CHAPTER 35
WELDING AND OTHER HOT WORK

User note:

About this chapter: *Chapter 35 covers requirements for safety in welding and other types of hot work by reducing the potential for fire ignitions that usually result in large losses. Several different types of hot work would fall under the requirements found in Chapter 35, including both gas and electric arc methods and any open-torch operations. Many of the activities of this chapter focus on the actions of the occupants.*

SECTION 3501
GENERAL

[S] 3501.1 Scope. Welding, cutting, open torches and other *hot work* operations and equipment shall comply with this chapter.

Exception: Hot work on board marine vessels at dock or under construction or repair shall be in accordance with Administrative Rules 26.01.14, *Cutting, Welding and Other Hot Work on Marine Vessels*, 26.02.09, *Designated Marine Hot Work Facilities and Shipyards*, and any future revisions of these rules adopted by the *fire code official.*

3501.2 Permits. Permits shall be required as set forth in Section 105.6.

3501.3 Restricted areas. *Hot work* shall only be conducted in areas designed or authorized for that purpose by the personnel responsible for a *hot work program*. *Hot work* shall not be conducted in the following areas unless approval has been obtained from the *fire code official*:

1. Areas where the sprinkler system is impaired.
2. Areas where there exists the potential of an explosive atmosphere, such as locations where flammable gases, liquids or vapors are present.
3. Areas with readily ignitable materials, such as storage of large quantities of bulk sulfur, baled paper, cotton, lint, dust or loose combustible materials.
4. On board ships at dock or ships under construction or repair.
5. At other locations as specified by the *fire code official.*

3501.4 Cylinders and containers. *Compressed gas* cylinders and fuel containers shall comply with this chapter and Chapter 53.

3501.5 Design and installation of oxygen-fuel gas systems. An oxygen-fuel gas system with two or more manifolded cylinders of oxygen shall be in accordance with NFPA 51.

SECTION 3502
DEFINITIONS

[S] 3502.1 Definitions. The following terms are defined in Chapter 2:

HOT WORK.

HOT WORK AREA.

HOT WORK EQUIPMENT.

HOT WORK PERMITS.

HOT WORK PROGRAM.

RESPONSIBLE PERSON.

THERMIT WELDING.

SECTION 3503
GENERAL REQUIREMENTS

3503.1 General. *Hot work* conditions and operations shall comply with this chapter.

3503.2 Temporary and fixed hot work areas. Temporary and fixed *hot work areas* shall comply with this section.

3503.3 Hot work program permit. *Hot work permits*, issued by an *approved responsible* person under a *hot work program*, shall be available for review by the *fire code official* at the time the work is conducted and for 48 hours after work is complete.

3503.4 Qualifications of operators. A permit for *hot work* operations shall not be issued unless the individuals in charge of performing such operations are capable of performing such operations safely. Demonstration of a working knowledge of the provisions of this chapter shall constitute acceptable evidence of compliance with this requirement.

3503.5 Records. The individual responsible for the *hot work area* shall maintain "prework check" reports in accordance with Section 3504.3.1. Such reports shall be maintained on the premises for not less than 48 hours after work is complete.

3503.6 Signage. Visible hazard identification signs shall be provided where required by Chapter 50. Where the *hot work area* is open to persons other than the operator of the *hot work equipment*, conspicuous signs shall be posted to warn others before they enter the *hot work area*. Such signs shall display the following warning:

CAUTION

HOT WORK IN PROGRESS

STAY CLEAR

SECTION 3504
FIRE SAFETY REQUIREMENTS

3504.1 Protection of combustibles. Protection of combustibles shall be in accordance with Sections 3504.1.1 through 3504.1.9.

3504.1.1 Combustibles. *Hot work areas* shall not contain combustibles or shall be provided with appropriate shielding to prevent sparks, slag or heat from igniting exposed combