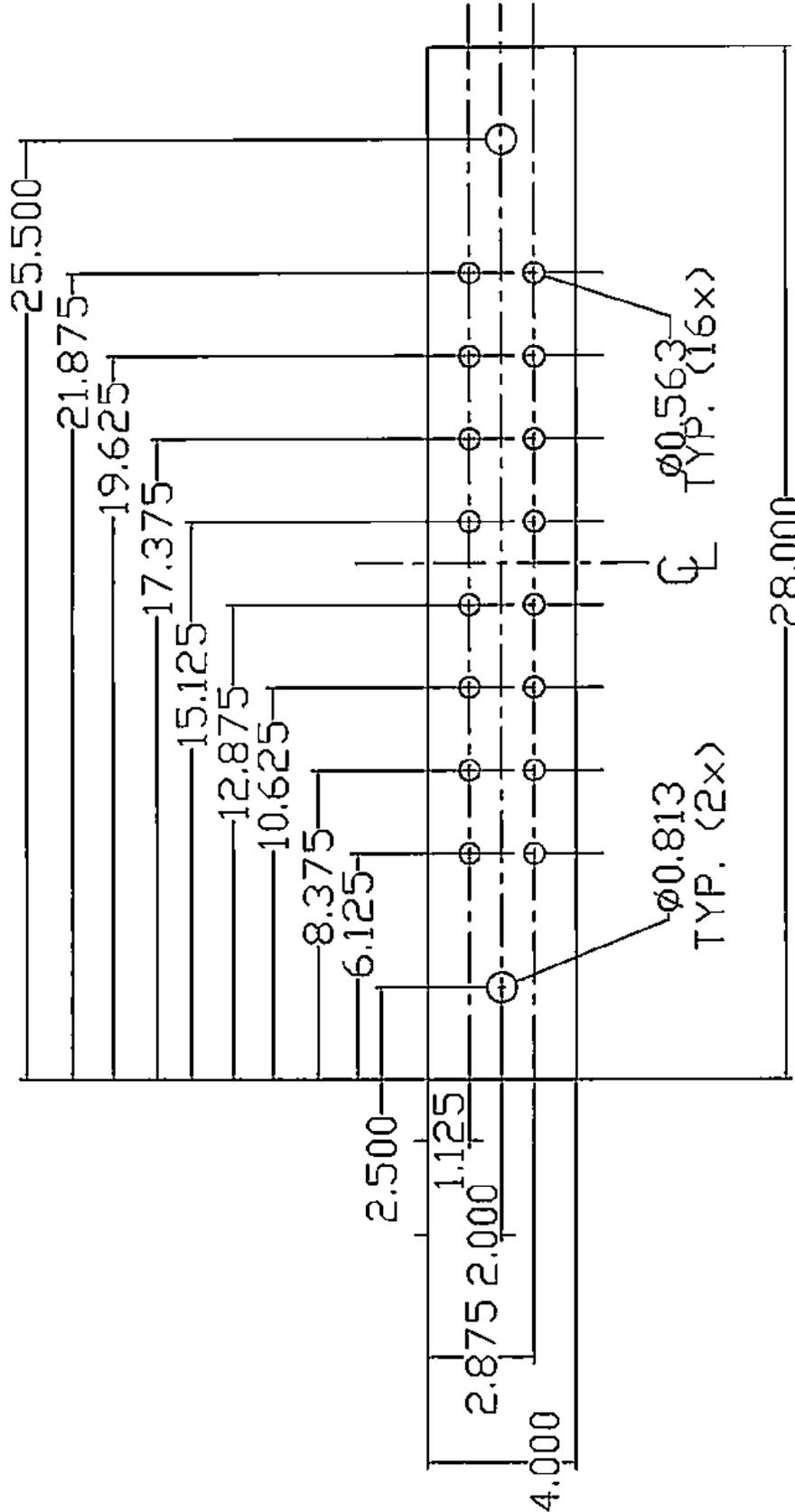


Figure 4.2b. 36-in Light Density Bus Bar, Stock No. 679757

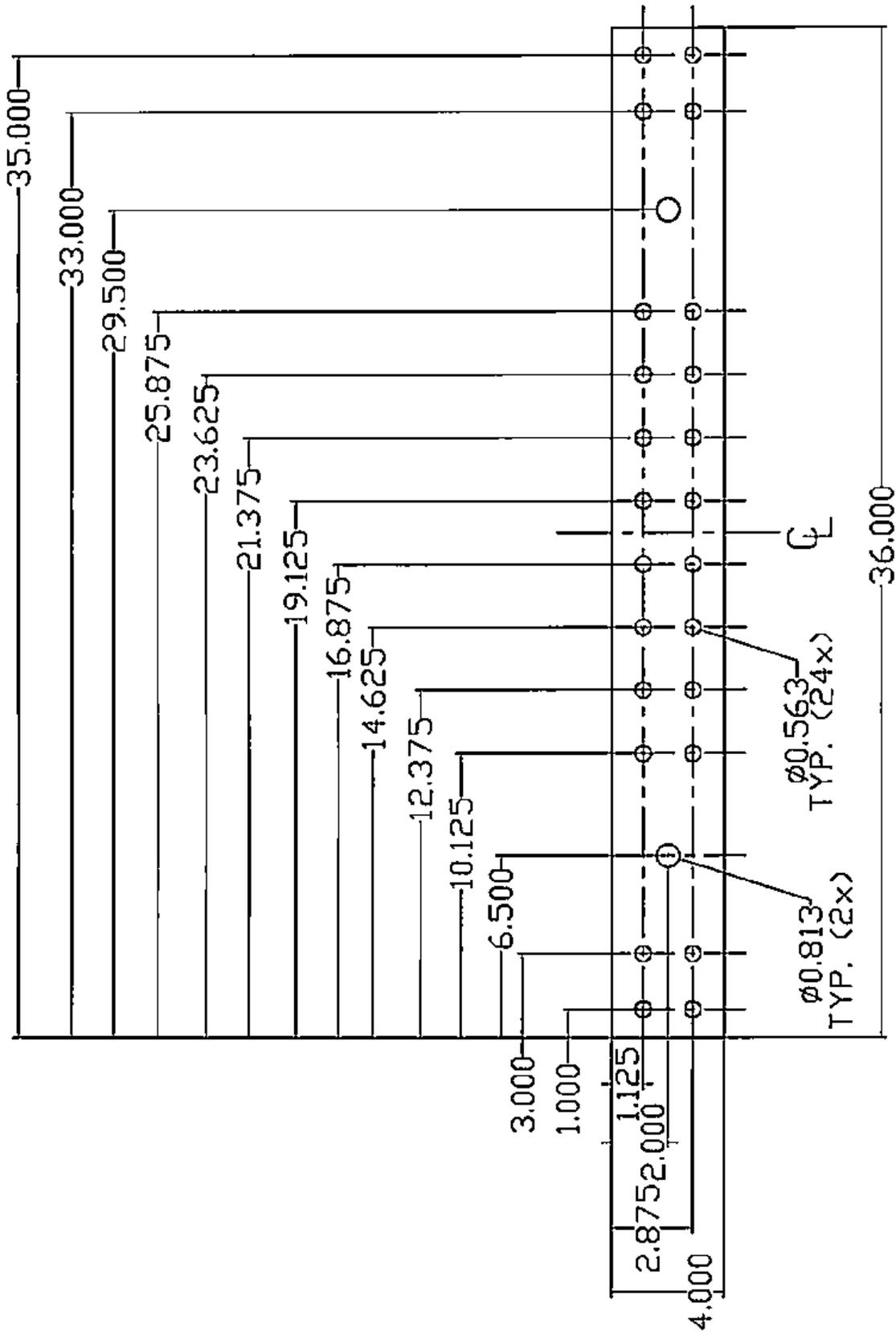


Figure 4.2c. 48-in Heavy Density Bus Bar, Stock No. 679760

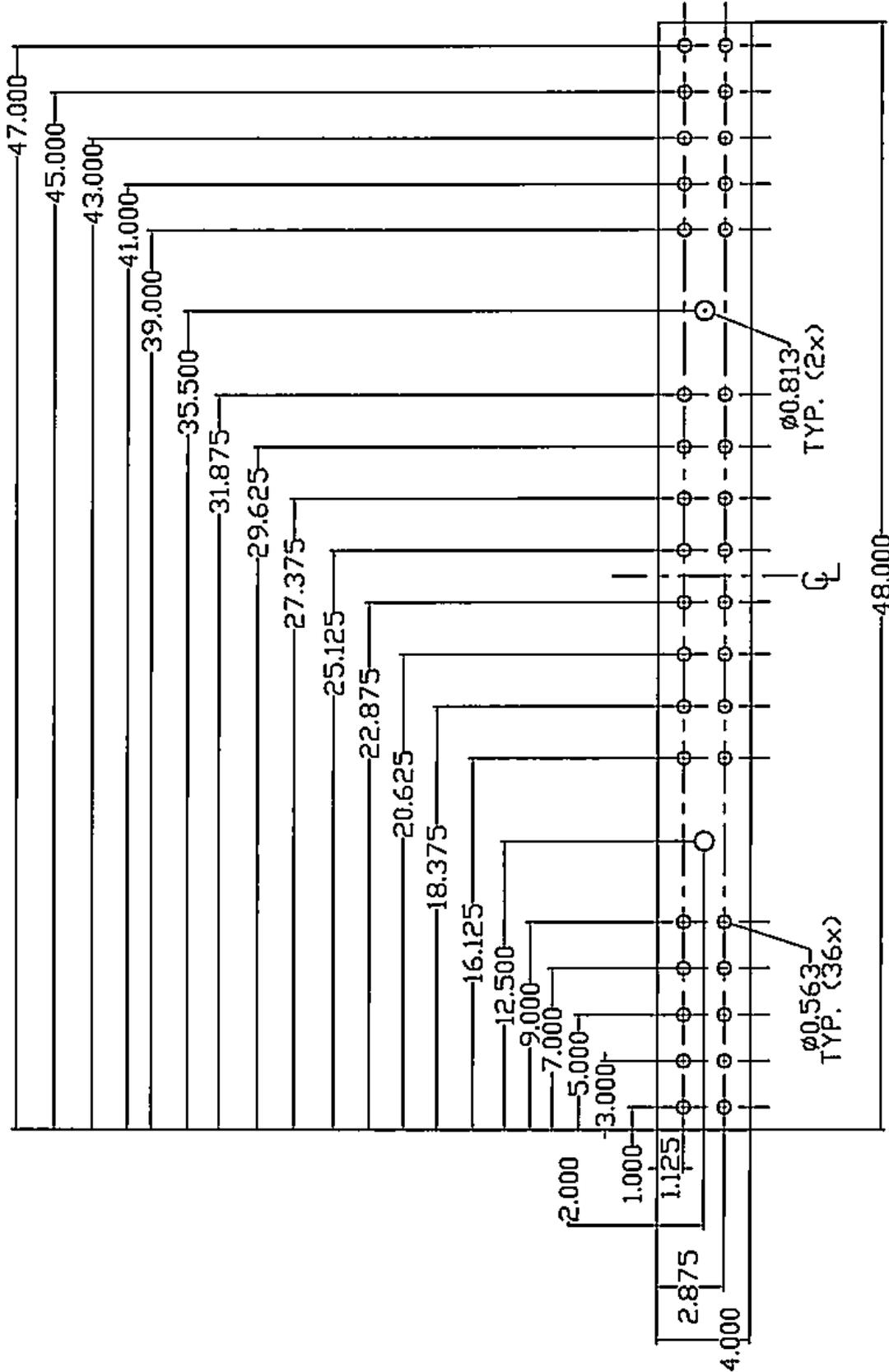


Figure 4.2d. 51-in Spot Network Bus Bar, Stock No. 679763

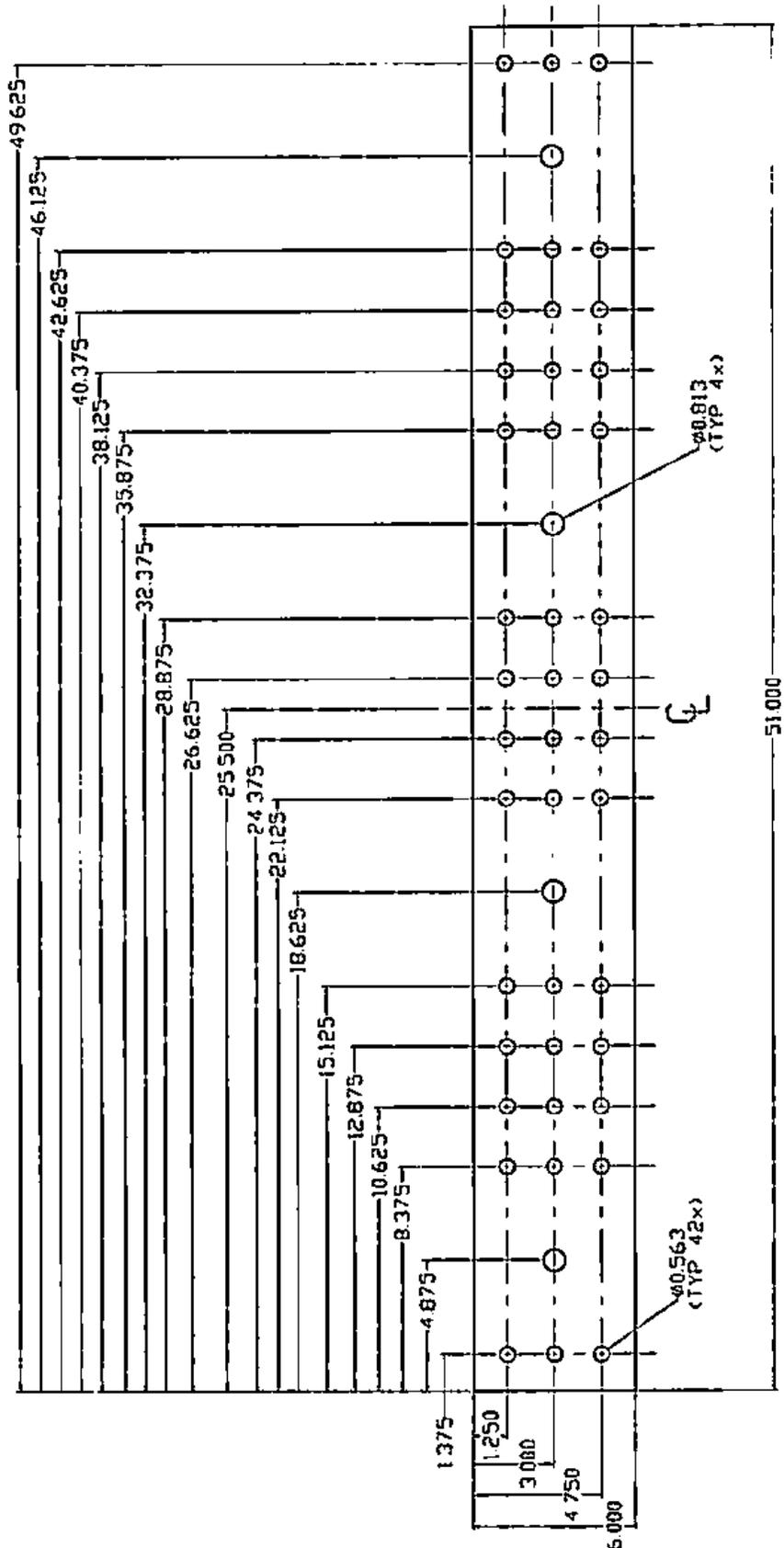
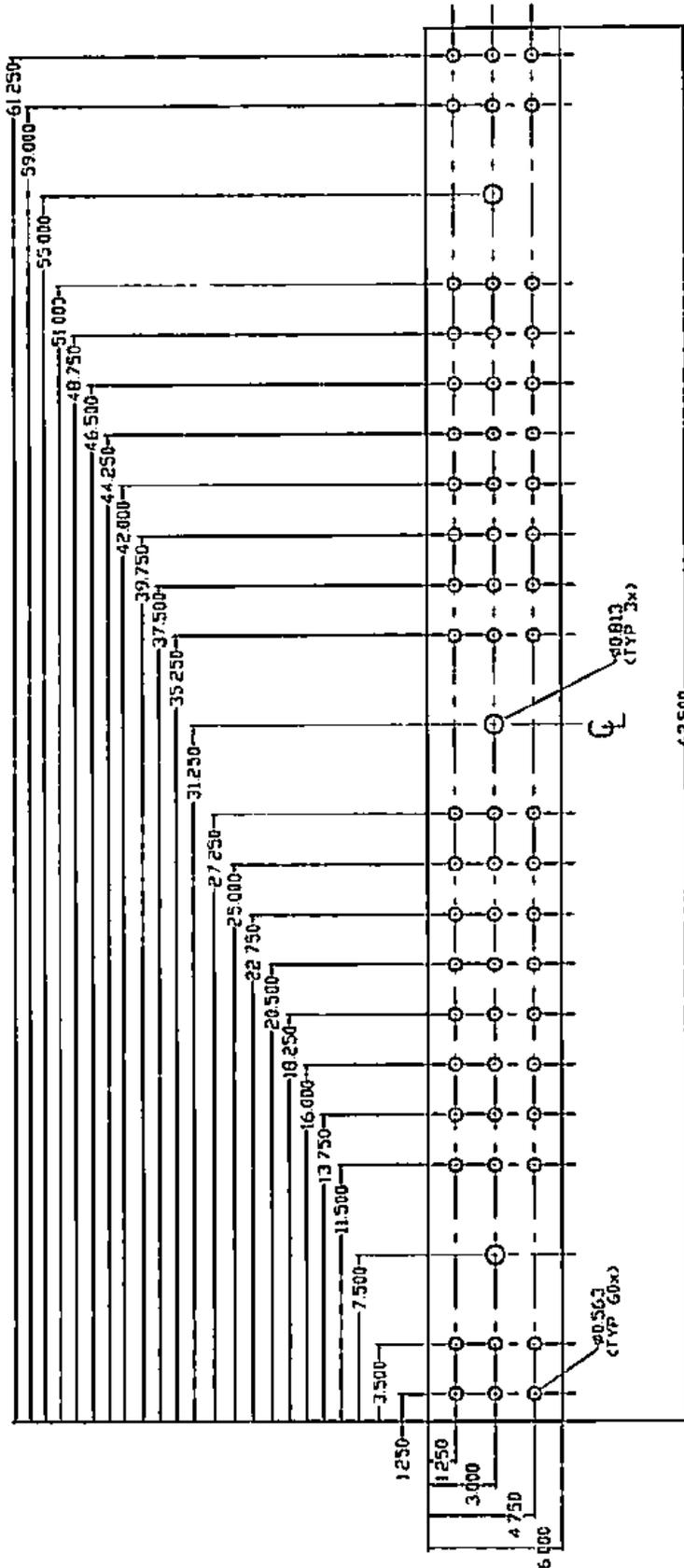


Figure 4.2e. 62.5-in Spot Network Bus Bar, Stock No. 679764



## 5. Packaging

Completed bars shall be cleaned of all cutting oil and individually wrapped in chemically neutral paper to prevent oxidation and damage in handling.

Completed bars shall be protected and secured to pallets in a manner that prevents damage during shipping, handling, and storage. Banding straps shall be carefully attached in a way that prevents damage to the completed bars.

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## 6. Issuance

Stock Unit: EA

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## 7. Approved Manufacturers

Stock No.	Width (in)	Length (in)	Manufacturer	MFR Part No.
679762	4	28	ThyssenKrupp	XCUREC05548
679757	4	36	ThyssenKrupp	XCUREC05547
679760	4	48	ThyssenKrupp	XCUREC05550
679763	6	51	ThyssenKrupp	CUREC01229
679764	6	62-1/2	ThyssenKrupp	XCUREC05549

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## 8. Sources

**SCL Construction Standard NCB-30**; “Grounding Network System, Wet Vault, Non-Transformer One or Two 48-Inch Bus Bars”

**SCL Construction Standard U4-5/NCB-50**; “Installation of Secondary Bus Bar”

**Byun, Robin**; SCL Standards Engineer and subject matter expert for 6303.00 (robin.byun@seattle.gov)

**ThyssenKrupp Materials Catalog**; tkmna.com

**MATERIAL STANDARD****COPPER PIPE AND TUBE****1. Scope**

This specification covers purchase and delivery f.o.b. the specified City of Seattle warehouse, of seamless copper pipe and tube suitable for electrical work.

**2. Applicable Specifications**

Material shall be supplied under the provisions of, and meet the physical and electrical requirements of, ASTM B188, "Seamless Copper Pipe and Tube," latest revision, except as modified herein.

**3. City Light Standard Items**

Copper bus pipe and tube used by the City Light Department will be ordered on the basis of this specification. Certain sizes and types of pipe and tube will be selected as standard stock items, and will be defined in a City Light Material Catalog description containing reference to this specification.

**4. Basis of Purchase**

Request for bids on the basis of this specification will include the following information:

- (a) dimension and form
- (b) temper
- (c) total length of each size

**5. Material**

- 5.1 Material shall be C10200, C10300, C10400, C10500, C10700, C11000, C11300, C11400, C11600, or high conductivity C12000 copper (latest revision).
- 5.2 Pipe shall be hard drawn. Tube shall be hard tempered or annealed, as specified in the request for bids.
- 5.3 Pipe shall conform to sizes known as Standard Pipe Sizes, except when specified.

**6. Testing and Certification**

Material supplied under this specification shall have been tested in accordance with ASTM Specification B188, latest revision, and shall have satisfied all test requirements. The optional bend tests specified therein are required on all pipe.

**7. Inspection**

Should it be necessary to send a City inspector to observe any manufacturing or testing process, the supplier shall afford the inspector all reasonable facilities, without charge, to complete his inspection.

**8. Packing and Marking**

Packing and marking for shipment shall be in accordance with ASTM Specification B188, latest revision.

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold Gray</i>

**MATERIAL STANDARD****9. Rejection**

Failure of all or part of a shipment of material to comply with this specification shall be grounds for rejection of all or part of the shipment, or the supplier may be required to replace the rejected material.

**Stock Unit:** FT

**PIPE, SEAMLESS, HARD DRAWN**  
(Conductivity over 96.6% IACS)

<b>Stock Number</b>	<b>SPS Nominal Inches</b>	<b>Strength</b>	<b>Purchase Length Ft.</b>	<b>O.D. Nominal Inches</b>	<b>I.D. Inches</b>	<b>Wall Thickness Inches</b>	<b>Unit Wt. Nominal Lb/Ft.</b>
630505	3/4	Regular	20	1.050	0.822	0.114	1.30
630507	1-1/4	Regular	20	1.660	1.368	0.146	2.69
630508	1-1/2	Regular	20	1.900	1.600	0.150	3.20
630509	2	Regular	20	2.375	2.062	0.156	4.22
*	2-1/2	Regular	20	2.875	2.500	0.187	6.12
*	3	Regular	20	3.500	3.062	0.219	8.75
*	3-1/2	Regular	20	4.000	3.500	0.250	11.40
*	4	Regular	20	4.500	4.000	0.250	12.90

\*Not normally stocked.

**CONTROL CABLE, MULTI-CONDUCTOR, 600 VOLT**



**1. Scope**

This material standard covers the requirements for 600 volt, multi-conductor, control cable.

This material standard applies to the Seattle City Light Stock Numbers shown in Table 1.

Table 1

Stock Number	Conductor Size (AWG)	Number Conductors	Common Application
640442	12	2	control and DC supply circuits
640443	12	3	-
640444	12	4	PT circuits
640447	12	7	control circuits
640449	12	9	control circuits
640462	10	2	DC supply circuits
640464	10	4	CT circuits
640467	10	7	-
640469	10	9	control circuits (long runs)

**2. Application**

Control cable is suitable for use in AC or DC circuits, in wet or dry locations, for direct burial or in conduit, at a temperature not exceeding 90 degrees C.

Control cable is used in a variety of applications inside substations. Refer to Table 1. Unless there are no other options, design engineers should avoid specifying Stock Numbers 640443 and 640467.

Contact Substation Engineering for "Color Coding

Standard on Relay and Control Drawings". This standard identifies what individual conductors within an assembly are used for.

**3. Industry Standards**

Control cable shall meet the applicable requirements of the following industry standards:

**ANSI/NEMA WC 57-2004/ICEA S-73-532;** "Standard for Control, Thermocouple Extension and Instrumentation Cables;" December 20, 2004

**ASTM B8-04;** "Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft"

**ASTM B33-04;** "Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes"

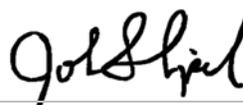
**NEMA WC 26-2008 (EEMAC 201-2008);** "Binational Wire and Cable Packaging Standard"

**ICEA T-29-520;** "Vertical Cable Tray Flame Tests @ 210,000 BTU;" January 1, 1986

**UL Standard 44;** "Standard for Safety - Thermoset-Insulated Wires and Cables;" Underwriters Laboratories Inc.; May 13, 2002

**UL Standard 1277;** "Standard for Safety - Electrical Power and Control Tray Cables with Optional-Fiber Members;" 4th Edition; Underwriters Laboratories Inc.; November 14, 2001

**UL Standard 1685;** "Standard for Safety - Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables;" 3rd Edition; Underwriters Laboratories Inc.; April 25, 2007

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Control Cable, Multi-Conductor, 600 Volt

standard number: **6404.11**

superseding: May 14, 2010

effective date: February 15, 2013

page: 2 of 4

**4. Construction****4.1 General**

Unless indicated otherwise, all values cited below should be consistent with industry standards; they are repeated here for the convenience of the reader.

**4.2 Conductor**

Conductor shall have the following attributes:

	Requirements	Reference
Metal	tinned copper	ASTM B33
Stranding	concentric or unilay	ASTM B8
Stranding subtype	compressed	ASTM B8, section 11
Class	C	ASTM B8, Table 1
Number of strands	19	ASTM B8, Table 1
Temper	soft drawn	ASTM B8
Lay	left-hand	ASTM B8, section 5

Number and size of conductors shall be according to Table 1.

**4.3 Insulation**

Insulation shall be flame retardant.

Insulation shall have the following attributes:

	Requirements	Reference
Material	crosslinked polyethylene (XLPE) type II (thermoset)	ICEA S-73-532, Table 3-2
Type	XHHW-2	UL 44, Table 5.1
Operating temperature, maximum	90 degrees C	UL 44, Table 5.1
Voltage rating	600 V	ICEA S-73-532, Table 3-1 & UL 44, Table 5.1
Thickness		
minimum	0.027 in	ICEA S-73-532, section 3.3 & UL 44, Table 15.3
nominal	0.030 in	ICEA S-73-532, Table 3-1 & UL 44, Table 15.3

**4.4 Shielding and Covering**

Metallic shielding is not required or desired.

Jacket shall be a low smoke halogen-free extruded material meeting the requirements of ICEA S-73-532, Section 7.1.6 for Thermoset Type II (moisture resistant) and UL 1685.

Jacket shall be flame retardant.

Jacket shall be moisture resistant.

Jacket for Stock Numbers 640442, 640443, 640444, and 640462 shall have the following attributes:

Requirements		Reference
Thickness		
minimum average	0.045 in	ICEA S-73-532, section 4.2.1 & UL 1277, Table 11.3
minimum point	0.036 in	ICEA S-73-532, section 4.2.1 & UL 1277, Table 11.3

Jacket for Stock Numbers 640447, 640449, 640464, 640467, and 640469 shall have the following attributes:

Requirements		Reference
Thickness		
minimum average	0.060 in	ICEA S-73-532, section 4.2.1 & UL 1277, Table 11.3
minimum point	0.048 in	ICEA S-73-532, section 4.2.1 & UL 1277, Table 11.3

**4.5 Assembly, Fillers, and Identification**

Individual conductors shall be cabled concentrically with the outer layer having a left-hand lay.

Fillers shall be flame resistant, nonfibrous, and nonhygroscopic.

Cable assembly shall be enclosed in a mylar binder tape.

Identification method shall use base colors with tracers according to the requirements of ICEA S-73-532, Appendix E, section E.3.1., Method 1, Table E-1.

**MATERIAL STANDARD**

Control Cable, Multi-Conductor, 600 Volt

standard number: **6404.11**

superseding: May 14, 2010

effective date: February 15, 2013

page: 3 of 4

**4.5 Assembly, Fillers, and Identification,**  
continued

Table 4.5 below conforms to the ICEA S-73-532, Appendix E, section E.3.1., Method 1, Table E-1 and is provided here for the convenience of the reader.

Table 4.5

Conductor Number	Background or Base Color	First Tracer Color
1	black	-
2	white	-
3	red	-
4	green	-
5	orange	-
6	blue	-
7	white	black
8	red	black
9	green	black

**4.6 Testing and Test Methods**

Control cable shall be tested at the factory according to the requirements of ICEA S-73-532, section 6.

Control cable shall be flame tested according to the requirements of ICEA T-29-520.

Control cable shall be listed as Type TC, Sunlight Resistant, and Oil Resistant II according to the requirements of UL 1277.

Control cable shall be listed as Type LS according to the requirements of UL 1685.

**5. Tests and Test Reports**

Data that establishes compliance with the requirements of ICEA S-73-532, ICEA T-29-520, UL 44, UL 1277, UL 1685, and this material standard shall be provided upon request.

**6. Marking**

Control cable outer surface shall be durably and legibly marked with a print legend though out its length a maximum interval of twenty-four inches.

The print legend shall include, but not be limited to, the following information:

- Manufacturer's name or symbol
- Number and size of conductors
- Temperature rating, maximum
- Voltage rating
- Year of manufacture
- Type XHHW-2 (UL)
- Type TC-LS (UL)
- Type Sun Res & Oil Res II (UL)

**7. Packaging**

Control cable shall be packaged on Class 1, wood reels according to the requirements of NEMA WC 26, Section 2.2.1.

Cable shall be dry when shipped.

Cable ends shall be sealed to prevent the entrance of moisture.

The inner end of the cable shall be brought to the outside of the reel flange and securely fastened.

The inner end shall not be brought out through the reel arbor.

The outer end shall be securely fastened to the inner side of the flange; it is acceptable to use plastic wrap for this purpose.

Control cable shall be packaged according to Table 7 of this standard.

Each reel shall consist of one continuous, unspliced length.

Each reel shall be legibly marked with the following information:

- manufacturer's identification
- product description
- shipping length of cable on reel
- gross weight
- tare weight
- net weight
- date of manufacture
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

Cable shall be covered with a layer of protective plastic wrap.

**MATERIAL STANDARD**

superseding: May 14, 2010

effective date: February 15, 2013

page: 4 of 4

Control Cable, Multi-Conductor, 600 Volt

**7. Packaging, continued**

Table 7

Stock Number	Conductor Size, AWG	Number Conductors	Nominal Length per Reel, ft	Maximum Reel Diameter, in	Maximum Reel Traverse, in
640442	12	2	2,500	30	17
640443	12	3	2,500	30	17
640444	12	4	2,500	30	23
640447	12	7	2,500	36	23
640449	12	9	2,500	40	28
640462	10	2	2,500	30	23
640464	10	4	2,500	36	23
640467	10	7	2,500	40	28
640469	10	9	2,500	40	28

**8. Issuance**

FT

**9. Approved Manufacturer**

Prysmian (formerly Draka Cableteq USA)

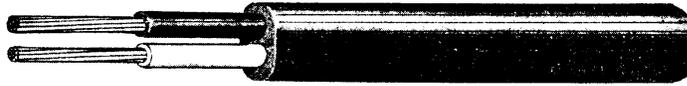
**10. References**

**Shipek, John**; SCL Standards Engineer; subject matter expert and originator of 6404.11  
(john.shipek@seattle.gov)

“Color Coding Standard on Relay and Control Drawings;” Seattle City Light; Engineering Services Division; Drafting Standards and Design Guidelines; 5/29/98

**MATERIAL STANDARD**

**CABLE, STREETLIGHT, OVERHEAD, CROSS-LINKED POLYETHYLENE INSULATED**



**1. Scope**

This specification covers a two conductor #12 AWG, parallel, 7-strand, 600V, cross-linked polyethylene insulated, PVC jacketed cable of flat configuration.

**2. Application**

The cable will be used in overhead streetlight brackets and will also be strung overhead between poles.

**3. Standards:**

The cable shall conform to all of the applicable requirements of ICEA S-95-658 (NEMA WC 70) except as modified by this specification.

**4. Conductor:**

The conductor shall be soft annealed-stranded copper, per ASTM B 3 and ASTM B 8.

**5. Insulation:**

The minimum average insulation thickness shall be 45 Mils. The minimum insulation thickness at any cross section along the cable length shall not be less than 40 mils. The insulation shall be a 600 volt cross-linked polyethylene compound rated at 90° C. for dry locations and 75° C. for wet locations per ASTM D 2655 or a 600 volt high molecular weight polyethylene compound rated at 80° C. The insulation shall be U V inhibited.

**6. Jacket:**

The jacket shall be PVC. The minimum average jacket thickness shall be 45 Mils. The jacket shall be black in color and U V inhibited.

**7. Identification:**

The cable shall have one black conductor and one white conductor.

**8. Marking:**

The jacket shall be marked at regular intervals with the manufacturer's name or symbol, wire size, conductor material, and voltage rating.

**9. Packaging:**

The length of cable on each reel shall be 1000 feet. The maximum reel flange diameter shall be 18 inches. Tare weight shall be printed on all reels. All reels shall be plainly marked with the cable size, type, voltage, length, gross weight, City of Seattle purchase order number, and manufacturer's name. The inner end of the cable shall be brought to the outside of the reel flange and securely fastened thereto. The inner end shall not be brought out through the reel arbor. The outer end of the cable shall be fastened to the inner side of the flange.

**10. Referenced Specifications:**

ASTM B 3, ASTM B 8, ASTM D 2655, ICEA S-95-658 (NEMA WC 70).

**11. Approved Manufacturers: Prysmian**

**12. Stock Unit: FT**

Stock Number	Size AWG	Number of Conductors	Layer Thickness, Mils		Lbs per 1000 Ft.	Approx. Dia., In.
			Insulation	Jacket		
640440	12	2	45	45	80	0.28 x 0.43

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

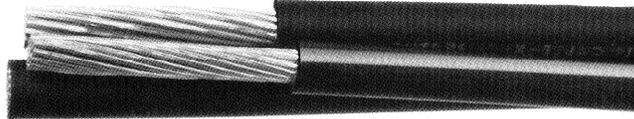
standard number: **6404.50**

superseding: January 25, 2008

effective date: February 15, 2013

page: 1 of 1

**CABLE, STREETLIGHT, UNDERGROUND,  
CROSS-LINKED POLYETHYLENE INSULATED**



**1. Scope:**

This specification covers a three conductor, triplexed 7-strand copper #8 AWG, 600V, insulated cable.

**2. Application:**

The cable will be pulled into underground conduit for power for streetlights.

**3. Standards:**

The cable shall conform to all of the applicable requirements of ICEA S-95-658 (NEMA WC 70).

**4. Conductor:**

The conductor shall be soft annealed-stranded copper, per ASTM B 3 and ASTM B 8.

**5. Insulation:**

The minimum insulation thickness shall be 45 Mils. The insulation shall be a 600 volt Type XHHW or XHHW-2. cross-linked polyethylene compound rated at 90° C for dry locations and 75° C for wet locations per ASTM D 2655. The insulation compound shall be U V inhibited.

**6. Jacket:**

The three conductor cable shall have one red, one white and one black conductor.

**7. Identification:**

The cable shall have one black conductor and one white conductor.

**8. Marking:**

At least one of the three conductors shall be marked at regular intervals with the manufacturer's name or symbol, wire size, conductor material, NEC type (where applicable), and voltage rating.

**9. Packaging:**

The length of cable on each reel shall be 1000 feet. The reel shall conform to the requirements of NEMA WC-26, Table 1-5a, "Nonreturnable Plywood Reels and Spools" and Table 1-7 "Drums for Nonreturnable Reels" and Table 2-1, "Capacities in Feet." Reel size shall be 24-12-10.

Tare weight shall be printed on all reels. All reels shall be plainly marked with the cable size, type, voltage, length, gross weight, City of Seattle purchase order number, and manufacturer's name. The inner end of the cable shall be brought to the outside of the reel flange and securely fastened thereto. The inner end shall not be brought out through the reel arbor. The outer end of the cable shall be fastened to the inner side of the flange.

**10. Referenced Specifications:**

Latest revisions of ASTM B3, ASTM B8, ASTM D2655, ICEA S95-658 (NEMA WC 70)

**11. Approved Manufacturers:** BICC/General, Prysmian, Service Wire, Southwire

**12. Stock Unit: FT**

Stock Number	Size AWG	Number of Conductors	Layer Thickness, Mils		Lbs per M-Ft.	Approx. Dia., In.
			Insulation	Jacket		
640450	8	3	45	none	-	triplexed

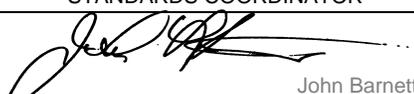
<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

**SWITCHBOARD WIRE, POLYETHYLENE INSULATED**

1. **Scope:** This specification covers single-conductor, flame-resistant polyethylene switchboard wire suitable for operation at conductor temperatures of 90 C or less, in dry locations, at a maximum voltage rating of 600 volts, and shall be listed by Underwriters' Laboratories as suitable for switchboard use.
2. **Conductor:** The conductors shall be coated copper, meeting the requirements of ICEA S-61-402 (NEMA WC 5), Section 2.1.1.3.
3. **Insulation:** The insulation shall be a 30-mil extruded wall of heat and light-stabilized, chemically cross-linked, polyethylene, dark gray in color. When tested in accordance with Part 6 of ICEA S-61-402, the insulation shall meet the following requirements:
  - 3.1 Physical properties of unaged polyethylene tensile strength, lbs. per square inch minimum ..... 1500  
 Elongation at rupture, minimum percent ..... 400
  - 3.2 Physical properties after accelerated aging test, air oven test at 121° ± 1° for 7 days, tensile strength, minimum percentage of unaged value ..... 70  
 Elongation at rupture, minimum percentage of unaged value ..... 70
  - 3.3 Minimum Thickness - The minimum thickness of the insulation shall be not less than 90 percent of the 30-mil average thickness.
4. **Stripping:** The insulation shall strip free from the conductor.
5. **Flame Test:** A 22-inch specimen of the insulated wire shall meet the vertical flame test requirement of ICEA S-61-402, Section 6.5.
6. **Voltage Test:** The insulation shall withstand 1500 volts AC supplied for 5 minutes between the conductor and a layer of metal foil wrapped over a 6-inch section of the test specimen.
7. **Identification:** The wire shall have a readily-identifiable permanent outside marking to indicate the manufacturer's trade name and UL Type SIS insulation. This marking shall be continuous throughout the entire length of the wire.
8. **Packaging:** The wire shall be packaged on 500 foot reels. Boxes are not acceptable.
9. **Reference Specification:** ICEA S-61-402/NEMA WC5, Thermoplastic-Insulated Wire and Cable, latest revision
10. **Purchase Unit:** 500-ft. reel
11. **Stock Unit:** FT

Stock Number	Size, AWG	Conductor Stranding	Approximate OD, in.	Net Weight/ lbs. per 500-ft. Reel
<del>642063</del>	12	obsolete	<del>0.15</del>	14
<del>642080</del>	18	obsolete	<del>0.11</del>	06
642082	14	41	0.14	10
642083	12	65	0.16	14
642084	10	105	0.17	21

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Barnett	 John Barnett	 John Nierenberg



## Connectors, Aluminum Compression, Range-Taking



### 1. Scope

This standard details manufacturer requirements for aluminum compression connectors.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Class	Stock No.	Conductor Range
Minimum Tension	650100	#10 AWG Solid Cu – 1/0 ACSR
	650102	#8 AWG Solid Cu – 2/0 ACSR
	650104	#4 AWG Solid Cu – 4/0 ACSR
	650106	2/0 – 336.4 kcmil ACSR
Partial	013530	1/0 – 4/0 ACSR
	650138	4/0 – 477 kcmil ACSR
	650172	1/0 – 4/0 ACSR
Full Tension	650174	4/0 – 336.4 kcmil AAC
	650196	4/0 – 397.5 kcmil ACSR
	650198	397.5 – 477 kcmil ACSR
Tap	650314	#4 AWG – 4/0 ACSR

### 2. Application

Aluminum compression connectors are intended for use on aluminum, aluminum to copper or ACSR conductors in overhead construction.

Standards Coordinator  
Tonya Panomvana

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Aluminum compression connectors shall meet the applicable requirements of the following industry standard:

**ANSI C119.4-2011** American National Standard for Electric Connectors – Connectors for Use Between Aluminum-to-Aluminum and Aluminum-to-Copper Conductors Designed for Normal Operations at or Below 93° C and Copper-to-Copper Conductors Designed for Normal Operation at or Below 100°C

### 4. Requirements

#### 4.1 General

Connectors shall be designed and manufactured to be installed with VERSA-CRIMP® compression tool VC6.

Each connector shall be factory-filled with a measured amount of oxide-inhibiting compound that will not affect the dielectric strength or power factor of cables insulated with butyl, cross-linked polyethylene or ethylene-propylene rubber.

#### 4.2 Detailed Requirements

##### 4.2.1 Minimum Tension

Compression connectors shall be tensile strength Class 3, as defined in ANSI C119.4.

Stock No.	Conductor Range	Length (in)
650100	#10 AWG Solid Cu – 1/0 ACSR	2 ± 1/16
650102	#8 AWG Solid Cu – 2/0 ACSR	3 ± 1/16
650104	#4 AWG Solid Cu – 4/0 ACSR	4 ± 1/16
650106	2/0 – 336.4 kcmil ACSR	5-5/16 ± 7/16



##### 4.2.2 Partial Tension

Compression connectors shall be tensile strength Class 2, as defined in ANSI C119.4.

Stock No.	Conductor Range	Length (in)
013530	1/0 – 4/0 ACSR	7-11/16 ± 7/16
650138	4/0 – 477 kcmil ACSR	7-11/16 ± 7/16



#### 4.2.3 Full Tension

Compression connectors shall be tensile strength Class 1, as defined in ANSI C119.4.

Stock No.	Conductor Range	Length (in)
650172	1/0 – 4/0 ACSR	19-7/8 ± 1/8
650174	4/0 – 336.4 kcmil AAC	9 ± 1/2
650196	4/0 – 397.5 kcmil ACSR	22-7/8 ± 1/8
650198	397.5 – 477 kcmil ACSR	22-7/8 ± 1/8



#### 4.2.4 Tap

Tap connectors shall be tensile strength Class 3, as defined in ANSI C119.4.

Stock No.	Conductor Range
650314	#4 AWG – 4/0 ACSR



---

### 5. Product Marking

Each connector shall be clearly and indelibly marked with the following:

- Manufacturer's name or symbol
- Aluminum or copper application
- Conductor range
- Number of crimps
- Catalog number
- VERSA-CRIMP<sup>®</sup> tool
- Insulating strip length.

---

### 6. Packaging

Connectors shall be packaged to prevent damage during shipping.

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Quantity contained
- Seattle City Light's purchase order number
- Seattle City Light's stock number.

Shipping container weight shall not exceed 50 pounds.

**7. Issuance**

Stock Unit: EA

**8. Approved Manufactures**

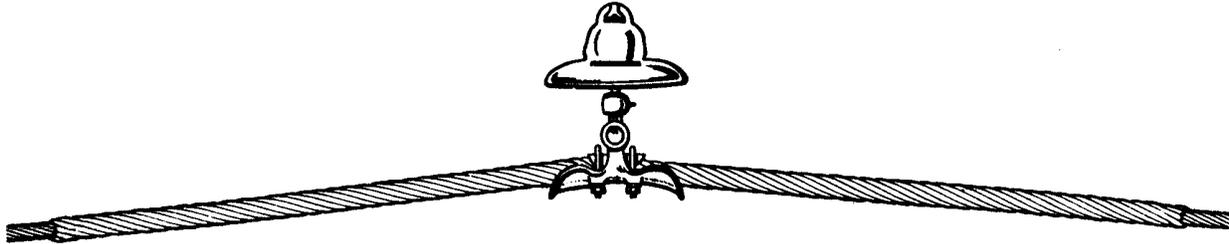
Class	Stock No.	Conductor Range	Hubbell Power Systems (formerly Anderson)	Homac (a division of Thomas & Betts)
Minimum Tension	650100	#10 AWG Solid Cu – 1/0 ACSR	VCSE44	SGAC 1/0
	650102	#8 AWG Solid Cu – 2/0 ACSR	VCSE55	SGAC 3/0
	650104	#4 AWG Solid Cu – 4/0 ACSR	VCSE66	SGAC 250
	650106	2/0 – 336.4 kcmil ACSR	VCSE77	SGAC 350
Partial	013530	1/0 – 4/0 ACSR	VCJS61R	SKAC 4/0
	650138	4/0 – 477 kcmil ACSR	VCJS85R	SKAC 500
Full Tension	650172	1/0 – 4/0 ACSR	VC61R	ACSR 4/0FT
	650174	4/0 – 336.4 kcmil AAC	VC70A	AAC 350FT
	650196	4/0 – 397.5 kcmil ACSR	VC80R	ACSR 397.5FT
	650198	397.5 – 477 kcmil ACSR	VC90R	–
Tap	650314	#4 AWG – 4/0 ACSR	VCL66	–

**9. References**

**SCL Material Standard 6501.1 (canceled);** “Connectors, Aluminum Compression, Range-Taking”

**Panomvana, Tanya;** SCL Standards Engineer, subject matter expert and originator of 6501.10 (tanya.panomvana@seattle.gov)

**ROD, ARMOR  
 FORMED ALUMINUM**



1. **Formed Aluminum Armor Rods** shall be of the configuration shown, and shall be made of aluminum alloy meeting the requirements of ASTM specification B 211, alloy GS11A (AA6061).
2. The armor rods shall be helically wound, free of machine marks or surface distortion, and the ends smooth to protect the conductor and minimize corona.
3. Armor rods shall be packaged in sets, with the container legibly marked with the type, size, and quantity of the items contained therein.
4. **Reference Specification:** ASTM B 211, latest revision
5. **Stock Unit:** ST (13 rods per set)

Stock Number	Conductor		Armor Rod, in.		Approved Manufacturer		
	Size	Strand	Dia.	Length	Preformed	Helical	Dulmison/Tyco
658915	795000	30 x 19	0.31	100-S	AR-0142	100AAR-546	AAR 2895
658920	795000	30 x 19	0.31	124-D	AR-MS-6993	124AAR-546	AAR 2895-124

▲ S = single support  
 ‡ D = double support

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Charles L. Shaffer</i>	<i>John Blinner</i>	<i>Hardee Juy</i>

**LINEGUARDS  
 FORMED ALUMINUM**



1. **Formed Aluminum Lineguards** shall be of the configuration shown and shall be made of aluminum alloy meeting the requirements of ASTM B 211. Lineguards are used to protect conductor from tie wire abrasion, flashover, as tap armor, and to repair strand damage.
2. The lineguards shall be helically wound and shall be free of machine marks or surface distortion. The ends shall be smooth and round to prevent conductor damage and minimize corona. When applied, the lineguards shall restore full conductance and strength to aluminum or ACSR conductors where damage does not exceed 25 percent of the outer strand layer.
3. Lineguards shall be packaged in sets with the containers legibly marked with the type, size, and quantity of the items therein.
4. **Reference Specification:** ASTM B 211, latest revision
5. **Stock Unit:** ST

Stock Number	Conductor			Length, in.	Rods/Set	Approved Manufacturers		
	Code Word	Size, kcmil	Dia., in.			Dulmison/Tyco	Helical	Preformed
658935	Chickadee	397.5	0.743	39	17	ALG 1880	39ALG535	MG-0148
658940	Arbutus	795	1.026	47	18	ALG 2585	47ALG541	MG-0154
658944	Mallard	795	1.140	49	15	ALG 2790	49ALG543	MG-0156
658946	Rail	954	1.165	51	15	ALG 2930	51ALG544	MG-0157

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

*John Blinner*

UNIT DIRECTOR

*Hardee Juy*

# MATERIAL STANDARD

## SPLICES, FORMED WIRE FOR ACSR AND ALL-ALUMINUM CONDUCTOR



### 1. Application

**Formed Wire Aluminum Alloy Splices** are used to splice all-aluminum conductor, ACSR conductor, or to restore mechanical and electrical properties to damaged aluminum strands of the conductor.

### 2. Material

The aluminum alloy shall meet the requirements of ASTM B 211, alloy 6061.

### 3. Construction

The splices shall be helically wound, free of machine marks or surface distortions, and the ends smoothly rounded to protect the conductor and to minimize corona. The splices shall have identifying marks to indicate the proper crossover points. The contact areas of the splices shall be coated with grit particles capable of penetrating oxides and establishing permanent electrical contact.

### 4. Packaging

The splices shall be packaged in sets, with the container legibly marked with the type, size and quantity of the items contained therein.

### 5. Reference Specification: ASTM B 211, latest revision.

### 6. Stock Unit: ST

Stock Number	kcmil	Conductor			Rated Holding Strength as percent of Conductor RBS	Length (+0, -5), in.	Rods		Approved Manufacturers	
		Code Name	Strands	Diameter, in.			Number	Sets of	Dulmison/ Tyco	Pre-formed
659195	397.5	Chickadee	18/1	0.743	75	79	10	3,3,4	ALS 1855	LS-0141
012592	397.5	Ibis	26/7	0.783	50	83	—	—	ALS 1935	LS-0142
659197	795	Arbutus	37/0	1.026	100	121	11	2,3,3,3	ALS 2565	LS-0149
659194	795	Mallard	30/19	1.140	~35	141	11	2,3,3,3	ALS 2890	LS-0152
	954	Rail	45/7	1.165	50					

STANDARDS COORDINATOR

*Charles L. Shaffer*

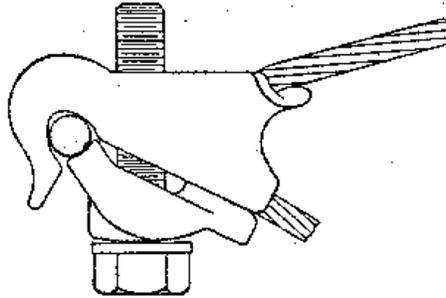
STANDARDS SUPERVISOR

*John Chinner*

UNIT DIRECTOR

*Harold Gray*

**CLAMP, ALUMINUM  
BOLTED MID-SPAN TAP**



**Aluminum Bolted Mid-Span Tap Clamps** are used for making in-span taps on the neutral messenger of secondary aerial cable.

The clamps and cap screws shall be made of high-strength aluminum alloy and shall meet the applicable requirements of NEMA SG 1. The cap screws shall be anodized and the threads lubricated with a film of antioxidant, to resist corrosion and prevent seizing of threads.

Conductor grooves shall be factory-filled with an oxide-inhibiting compound and the clamps individually packaged in plastic bags.

Reference specification: NEMA SG1, latest revision

Stock Unit: EA

Stock Number	Conductor Range		Approved Manufacturers		
	MAIN	Tap	Alcoa		
651110	1/0 ACSR - 3/0 Str	4 Str - 2 ACSR	SCL 206		

standards coordinator

John Shipek

standards supervisor

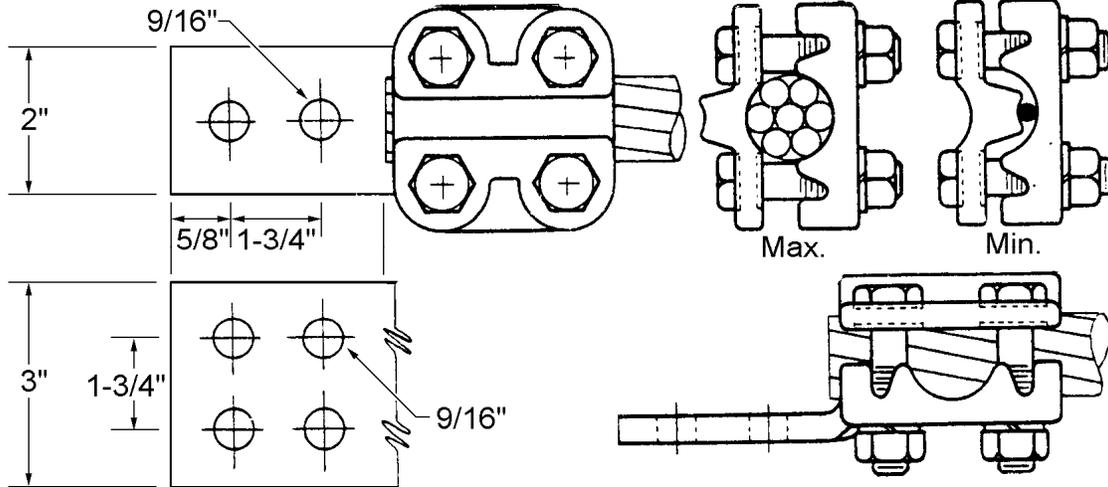
John Shipek

unit director

Pamela S. Johnson

# MATERIAL STANDARD

## LUGS, TERMINAL CONNECTOR UNIVERSAL AND TUBE TYPE



**Terminal Connector Lugs** of the Universal type shall be of the general configuration shown and shall be forged or cast from high-conductivity copper alloy. The bolts, nuts, and lock washers shall be high-strength silicon bronze. The connectors shall meet the applicable requirements of ANSI/NEMA CC-1, *Electric Power Connectors for Substations*.

**Reference:** ANSI/NEMA CC-1

**Stock Unit:** EA

Stock No.	Range		Pad Holes	Approved Manufacturers					
	Cable	IPS		Anderson	Burndy	Dossert	Fargo	*Homac	S. States
667786	#2 Sol-800 kcmil	1/4" - 3/4"	2	SF-1-B2-3	-	-	-	7MK-80-2N	-
661241	-	1-1/4"	4	STF4-12C	NA16-4N	TP 125-4N	T3A4N	KL-G-4N	UA-25-4
661244	-	1-1/2"	4	STF4-14C	NA17-4N	TP 150-4N	T4A4N	KL-H-4N	UA-26-4

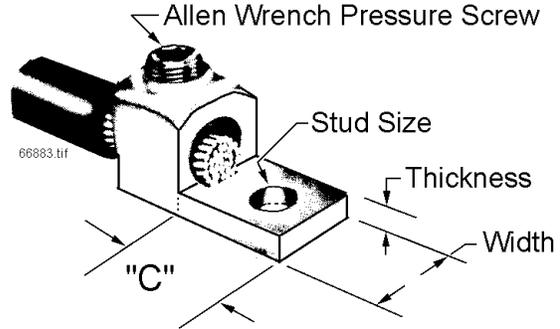
\*Frankel acceptable.

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John Chinner</i>	<i>Harold J. J.</i>

# MATERIAL STANDARD

## CONDUCTOR FITTINGS – COPPER CABLE CONNECTORS

Cable Range kcmil	Dimensions (Minimum), Inches			
	Stud Size	Width	Thick	"C"
2/0 - 4/0	3/8	1	1/4	1
4/0 - 300	1/2	1-1/16	9/32	1-1/4
300-500	1/2	1-3/8	11/32	1-1/2
500-750	1/2	1-5/8	3/8	1-3/4



**Terminal Lug, Straight Blade** shall be of the description and configuration shown, and shall meet the applicable requirements of ANSI/NEMA CC-1, *Electrical Power Connectors for Substations*. The connector shall have a cast copper alloy body. The pressure screw shall be cadmium-plated steel or silicon bronze, with an attached saddle and a shake-proof washer. The pressure screw shall accommodate an Allen wrench (hex or square bolts are not acceptable).

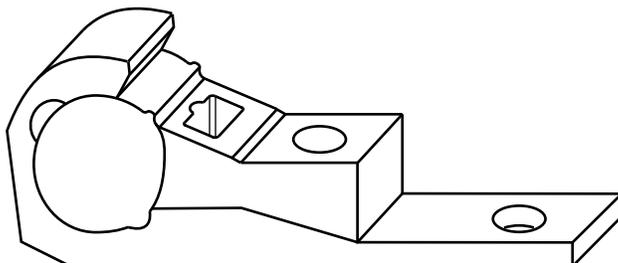
**Stock Unit:** EA

**Table I**  
**Standard One-Hole Straight Terminals**

Stock Number	Cable Range		Bolt Holes	Approved Items				
	Min.	Max.		Bronco	Dossert	O.Z.	Penn Union	T & B
668810	2/0	4/0	1	BT21687	HL-21-1-A	XL 241	VL-21687	31011
668811	4/0	300	1	BT21689	HL-30-1-A	XL 301	VL-21689	31013
668812	300	500	1	BT21692	HL-50-1-A	XL 501	VL-21692	31015
668813	500	750	1	BT21694	HL-75-1-A	XL 751	VL-21694	31017

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**CONNECTORS, ALUMINUM,  
 TERMINAL, BOLTED PRESSURE**



**Requirements:** Aluminum Terminal Connectors (Lugs) shall be of the configuration shown and made of high-strength aluminum alloy. The connectors shall be suitable for use on aluminum or copper conductors.

**Standards:** The connectors shall meet the requirements of the latest revision of ANSI C119.4 for a heavy duty (Class A), partial tension (Class 2) connector.

**Marking:** Packages shall be marked with the item name, catalog number and manufacturer's name or logo. Connectors shall be marked with the manufacturer's name or logo and the conductor size range. If the conductor sizing information is marked on the connectors in coded form, decoding information shall be provided in each connector package of no more than six connectors.

**Packaging:** Connectors shall be packaged in a manner to effectively prevent damage or loss during shipment and storage.

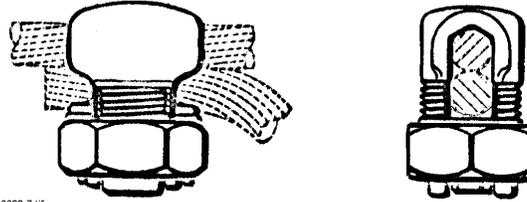
**Reference Specification:** ANSI C119.4

Stock Unit: Each

Stock Number	Wire Size AWG-kcmil	Stud Size Inches	Width Inches	No. Holes in Tang	Approved Manufacturers	
					Buchanan/ Cytolok®	
668822	1/0 to 2/0	1/2"	0.89"	2	CL-510B41	
668823	3/0 to 4/0	1/2"	1"	2	CL-526-2	
668825	350 to 400	1/2"	1.32"	2	CL-544-2	
668826	500 to 600	1/2"	1.52"	2	CL-560-2	

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**CONDUCTOR FITTINGS, COPPER  
PARALLEL TAP, SPLIT BOLT CABLE CONNECTORS**



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**1. Scope**

**Parallel tap, split bolt connectors** shall be of the configuration shown. The body, nut and retainer shall be manufactured from high-strength bronze alloys. The retainer must be V-grooved or have a serrated contact face.

**2. Standards**

Seattle City Light Material Standard 6600.0, latest revision: Connectors, Electrical, Wire and Cable, Copper Alloy, Pressure

**3. Stock Unit: EA**

**4. Approved Manufacturers**

Stock No.	Maximum Copper Conductor		Approved Manufacturers					
	Solid	Stranded	Anderson	Blackburn	Burndy	Dossert	Homac	Ilco
668860	#10	#12	C10	9H	KS90	DS09	E10	IK-10
668861	8	8	SBN8	8H	KS15	DS1	E8	IK-8
668862	6	7	SBN6	6H	KS17	DS2	E6	IK-6
668864	4	5	SBN4	4H	KS20	DS3	E4	IK-4
668867	1	2	SBN2	1H	KS23	DS6	E2	IK-2

STANDARDS COORDINATOR

*Charles L. Shaffer*

Charles L. Shaffer

STANDARDS SUPERVISOR

*John G. Skinner*

John G. Skinner

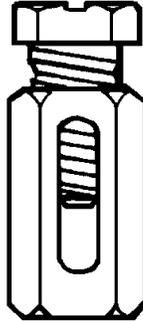
UNIT DIRECTOR

*Hardev Juj*

Hardev Juj

**MATERIAL STANDARD**

**CONNECTOR, CABLE**



**Parallel Tap, Setscrew Type**

**Body.** The body shall be manufactured from hard drawn copper extrusions, or high-strength hex or square bronze rod. Round bodies are not acceptable.

**Screw.** The screw shall be silicon bronze. The heads shall be both hexagonal and slotted for installation with wrench or screwdriver.

**Reference Specification:** City Light Material Standard No. 6600.0, latest revision

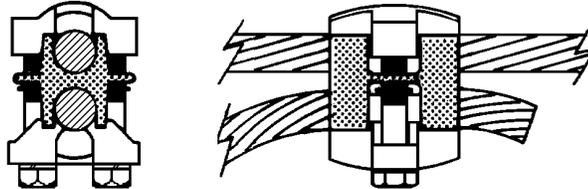
**Stock Unit:** EA

Stock Number	Max. Wire Size	Approved Manufacturers					Penn-U Bronco* IlSCO
		Blackburn	Burndy	Homac	Kearney		
669138	10 Str	10N	-	SE-1	118116	SX-10-8 SEX-10	
669140	4 Str	4N	KP4C	SE-3	118118	SX-4 SEX-4	
669141	2 Str	-	-	SE-4	118119	SX-2 SEX-2	

\* Bronco catalog letter prefixes -- BX and BEX

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**CONNECTORS, ALUMINUM  
 TWO-BOLT, PARALLEL GROOVE**



**1. Scope**

Two-bolt aluminum parallel groove connectors shall be suitable for use on aluminum to aluminum or aluminum to copper applications.

**2. Industry Standards**

The connectors shall meet the applicable requirements of the following national standards:  
 EEI-NEMA Standard TDJ-162 (ANSI C119.4), Connectors for Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors  
 NEMA Standard CC1, Electric Power Connectors for Substations

**3. Requirements**

- Body Material ..... high strength, copper-free aluminum alloy
- Spacer Bar Material ..... 1350 grade aluminum alloy
- Bolt Material ..... high strength, anodized aluminum alloy
- Thread Lubrication ..... film of anti-oxidant to resist corrosion and reduce bolt-thread friction
- Retraining Rings Material ..... neoprene
- Contact Surfaces Coating ..... oxide-inhibiting compound

ACSR Range, Stock No. 651132

Main ..... 4/0 - 336.4

Tap ..... #6 - 336.4

ACSR Range, Stock No. 651134

Main ..... 336.4 - 715.5

Tap ..... 3/0 - 715.5

**4. Packaging**

Each connector shall be individually packaged to prevent contamination.

**Stock Unit:** EA

**Stock Number 651132**

**Stock Number 651134**

Approved Manufacturers	Catalog Number
Burndy	KVS-31AS
Dossert	ASU-35LP
Penn-U	AVT-3ABF

Approved Manufacturers	Catalog Number
Burndy	KVS-40AS
Dossert	ASU-80LP
Penn-U	AVT-5ABF

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
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**CONNECTOR - TWO-BOLT PARALLEL CLAMP**



**1. Scope**

This material standard covers the requirements for two-bolt parallel clamp connectors.

**2. Application**

These compact, two-piece, high strength mechanical connectors are suitable for heavy-duty service connections and are rated for use up to 90 degrees C. Connector is for copper conductor and may be installed with an ordinary wrench.

**3. Requirements**

Body and clip shall be cast from high strength bronze.

A lock washer shall be fitted on each bolt.

Bolts and lock washers shall be silicon bronze or stainless steel.

Loose parts shall be designed to be held captive.

**4. Packaging**

Individual cartons shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Stock Number

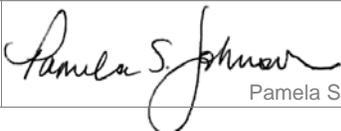
Shipping containers shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**5. Issuance: EA**

**6. Approved Manufacturers**

Stock Number	Run Conductor Range (AWG/kcmil)	Tap Conductor Range (AWG/kcmil)	Burndy	Dossert	Penn-Union
669379	#2 str - 2/0 str	#6 sol - 2/0 str	KVS26G15	DSU13	VT-1
669380	1/0 str - 4/0 str	#10 str - 4/0 str	KVS28G17	DSU21	VT-2
669381	250 - 350	#10 str - 350	KVS31G14	DSU35	VT-3
669382	400 - 500	#10 - 500	KVS34G17	DSU50	VT-4
669383	400 - 800	3/0 str - 800	KVS40G10	DSU80	VT-5
669384	500 - 1000	3/0 str - 1000	KVS44G10	DSU100	VT-6

<i>standards coordinator</i>	<i>standards manager</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pamela S. Johnson

**CONNECTOR, BRONZE VISE**



**1. Scope**

This material standard covers the requirements for bronze, side-opening, vise type connectors with standard hex bolt head.

**2. Application**

Vise connectors are used in a variety of applications to join solid and stranded copper conductors. For primary application, connectors are designed to be installed with live line tools.

**3. Construction**

Vise connector body and jaw shall be forged bronze.

Vise connector bolt shall be silicon bronze or stainless steel.

Vise connector bolt shall be hex-type designed for use with standard, English-sized ratchet wrenches.

Vise connector shall be of interlocking design to eliminate the problem of lost parts.

Vise connector shall be designed to be installed and removed with live line tools.

**4. Packaging**

Vise connectors shall be packaged to prevent damage during shipping, storage, and casual handling prior to installation.

Each package shall be legibly marked with the following information:

- Manufacturer's identification
- Quantity contained
- Product description
- Seattle City Light's Purchase Order Number

Seattle City Light's Stock Number Quantity of vise connectors per package shall be as mutually agreed upon between supplier and Seattle City Light.

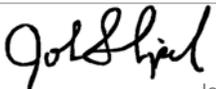
Package weight shall not exceed 50 pounds.

**5. Issuance**

**Stock Unit:** EA

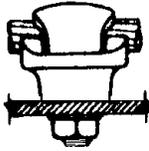
**6. Approved Manufacturers**

Stock Number	Conductor Size, AWG / kcmil	Hubbell Power Systems (Fargo)	MacLean Power Systems	Richards Manufacturing
012173	4	GC-5004	BVC-4	VC5
012171	2	GC-5002S	BVC-2S	VC10
012169	2/0	GC-5020S	BVC-20S	VC10s
012170	4/0	GC-5040	BVC-40	VC12
012172	500	—	—	VC18

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

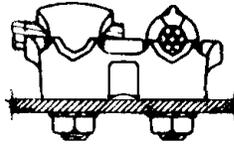
# MATERIAL STANDARD

## CONDUCTOR FITTINGS TAP LUGS - COPPER CABLE TO FLAT



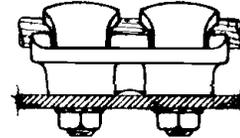
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**Fig.1**  
(one way)



1-3/4"

**Fig. 2**  
(two way)



1-3/4"

**Fig. 3**  
(one way)

**Terminal, Tap Lug** shall be of the configurations shown and shall have a forged or cast body of high conductivity copper alloy. The eye bolt shall be high-strength silicon bronze or aluminum bronze. Threads shall be 1/2 x 13NC, Class 2 fit. The bolt shall be provided with a nonferrous nut and shakeproof washer. The terminals shall meet the applicable requirements of ANSI/NEMA CC-1, Electrical Power Connectors for Substations.

**Reference:** ANSI/NEMA CC-1

**Stock Unit:** EA

Stock Number	Conductor Range	Fig. No.	Bus Bar, In.	Approved Manufacturers					
				Anderson	Penn Union	So States	Burndy	Anixter Royal	Dossert
676102	#8 sol-2/0 str	1	1/4	TLS-32	LSN-2/0N	UN-4048	QGFL26B2	12206	QL-13-50
676104	#6 sol-250 kcmil	1	1/4	TLS-42	LSN-025N	UN-4151	QGFL29B1	12208	QL-25
676115	#8 sol-2/0 str	2	3/4	TLD-32L	LDN-2/0N2E	UNN-4048T	--	--	Q2L-13-50E
676117	#6 sol-250 kcmil	2	3/4	TLD-52L	LDN-025N2E	UNN-4151T	--	--	Q2L-125E
676120	1/0 sol-500 kcmil	3	3/4	TLD-62L	LDN-050NE	UNN-4656T	--	--	Q2L-50E
676123	2/0 sol-1000 kcmil	3	3/4	TLD-89L	LDN-100NE	--	--	--	--

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Betty Robm</i>

**OVERHEAD TRANSFORMER GROUND CLAMP**



**1. Scope**

This standard covers the requirements for overhead transformer ground clamps.

This standard applies to Seattle City Light stock number 676200.

**2. Application**

Overhead transformer ground clamps are used to replace damaged ground clamps on transformers that are returned from the field. Two ground clamps are supplied by the manufacturer on each new overhead transformer. One ground clamp is installed in the low-voltage ground provision located below the X2 bushing. A second ground clamp is installed in the tank ground provision. See Figure 2.

**Figure 2 Overhead Transformer Ground Clamp Locations**



**3. Attributes**

Stud threads	NC 1/2-13
Stud length, nominal	7/16 in
Copper cable range	#8 solid – 2/0 stranded
Casting and eyebolt material	Bronze alloy
Hardware material	Silicon bronze or stainless steel

**4. Issuance**

EA

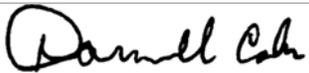
**5. Approved Manufacturers**

Manufacturer	Part Number
CMC	TGC2
Penn Union	HGSE-020-SBH

**6. References**

Hanson, Brett; SCL Standards Engineer, originator of Material Standard 6762.10 ([brett.hanson@seattle.gov](mailto:brett.hanson@seattle.gov))

**SCL 4150.00**; "Overhead-type, Single-Phase, Natural Ester Fluid Distribution Transformer;" Material Standard

standards coordinator	standards supervisor	unit director
 Brett Hanson	 John Shipek	 Darnell Cola

**CLAMP FOR 5/8-INCH GROUND RODS**



**1. Scope**

This standard covers the requirements for all stainless steel ground rod clamps.

This standard applies to Seattle City Light Stock Number 564012.

**2. Application**

Ground rod clamps are used to connect a ground lead conductor to a 1/2-inch to 5/8-inch diameter ground rod or #4 rebar.

Ground rod clamps are appropriate for direct burial use in wet or dry locations.

Refer to Material Standard 5640.32 for clamps appropriate for use with 3/4-inch ground rods.

**3. Attributes**

Ground rod clamps shall be UL listed.

Ground rod clamp shall be of a non-rigid, stainless steel, metal strip design.

Ground clamp shall have the following attributes:

ground rod diameter, in	
minimum	1/2
maximum	5/8
conductor size, AWG	
minimum	#10
maximum	#2
material, stainless steel (ss)	
body	18-8 ss
bolt	18-8 ss
torque withstand, in-lbs	
minimum	300

**4. Marking**

Each ground rod clamp shall be permanently marked with:

- Manufacturer's name or symbol
- Manufacturer's catalog number
- Electrode sizes
- Conductor sizes or range
- UL symbol

**5. Packaging**

Ground rod clamps shall be packaged to prevent damage during shipping and storage.

Each package shall be marked with Seattle City Light's Stock Number.

**6. Issuance: EA**

**7. Approved Manufacturer**

Stock Number	Manufacturer	Catalog Number
564012	Eritech	SP58

**8. References**

**UL-467**; "Grounding and Bonding Equipment," 9th Edition, Underwriters Laboratories Inc.

**Shipek, John**; SCL Standards Engineer, subject matter expert and originator of 6762.15 (john.shipek@seattle.gov)

**5640.32**; "Clamp, for 3/4-Inch Ground Rods"; Material Standard; SCL (renumbered to 6762.20 in October 2015)

**SCL Material Standard 5640.30**; "Clamp for 5/8-in Ground Rods" (renumbered to 6762.15 in October 2015)

Standards Coordinator  
 Laura Vanderpool

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

**CLAMP FOR 3/4-INCH GROUND RODS**



**1. Scope**

This standard covers the requirements for bronze alloy ground rod clamps.

This standard applies to Seattle City Light Stock Number 013283.

**2. Application**

Ground rod clamps are used to connect a ground lead conductor to a 3/4-inch diameter ground rod or #4 rebar.

Ground rod clamps are appropriate for direct burial use in wet or dry locations.

Refer to Material Standard 6762.15 for clamps appropriate for use with 1/2-inch to 5/8-inch ground rods.

**3. Attributes**

Ground rod clamps shall be UL listed.

Ground rod clamp shall be of a bronze alloy design.

Ground clamp shall have the following attributes:

ground rod diameter, in	
nominal	3/4
conductor size, AWG	
minimum	#8
maximum	1/0
material	
body	bronze
bolt	18-8 ss or bronze
torque withstand, in-lbs	
minimum	450

**4. Marking**

Each ground rod clamp shall be permanently marked with:

- Manufacturer's name or symbol
- Manufacturer's catalog number
- Electrode sizes
- Conductor sizes or range
- UL symbol

**5. Packaging**

Ground rod clamps shall be packaged to prevent damage during shipping and storage.

Each package shall be marked with Seattle City Light's Stock Number.

**6. Issuance: EA**

**7. Approved Manufacturers**

Stock No.	Manufacturer	Catalog Number
013283	Eritech	HDC 34
	Hubbell	GC10303
	Wilcor	WAG34HGR

**8. References**

**UL-467** - "Grounding and Bonding Equipment," 9th Edition, Underwriters Laboratories Inc.

**Hanson, Brett**; SCL Standards Engineer, subject matter expert and originator of 6762.20 (brett.hanson@seattle.gov)

**6762.15**; "Clamp, for 5/8-Inch Ground Rods"; Material Standard; SCL

**SCL Material Standard 5640.32**, "Clamp for 3/4-in Ground Rods" (renumbered to 6762.20 in October 2015)

Standards Coordinator  
 Laura Vanderpool

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

## Ground Rods, Copper-Covered, Sectional



1. **Ground Rods** shall be fabricated from cold-finished carbon steel shafting in accordance with ASTM Specification A 108, as it applies to Grade 1018.
2. **Construction:** The covering of the steel core shall be a molecularly-bonded sheath of electrolytic-grade copper having a minimum thickness of 0.010". The rods shall have rolled threads at each end for joining together with couplings. The rods shall conform to the applicable requirements of Underwriters' Laboratories UL-467, except as modified herein.
3. **Couplings** for sectional rods shall be made of high-strength, corrosion-resistant bronze, internally threaded to fit standard rods.
4. **Driving Studs** shall be made of high-strength, hardened steel of SAE 1045 or equal quality.
5. **Packaging:** The threaded rod ends shall be protected to prevent thread damage during shipment.
6. **Reference Specifications:**  
     **ASTM A 108, SAE 1045**, latest revisions  
     **NEMA Standard Publication GR 1-2001**  
     **Underwriters' Laboratories UL-467**
7. **Stock Unit:** EA
8. **Approved Manufacturers:**

Stock No.	Description	Hubbell	Eritech	Galvan Industries, Inc.	Southern Grounding Products	Wilcor
564235	5/8-in x 5-ft ground rod	—	635850	6255-10MS	CS 586	WA 585CT
564238	5/8-in x 8-ft ground rod	C635880	635880	6258S	CS 588	WA 588CT
564260	3/4-in x 10-ft ground rod	C633400	633400	7510S	CS 3410	WA 3410CT
564074	5/8-in coupling	CTC58	CR-58	60-C	58C	C 158
564075	3/4-in coupling	CTC34	CR-34	70-C	34C	C 134
564604	5/8-in driving stud	CTDH58	DS58	60-DS	DS 58	D 358
013282	3/4-in driving stud	CTDH34	DS34	70-DS	DS 34	D 334

In October 2015, this standard was renumbered from 5642.10 to 6762.25.

Standards Coordinator  
 Laura Vanderpool

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

**GROUND CLAMPS  
 PARALLEL OR TRANSVERSE CABLE CONNECTION(S) TO ROD OR PIPE**

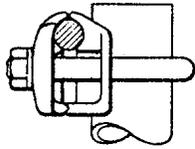


Figure 1

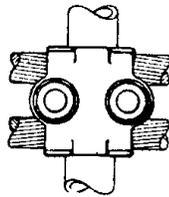


Figure 2

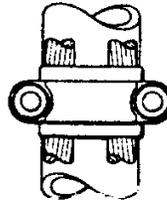


Figure 3

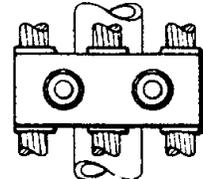


Figure 4

**Parallel, Transverse or Universal Ground Clamps** shall be of the configuration shown. The body shall be of forged or cast high-conductivity alloy. U-bolts, nuts and lock washers shall be silicone bronze or stainless steel. Clamps shall meet the applicable requirements of ANSI/NEMA CC 1, Electric Power Connectors for Substations.

**References:** ANSI/NEMA CC 1 – latest revision

**Stock Unit:** EA

Stock No.	Conductor Range Cable to Rod/Pipe	Fig. No.	Approved Manufacturers				
			Anderson (Hubbell)	Burndy	Dossert	Homac	Penn Un.
676254	#4 Sol to 2/0 Str to 5/8" - 3/4" rod	1	GC-111-3B	GAR6426	GPC 38-13	2755-E-2/0	GPL-5
676255	2/0 Sol to 250 to 5/8" - 3/4" rod	1	GC-111-3C3	GAR6429	GPC 38-25	2755-E-25	GPL-6
676271	#4 Sol to 2/0 to 1-1/4" IPS	1	GC-111-5B	GAR1626	GPC-125-13	2755-G-2/0	GPL-21
676277	#4 Sol to 2/0 Str to 1-1/2" IPS	1	GC-111-6B	GAR1726	GPC-150-13	2755-H-2/0	GPL-27
676283	#4 Sol to 2/0 Str to 2" IPS	1	GC-111-7B	GAR1826	GPC 200-13	2755-J-2/0	GPL-33
676285	#4 Sol to 2/0 Str to 3" IPS	1	GC-111-9B	GAR 2026	GPC 300-13	2755-L-2/0	GPL-45
676286	#4 Sol to 2/0 Str to 4" IPS	1	GC-111-11B	GAR 2226	GPC 400-13	2755-P-2/0	GPL-57
676287	#4 Sol to 2/0 Str to 5" IPS	1	GC-111-13B	GAR 2426	–	2755-R-2/0	GPL-69
676389	2/0 Sol to 250 to 2" IPS	2	GC-110-82C	GD 1829	GW 200-25	2752-3-J-25	GU-12
676392	#4 Sol to 2/0 Str to 2-1/2" IPS	2	GC-110-101C	GD 1926	GW 250-13	2752-3-K-2/0	GU-15
676393	2/0 Sol to 250 to 2-1/2" IPS	2	GC-110-102C	GD 1929	GW 250-25	2752-3-K-25	GU-16
676398	2/0 Sol to 250 to 3" IPS	2	GC-110-122C	GD 2029	GW-300-25	2752-3-L-25	GU-21
676410	2/0 Sol to 250 to 4" IPS	2	GC-110-162C	GD 2229	GW 400-25	2752-3-P-25	GU-33
676551	#4 Sol to 2/0 Str to 5/8" - 3/4" rod	3	GC-115-2B	GP 6426	GS 38-13	GB-8610	GT-5
676427	300 to 500 to 5/8" - 3/4" rod	4	–	GK 6434	GZ 38-50	2752-3-B-50	GR-7

Standards Coordinator  
 Kathy Tilley

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

## Exothermic Connection System



### 1. Scope

This standard covers the requirements of an exothermic connection system consisting of weld metal, molds, tools, and accessories.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Description
013335	Electronic Control Unit (ignition tool) with 6-foot lead
013336	Handle Clamp for type "C" "E," "Q," and "R" molds
013397	Handle Clamp for type "D," F," "J," and "Z" molds
013560	Weld Metal, gray color code
013338	Weld Metal, orange color code
013398	Weld Metal, dark-blue color code
013399	Weld Metal, yellow color code
013561	Weld Metal, purple color code
013400	Weld Metal, brown color code
013440	Weld Metal, light brown color code
013557	Mold for 4/0 stranded wire butt splice
013339	Mold for 250 kcmil stranded wire butt splice
013401	Mold for 500 kcmil stranded wire butt splice
013402	Mold for 250 kcmil stranded wire to 5/8-inch ground rod
013403	Mold for 500 kcmil stranded wire to 5/8-inch ground rod
013441	Mold for 250 kcmil stranded wire to 3/4-in ground rod
013442	Mold for 500 kcmil stranded wire to 3/4-in ground rod
013558	Mold for 4/0 stranded wire all way, horizontal T-connection
013559	Mold for 4/0 stranded wire all way, lapped horizontal X-connection
013580	Mold for #2 AWG stranded wire to 5/8-in ground rod
013581	Mold for #4 AWG solid wire to 5/8-in ground rod
013585	Mold for 2/0 stranded wire to 5/8-in ground rod

Standards Coordinator  
 Kathy Tilley

Standards Supervisor  
 John Shipek

Unit Director  
 Darnell Cola

*Kathy Tilley*

*John Shipek*

*Darnell Cola*

## 2. Application

Exothermic connection systems are used to form permanent, low resistance; highly reliable, welded electrical connections that may be direct buried or embedded in concrete. The term “exothermic” means the process gives off heat.

Exothermic connection systems are commonly used to construct power station ground mats where it is not practical to inspect connections or easily repair failing connections.

Unless noted otherwise, butt splice, T-connection and X-connection molds are for horizontal-lying cable.

Exothermic connection systems have long been referred to as Cadweld®, however Cadweld® is just one of many manufacturers of such systems. Components from different suppliers may or may not be interchangeable.

For copper conductor only.

For more information, refer to SCL 0468.90.

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## 3. Industry Standards

Connection system shall meet the applicable requirements of the following industry standards:

**IEEE 80-2000** – Guide for Safety in AC Substation Grounding

**IEEE 837-2002** – Standard for Qualifying Permanent Connections Used in Substation Grounding

---

## 4. Requirements

Molds shall bear permanent marking indicating the name of the manufacturer, the mold part number, the type and size of welding mixture compatible with the welding process and the size of the cable or bus connection.

### Figure 4. Mold, Example



Molds shall have a minimum average life of 50 separate weld operations.

Each mold shall be provided with instructions detailing general safety information, connection preparation, and welding procedures.

Weld metal packages shall be identified as to the part number (size) and type of metals to be connected, such as copper to copper or copper to steel, cast iron, etc.

---

## 5. Testing

Test data that establishes compliance with the requirements of IEEE 80, IEEE 837, and this standard shall be provided upon request.

## 6. Packaging

Weld metal, molds, tools, and accessories shall be packaged to prevent damage during shipping, handling, and inside storage.

Weld metal containers shall be moisture resistant.

Shipping containers shall be legibly marked with:

- Manufacturer's name
- Product description
- Seattle City Light's purchase order number.

## 7. Issuance

Stock unit: EA

## 8. Approved Manufacturers

<b>Stock No.</b>	<b>013335</b>
Description	Electronic Control Unit (ignition tool) with 6-ft lead
Manufacturer	Erico/Cadweld
Catalog No.	PLUSCU



<b>Stock No.</b>	<b>013336</b>
Description	Handle Clamp, for type "C" "E," "Q," and "R" molds
Manufacturer	Erico/Cadweld
Catalog No.	L160



<b>Stock No.</b>	<b>013397</b>
Description	Handle Clamp for type "D," "F," "J," and "Z" molds
Manufacturer	Erico/Cadweld
Catalog No.	L159

<b>Stock No.</b>	<b>013560</b>
Description	Weld Metal, gray color code
Manufacturer	Erico/Cadweld
Catalog No.	90PLUSF20



<b>Stock No.</b>	<b>013338</b>
Description	Weld Metal, orange color code
Manufacturer	Erico/Cadweld
Catalog No.	115PLUSF20



<b>Stock No.</b>	<b>013398</b>
Description	Weld Metal, dark-blue color code
Manufacturer	Erico/Cadweld
Catalog No.	150PLUSF20



<b>Stock No.</b>	<b>013399</b>
Description	Weld Metal, yellow color code
Manufacturer	Erico/Cadweld
Catalog No.	200PLUSF20



<b>Stock No.</b>	<b>013561</b>
Description	Weld Metal, purple color code
Manufacturer	Erico/Cadweld
Catalog No.	250PLUSF20



<b>Stock No.</b>	<b>013400</b>
Description	Weld Metal, brown color code
Manufacturer	Erico/Cadweld
Catalog No.	400PLUSF20



<b>Stock No.</b>	<b>013440</b>
Description	Weld Metal, light brown color code
Manufacturer	Erico/Cadweld
Catalog No.	500PLUSF20



<b>Stock No.</b>	<b>013557</b>
Description	Mold for 4/0 stranded wire butt splice
Manufacturer	Erico/Cadweld
Catalog No.	SSC-2Q



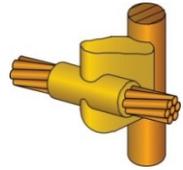
<b>Stock No.</b>	<b>013339</b>
Description	Mold for 250 kcmil stranded wire butt splice
Manufacturer	Erico/Cadweld
Catalog No.	SSC-2V



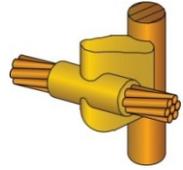
<b>Stock No.</b>	<b>013401</b>
Description	Mold for 500 kcmil stranded wire butt splice
Manufacturer	Erico/Cadweld
Catalog No.	SSC3Q



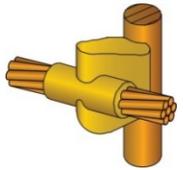
<b>Stock No.</b>	<b>013402</b>
Description	Mold for 250 kcmil stranded wire to 5/8-inch ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYR162V



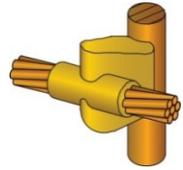
<b>Stock No.</b>	<b>013403</b>
Description	Mold for 500 kcmil stranded wire to 5/8-inch ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYR163Q



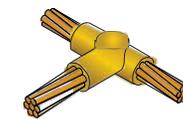
<b>Stock No.</b>	<b>013441</b>
Description	Mold for 250 kcmil stranded wire to 3/4-in ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYR182V



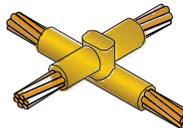
<b>Stock No.</b>	<b>013442</b>
Description	Mold for 500 kcmil stranded wire to 3/4-in ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYF183Q



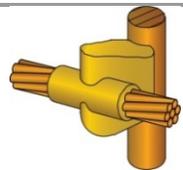
<b>Stock No.</b>	<b>013558</b>
Description	Mold for 4/0 stranded wire all way, horizontal T-connection
Manufacturer	Erico/Cadweld
Catalog No.	TAC2Q2Q



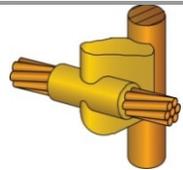
<b>Stock No.</b>	<b>013559</b>
Description	Mold for 4/0 stranded wire all way, horizontal X-connection
Manufacturer	Erico/Cadweld
Catalog No.	XBQ2Q2Q



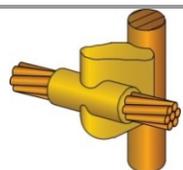
<b>Stock No.</b>	<b>013580</b>
Description	Mold for #2 AWG stranded to 5/8-in ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYE161V



<b>Stock No.</b>	<b>013581</b>
Description	Mold for #4 AWG solid wire to 5/8-in ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYE161K



<b>Stock No.</b>	<b>013585</b>
Description	Mold for 2/0 stranded wire to 5/8-in ground rod
Manufacturer	Erico/Cadweld
Catalog No.	GYE162G



## 9. References

**SCL Construction Standard 0468.90**; “Exothermic Connection System”

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## 10. Sources

**CADWELD® Welded Electrical Connections Facility Electrical Protection Catalog**, A1C E1068CT08NAEN 00610M8 (Erico literature file name LT0039)

**CADWELD® PLUS Leading Technologies In Exothermic Welding** (Erico literature file name LT0414)

**CADWELD® PLUS Pictorial Instructions**, ERICO P/N IPX B295WMPLUS E918IS05WW (Erico literature file name LT0580)

**CADWELD® PLUS Welding Material**; MATERIAL SAFETY DATA SHEET (Erico literature file name LT1298)

**CADWELD® Welded Electrical Connections Quick Reference Product Guide**, E782C-NAEN E1820CT07NAEN 0045M8 (Erico literature file name LT1449)

**CADWELD® PLUS Control Unit** (Erico literature file name LT31163)

**CADWELD® Exothermic Welding Manual**, E834I E1123LT08WWEN 0071M9 (Erico literature file name LT30323)

**Electric Railway Improvement Company** (ERICO); [www.erico.com](http://www.erico.com)

**Shipek, John**; SCL Standards Engineer, originator and subject matter expert for 6762.90 ([john.shipek@seattle.gov](mailto:john.shipek@seattle.gov))

**CLAMPS, GROUND, CABLE(S) TO FLAT BAR**

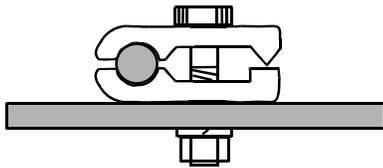


Figure 1

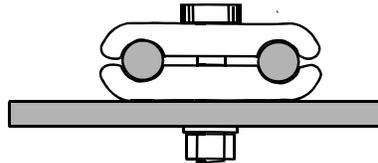


Figure 2

**Cable(s) to flat bar ground clamps connectors** shall be of the configurations shown above and shall meet the requirements of the latest revision of NEMA CC1.

**Materials:** The body shall be forged or cast of high-conductivity copper or bronze alloy. The bolt, nut and lock washer shall be silicon bronze.

**Reference Specification:** NEMA CC1, *Electric Power Connectors for Substations*.

**Stock Unit:** EA

Stock Number	Conductor Range AWG/kcmil	Fig. No.	Approved Manufacturers						
			Anderson	Burndy	Dossert	Homac	O. Z. Gedney	Penn Union	Southern States
676674	#4 Sol to 2/0	1	GC-141-01	GB26	GF 13	2709-1-2/0	KG22	GM-2	1-OA-48
676675	2/0 Sol to 250	1	GC-141A-02	GB29	GF 25	2709-1-25	KG25	GM-3	1-OA-51
676676	300 to 500	1	GC-141-03	GB34	GF 50	2709-1-50	KG50	GM-4	1-OA-56
676694	#4 Sol to 2/0	2	GC-143-01	GC2626	GA 13	2710-2-2/0	LG22	GH-2	2-OA-48
676695	2/0 Sol to 250	2	GC-143A-02	GC2929	GA 25	2710-2-25	LG25	GH-3	2-OA-51

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John Chinner</i>	<i>Harold Juy</i>

**MATERIAL STANDARD**

**COPPER COMPRESSION TERMINAL, TIN-PLATED**



one-hole



two-hole



two-hole stacking

**1. Scope**

This material standard covers the requirements for tin-plated, copper compression terminals.

**2. Application**

Copper compression terminals are used to connect copper conductors rated 600 V and below to equipment terminals or bus. Compression terminals are used overhead, underground, and in the network.

Copper compression terminals are not appropriate for connecting aluminum conductor.

**3. Industry Standards**

Compression terminals shall meet the applicable requirements of the following industry standard:

**C119.4-2004**; "American National Standard for Electrical Connectors - Connectors for Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Conductors"; ANSI

**4. Requirements**

**4.1 General**

Compression terminals shall be all-copper and tin-plated.

Compression terminals shall be current Class A, as defined in ANSI C119.4.

**4.1 General, continued**

Compression terminals shall be tensile strength Class 3, minimum tension (or better), as defined in ANSI C119.4.

Compression terminal width shall not exceed 1-3/4 inches to allow side-by-side installation on a NEMA-drilled equipment terminal or bus bar.

Each compression terminal shall be provided with tool type, die number, and number of crimps information for:

- Burndy
- Kearney
- Thomas & Betts (T&B)

**4.2 Detailed Requirements, One-hole type**

Compression terminals shall be of the style shown in Figure 4.2.

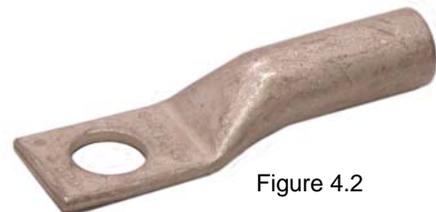


Figure 4.2

STANDARDS COORDINATOR

*John Shipek*  
John Shipek

STANDARDS SUPERVISOR

*John Barnett*  
John Barnett

UNIT DIRECTOR

*Richard Kent*  
Richard Kent

**4.2 Detailed Requirements, One-hole type, continued**

Compression terminals shall meet the dimensional requirements of Table 4.2.

**Table 4.2**

Stock Number	Conductor Size, AWG/kcmil	Bolt Size, in.	Tool-Die		
			Burndy	Kearney	Thomas & Betts
677065	6	1/4	7	-	24
677071	2	1/2	10	3/8	33
677072	2	3/8	10	3/8	33
677075	1/0	1/2	12	1/2	42
677077	2/0	1/2	13	9/16	45
677079	3/0	1/2	14	5/8	49-50

**4.3 Detailed Requirements, Two-hole type**

Compression terminals shall be of the style shown in Figure 4.3.

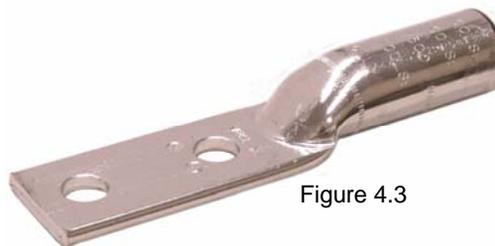


Figure 4.3

Compression terminals shall meet the dimensional requirements of Table 4.3.

**Table 4.3**

Stock Number	Conductor Size, AWG/kcmil	Bolt Size, in.	Tool-Die		
			Burndy	Kearney	Thomas & Betts
677069	4	1/2	8	5/16	29
677081	4/0	1/2	15	5/8	54
677083	250	1/2	16	11/16	60
677085	300	1/2	17	7/8	66
677087	350	1/2	18	8/8	71
677091	500	1/2	20	1	87
677096	600	1/2	22	1-1/8	96
677100	750	1/2	24	1-5/16	106
677110	1000	1/2	27	1-1/2	125

Compression terminals shall be designed to fit underneath the corresponding same conductor size stacking terminals specified in Sections 4.4 and 8.

Spacing between holes shall be 1-3/4 inch.

**4.4 Detailed Requirements, Two-Hole Stacking type**

Compression terminals shall be of the style shown in Figure 4.3.



Figure 4.3

Compression terminals shall meet the dimensional requirements of Table 4.4.

**Table 4.4**

Stock Number	Conductor Size, AWG/kcmil	Bolt Size, in.	Tool-Die		
			Burndy	Kearney	Thomas & Betts
677291	500	1/2	20	1	87

Stacking type compression terminals shall be designed to fit on top of the corresponding same conductor size bottom terminals specified in Sections 4.3 and 8.

Spacing between holes shall be 1-3/4 inch.

**5. Marking**

Each compression terminal shall be permanently marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Conductor types and sizes (ranges)
- Die number

**6. Packaging**

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light's Purchase Order Number
- Seattle City Light's Stock Number

**7. Issuance**

EA

**MATERIAL STANDARD**

Copper Compression Terminal, Tin-Plated

STANDARD NUMBER: **6770.7**

PAGE: 4 of 4

SUPERSEDING: December 7, 2007

EFFECTIVE DATE: January 25, 2008

**8. Approved Manufacturers**

Stock Number	Conductor Size, AWG/kcmil	Number of Holes	Bolt Size, in.				
				Anderson	Burndy	Homac	Richards
677065	6	1	1/4	VHCL-6-14	YA6C	L6-14	CL3-1/4
677071	2	1	1/2	na	YA2CT6	L2-48	CL7
677072	2	1	3/8	VHCL-2-38	na	L2-38	CL7-3/8
677075	1/0	1	1/2	VHCL-1/0-12	YA25-N	L1/0-48	CL9
677077	2/0	1	1/2	VHCL-2/0-12	YA26-N	L2/0-48	CL10-1/2
677079	3/0	1	1/2	VHCL-3/0-12	YA27	na	CL11
677069	4	2	1/2	na	YA4C-2N	na	na
677081	4/0	2	1/2	VHCL-4/0-12BN	YA28-2N	L4/0-N	CL12-2N
677083	250	2	1/2	VHCL-250-12BN	YA29-2N	L250-N	CL13-2N
677085	300	2	1/2	VHCL-300-12BN	YA30-2N	L300-N	CL14-2N
677087	350	2	1/2	VHCL-350-12BN	YA31-2N	L350-N	CL15-2N
677091	500	2	1/2	VHCL-500-12BN	YA34-2N	L500-N	CL18-2N
677096	600	2	1/2	VHCL-600-12BN	YA36-2N	L600-N	CL20-2N
677100	750	2	1/2	CHL-750-BN-TT	na	L750-N	CL23-2N
677110	1000	2	1/2	CHL-1000-BN-TT	na	L1000-NT	CL28-2N
677291	500	2	1/2	CSL-500-BN	na	SL500-N	CSL-18-2N

**9. References**

**Shipek, John;** SCL Standards Engineer, subject matter expert SCL Material Standard 6770.7 (john.shipek@seattle.gov)

**TERMINALS AND SPLICES, NON-INSULATED SOLDERLESS TYPE**



**1. Scope**

This standard covers the requirements for non-insulated, standard and heavy-duty, ring terminals and butt splices.

Stock Number	Wire Size Range, AWG	Stud Size, Stud #/in
<i>standard duty, ring terminal</i>		
677141	#22-#18	#10
677144	#16-#14	#10
667145	#16-#14	1/4
677159	#12-#10	#10
677161	#12-#10	1/4
<i>heavy duty, ring terminal</i>		
677169	#10-#9	#10
013515	#12-#10	#10
677189	#12-#10	1/2
677187	#6	1/2
677193	#4	5/8
677188	#2	5/8
<i>standard duty, butt splice</i>		
677390	#22-#18	-
677391	#16-#14	-
677425	#12-#10	-

**2. Application**

Ring terminals are installed on the ends of low voltage conductors and secured with a hand-operated crimping tool. Design provides a low cost, reliable electrical connection.

Non-insulated terminals and splices do not have a voltage or temperature rating.

Non-insulated terminals and splices are not appropriate for direct burial, where strain relief is required, or where long-term vibration may occur. If wire strain relief or vibration resistance is required, use insulated terminals, Material Standard 6771.30. If a greater selection is desired, insulated terminals may be substituted for non-insulated ones.

**3. Industry Standards**

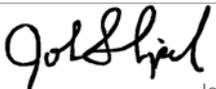
Terminals and splices shall meet the applicable requirements of the following industry standard:

**ANSI/UL 486A-486B; Wire Connectors**

**4. Attributes**

Terminals and splices shall have the following attributes and ratings and conform to the requirements cited in section 11:

- straight receptacle style
- chamfered/funneled terminal entry
- deep serrated barrel interior
- brazed or overlap seam
- pure copper body
- electroplated-tin finish
- EU RoHS/ELV compliant

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cole

**MATERIAL STANDARD**

Terminals and Splices, Non-Insulated Solderless Type

standard number: **6771.20**  
 superseding: November 4, 2011  
 effective date: October 16, 2013  
 page: 2 of 3

**4. Attributes, continued**Terminal tongue thickness,  
nominal, in

wire size

#22 to #14	0.03
------------	------

#12 to #10	0.04
------------	------

#6	0.06
----	------

#4 to #2	0.07
----------	------

Stud #, equivalent diameter, in

#10	0.190
-----	-------

Terminals and splices shall be free from sharp edges and degreased prior to plating.

**5. Tests and Test Reports**

Data that establishes compliance with the requirements of ANSI/UL 486A-486B and this material standard shall be provided upon request.

**6. Product Approval**

Manufacturers interested in having their product approved for purchase by Seattle City Light must participate in a stepped evaluation process. Contact Standards for the details.

**7. Marking**

Each terminal and splice shall be permanently and legibly marked with:

- Manufacturer's name or symbol
- Wire size/range

**8. Packaging**

Terminals and splices shall be packaged to prevent damage during shipping, handling, and inside storage.

Individual packages shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

Standard package quantity shall be 50, 100, 500, or 1000 units, as determined by the manufacturer's approved catalog number, purchase order, or mutual agreement.

**9. Issuance****Stock Unit:** EA**10. References****6771.30:** "Terminals and Splices, Insulated, Solderless Type"; Material Standard; SCL**AMP SOLISTRAND;** *Budget and DIAMOND GRIP Uninsulated Terminals and Splices*; Catalog 65505; revised 09-00**Burndy Master Catalog;** *Solutions for the Electrical Industry*; circa 2011**Shipek, John;** SCL standards engineer, subject matter expert, and originator of 6771.20; (john.shipek@seattle.gov)**SCL Drawing D-44327,** *Wiring Method Specification*, Revision 4**Thomas & Betts Electrical Components;** *Products and Systems*; Volume 1; effective January 2003[www.burndy.com](http://www.burndy.com)[www.tnb.com](http://www.tnb.com)**11. Approved Manufacturers****11.1 General**

Refer to the following sub sections for approved catalog numbers.

- TE Connectivity AMP (formerly Tyco Electronics AMP), abbreviated **AMP**, SOLISTRAND series
- **Burndy** (a division of Hubbell), HYLUG and HYLINK series
- Thomas & Betts, abbreviated **T&B**, Sta-Kon series

**MATERIAL STANDARD**

Terminals and Splices, Non-Insulated Solderless Type

standard number: **6771.20**  
 superseding: November 4, 2011  
 effective date: October 16, 2013  
 page: 3 of 3

**11. Approved Manufacturers, continued****11.2 Ring Terminals**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Duty	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677141	#22 - #18	#10	standard	34109	T18-10	A18-10
677144	#16 - #14	#10	standard	34123	T14-10	B14-10
667145	#16 - #14	1/4	standard	34124	T14-14	B14-14
677159	#12 - #10	#10	standard	35771	T10-10	C10-10
677161	#12 - #10	1/4	standard	35772	T10-14	C10-14
677169	#10 - #9	#10	heavy	-	YAV9C-L36 BOX	-
013515	#12 - #10	#10	heavy	-	YAV10-L36 BOX	-
677189	#12 - #10	1/2	heavy	35135	-	C10-12
677187	#6	1/2	heavy	320344	-	E6-12 or E75
677193	#4	5/8	heavy	35669	-	-
677188	#2	5/8	heavy	320754	-	-

**11.3 Butt Splices**

Stock Number	Wire Size Range, AWG	Duty	Manufacturer and Catalog Number		
			AMP	Burndy	T&B
677390	#22 - #18	standard	31818	YSV18	2A18
677391	#16 - #14	standard	31819	YSV14	2B14
677425	#12 - #10	standard	32151	YSV10	2C10

**TERMINALS AND SPLICES, INSULATED SOLDERLESS TYPE**



**1. Scope**

This standard covers the requirements for insulated ring, fork, and flanged fork terminals and butt splices.

This material standard applies to the Seattle City Light Stock Numbers cited in Section 11.

**2. Application**

Terminals are installed on the ends of low voltage conductors and secured with a hand-operated crimping tool. Design provides a reliable electrical connection and wire strain relief. Terminals are intended for use with a wide range of insulated control cable, metering, switchboard, streetlight, automotive, and appliance wire. Terminals and splices are not appropriate for direct burial.

Standard work practice in stations, generation, and relay is to use Amp crimp tools with Amp ring terminals exclusively.

This class is connector is known as Pre-Insulated Diamond Grip (PIDG) type. Industry standard color-coding indicates intended wire range.

Refer to Material Standard 6771.20 for non-insulated terminals.

**3. Industry Standards**

Terminals and splices shall meet the applicable requirements of the following industry standard:

**ANSI/UL 486A-486B; Wire Connectors**

**4. Attributes**

Terminals and splices shall have the following attributes and ratings:

- nylon insulation
- straight receptacle style
- standard duty
- chamfered/funneled terminal entry
- deep serrated barrel interior
- brazed or overlap seam
- pure copper body
- electroplated-tin finish
- insulation support
- EU RoHS/ELV compliant

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

**MATERIAL STANDARD**

Terminals and Splices, Insulated Solderless Type

standard number: **6771.30**

superseding: February 15, 2013

effective date: August 24, 2015

page: 2 of 5

**4. Attributes, continued**

Insulation rating, minimum, V	300
Operating temperature, maximum, degrees C	105
Terminal tongue thickness, nominal, in	
wire size, #22 to #14	0.033
wire size, #12 to #10	0.042
Female disconnect terminal tab size, nominal, in	0.250 x 0.032
Stud #, equivalent diameter, in	
#4	0.112
#6	0.138
#8	0.164
#10	0.190

Terminals and splices shall be free from sharp edges and degreased prior to plating.

**5. Tests and Test Reports**

Data that establishes compliance with the requirements of ANSI/UL 486A-486B and this material standard shall be provided upon request.

**6. Product Approval**

Manufacturers interested in having their product approved for purchase by Seattle City Light must participate in a stepped evaluation process. Contact Standards for the details.

**7. Marking**

Each terminal and splice shall be permanently and legibly marked with:

- Manufacturer's name or symbol
- Wire size/range

Terminal and splice insulation shall be color-coded to indicate intended wire size range according to established industry convention.

**8. Packaging**

Terminals and splices shall be packaged to prevent damage during shipping, handling, and inside storage.

Individual packages shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's Stock Number

Standard package quantity shall be 50, 100, 500, or 1000 units, as determined by the manufacturer's approved catalog number, purchase order, or mutual agreement.

**9. Issuance**

**Stock Unit:** EA

**10. References**

**6771.20**; "Terminals and Splices, Non-Insulated, Solderless Type"; Material Standard; SCL

**6771.3** (canceled); "Connectors, Compression Terminals and Splices, Pre-Insulated with Wire Insulation Support"; Material Standard; SCL

**Seattle City Light Drawing D-44327**, Class E, Revision 4, 04/03/12, Wiring Method Specification

**AMP Standard Terminals and Splices**; Catalog 82042; Tyco Electronics; Revised 07-08

**"Anatomy of a Good Solderless Terminal Connection"**; Aero Electric Connection; Bob Nuckolls; November 18, 1999

**Shipek, John**; SCL standards engineer, subject matter expert, and originator of 6771.30; (john.shipek@seattle.gov)

[www.burndy.com](http://www.burndy.com)

[www.tnb.com](http://www.tnb.com)

[www.tycoelectronics.com](http://www.tycoelectronics.com)

**11. Approved Manufacturers****11.1 General**

Refer to the following subsections for approved catalog numbers.

- TE Connectivity AMP (formerly Tyco Electronics AMP), abbreviated **AMP**
- **Burndy** (a division of Hubbell), Insulug series
- Thomas & Betts, Sta-Kon series, abbreviated **T&B**

**MATERIAL STANDARD**

Terminals and Splices, Insulated Solderless Type

standard number: **6771.30**

superseding: February 15, 2013

effective date: August 24, 2015

page: 3 of 5

**11. Approved Manufacturers, continued****11.2 Ring Terminals**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Insulation Color	Manufacturer and Catalog Number	
				AMP	
677172	#22 - #18	#4	red <span style="color:red">■</span>	8-31880-1	
677174	#22 - #18	#6	red <span style="color:red">■</span>	8-36152-1	
677173	#22 - #18	#8	red <span style="color:red">■</span>	8-31890-1	
677175	#22 - #18	#10	red <span style="color:red">■</span>	8-36154-1	
677177	#22 - #18	1/4	red <span style="color:red">■</span>	8-31894-1	
677178	#22 - #18	5/16	red <span style="color:red">■</span>	8-31895-1	
677179	#22 - #18	3/8	red <span style="color:red">■</span>	8-31897-1	
677154	#16 - #14	#4	blue <span style="color:blue">■</span>	8-328996-1	
677155	#16 - #14	#6	blue <span style="color:blue">■</span>	8-320619-1	
677156	#16 - #14	#8	blue <span style="color:blue">■</span>	8-320565-1	
677157	#16 - #14	#10	blue <span style="color:blue">■</span>	8-36160-1	
677151	#16 - #14	1/4	blue <span style="color:blue">■</span>	8-321045-1	
677153	#16 - #14	3/8	blue <span style="color:blue">■</span>	8-328999-1	
677176	#12 - #10	#6	yellow <span style="color:yellow">■</span>	8-35149-2	
677164	#12 - #10	#8	yellow <span style="color:yellow">■</span>	8-35108-1	
677160	#12 - #10	#10	yellow <span style="color:yellow">■</span>	8-35109-1	
677165	#12 - #10	1/4	yellow <span style="color:yellow">■</span>	8-35110-1	
677166	#12 - #10	5/16	yellow <span style="color:yellow">■</span>	8-35111-1	
677167	#12 - #10	3/8	yellow <span style="color:yellow">■</span>	8-35112-1	
677168	#12 - #10	1/2	yellow <span style="color:yellow">■</span>	8-35151-2	

**MATERIAL STANDARD**

Terminals and Splices, Insulated Solderless Type

standard number: **6771.30**

superseding: February 15, 2013

effective date: August 24, 2015

page: 4 of 5

**11. Approved Manufacturers, continued****11.3 Fork Terminals**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Insulation Color	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677184	#22 - #18	#6	red 	8-34541-1	TN186F	18 RA-6F
677190	#16 - #14	#6	blue 	8-35559-1	TN146F	14 RB-6F
677191	#16 - #14	#10	blue 	8-32060-1	TN1410F	14 RB-10F
677196	#12 - #10	#6	yellow 	8-35152-2	TN108F	10 RC-6F
677197	#12 - #10	#10	yellow 	8-32589-2	TN1010F	10 RC-10F

**11.4 Flanged Fork Terminals**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Insulation Color	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677185	#22 - #18	#6	red 	8-32562-1	YAE18Z2BOX	RA 1103
677186	#22 - #18	#8	red 	8-32498-1	YAE18Z3 BOX	RA 1223
677192	#16 - #14	#6	blue 	8-320861-1	YAE14Z2 BOX	RB 1203

**11.5 Short Spade Tongue**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Insulation Color	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677200	#22 - #18	#6	red 	8-52929-1	TN186 LF	-
677201	#22 - #18	#8	red 	8-52930-1	TN188 LF	-
677206	#16 - #14	#6	blue 	7-52935-1	TN146 LF	-
677210	#12 - #10	#6	yellow 	8-52941-2	TN106 LF	-
677211	#12 - #10	#8	yellow 	8-52942-1	TN108 LF	-

**MATERIAL STANDARD**

Terminals and Splices, Insulated Solderless Type

standard number: **6771.30**

superseding: February 15, 2013

effective date: August 24, 2015

page: 5 of 5

**11. Approved Manufacturers, continued****11.6 Long Spade Tongue**

Stock Number	Wire Size Range, AWG	Stud Size, Stud # / in	Insulation Color	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677207	#16 - #14	#8	blue 	8-52421-1	TN148LF	-
677212	#12 - #10	#10	yellow 	52432-1	TN1010LF	-
677213	#12 - #10	1/4	yellow 	52433-1	-	-

**11.7 Female Disconnect Terminal**

Stock Number	Wire Size Range, AWG	Duty	Insulation Color	Manufacturer and Catalog Number		
				AMP	Burndy	T&B
677170	#16 - #14	standard	blue 	640905-1	QN14F25X03D	RBD14-183

**11.8 Butt Splices**

Stock Number	Wire Size Range, AWG	Insulation Color	Manufacturer and Catalog Number		
			AMP	Burndy	T&B
677384	#22 - #18	red 	8-320559-2	SN18	2RA18
677386	#16 - #14	blue 	8-320562-5	SN14	2RB14
677392	#12 - #10	yellow 	8-320570-2	SN10	2RC10

**MATERIAL STANDARD**

**TERMINAL BLOCK, DIN MODULAR SYSTEM**

- 1. **Terminal Blocks**, of the configuration shown, shall mount to a DIN Rail system similar to the DIN EN 50 022: 1977 35 mm x 15 mm.

Note: DIN stands for Deutsches Institut für Normung, the German Institute for Standardization.

For purposes of this standard the descriptions of the Phoenix brand "Clipline" Series are used. Other manufacturers of DIN rail terminal modular blocks are Weidmuller, Entrellec and Allen-Bradley.

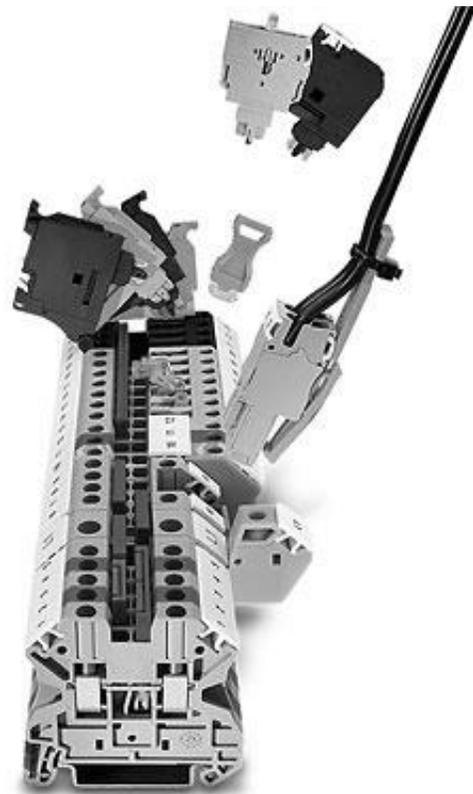
- 2. **Construction:**

The plastic bodies of the modules are made of Thermoplastic Polyimide PA.

Metal parts shall be corrosion proof and made of a copper alloy, and metal surfaces shall be protected by galvanic nickel or tin plating.

- 3. **Wire Size:** The terminal shall accommodate wire sizes of 24 – 10 AWG.
- 4. **Nominal voltage class** shall be 600 Volt.

- 5. **Terminal Block Components**

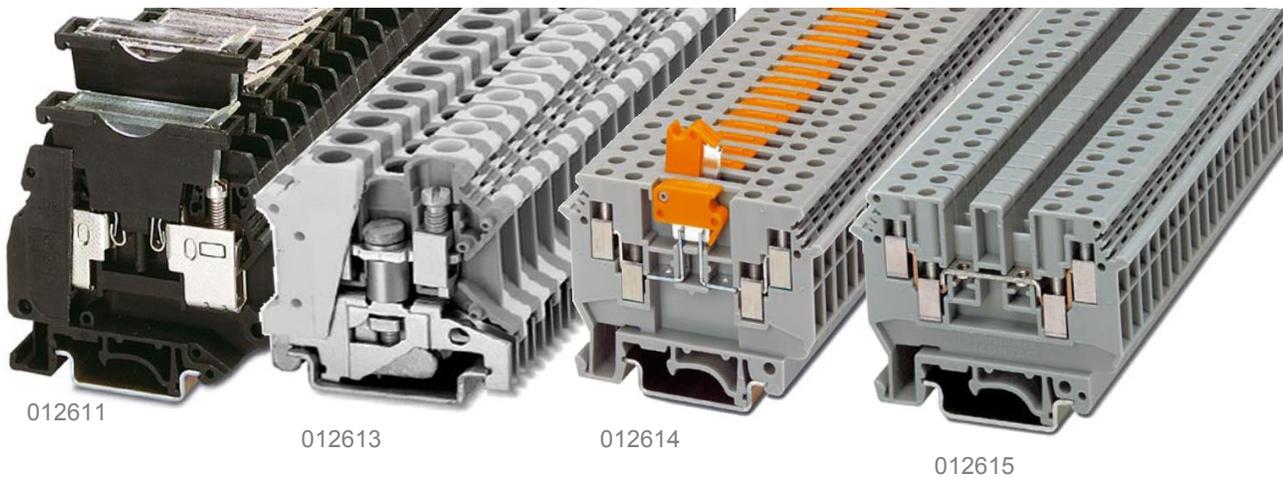


Fuse Terminal Block

Ground Terminal Block

Knife Disconnect Terminal Block

One-Level Terminal Block



012611

012613

012614

012615

STANDARDS COORDINATOR

STANDARDS SUPERVISOR

UNIT DIRECTOR

Laura Vanderpool

John Shipek

Darrell Cola

**MATERIAL STANDARD****5. Terminal Block Components, continued**

Component	Description	Cross Section, mm <sup>2</sup>	Dimensions, mm	Color	Phoenix		SCL
					Type	Model/Order No.	Stock No.
<b>DIN Rail</b> 	deep-drawn, high profile, unperforated, 1.5 mm thick, aluminum order designation: AL UNPERF 2000MM	–	15 high, 35 wide, 2 meters long	gray Al	NS 35/15	1201756	012609
<b>End Clamp</b> 	for supporting the electronic base. If mounted vertically, two end clamps are required in each case.	–	–	–	E/UK	1201442	012610
<b>Fuse Terminal Block</b> 	18 – 8 AWG	0.5 - 16	10.2 wide	black	USIG	0920083	012611
<b>Fuse Plug</b>	for cartridge fuse inserts	–	5 x 20, 5 x 25, 5 x 30	black	ST - SI	0920229	012612
<b>Ground Terminal</b> 	with screw connection	0.2 - 6	8.2 wide	green-yellow	USLKG 6 N	0442079	012613
<b>Knife Disconnect Terminal Block</b> 	with double test socket connection on both sides, 30 by 10 AWG	0.2 - 2.5	6.2 wide	gray	UDK 4-MTK-P/P	2775210	012614
				blue	UDK 4-MTK-P/P BU	2775223	012715
<b>One-Level Terminal Block</b> 	with double connection on both sides, 30 by 10 AWG	0.2 - 2.5	6.2 wide	gray	UDK 4	2775016	012615
				blue	UDK 4-BU	2775090	012716
<b>Ferrule</b> 	with plastic sleeve	–	AWG #12	gray	AI 4 – 12 GY	3200959	012617
			AWG #14	blue	AI 2.5 – 12 BU	3200962	012618

**6. References**

SCL Material Standard 2903.20; Switch, Test, 600 Volt, 30 Amp” (renumbered to 6771.45 in October 2015)

**TERMINAL BLOCKS, HEAVY DUTY**



**1. Scope**

This standard covers the requirements for heavy-duty terminal blocks.

This standard applies to the following Seattle City Light stock numbers:

Stock Number	Number of Poles
290308	8
290310	12

**2. Application**

While heavy-duty terminal blocks have many uses, they are used primarily for installations of short-circuiting bars and multiple-circuit jumpers in station control houses.

The manufacturer recommends a screw torque of 20 ft-lbs.

**3. Industry Standards**

Heavy-duty terminal blocks shall meet the applicable requirements of the latest revision of the following industry standards and international directives:

**UL Standard 1059** – Underwriters Laboratories Inc., Terminal Blocks

**ANSI/UL Standard 486A-486B** – Underwriters Laboratories Inc., Wire Connectors

**RoHS** (European Union Directive 2002/95/EC for Restriction of Hazardous Substance)

**4. Requirements**

**4.1 General**

Heavy-duty terminal blocks shall have the following electrical ratings and attributes:

Voltage rating, maximum, ac/dc volts	600
Current rating, maximum, amperes	
Unprepared wire, #10-22 AWG, copper	30
Crimp type ring, spade, or fork terminal	75

**Material**

Base	general purpose phenolic, 150° C max.
Connector	brass or nickel plated
Screw	brass or nickel plated, size 10-32

Screw style	slotted
Block style	removable connector with brass insert
Marking strip	
Material	vinyl, white
Screws	steel, zinc-plated

Heavy-duty terminal blocks shall be UL-recognized (UL 1059 Class C, User Group - General Industrial) and Canadian Standards Association. (CSA)-certified.

Heavy-duty terminal blocks shall be RoHS (European Union Directive 2002/95/EC for Restriction of Hazardous Substance) compliant.

Standards Coordinator  
 Laura Vanderpool

Standards Supervisor  
 John Shippek

Unit Director  
 Darnell Cola

Seattle City Light  
**MATERIAL STANDARD**

Terminal Blocks, Heavy Duty

standard number: **6771.50**

superseding: March 4, 2013

effective date: October 20, 2015

page: 2 of 2

**4.2 Dimensions**

Stock Number	Number of Poles	A, in	B, in
290308	8	6.38	5.72
290310	12	9.00	8.34

**5. Marking**

Each heavy-duty terminal block shall be permanently and legibly marked with:

- Manufacturer's name or symbol.
- Manufacturer's catalog number.
- Wire size/range.
- Maximum voltage rating.
- Maximum current rating.
- Industry certification symbol(s).

**6. Packaging**

Heavy-duty terminal blocks shall be packaged to prevent damage during shipping, handling, and inside storage.

Individual packages shall be legibly marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Product description
- Quantity contained
- Seattle City Light's stock number

Standard package quantity shall be 20 units or as established by mutual agreement

**7. Issuance**

EA

**8. Approved Manufacturers**

Stock Number	Number of Poles	Marathon Special Products
290308	8	1608 DJ-SLB
290310	12	1612 DJ-SLB

**9. References**

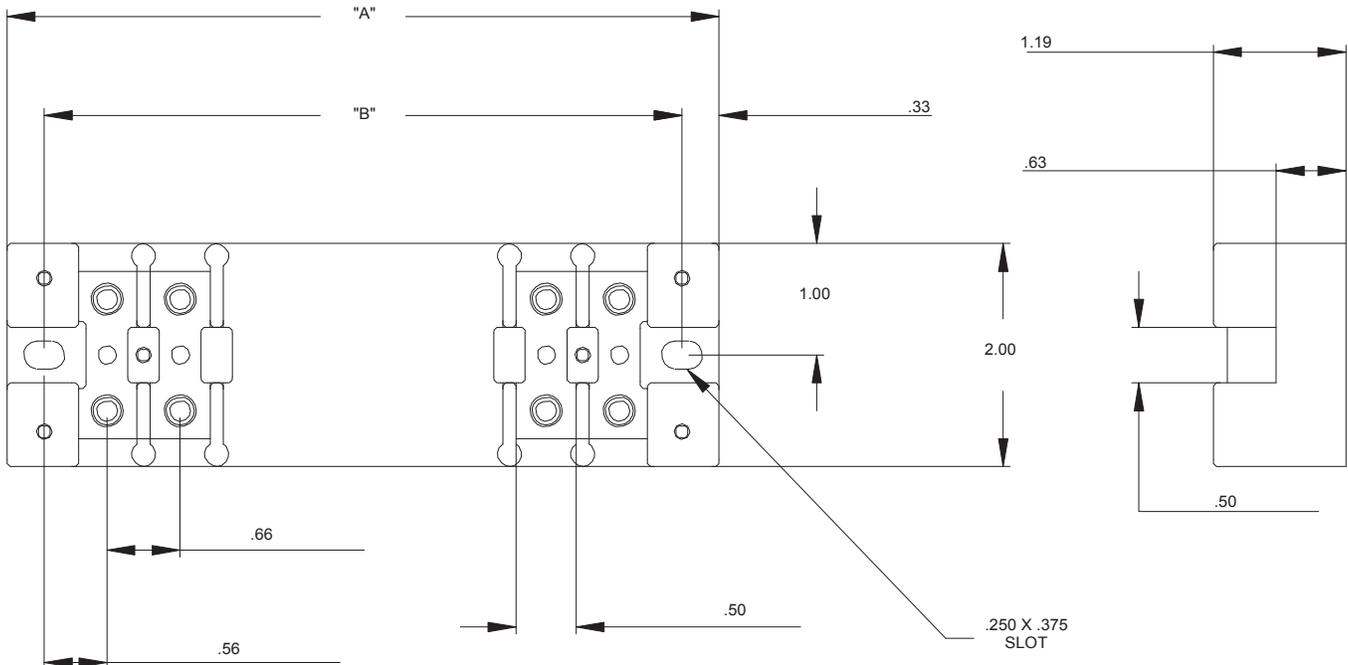
**Shipek, John**; SCL Standards Supervisor, originator and subject matter expert for 6771.50 (john.shipek@seattle.gov)

**SCL Material Standard 2903.1** (canceled)

**SCL Material Standard 2940.1**; "Terminal Blocks, Heavy Duty" (renumbered to 6771.50 in October 2015)

[www.marathonsp.com](http://www.marathonsp.com)

**Figure 4.2. Terminal Block Dimensions**



# MATERIAL STANDARD

## CONNECTORS, COMPRESSION, PIGTAIL ADAPTER



### 1. Scope

This material standard covers the requirements for pigtail adapter type compression connectors with tin plated, copper pins.

This material standard applies to the following Seattle City Light Stock Numbers:

- 686076
- 686056
- 650578
- 650579
- 686075
- 010320

### 2. Application

Pigtail adapters are used to:

- Join aluminum conductor to equipment terminals designed for copper conductor.
- Terminate and seal stranded primary cable when used in conjunction with primary terminations.
- Simplify work by allowing more flexibility when terminating cable in equipment in straight-on (or slight angle) situations, such as padmount switchgear.

Pigtail adapters are appropriate for secondary or primary voltage application and may be installed on aluminum or copper conductor.

### 3. Industry Standards

Pigtail adapters shall meet the applicable requirements of the following industry standards:

**ANSI C119.4-2004** – American National Standard for Electric Connectors – Connectors for Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Conductors

### 4. Construction

Pigtail adapter shall be current Class A, as defined in ANSI C119.4.

Pigtail adapter shall be tensile strength Class 3, minimum tension (or better), as defined in ANSI C119.4.

Compression sleeves shall be highly conductive aluminum.

Compression sleeves shall be pre-filled with oxide inhibitor.

Compression sleeve ends shall be capped or sealed to protect the oxide inhibitor from contamination.

Pigtail adapter pins shall be tin-plated, solid, annealed copper.

Pigtail adapter pins shall meet the nominal requirements of **Table 1**.

Pigtail adapters shall accommodate conductors according to **Table 1**.

standards coordinator	standards supervisor	unit director
 Quan Wang	 John Shippek	 Darnell Cola

**MATERIAL STANDARD**

superseding: July 13, 2011  
 effective date: August 17, 2015  
 page: 2 of 2

Connectors, Compression, Pigtail Adapter

**4. Construction, continued****Table 1**

Stock Number	Pin Diameter, AWG / in.	Pin Length, in.	Conductor
686076	#4	2-1/4 +/- 1/2	#8 AWG compressed
686056	#2	6-1/2 +/- 1	#1 AWG compressed 1/0 AWG solid
650578	4/0	6-1/2 +/- 1	350 kcmil compact 350 kcmil compressed
650579	5/8	6-1/2 +/- 1	500 kcmil compact 500 kcmil compressed
686075	5/8 to 3/4	6-1/2 +/- 1	750 kcmil compact
010320	5/8 to 3/4	6-1/2 +/- 1	1000 kcmil compact 1000 kcmil compressed

**5. Tests and Test Reports**

Pigtail adapter data that establishes compliance with the requirements of ANSI C119.4 and this material standard shall be provided upon request.

**6. Marking**

Pigtail adapters shall be permanently marked with:

- Manufacturer's name
- Manufacturer's catalog number
- Conductor types and sizes (ranges)

**7. Packaging**

Pigtail adapters shall be packaged to prevent damage during shipping, storage, and casual handling prior to installation; clear plastic bagging shall count as acceptable packaging.

Each package shall be marked with Seattle City Light's Stock Number.

**8. Issuance**

EA

**9. Approved Manufacturers**

Stock Number	Burndy	Homac Mfg. Co.	Hubbell (Anderson)	Richards Mfg. Co.	Thomas & Betts (Blackburn)	Conductor
686076	–	U5U8	PT-84-2.5	APT2-SCL	–	#8 AWG compressed
686056	–	–	PT-24-6SCL	APT9-SCL	PKL 31-1	#1 AWG compressed 1/0 AWG solid
650578	YE32R-60	PTB-350-6	PT-35050-6	APT15-SCL	PRS 30N	350 kcmil compact 350 kcmil compressed
650579	–	–	PT-45062-6	APT18-SCL	PRS 40N	500 kcmil compact 500 kcmil compressed
686075	YE43R-70	–	–	APT23-SCL	–	750 kcmil compact
010320	–	PTL-1000	–	APT28-SCL	–	1000 kcmil compact 1000 kcmil compressed

**10. References**

**6772.0** (renumbered to 6772.00), "Connectors, Compression (Pigtail Adapters, Al To Cu)"; Material Standard; SCL

**Shipek, John**; SCL Standards Engineer, subject matter expert of 6772.00 (john.shipek@seattle.gov)

# MATERIAL STANDARD

## CONNECTOR, PRESSURE TAP, COPPER

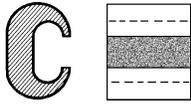


figure 1

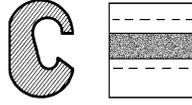


figure 2

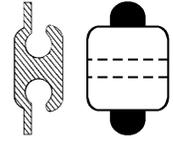


figure 3

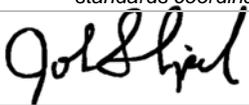
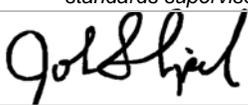
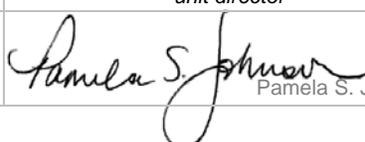
1. **Scope:** This standard specifies the requirements for copper pressure tap connectors.
2. **Application:** Pressure tap connectors are used to make a variety of overhead and underground connections.
3. **Industry Standards:**  
**ANSI C119.4:** American National Standard for Electric Connectors – Connectors for Use between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors
4. **Requirements:** Connectors shall meet the tool and die requirements listed below.

Stock Number	Figure	Conductor Sizes		Tool and Die		Thomas & Betts (Elastimold) Color Code
		Run Size	Tap Size	MD-6	Y35 & 39	
677323	1	#4	#4	BG (2) W-BG (1)	U-BG (1)	Purple
677325	2	#2	#4	W-C (2)	U-C (1)	White
677326	1	#2	#2	W-C (2)	U-C (1)	White
677329	1	1/0 to 2/0	1/0 to 2/0	–	U-O (3), U-E (1)	–
677330	3	2/0 to 4/0	#4	–	D, D3 (1), DAD	–
677331	3	2/0 to 4/0	#2 to 1/0	–	D, D3 (1), DAD	–
677332	3	2/0 to 4/0	2/0 to 4/0	–	D, D3 (1), DAD	–
677333	1	250 to 350	#1 to 3/0	–	T&B 12-15 Ton #106	Black 106H (2)
677336	1	250 to 300	#6 to 2/0	–	T&B 12-15 Ton #99	Pink 99H (2)

5. **Issuance**  
**Stock Unit:** EA

6. **Approved Manufacturers:**

Stock Number	Blackburn	Burndy	Homac	Kearney	Penn Union	Thomas & Betts (Elastimold)	Utilco
677323	–	YC4C4	CC44	–	–	–	ULT-5
677325	–	YC2C4	CC24	–	–	–	ULT-6
677326	–	YC2C2	CC22	–	–	–	ULT-7
677329	–	YC26C26	–	–	–	–	–
677330	CF402-1	–	–	309-82	–	–	–
677331	CF 4010-1	–	–	308-82	CDT-308-8	–	–
677332	CF 4040-1	–	–	307-82	CDT-307-8	–	–
677333	–	–	–	–	–	54770	–
677336	–	–	–	–	–	54765	–

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Pamela S. Johnson

## Connector, Thin-Wall, Pressure-Tap, Copper



### 1. Scope

This standard covers the requirements for thin-wall, pressure-tap, copper connectors. These connectors are also known as C-connectors.

This standard covers the Seattle City Light (SCL) stock numbers cited in Table 4.

### 2. Application

Thin-wall, pressure-tap connectors are:

- Used to make a variety of overhead and underground connections.
- Rated at 600 V.
- Range-taking.
- Color-keyed for ease of identification and installation.

See Table 4 for wire strip lengths.

### 3. Industry Standards

Thin-wall, pressure-tap connectors shall meet the requirements of the latest revision of the following industry standards:

- UL 486A-486B**; Wire Connectors
- UL 486C**; Splicing Wire Connectors
- UL 467**; Grounding and Bonding Equipment

### 4. Requirements

Thin-wall, pressure-tap connectors shall be:

- Made from high conductivity, wrought copper.
- Reinforced with ribs.
- UL Listed (486A-486B) for 600 V, wire connector applications.
- UL Listed (486C) for 600 V, splicing wire connector applications.
- UL Listed (467) for grounding and bonding applications.
- UL approved for underground applications.

Standards Coordinator  
Yaochiem Chao

Handwritten signature of Yaochiem Chao in black ink.

Standards Supervisor  
John Shipek

Handwritten signature of John Shipek in black ink.

Unit Director  
Darnell Cola

Handwritten signature of Darnell Cola in black ink.

The following table shows the wire strip lengths and other characteristics for thin-wall, pressure-tap connectors.

**Table 4. Wire Strip Lengths**

Stock No.	Accommodates Run (AWG)	Tap (AWG)	Color	Code	Wire Strip Length (in)
013633	#4	#4		Pink	1-13/16
	#3	#5			
	#2	#12-#6			
013634	#6	#8-#6		Brown	1-3/16
	#5, #4	#12-#8			
013635	#8	#12-#8		Gray	5/8
	#6	#12-#10			

**5. Issuance**

Stock Unit: EA

**6. Approved Manufacturers**

Stock No.	Burndy	Thomas & Betts
013633	YC2L12	54730
013634	YC4L12	54720
013635	YC6L12	54715

**7. References**

**SCL Construction Standard 1714.30**; "Streetlight Handhole Connections"

**8. Sources**

**Burndy Compression Master Catalog**; burndy.com

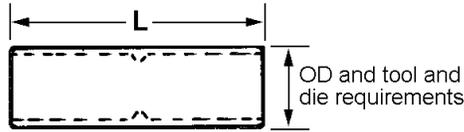
**Chao, Yaochiem**; SCL Standards Engineer and originator of 6773.61 (yaochiem.chao@seattle.gov)

**Edwards, Tommy**; SCL Electrical Reviewer and subject matter expert for 6773.61 (tommy.edwards@seattle.gov)

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist and subject matter expert for 6773.61 (kathy.tilley@seattle.gov)

**MATERIAL STANDARD**

**SPLICE, COPPER COMPRESSION**



- Copper Compression Splices** are intended primarily for connecting underground cables. The splices shall meet the physical dimensions and tool-die requirements listed below.
- Stock Unit:** EA

Wire Size	L, in.	OD, in.	Tool - Die			Wire Size	L, in.	OD, in.	Tool - Die		
			Burndy	Kearney	T&B				Burndy	Kearney	T&B
#6	1-3/4	0.29	7	-	24	4/0	3-3/8	0.69	15	5/8	54
#4	1-3/4	0.34	8	5/16	29	250	3-3/8	0.75	16	11/16	60
#2	1-7/8	0.42	10	3/8	33	300	4-1/8	0.81	17	7/8	66
#1	1-7/8	0.46	11	3/8	37	350	4-1/8	0.88	18	8/8	71
1/0	2-7/8	0.51	12	1/2	42	500	4-5/8	1.06	20	1	87
2/0	3-1/8	0.56	13	9/16	45	750	5-7/8	1.30	24	1-5/16	106
3/0	3-1/8	0.62	14	5/8	49-50	1000	6	-	27	-	125

**3. Approved Manufacturers**

Stock Number	Wire AWG /kcmil	Anderson	Burndy	Dossert	Homac	Mac	Penn-Union	Richards	ILSCO/ Utilco
677354	6	VHSS-6	YS6C-L	DPCS 2	SC-6	MSC 6	BCU-6	SCC3	CT-6
677355	4	VHSS-4	YS4C-L	DPCS 4	SC-4	MSC 4	BCU-4	SCC5	CT-4
677357	2	VHSS-2	YS2C-L	DPCS 6	SC-2	MSC 2	BCU-2	SCC7	CT-2
677358	1	VHSS-1	YS1C-L	DPCS 8	SC-1	MSC 1	BCU-1	SCC8	CT-1
677359	1/0	VHS-1/0	YS25	DPC 10	C-1/0	MRC 1/0	BBCU-1/0	CC9	CTL-1/0
677360	2/0	VHS-2/0	YS26	DPC 13	C-2/0	MRC 2/0	BBCU-2/0	CC10	CTL-2/0
677361	3/0	VHS-3/0	YS27	DPC 17	C-3/0	MRC 3/0	BBCU-3/0	CC11	CTL-3/0
677362	4/0	VHS-4/0	YS28	DPC 21	C-4/0	MRC 4/0	BBCU-4/0	CC12	CTL-4/0
677363	250	VHS-250	YS29	DPC 25	C-250	MRC 250	BBCU-025	CC13	CTL-250
677364	300	VHS-300	YS30	DPC 30	C-300	MRC 300	BBCU-030	CC14	CTL-300
677365	350	VHS-350	YS31	DPC 35	C-350	MRC 350	BBCU-035	CC15	CTL-350
677367	500	VHS-500	YS34	DPC 50	C-500	MRC 500	BBCU-050	CC18	CTL-500
677371	750	VHS-750	YS39	DPC 75	C-750	MRC 750	BBCU-075	CC23	CTL-750
677373	1000	VHS-1000	-	DPC 100	C-1000	-	BBCU-100	-	-

STANDARDS COORDINATOR

*John Shipek*  
John Shipek

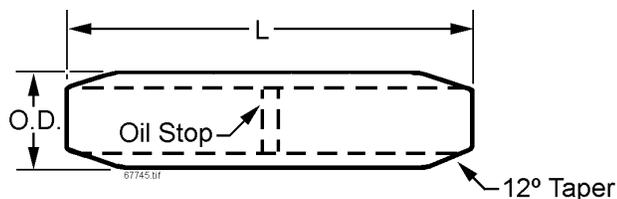
STANDARDS SUPERVISOR

*John Barnett*  
John Barnett

UNIT DIRECTOR

*Richard Kent*  
Richard Kent

**CONNECTORS  
 OIL STOP, TAPERED, COPPER, COMPRESSION**



**1. Scope**

This material standard covers the requirements for oil stop, tapered copper compression connectors.

**2. Application**

Oil Stop, Tapered Copper Compression Connectors of the configuration shown are intended for use on 4 kV and higher insulated copper conductors in Underground Construction.

**3. Industry Standards**

Compression connector shall meet the applicable requirements of **NEMA CC1**, *Electric Power Connectors*.

**4. Construction**

A tinned, high conductivity copper oil stop shall be brazed in place in the center of the connector. The ends of the connector shall have a 12° taper.

The body of the connector shall be made from tinned, high conductivity, seamless, annealed copper.

**5. Marking**

Each connector shall have a durable marking showing conductor size and manufacturer's name or trademark and catalog number of the connector.

**6. Stock Unit: EA**

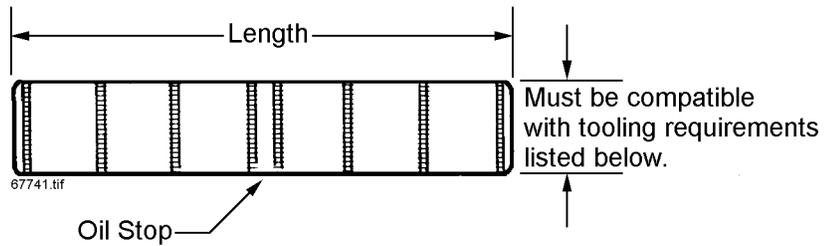
**7. Approved Manufacturer**

Stock Number	Wire Size	Dimension, in		Approved Manufacturers				
		OD	Length	Dossert	Homac	MAC	Penn-Union	Richards
677300	#4	0.34	1-29/32	DPCP4-T	PTC-4	MTCP 4	BCU-4-PT	OTCC5
677303	#1	0.46	2-1/16	DPCP8-T	PTC-1	MTCP 1	–	OTCC8
677304	2/0	0.56	2-7/32	DPCP13-T	PTC-2/0	MTCP 2/0	BCU-2/0-PT	OTCC10
677306	3/0	0.62	2-13/32	DPCP17-T	PTC-3/0	MTCP 3/0	–	OTCC11
677309	300	0.81	2-5/8	DPCP30-T	PTC-300	MTCP 300	BCU 030-PT	OTCC14
677310	350	0.88	2-25/32	DPCP35-T	PTC-350	MTCP 350	BCU 035-PT	OTCC15
677311	500	1.06	3-17/32	DPCP50-T	PTC-500	MTCP 500	BCU 050-PT	OTCC18

standards coordinator	standards supervisor	unit director
 John Shipek	 John Shipek	 Pamela S. Johnson

# MATERIAL STANDARD

## CONNECTORS, ALUMINUM COMPRESSION



**Aluminum Compression Connectors** of the configuration shown are intended for use aluminum and copper conductors in underground construction, and shall meet the applicable requirements of ANSI C119.4, Standard for Aluminum Connectors for Aluminum/Copper Conductors. Tin plating of connectors is required.

**Inhibitor.** Each connector shall be factory-filled with a measured amount of oxide-inhibiting compound that will not affect the dielectric strength or power factor of cables insulated with butyl, cross-linked polyethylene, or ethylene-propylene rubber.

**Marking.** Each connector shall have durable markings showing conductor size, die number, number of crimps, and manufacturer's name or trademark, and catalog number of the connector.

**Packaging.** The connector ends shall be sealed to prevent leakage or contamination of the inhibitor. Each connector shall be individually packaged in a sealed plastic bag.

**Reference Specification:** ANSI C119.4, latest revision.

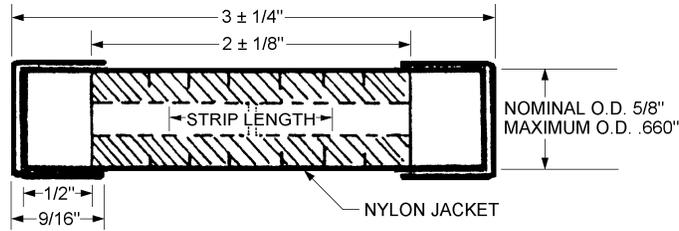
### Tooling and Die Requirements

Stock Number	Connector Size	EEI	Burndy Y-35	T&B 12-Ton #13642	T&B TBM-15 (UT-15)
650609	350 kcmil	13A	U-31 ART U-299	96H	96H (CA 96H)
650611	500 kcmil	15A	U-34 ART U-300	115H	115H (CA 115H)
650613	750 kcmil	—	P-39 ART U-301	125H	125H (CA 125H)

Stock Number	Conductor AWG/kcmil	Length, Inches	Approved Manufacturers			
			Burndy	Homac	MAC	Richards
650609	350	6-3/4 ± 1/4	YS31AY-TN	AC-350-TN	MULC 350-TN	ALC 15-TN
650611	500	7-3/4 ± 1/4	YS34AY-TN	AC-500-TN	MULC 500-TN	ALC 18-TN
650613	750	9 ± 1	YS39AY-TN	AC-750-TN	MULC 750-TN	ALC 23-TN

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Minner</i>	<i>Harold J. J...</i>

**INSULATED ALUMINUM COMPRESSION CONNECTORS**



**1. Scope**

The insulated aluminum compression connectors are intended for splicing aluminum to aluminum or aluminum to copper service entrance conductors.

**2. Industry Standards**

ASTM D 566, Standard Test Method for Dropping Point of Lubricating Grease

ASTM D 1248, Polyethylene Plastics Molding and Extrusion Materials

EEl-NEMA Standard TDJ-162 (ANSI C119.4), Connectors to Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors

Military Standard Specification for Nylon, MIL-M-20693

**3. Requirements**

**Connector Material** ..... The connector shall be of 1350 grade aluminum and of the configuration and dimensions shown and shall meet all applicable requirements of EEl TDJ-162.

**Jacket** ..... The connector shall be covered with a nylon (polyamide plastic) insulating jacket. The nylon shall conform to the latest revision of MIL-M-20693 Type III, Grade E. The nylon jacket shall be securely anchored to the connector to prevent the jacket from slipping during compression.

**End Caps** ..... End caps shall be made of polyethylene conforming to ASTM D 1248, Class C. The end caps shall be of the dimensions shown and shall be secured to the nylon shell so as to act as a guide to keep the compression tool on the connector.

**Inhibitor** ..... The connectors shall be factory-filled with a measured amount of oxide-inhibiting compound containing metallic particles held in suspension. The dropping point of the inhibitor shall meet the requirements of ASTM D566.

**Marking** ..... Each connector shall have durable markings showing conductor size, die number, number of crimps, strip length and manufacturer's name or trademark and catalog number.

**Installing Tool and Die** ..... The connector shall be designed to be installed with *any* of the following tools and dies and the given number of crimps on each end:

Tool	EEl	Kearney	T&B	T&B	Burndy	Burndy	Burndy
Die Code	8A	5/8	TU	52	BG	W-BG	U-BG
Crimps	1/8" apart	3	3	1	3	1	1

STANDARDS COORDINATOR

*Charles L. Shaffer*

STANDARDS SUPERVISOR

*John Schinner*

UNIT DIRECTOR

*Harold Gray*

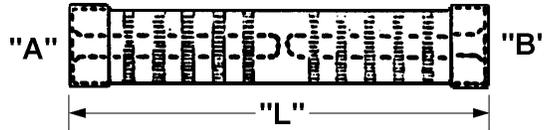
**MATERIAL STANDARD**

**Color Coding and Conductor Size** ..... The connector shall be color coded for ease of identification of wire sizes. The color code shall be as listed below.

Stock No.	Conductor "A"			Conductor "B"			Approved Manufacturer
	Al or Cu		Color Code	Al or Cu		Color Code	
	Solid	Stranded		Solid	Stranded		Homac
650554	4	5 & 6	Blue	6	8	Green	U1N68
650557	2	3 & 4	Orange	6	8	Green	U1N48
650558	2	3 & 4	Orange	4	5 & 6	Blue	U1N46
650559	2	3 & 4	Orange	2	3 & 4	Orange	U1N44
650561	1	2	Red	6	8	Green	U1N28
650562	1	2	Red	4	5 & 6	Blue	U1N26
650563	1	2	Red	2	3 & 4	Orange	U1N24
650564	1	2	Red	1	2	Red	U1N22
650565	-	1/0	Yellow	1	2	Red	U1N102
650567	-	1/0	Yellow	4	5 & 6	Blue	U1N106
650568	-	1/0	Yellow	2	3 & 4	Orange	U1N104
650569	-	1/0	Yellow	-	1/0	Yellow	U1N1010

**Stock Unit:** EA

**SPLICE  
 ACSR NEUTRAL MESSENGER**



**1. Scope**

**ACSR Neutral Messenger Splices** shall be designed to splice the neutrals of triplex and quadruplex service drop cables. The splices shall be made of 1350 grade aluminum and shall meet the applicable requirements of EEI TDJ-162.

**2. Industry Standards**

EEI-NEMA Standard TDJ-162 (ANSI C119.4), Connectors for Use Between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors

ASTM Standard D 566, Standard Test Method for Dropping Point of Lubricating Grease

**3. Requirements**

Stock Number	Length "L" Minimum, in.	Wire Size "A"	Wire Size "B"	Approved Manufacturers			
				Blackburn	Burndy	Homac	Penn-Union
650501	4	4	4	TR 63	YSS4R	SNG 44	PNK-22
650502	4	2	2	TR 64	YSS2R	SNG 22	PNK-11
650503	6	1/0	1/0	TR 66	YCS25R	-	-

**4. Holding Strength**

The holding strength shall not be less than approximately 50% of the ACSR rated breaking strength nor less than approximately 80% of the rated breaking strength of all-aluminum.

**5. Inhibitor**

Each splice shall be factory filled with a measured amount of oxide-inhibiting compound containing metallic particles in suspension. The dropping point of the compound shall be in accordance with ASTM D 566. The ends of the splice shall be covered with plastic caps to prevent contamination or leakage of the inhibiting compound.

**6. Markings**

Each splice shall have durable markings showing the conductor size, die number, number of crimps, manufacturer's name or trademark, and the manufacturer's catalog number.

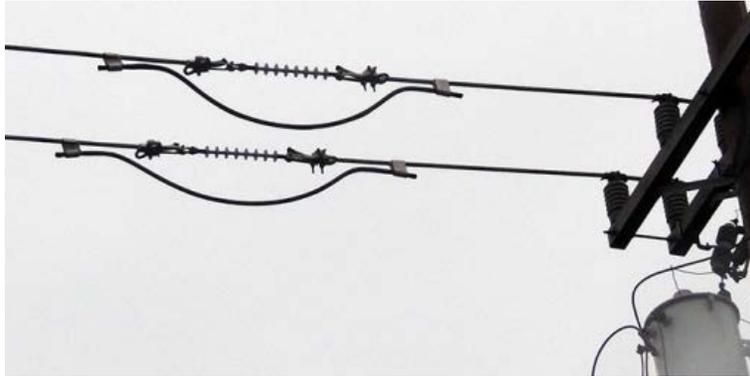
**7. Tool Die Requirements**

Tool	Burndy	EEI	Kearney	Nicro	T&B
Die Code	BG, 243	8A	5/8	Peach	TU, 52

Stock Unit: EA

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Charles L. Shaffer</i>	<i>John Schinner</i>	<i>Hardee Juy</i>

## Burndy Compression Connector Wedge Taps for Aluminum and Copper Conductor



### 1. Scope

This standard covers the material requirements for Burndy compression connector wedge taps and tool accessories which are compatible with both aluminum and copper conductor.

This standard applies to the Seattle City Light (SCL) stock numbers cited in Section 7. AMP products are outside the scope of this standard.

### 2. Application

A compression connector wedge tap provides an electrical connection between a primary conductor and a tap conductor. Joined conductors may be aluminum or copper, or both. Wedge taps allow a tap to a primary conductor to power another tap conductor.

Wedge taps have a variety of applications. For example, they can be used as a single-phase or three-phase overhead primary line jumper, or to power a line switch to an underground termination pole.

Burndy Wejtap wedge taps use an aluminum alloy wedge that is power driven between a run and a tap conductor. This makes a connection by locking the connector wedge into the "C"-shaped aluminum alloy spring-body. The spring-body is designed to maintain consistent pressure throughout the connection. An inhibitor is used in the channels to help maintain the integrity of the connector contact.

Wedge taps are installed using a Burndy Wejtap tool. The Wejtap tool and wedge taps allow for a quality connection using a fired-on system. The Wejtap tool and wedges taps are intended to be used together as a system.

Wedge taps are removable, which allows sections of the line to be isolated and de-energized if necessary.

AMP wedge taps are being phased out and replaced by Burndy taps.

Standards Coordinator  
Kathy Tilley

Standards Supervisor  
John Shipek

Unit Director  
Darnell Cola

### 3. Industry Standards

Wedge taps shall meet the requirements of the following industry standards:

**ANSI C119.4**; Electric Connectors—Connectors for Use Between Aluminum-to-Aluminum and Aluminum-to-Copper Bare Overhead Conductors

**ASTM B117-73**; Salt Spray and Salt Fog Testing

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### 4. Design

Wedge taps shall have the following characteristics:

- Manufactured from extruded heat-treated aluminum. The heat treatment aids in aligning the grain structure. Wedge taps shall be impact shaped to ensure spring loading meets high temperature rating ANSI C119.4 Class 3, NEMA CC3 1973 Class AA, 500 heat cycles.
  - Color coded to assist in identification.
  - Prefilled with high temperature antioxidant inhibitor.
  - Ink-stamped with commonly used run and tap size information.
  - A chamfer machined into the end of the run connector groove (which is always larger than the tap) for visual and tactile identification and proper placement.
- 

### 5. Packaging

Wedge taps shall be packaged individually in plastic bags. A sticker shall be attached to the outside of each bag that details the following:

- Manufacturer's name and symbol
  - Wire size and range of each wedge tap
  - Manufacturer's catalog number
  - Date of manufacture
  - SCL stock number
- 

### 6. Issuance

Unit: EA

## 7. Approved Manufacturers

All wedge taps are aluminum C-type taps unless otherwise stated.

**Table 7.1. Burndy Wedge Taps**

SCL Stock No.	Conductor Range (Aluminum or Copper)		Catalog No.
	Run	Tap	
013610	2/0 AWG	2/0 AWG	WCB11
013611	4/0 AWG	4/0 AWG	WCB20
013612	397.5 kcmil	#4 AWG	WCY49
013613	397.5 kcmil	2/0 AWG	WCY51
013614	397.5 kcmil	4/0 AWG	WCY54
013615	336.4 kcmil	336.4 kcmil	WCT56
013616	477 kcmil	500 kcmil	WCY61
013617	477 kcmil	2/0-4/0 AWG	WCY64
013618	4/0 AWG	#4 AWG	WCB16
013619	954 kcmil	397.5 kcmil	WCY94
013620	397.5 kcmil	397.5 kcmil	WCY62
013621	4/0 AWG	#1 to 1/0 AWG	WCB17
013622	#2 AWG	#2 AWG Cu	WCB10
013623	1/0 AWG	#2 AWG Cu	WCR29
013624	954 kcmil	795 and 954 kcmil	WCY88
013625	954 kcmil	795 to 954 kcmil	WCY89
013626	795 kcmil	795 kcmil AAC	WCY90
013627	954 kcmil	500 kcmil Cu	WCY93
013628	4/0 AWG	4/0 AWG	WCB28C28

**Table 7.2 Burndy Shells**

SCL Stock No.	Color	Application	Catalog No.
013629	Blue	Install and remove 2/0 to 4/0 AWG	WPBBNBO
013630	Red	Remove red cartridges	WPBRNBO
013631	Yellow	Install and remove 336.4 kcmil	WPBYNBO

## 8. Sources

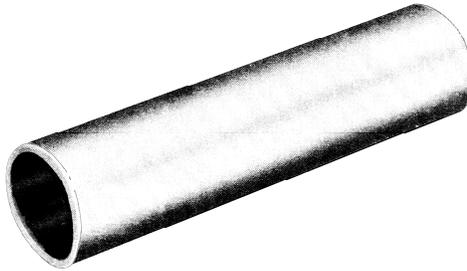
**Caddy, Tom**; SCL Field Operations Supervisor and subject matter expert (tom.caddy@seattle.gov)

**Tilley, Kathy**; SCL Electrical Engineering Support Specialist and originator of SCL 6774.31 (kathy.tilley@seattle.gov).

**Carr, Bob**; Burndy Corporation subject matter expert

[www.burndy.com](http://www.burndy.com)

**ADAPTER, COPPER REDUCING**



1. **General:** The copper-reducing adapters shall be of the general configuration shown. The adapters are used to reduce the socket size of standard compression connectors. Corrugated and split designs are not acceptable. They are intended for use in insulated high-voltage splices of cables with 4 kV and greater insulation.
2. **Material:** The reducing adapters shall be made of high-conductivity copper, of one-piece construction, and shall be tin coated. The adapters shall be solid without splits or corrugation, and shall have a smooth inside and outside surface.
3. **Marking:** Each reducing adapter shall have durable markings showing cable sizes, manufacturer's name or trademark, and catalog number of the reducing adapter.
4. **Stock Unit:** EA

Stock Number	Size		Length ± 1/4, in.	Approved Manufacturers	
	From	To		Burndy	Richards
679775	3/0	#1	2	–	CRA11-8-SCL
679778	350	#1	2	–	CRA15-8-SCL
679780	350	3/0	2	–	CRA15-11-SCL
679783	500	3/0	2-3/4	Y3427R	CRA18-11-SCL
679785	500	350	2-1/2	Y3431R	CRA18-15-SCL
679789	750	350	2-7/8	Y3931R	CRA23-15-SCL
679790	750	500	2-7/8	Y3934R	CRA23-18-SCL
679791	1000	750	3	Y4439R	CRA28-23-SCL

STANDARDS COORDINATOR

*Bill Shoemaker*

Bill Shoemaker

STANDARDS SUPERVISOR

*John Barnett*

John Barnett

UNIT DIRECTOR

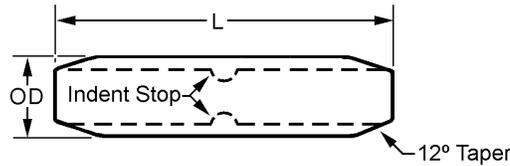
*Hardev Juj*

Hardev Juj

# MATERIAL STANDARD

## CONNECTORS - TAPERED COPPER COMPRESSION

1. **Description:** Tapered Copper Compression Connectors of the configuration shown are intended for use on 4 kV and higher insulated copper conductors in Underground Construction and shall meet the applicable requirements of NEMA CC1, *Electric Power Connectors*.



Conductor, AWG	Dimension, in.	
	OD	L
1	0.46	2-1/16
1/0	0.51	2-1/16
3/0	0.62	2-13/32
4/0	0.69	2-3/8

Conductor, kcmil	Dimension, in.	
	OD	L
300	0.81	2-5/8
350	0.88	2-25/32
500	1.06	3-17/32
600*	1.18	4-7/32
750	1.30	4-7/32
1000	1.50	4-31/32

\*Use for 750 kcmil compact round.

2. **Material:** Connectors shall be made from tinned, high conductivity, seamless annealed copper.
3. **Construction:** An indent stop shall be provided at the center of the connector to ensure proper conductor insertion. The ends shall have a 12° taper.
4. **Marking:** Each connector shall have durable markings showing conductor size and manufacturer's name or trademark and catalog number of the connector.
5. **Reference Specification:** NEMA CC1, latest revision.
6. **Stock Unit:** EA
7. **Approved Manufacturers:**

Stock No.	Wire Size, AWG/kcmil	Approved Manufacturers				
		Burndy	Dossert	Homac	MAC	Richards
677337	1	-	-	TC-1	MTC 1	TCC 8
677338	1/0	-	DPC10-T	TC-1/0	MTC 1/0	TCC 9
677340	3/0	-	DPC17-T	TC-3/0	MTC 3/0	TCC 11
677341	4/0	YS28-T	DPC21-T	TC-4/0	MTC 4/0	TCC 12
677343	300	YS30-T	DPC30-T	TC-300	MTC 300	TCC 14
677345	350	YS31-T	DPC35-T	TC-350	MTC 350	TCC 15
677347	500	YS34-T	DPC50-T	TC-500	MTC 500	TCC 18
677348	600*	-	-	TC-600	MTC 600	TCC 20
677349	750	YS39-T	DPC75-T	TC-750	MTC 750	TCC 23
677351	1000	-	DPC100-T	TC-1000	MTC 1000	TCC 28

STANDARDS COORDINATOR

*Gold Shield*

STANDARDS SUPERVISOR

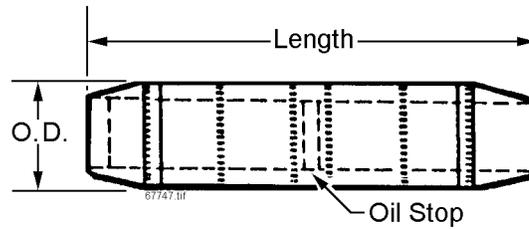
*John Chinn*

UNIT DIRECTOR

*Harold J. J.*

# MATERIAL STANDARD

## CONNECTORS TAPERED ALUMINUM COMPRESSION



**Tapered Aluminum Compression Connectors** of the configuration shown are intended for use on 4 kV and higher insulated aluminum and copper conductors in underground construction, and shall meet the applicable requirements of ANSI C119.4 Standard for Aluminum Connectors for Aluminum/Copper Conductors.

**Inhibitor.** Each connector shall be factory filled with a measured amount of oxide-inhibiting compound that will not effect the dielectric strength or power factor of cables insulated with butyl, polyvinyl chloride, polyethylene, cross linked polyethylene, or ethylene-propylene rubber.

**Oil Stop.** The connector ends shall be separated by a center oil stop.

**Tin Plate.** Each connector shall be tin-plated for Al-Al, Al-Cu, and Cu-Cu connections.

**Marking.** Each connector shall have durable markings showing conductor size, die number, number of crimps and manufacturer's name or trade mark and catalog number of the connector.

**Packaging.** The connector ends shall be sealed to prevent leakage or contamination of the inhibitor. Each connector shall be individually packaged in a sealed plastic bag.

**Reference Specification:** ANSI C119.4, latest revision

**Stock Unit:** EA

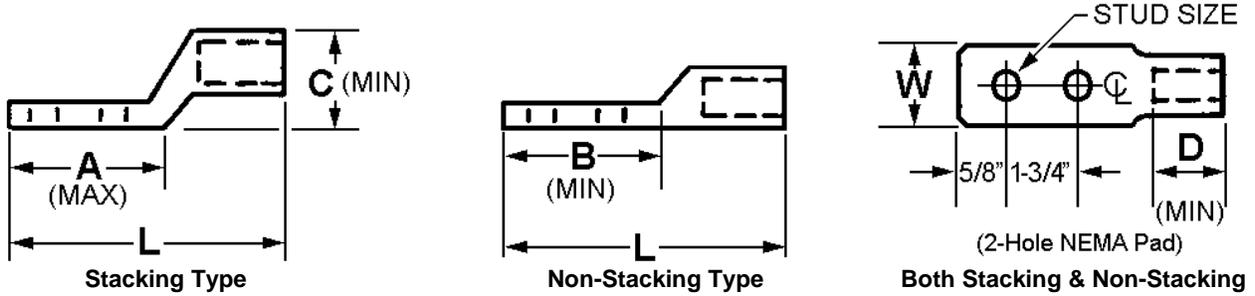
### Tooling and Die Requirements

Stock Number	Wire Size	O.D.	Nom. Length	Burndy	T&B	Kearney
650631	#1	0.530"	2.63"	U1CART, 163	45	1/2
650632	1/0	0.600"	2.67"	U25ART, 296	52	9/16
650634	4/0	0.840"	3.75"	U28ART, 298	76	840
650637	350	1.125"	4.94"	U31ART, 299	96	1-1/8
650639	500	1.320"	5.50"	U34ART, 300	115	1-5/16
650641	750	1.590"	6.88"	U39ART, 301	125	1-1/2

Stock Number	Wire Size	Nominal Length	Approved Manufacturers			
			Burndy (Tin Plate)	Homac	MAC	Richards
650631	#1	2.63"	YS1CAST	ATC-1-TN	MTAP 1-TN	OATC 8-TN
650632	1/0	2.67"	YS25AST	ATC-1/0-TN	MTAP 1/0-TN	OATC 9-TN
650634	4/0	3.75"	YS28AST	ATC-4/0-TN	MTAP 4/0-TN	-
650637	350	4.94"	YS31AST	ATC-350-TN	MTAP 350-TN	-
650639	500	5.50"	YS34AST	ATC-500-TN	MTAP 500-TN	OATC 18-TN
650641	750	6.88"	YS39AST	ATC-750-TN	MTAP 750-TN	OATC 23-TN

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Harold J. J.</i>

**CONNECTOR, TERMINAL – TIN-PLATED  
 ALUMINUM COMPRESSION, STACKING AND NON-STACKING**



REQUIRED DIMENSIONS

**Non-Stacking Lugs**

Stock No.	Nominal Conductor Size	Dimensions in Inches				
		B - Min.	D - Min.	L	Stud Size	W - Pad Width
651267	300	3-9/16	2-1/4	6-1/2 + 1/4	1/2	1-3/8 ± 1/16
651268	350	3-9/16	2-1/4	6-1/2 + 1/4	1/2	1-1/2
651269	400	3-9/16	2-1/4	6-1/2 + 1/4	1/2	1-5/8 ± 1/32
651270	500	3-9/16	2-1/4	7 + 1/2	1/2	1-3/4
651294	500	3-9/16	2-1/4	7 + 1/2	5/8	1-3/4
651271	600	3-5/8	3	7-1/2 + 1/2	1/2	1-3/4
651274	700	3-5/8	3	7-1/2 + 1/2	1/2	1-3/4
651275	700	3-5/8	3	7-1/2 + 1/2	5/8	1-3/4
651272	750	3-5/8	3	7-3/4 + 1/2	1/2	1-3/4
651295	1000 str	3-5/8	3	10	1/2	2-9/16
651296*	1000	3-5/8	3	10	1/2	3*

\* 4-Hole NEMA Pad

**Stacking Lugs**

Stock No.	Nominal Conductor Size	Dimensions in Inches					
		A - Max.	C - Min.	D - Min.	L	Stud Size	W-Pad Width
651276	4/0	3-3/8	1-7/8	1-3/4	5-5/16	1/2	1-3/16
651277	350	3-9/16	2-3/8	2-1/4	6-1/2 + 1/4	1/2	1-1/2
651278	500	3-9/16	2-5/8	2-1/4	7 + 1/2	5/8	1-3/4
651279	750	3-5/8	3	3	7-3/4 + 1/2	5/8	1-3/4

standards coordinator	standards supervisor	unit director
 Yaochiem Chao	 John Shipek	 Darnell Cola

**Aluminum Compression Terminal Connectors** of the configuration shown are intended for terminating aluminum or copper cables to an aluminum or copper surface. The terminals shall meet the requirements of ANSI C119.4 and EEI-NEMA TDJ-162, *Standard for Aluminum Connectors for Aluminum Conductors*. The terminals shall meet the physical dimensions listed above to ensure that the stacking-type terminals will fit on top of the non-stacking type terminals and that the non-stacking type terminals will fit beneath the stacking-type terminals. Tin-plating of the terminals is required.

**Inhibitor.** Each terminal shall be factory-filled with a measured amount of high-voltage oxide-inhibiting compound that will not affect the dielectric strength or power factor of cables installed with butyl or polyethylene insulation.

**Marking.** Each terminal shall have durable markings showing conductor size, die number, number of crimps, and manufacturer's name or trademark, and catalog number of the connector.

**Packing.** The terminal ends shall be sealed to prevent leakage or contamination of the inhibitor.

**Reference Specification:** ANSI C119.4, EEI-NEMA TDJ-162, Latest Revisions

**Non-Stacking Lugs**

Stock Number	Conductor Size	Approved Manufacturers			
		Anderson	Homac	MAC	Richards
651267	300 STR / 350 Comp	AHL-300-BN-TP	AL300-NTN	MLB 300-8N-HV	AL14-2N
651268	350 STR / 400 Comp.	AHL-350-BN-TP	AL350-NTN	MLB 350-8N-HV	AL15-2N
651269	400 STR / 500 Comp.	–	AL400-NTN	MLB 400-8N-HV	–
651270	500 STR / 600 Comp.	AHL-500-BN-TP	AL500-NTN	MLB 500-8N-HV	AL18-2N
651294*	500 STR / 600 Comp.	–	–	MLB 500-9N-HV	–
651271	600 STR / 700 Comp.	AHL-600-BN-TP	AL600-NTN	MLB 600-8N-HV	AL20-2N
651274	600 -700 STR / 700-795 Comp.	AHL-700-BN-TP	AL700-N-608-TN	–	–
651275*	600 -700 STR / 700-795 Comp.	–	AL700-258-608-TN	–	–
651272	700 - 800 STR / 1000 Comp.	AHL-750-BN-TP	AL750-NTN	MLB 750-8N-HV	AL23-2N
651295	1000 STR / Comp.	AHL-1000-BN-TP	AL1000-NTN	–	–
651296	1000 (Feeder only with 4-hole NEMA pad)	–	AL1000-4NTN	MLB1000-8N-4-HV	–

\* Terminals Drilled for 5/8-inch Studs

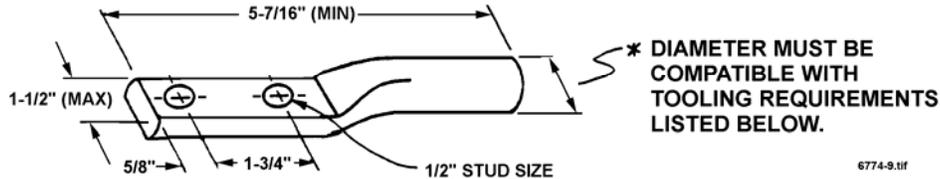
**Stacking Lugs**

Stock Number	Conductor Size	Approved Manufacturers			
		Anderson	Homac	MAC	Richards
651276	4/0	ATL-4/0-BN-TP	ASL4/0-NTN	MLB 4/0-NT-HV	ASL12-2N
651277	350	ATL-350-BN-TP	ASL350-NTN	MLB 350-NT-HV	ASL15-2N
651278*	500	ATL-500-BN-TP-SCL	ASL500-258-TN	MLB 500-9NT75-HV	ASL18-2N-5/8
651279*	750	ATL-750-BN-TP-SCL	ASL750-258-TN	MLB 750-9NT75-HV	ASL23-2N-5/8

\* Terminals Drilled for 5/8-inch Studs

**MATERIAL STANDARD**

**CONNECTOR – TIN-PLATED,  
 ALUMINUM COMPRESSION, SECONDARY UNDERGROUND**



**Aluminum Compression Connectors** of the configuration shown are intended for terminating aluminum cable to a copper or aluminum surface. The terminals shall meet the requirements of ANSI C119.4 and NEMA SG 14.10, *Standard for Aluminum Connectors for Aluminum Conductors*. Tin-plating of terminals is required.

**Inhibitor.** Each terminal shall be factory-filled with a measured amount of oxide-inhibiting compound that will not affect the dielectric strength or power factor of cables installed with butyl, polyvinyl chloride, polyethylene, or cross-linked polyethylene insulation.

**Marking.** Each terminal shall have durable markings showing conductor size, die number, number of crimps, and manufacturer's name or trademark, and catalog number of the connector.

**Packaging.** The terminal ends shall be sealed to prevent leakage or contamination of the inhibitor.

**Reference Specifications:** ANSI C119.4 and SG 14.10, latest revisions.

**Stock Unit:** EA

**Tooling and Die Requirements**

Connector Size	EEI	Burndy		T&B - Homac		Kearney
		MD-6	Y-35	TBM-8 (UT-5)	T&B HYD.	
all sizes	11A	W-K840 W-249	U-K840 U-249	Blue (TX)	76H	840

Stock No.	Conductor Size	Approved Manufacturers					
		Anderson	Blackburn	Homac	Kearney	Penn-Union	Richards
651255	#1-#2 Str/ #1 Comp	–	AL4P	SAK 2-NTN	104741-1	KSL-R2D-TN	ALCD8-2N-TN-SCL
651256	1/0 Str/ 1/0-2/0 Comp	–	AL6P	SAK 1/0-NTN	104741-2	KSL-1/0-D-TN	ALCD9-2N-TN-SCL
651257	2/0 Str/ 3/0 Comp	VAUL-2/0-12BN	AL8P	SA 2/0-NTN	104741-3	KSL-2/0-D-TN	ALCD10-2N-TN-SCL
651258	3/0 Str/ 4/0 Comp	VAUL-3/0-12BN	AL10P	SA 3/0-NTN	104741-4	KSL-3/0-D-TN	ALCD11-2N-TN
651265	4/0-250 Str/ 250-350 Comp	–	AL12P	AL 250-NTN	104741-5	KSL-4/0-D-TN	–

STANDARDS COORDINATOR <i>John Shipek</i> John Shipek	STANDARDS SUPERVISOR <i>John Barnett</i> John Barnett	UNIT DIRECTOR <i>Famela S. Johnson</i> Famela S. Johnson
--	---	--

**CONNECTOR, "WYE," COMPRESSION - COPPER****1. General**

This specification is for copper compression connectors of the type shown in the drawings on pages 4 through 10. They are intended for underground, medium voltage, primary cable splices insulated for 4-kV and greater. The connectors may be either a one piece casting or a central casting with soldered on tube connectors. The connectors shall be constructed and tested in accordance with the latest revisions of this specification.

**2. Material**

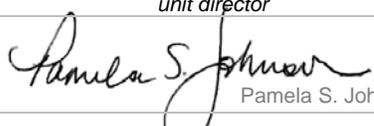
- 2.1 Connectors furnished in accordance with the provisions of this specification shall be made from materials conforming to the requirements of the Copper Development Association (CDA) Standards Handbook, Part 2, Alloy Data, Wrought Products; and Part 7, Alloy Data, Cast Copper and Copper Alloy Products.
- 2.2 For cast copper products, the preferred alloy shall be CDA Alloy C81500. The manufacturer may use a substitute alloy if authorization is obtained prior to beginning production. Objective evidence indicating that the proposed alloy will provide a minimum conductivity of 75% IACS and contain a minimum of 98.0% copper as determined by chemical analysis must be submitted.
- 2.3 For wrought products, those alloys specified by CDA Standards Handbook, Part 2, to provide a minimum 75% conductivity shall be acceptable.
- 2.4 Aluminum bronze alloys are not acceptable.
- 2.5 All current-carrying surfaces shall be tin-coated in accordance with ASTM B32, Grade Sn 60.
- 2.6 The temper and ductility of the cable sockets shall be such as to permit soldering, indenting, squeezing, or rolling, as may be required for proper attachment without surface cracking or crazing.
- 2.8 Central Cast With Soldered On Tube Connectors Only.
  - The cable sockets shall be made from seamless copper tubing or rod which will not lead to chemical or galvanic corrosion of the connectors.
  - The product used to join cast and wrought sections of these connectors, if required, shall provide electrical joint conductivity which does not degrade the performance of the connector.

**3. Construction**

- 3.1 The connector shall be symmetrical about the center axis except where one cable socket is smaller. The smaller socket shall be located on the tap branch of the wye.
- 3.2 Cable sockets shall have tapered ends with rounded edges, the slope of the taper being not greater than 12 from the connector axis.
- 3.3 The fit of the cable sockets for the various sizes of cable shall be such as to facilitate installation and provide the required electrical and mechanical properties when properly indented or pressed on conductors that are within the allowable tolerance range.
- 3.4 The body shall be cast to dimensions and tolerances that will preclude more than  $\pm 1/32$ " variation in the cast and wrought portions of the assembly. When legs have different diameters, the body shall be smoothly blended to avoid a step in excess of  $\pm 1/32$ " in the connector at the solder joint or elsewhere.
- 3.5 The dimensions and conformation shown in the drawings in this specification are considered optimum by Seattle City Light. If the manufacturer produces a similar item designed for this application the dimensions of which do not vary by more than 10%, that item may be approved if it complies with all other requirements of this specification.

**4. Marking**

Each connector shall have permanent markings showing conductor size, tool, and die requirements, manufacturer's name or trademark, crimp locations, and the manufacturer's catalog number (if any) of the connector.

standards coordinator	standards supervisor	unit director
 Bill Shoemaker	 John Shipek	 Pamela S. Johnson

**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

standard number: **6775.10**

superseding: April 17, 2003

effective date: September 10, 2008

page: 2 of 9

**5. Performance Requirements**

A completed compression connection, indented or pressed in accordance with the manufacturer's instructions, shall provide electrical conduction equal to or greater than an equivalent length of uncut conductor when measured between points one-quarter-inch beyond each end of the connectors. This test shall be performed using bare conductors.

**6. Tool-Die Requirements**

Stock Number	Connector Main-Main-Tap						6775.10
		3/0	350	500	750	1000	Page Number
663506	3/0-3/0-3/0	U27RT #14	–	–	–	–	3
663524	350-350-3/0	U27RT #14	U31RT #18	–	–	–	3
663530	350-350-350	–	U31RT #18	–	–	–	4
663538	500-500-3/0	U27RT #14	–	U34RT #20	–	–	4
663544	500-500-500	–	–	U34RT #20	–	–	5
663559	750-750-350	–	U31RT #18	–	U39RT #24	–	5
663561	750-750-750	–	–	–	U39RT #24	–	6
663562	1000-1000-350	–	–	–	–	P44RT	6
663563	1000-1000-3/0	U27RT #14	–	–	–	P44RT	7
663564	1000-1000-500	–	–	U34RT #20	–	P44RT	7
663565	1000-750-750	–	–	–	U39RT #24	P44RT	8
010129	1000-1000-1000	–	–	–	–	P44RT	8
663567	1000-750-350	–	U31RT #18	–	U39RT #24	P44RT	9

**7. Testing**

- 7.1 Seattle City Light reserves the right to test connectors supplied. Testing may be nondestructive, destructive, and/or analytical and may include, but not be limited to, radiographic, metallurgical, or chemical methods.
- 7.2 If testing is required, samples will be selected randomly in accordance with Mil-Std 105E, AQL 1.0, normal inspection Level 1. If the sample selected is not found acceptable, the lot shall be rejected. The manufacturer shall submit certified test reports from an independent testing laboratory indicating that a random sample of the replacement lot of new parts, taken in accordance with Mil-Std 105E, conforms with the requirements of this specification.
- 7.3 Following receipt, evaluation, and approval of the test reports, the vendor will be authorized to ship the lot covered by test reports. The vendor will provide positive identification for the parts tested and the test reports.
- 7.4 The cost of any testing required to verify quality of the product as a result of a previous rejection shall be the responsibility of the manufacturer.

**8. Packaging and Shipping**

Connector shall be packed and shipped in such a manner as to protect the individual connector from damage during shipment. Each shipping container shall be marked with the manufacturer's name, City Light Stock number and quantity of connectors contained.

**9. Stock Unit: EA.****10. Approved Manufacturer: Gil's Aluminum and Core Shop (Order by description)**

**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

standard number: **6775.10**

superseding: April 17, 2003

effective date: September 10, 2008

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11. Figures, in order by stock number

Figure 11.1

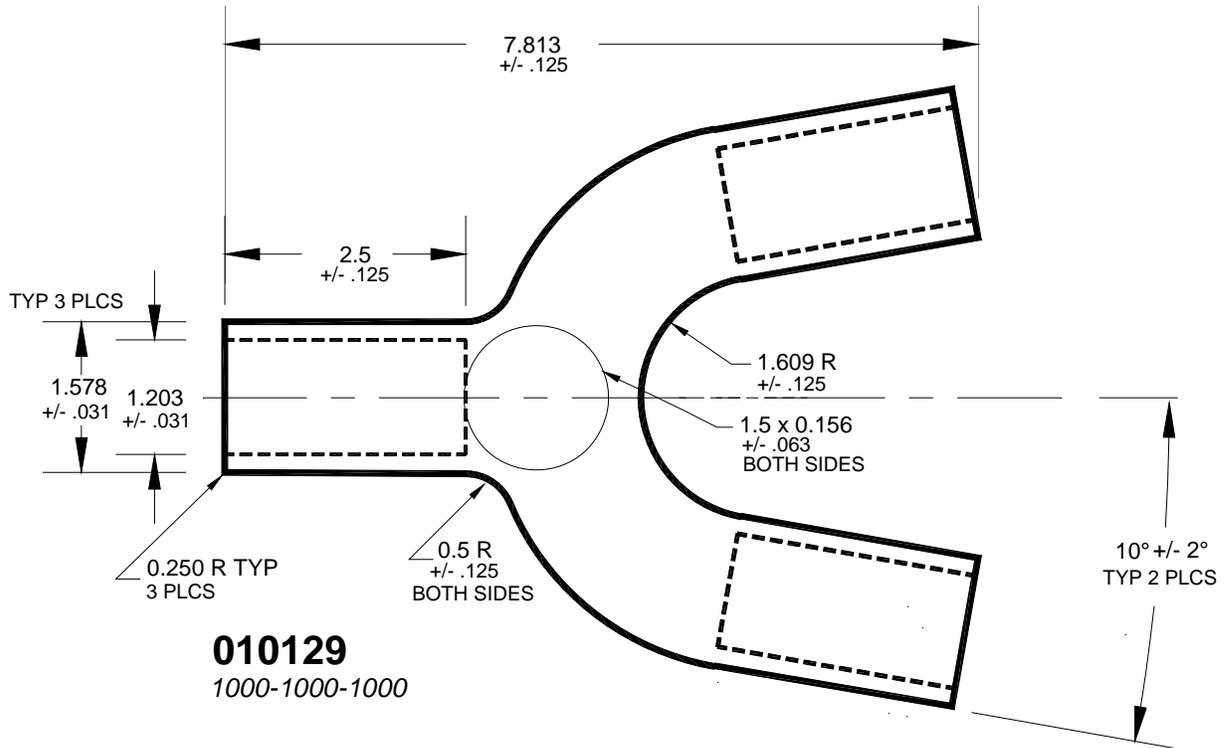
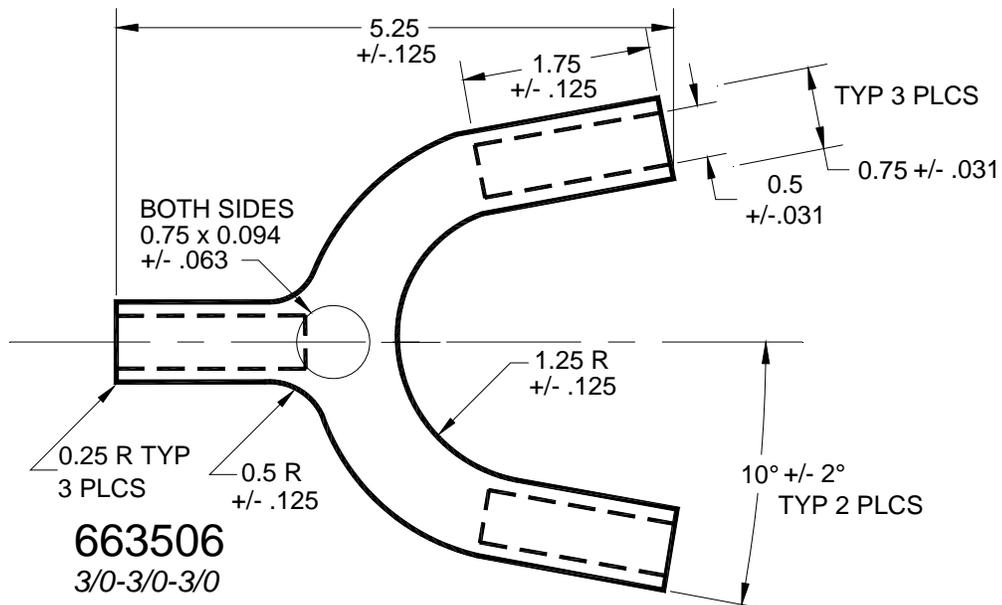


Figure 11.2



**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

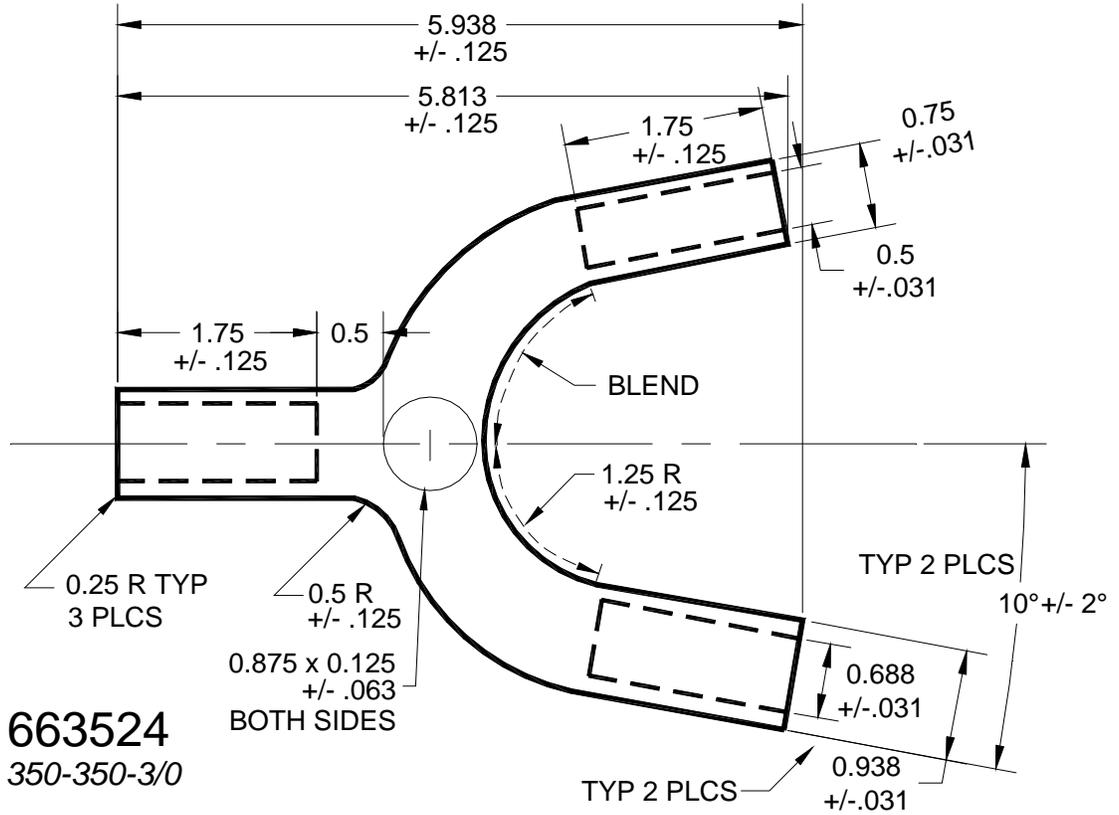
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superseding: April 17, 2003

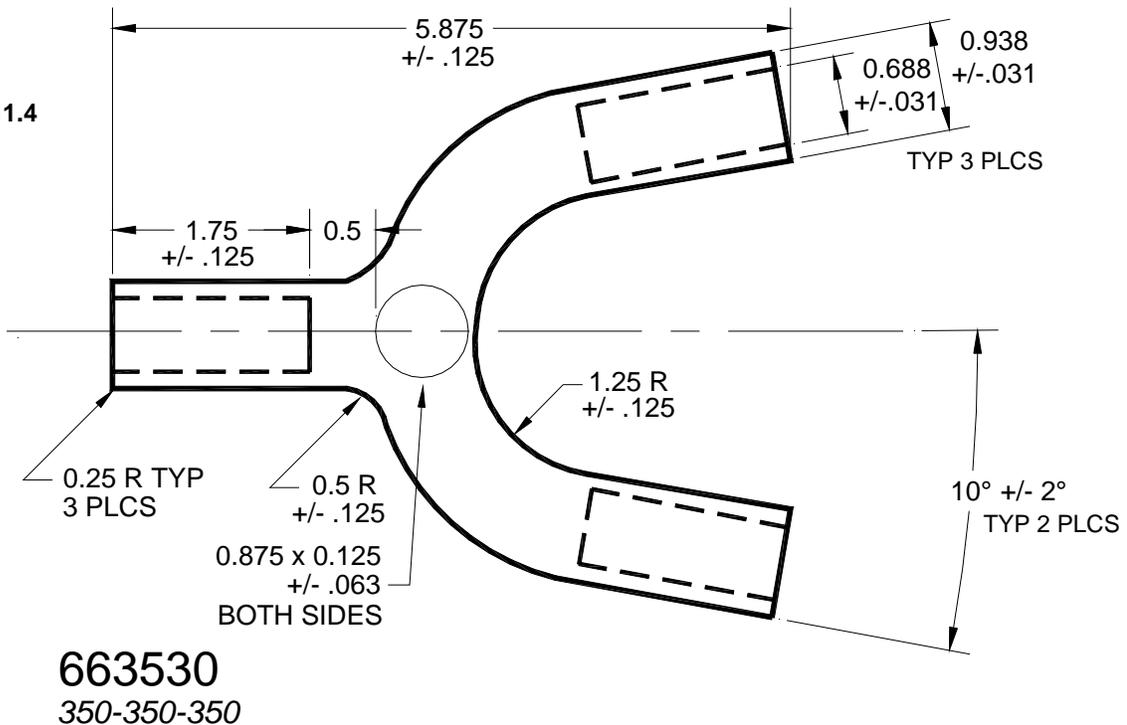
effective date: September 10, 2008

page: 4 of 9

**Figure 11.3**



**Figure 11.4**



**Figure 11.5**

**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

standard number: **6775.10**

superseding: April 17, 2003

effective date: September 10, 2008

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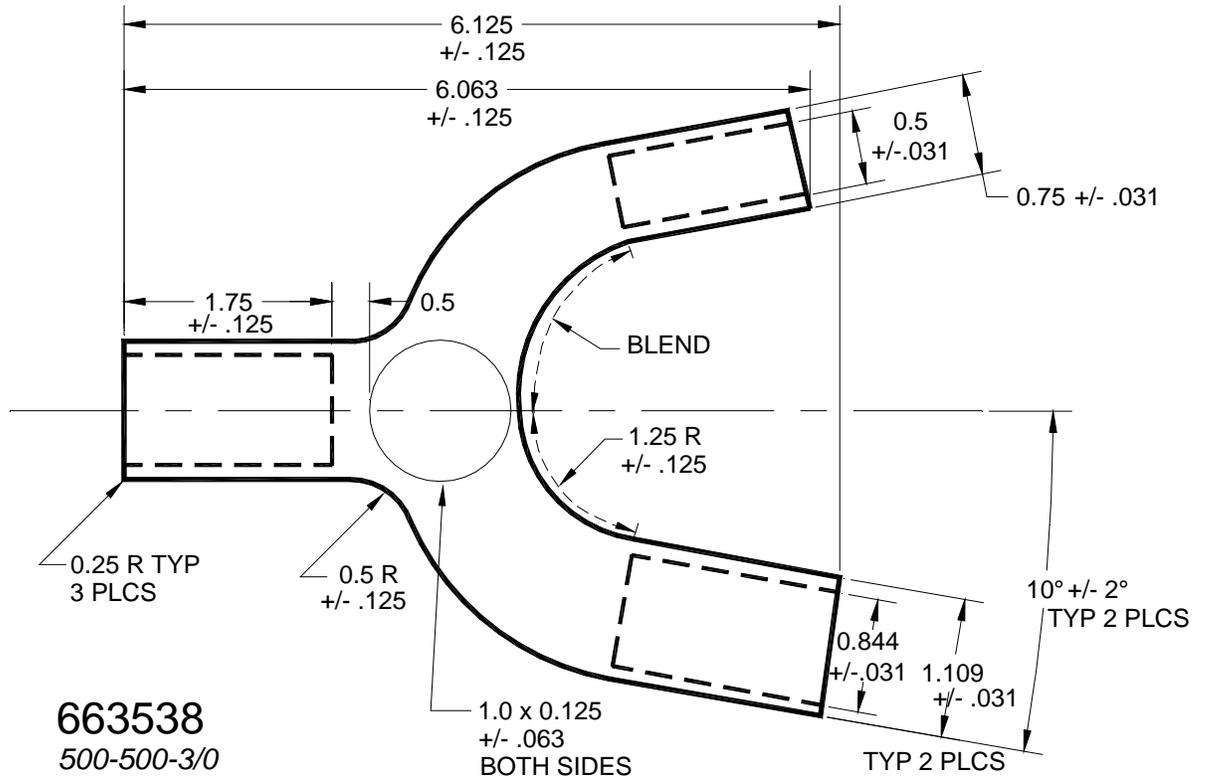
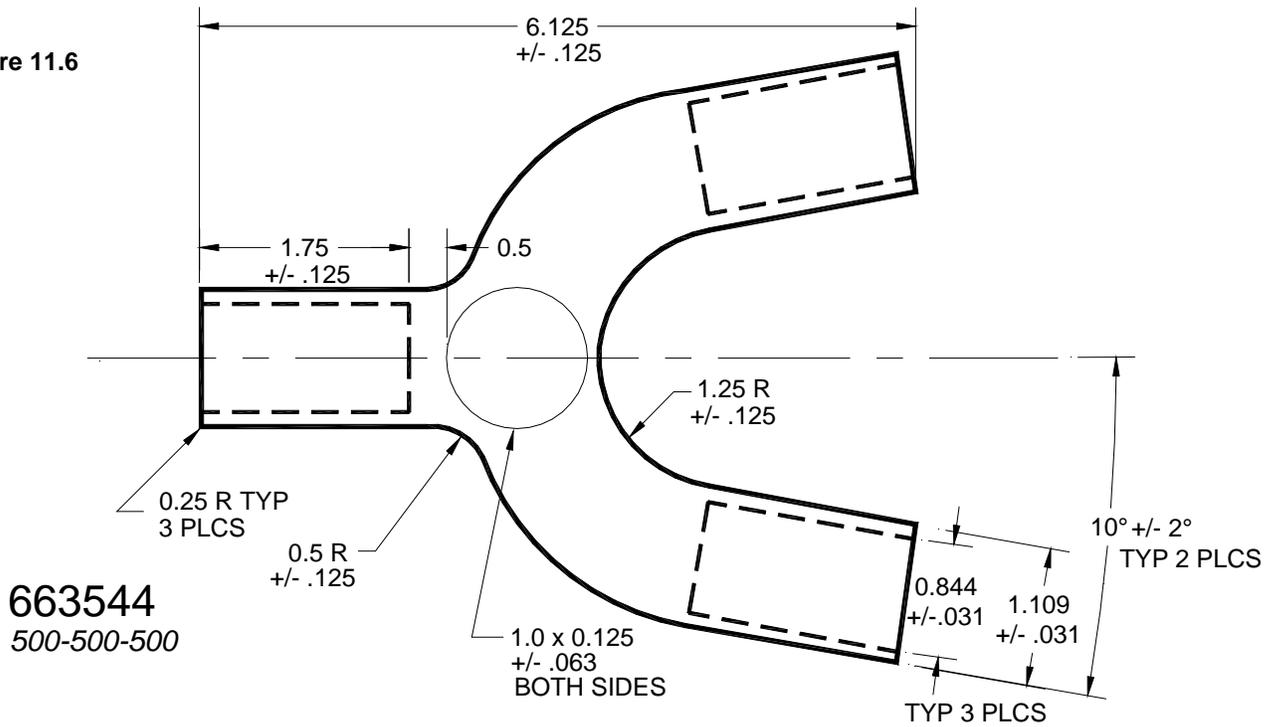


Figure 11.6



**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

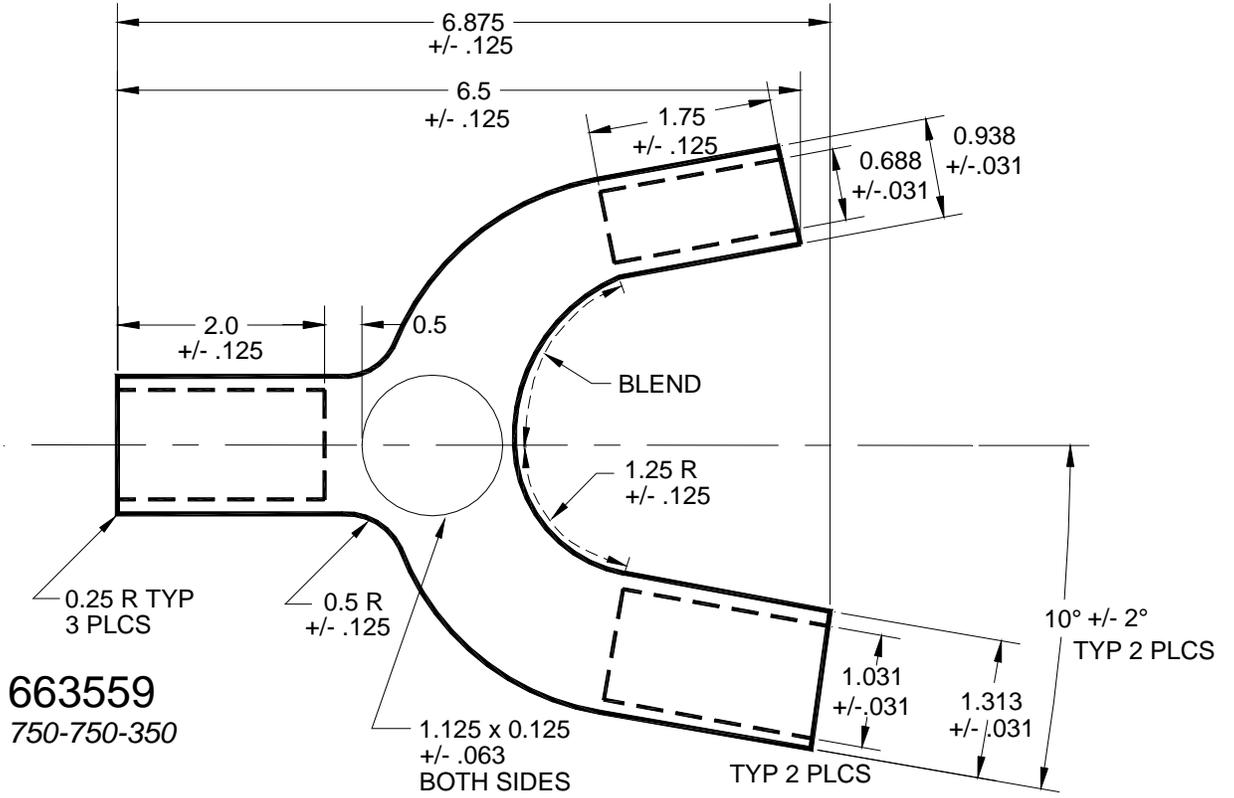
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superseding: April 17, 2003

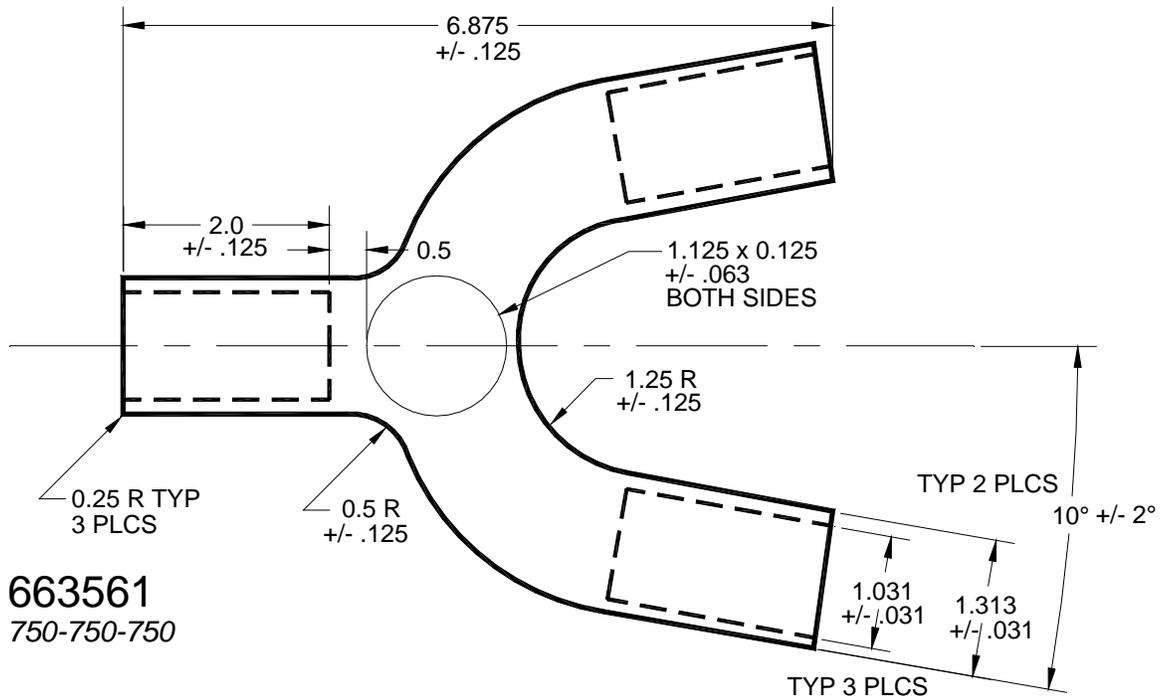
effective date: September 10, 2008

page: 6 of 9

**Figure 11.7**



**Figure 11.8**



# MATERIAL STANDARD

Connector, "Wye," Compression - Copper

standard number: **6775.10**

superseding: April 17, 2003

effective date: September 10, 2008

page: 7 of 9

Figure 11.9

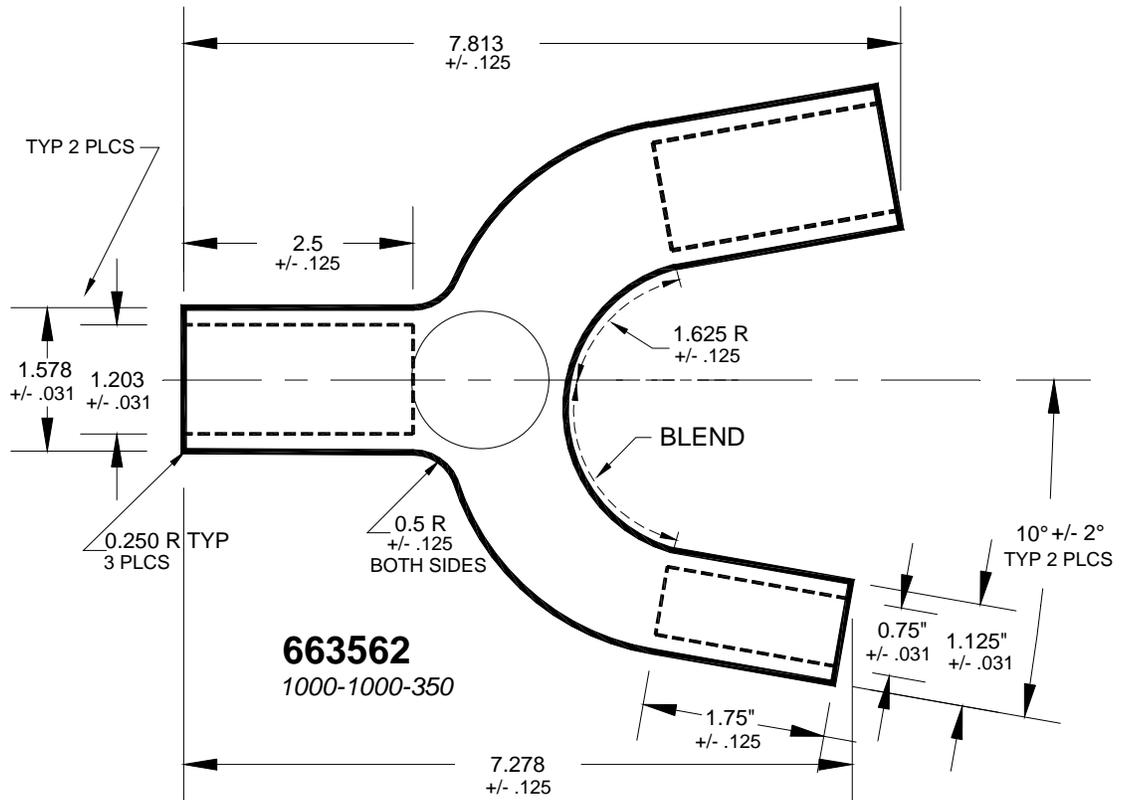
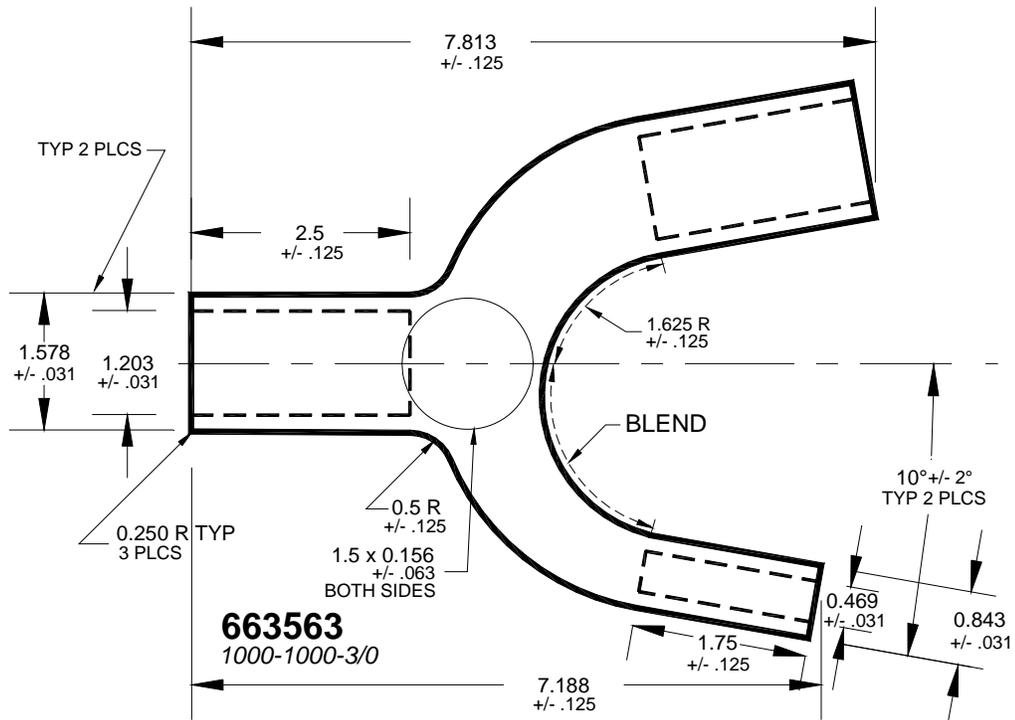


Figure 11.10



**MATERIAL STANDARD**

Connector, "Wye," Compression - Copper

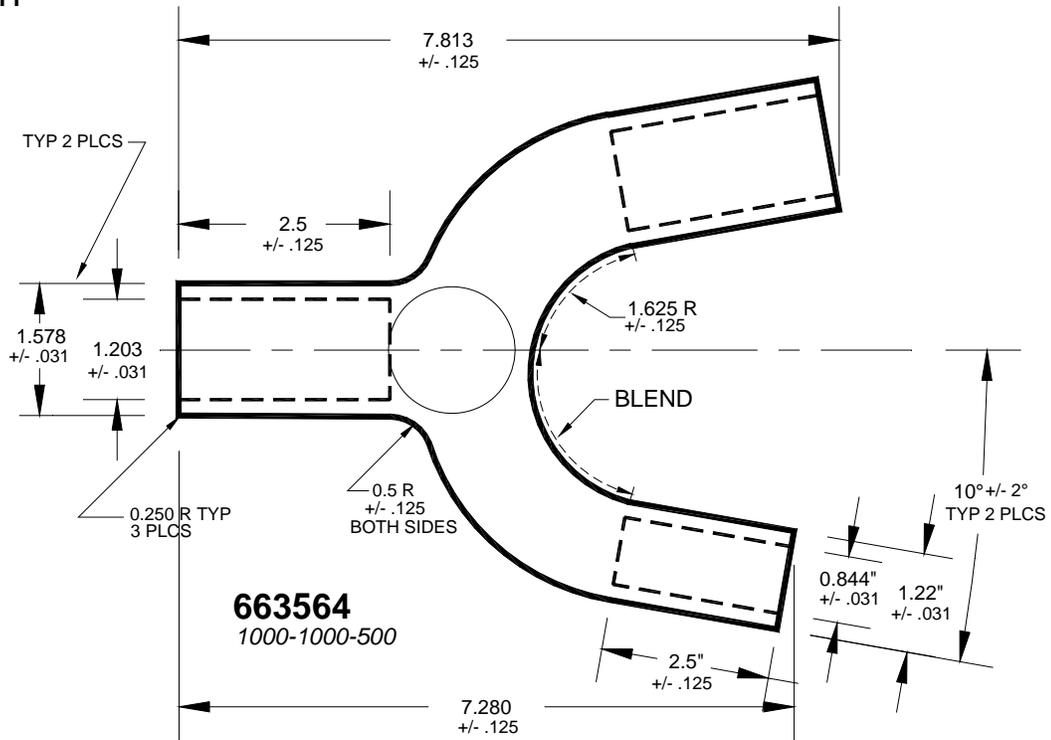
standard number: **6775.10**

superseding: April 17, 2003

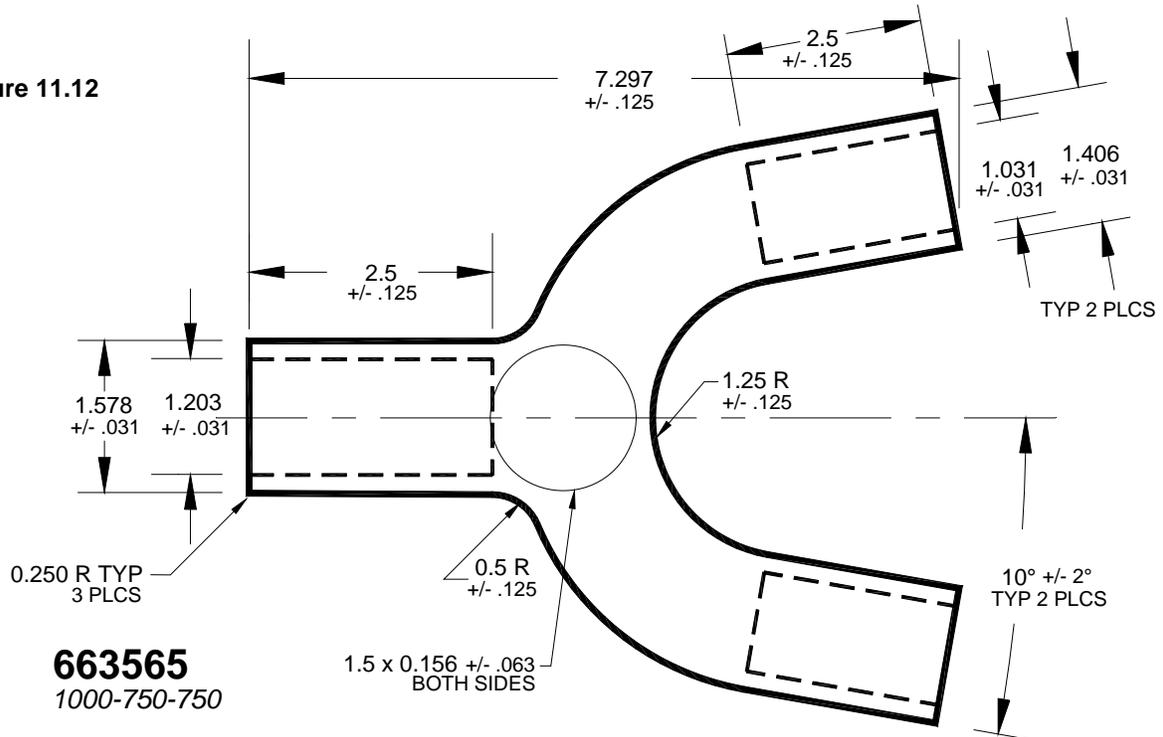
effective date: September 10, 2008

page: 8 of 9

**Figure 11.11**



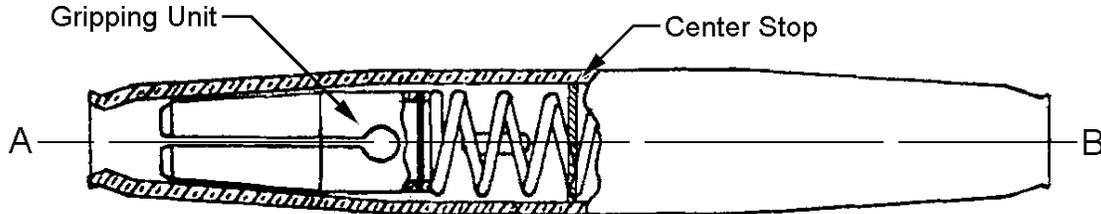
**Figure 11.12**





**MATERIAL STANDARD**

**SPLICE, AUTOMATIC  
 LINE, COPPER**



**Automatic Line Splices** shall be of the configuration shown and shall meet the requirements of EEI specification TD-72, except as modified herein.

**Materials:** The splice shell shall be made of drawn copper tubing. Springs shall be stainless steel. The gripping unit shall be a silicon-bronze alloy.

**Jaws:** The splice jaws shall have threaded or toothed contact surfaces.

**Performance:** Automatic line splices shall have a center barrier to effectively prevent insertion of either wire beyond the center of the splice. Splices shall incorporate strand guides and pilot cups of other means of ensuring that the wires can be easily inserted to full design depth.

**Inhibitor:** Each splice shall have a lubricant/inhibitor applied by the factory.

**Marking:** Splices shall have the manufacturer's name or logo and the conductor sizes permanently stamped thereon.

**Packing:** Each splice shall be individually packaged.

**Reference Specification:** EEI TD-72 (latest revision)

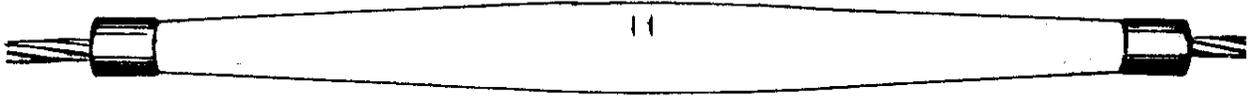
**Stock Unit:** EA

Stock No.	Conductor Size		Approved Manufacturers	
	Solid	Stranded	Fargo/Hubbell	Reliable/MacLean
677532	6	8	GL-1115	61
677533	4	6	GL-1125	41
677535	2	3	GL-1145	21
677536	1	2	GL-1155	27
677537	1/0	1	GL-1165	101
677538	2/0	1/0	GL-1175	107
677539	3/0	2/0	GL-1185	207
677540	4/0	3/0	GL-1195	307
677541	—	4/0	GL-1205	407
677544	—	300 kcmil	GL-1235	—
677545	—	350 kcmil	GL-1255	—

	End "A"		End "B"			
677556	4	6	6	8	GL-150	—
677577	3/0	2/0	2/0	1/0	—	207107
677581	—	4/0	4/0	3/0	GL-175	—

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Sam S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. ...</i>	<i>Harold J. ...</i>

**SPLICES, AUTOMATIC  
 ACSR FULL TENSION**



**Automatic Full Tension Splices for ACSR** shall be made of high-strength aluminum alloy, and shall meet the applicable requirements of EEI-TD-72, Specifications for Line Connectors and Splices.

**Conductor Holding Capability:** The splices shall be capable of the developing a minimum of 90 percent of the rated strength of standard ACSR without baring the core wire.

**Performance:** Automatic line splices shall effectively prevent insertion of either wire beyond the center of the splice. Splices shall incorporate strand guides and pilot cups of other means of ensuring that the wires can be easily inserted to full design depth.

**Packaging and Instructions:** The splices shall be individually packaged in sealed polyethylene bags with instructions for their use either enclosed with each splice or imprinted on the bag.

**Reference Specifications:** EEI TD-72, latest revision.

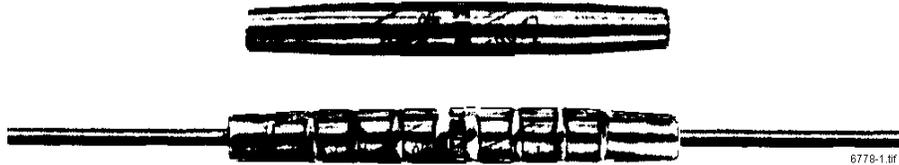
**Stock Unit:** EA

Stock Number	ACSR Size	Approved Manufacturers		
		Anderson/ Fargo	MacLean Power Systems	Blackburn
650663	2/0	GL-407	7654AP	ATS1020
650665	4/0	GL-409A	7656AP	ATS3040
650666	336.4	GL-411	7658AP	ATS266336
650668	397.5	GL-412	7659	—

<i>standards coordinator</i>	<i>standards supervisor</i>	<i>unit director</i>
 John Shipek	 John Shipek	 Darnell Cola

# MATERIAL STANDARD

## CONNECTORS COPPER SPLICING SLEEVES FULL TENSION



**Copper Splicing Sleeves** installed by the compression method shall be designed to develop the full rated strength of hard-drawn and medium-drawn copper conductors for which they are intended. They shall meet all the applicable requirements of NEMA Std. Pub. No. CC1, "Electric Power Connectors."

**Identification:** The sleeves shall be clearly marked with the manufacturer's trade-mark, conductor type and size, die groove, and catalog number.

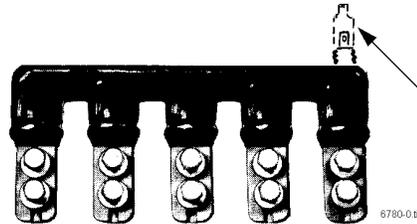
**Reference Specifications:** NEMA CCI, latest revision.

**Stock Unit:** EA

Stock Number	Wire Size AWG-kcmil	Tool Groove	Approved Manufacturers	
			Nicopress	Burndy
677796	10 Sol	C	1-102C	----
677802	8 Sol	J	1-128J	----
677803	6 Sol	J	1-162J	YDS6W
677804	4 Sol	M	1-204M	YDS4W
677808	2 Sol	X	1-258X	----
677901	2/0 Str	G3	1-365/7G3	----
677903	4/0 Str	H5	1-460/7H5	----

ORIGINATOR	STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
<i>Jim S. Horn</i>	<i>Charles L. Shaffer</i>	<i>John C. Skinner</i>	<i>Betty Robm</i>

**CONNECTORS, MULTIPLE  
 INSULATED, SUBMERSIBLE, RATED 1000 AMP**



Streetlight tap with cover - where required as indicated below.

**1. Scope**

**Insulated Submersible Multiple Connectors** of the configuration shown are designed for direct burial applications. The connectors shall conform to the applicable requirements of NEMA CC-P1 (OSP) and CC-1.

**2. Industry Standards**

NEMA CC-P1 (OSP), Sealed, Insulated Underground Systems Rated at 600 Volts  
 NEMA CC-1, Electric Power Connectors

**3. Requirements**

**Materials:** ..... The connectors shall be made of cast aluminum and insulated with cross-linked polyethylene (XLP), or with polyvinyl chloride (PVC) with a minimum insulation thickness of 80 mils.

**Bus Terminals:** ..... Bus terminals shall be equipped with two (2) 3/8" plated-steel hex head bolts and captive Belleville washers spaced on 7/8" centers, except secondary streetlight type shall have single set-screw terminals.

**Streetlight Adapters:** ..... Streetlighting adapters for streetlight taps shall be provided as shown on the table below.

**Moisture Seal:** ..... Sealing sleeves, caps, and plugs for terminals and adapter shall be made of EPDM rubber and shall effectively seal out moisture when installed.

**Approved Manufacturers**

Stock Number	Positions	Elastimold (Blackburn)	CMC/ESP
678800	3	UPC33	UC-33
678707	4	UPC44SL‡	UC-44SL‡
*	4	UPC44	UC-44
*	5	UPC55	UC-55
*	5	UPC55SL‡	UC-55-SL‡
678713	6	UPC66SL‡	UC-66-SL‡
*	6	UPC66	UC-66
678715	8	UPC88SL‡	UC-88-SL‡
*	8	UPC88	UC-88
678703	3	USL30▲	-

‡ With streetlight tap.

\* For contractor's use. No City Light stock.

▲ For secondary streetlight circuits, #12 Sol. to #4 Str. wire range.

**Stock Unit:** EA

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR

## Connectors, Underground, Multi-Tap, 600 Volt



### 1. Scope

This standard covers the material requirements for 600 V, multi-tap underground connectors.

This standard applies to the following Seattle City Light (SCL) stock numbers:

Stock No.	Number Positions	Conductor Range
013661	4	#12 AWG to 350 kcmil
013662	6	#12 AWG to 350 kcmil
013694	4	#10 AWG to 500 kcmil
013695	6	#10 AWG to 500 kcmil

### 2. Application

Multi-tap underground connectors may be used for direct bury, handhole, and pedestal applications.

Multi-tap underground connectors can be used to construct services, power streetlighting, or provide network vault lighting.

Copper or aluminum conductor can be used with 4- or 6-position underground connectors.

Install connectors using a 5/16-in Allen wrench and torque to 20 ft-lb.

### 3. Industry Standards

Multi-tap underground connectors shall meet the applicable requirements of the following industry standards:

**ANSI C119.1**; Sealed Insulated Underground Connector Systems Rated 600 Volts

**ANSI C119.4**; Connectors for Use Between Aluminum-to-Aluminum and Aluminum-to-Copper Conductors Designed for Normal Operation at or Below 93°C and Copper-to Copper Conductors Designed for Normal Operation at or Below 100°C

**UL 486D**; UL file E125087

### 4. General Requirements

Multi-tap underground connectors shall be manufactured from high-strength 6061-T6 aluminum alloy.

Connectors shall have insulation encapsulated in Thermoplastic Elastomer (TPE) that meets the requirements of UL 486D.

Connectors shall be watertight and suitable for direct burial in earth or concrete.

Oxide-inhibiting grease shall be used in each port.

Connectors shall have resealable wire ports.

Connectors shall be UL Listed as detailed in Section 3.

Connectors shall have a minimum temperature rating of 90° C.

Connectors shall be rated 600 V.

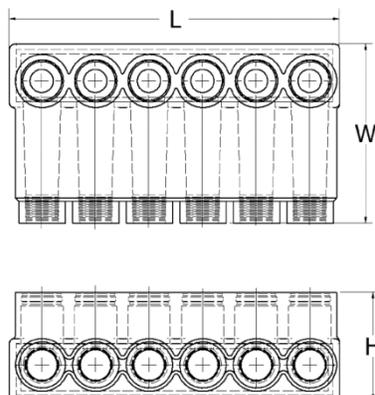
Cap and tether (if one is used) shall be of durable design and made from the same TPE material as the connector.

### 5. Detailed Requirements

**Table 5. Requirements for Multi-tap Underground Connectors**

Stock No.	Number Positions	Conductor Range	Length/Width/Height, Nominal (in)
013661	4	#12 AWG to 350 kcmil	5 x 5 x 3
013662	6	#12 AWG to 350 kcmil	7 x 5 x 3
013694	4	#10 AWG to 500 kcmil	6 x 5 x 3
013695	6	#10 AWG to 500 kcmil	9 x 5 x 3

**Figure 5. Dimension Definitions for a Multi-tap Underground Connector**



## 6. Packaging

Each standard package shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light stock number
- Quantity contained

Standard package shall consist of two connectors.

Each shipping container shall be legibly marked with the following information:

- Manufacturer's identification
- Product description
- Seattle City Light purchase order number
- Seattle City Light stock number

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## 7. Issuance

Stock Unit: EA

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## 8. Approved Manufacturers

Stock No.	Number Positions	Conductor Range	Approved Manufacturer	Catalog No.
013661	4	#12 AWG to 350 kcmil	Burndy	BIBS-350-4DB
			CMC	SSBC-350-4SI
			Utilco	PED4-350-SS (DB)
013662	6	#12 AWG to 350 kcmil	Burndy	BIBS-350-6DB
			CMC	SSBC-350-6SI
			Utilco	PED6-350-SS (DB)
013694	4	#10 AWG to 500 kcmil	Burndy	BIBS-500-4DB
			CMC	SSBC-500-4SI
			Utilco	PED-4-500-SSP-Z
013695	6	#10 AWG to 500 kcmil	Burndy	BIBS-500-6DB
			CMC	SSBC-500-6SI
			Utilco	PED-6-500-SSP-Z

---

## 9. Sources

**Ilsco Product Literature;** [www.ilsco.com](http://www.ilsco.com)

**Chao, Yaochiem;** SCL Standards Engineer and subject matter expert for 6780.46  
([yaochiem.chao@seattle.gov](mailto:yaochiem.chao@seattle.gov))

**Tilley, Kathy;** SCL Electrical Engineering Support Specialist and originator of 6780.46  
([kathy.tilley@seattle.gov](mailto:kathy.tilley@seattle.gov))

**MATERIAL STANDARD**

**CONNECTOR, TERMINAL, COMPRESSION  
 FOR SUBMERSIBLE INSULATED BUS**

**1. Application**

The compression terminals of the configuration shown are used to connect underground cables to submersible insulated bus (See Material Standard 6780.0).

**2. Industry Standards**

The connectors shall meet the applicable requirements of the following national standards except as modified herein:

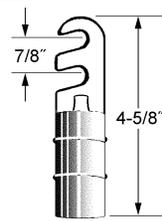
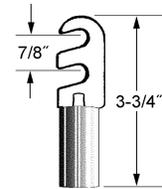
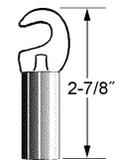
**NEMA Standard CC1**, Electric Power Connectors for Substations

**3. Requirements**

All connectors, except stock number 012729 (which shall be copper) shall be made of 1350 grade aluminum and designed for use with aluminum or copper conductor. All connectors shall conform to EEI Die Code Index for aluminum or copper connector listed below.

References to conductor sizes below are for stranded or compressed conductors except as noted.

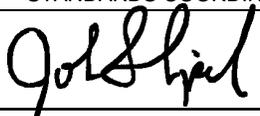
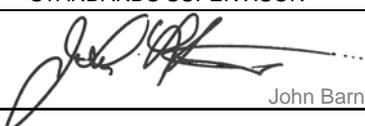
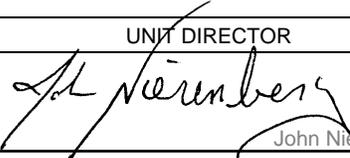
Stock Number	Conductor Size	Approved Manufacturers			Tool & Die Requirements
		CMC/ESP	Homac	T & B/ Blackburn	
678697	4	LA4	---	LAC4	Alcoa 11AH Burndy 249 EEI 11A Kearney 840 T&B TX, 76
678695	6	LA6	---	LAC6	
678687	2/0	LA2-2/0	---	LAC202	Alcoa 11AH Burndy 249 EEI 11A Kearney 840 T&B TX, 76
678689	4/0	LA2-4/0	DHK 4/0	LAC402	
678692	2	LA2-2	DHK 2	LAC22	
678693	1	LA2-1	DHK 1	LAC12	
678694	1/0	LA2-1/0	DHK 1/0	LAC102	
678696	3/0	LA2-3/0	---	LAC302	Burndy 655 EEI 13A Kearney 1-1/8 T&B 96 U31AR
678698	250 str./comp., 400 comp.	LA2-250	---	LAC25	
678699	300-350 str./ comp., 350 comp.	LA2-350	DHB 350	LAC35	
678700	400-500 str./ comp., 500 comp.	LA2-500	DHB 500	LAC50	MD6, Wk-162 3/8
012729	#2, str. Cu conductor for transformer ground	---	---	LCU 22L	



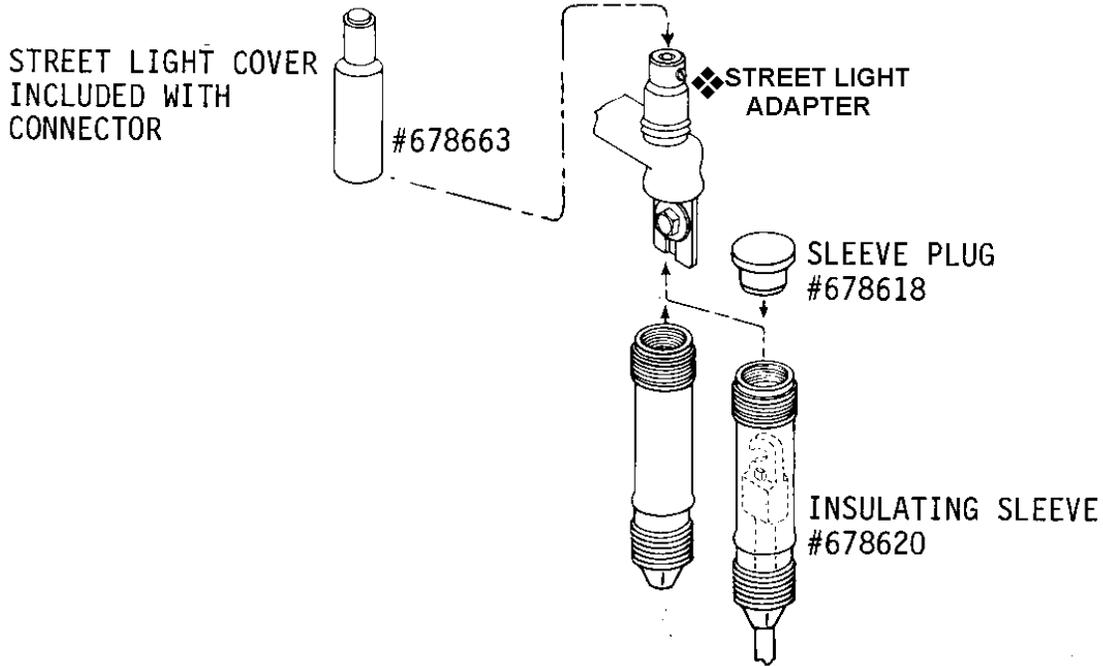
**4. Inhibitor**

The connectors shall be pre-filled with an oxide-inhibiting compound and the ends covered with a plastic cap to prevent contamination or leakage of the inhibitor.

**5. Stock Unit: EA**

STANDARDS COORDINATOR	STANDARDS SUPERVISOR	UNIT DIRECTOR
 John Shipek	 John Barnett	 John Nierenberg

**INSULATING SLEEVES, COVERS, AND PLUGS  
FOR SUBMERSIBLE MULTIPLE CONNECTORS**



Insulating sleeves, plugs, and terminal covers shall be of the general configuration shown and shall be made of EPDM (Ethylene, Propylene, Diene, Modified) rubber.

The sleeves, plugs, and covers are used to eliminate taping and to form an effective moisture seal when used on submersible connectors.

Insulating sleeves shall be capable of being cut in the field to fit insulation ranging in outside diameter from 0.150 to 1.940 inches, and also shall be usable as a terminal cover for unused positions.

❖ Part of 1000 Ampere connectors, Stock Nos. 678707, 678713 & 678715

**Stock Unit:** EA

**Approved Manufacturers**

Stock No.	Item	Connector Manufacturing Company (CMC)	Thomas & Betts (T&B)
678620	Sleeve, Insulating	T-L	CSN2011
678618	Plug, Sleeve	-	LP
678663	Cover, St. Lt.	SS-750	UPC-SL

standards coordinator

John Shipek

standards supervisor

John Shipek

unit director

Darnell Cola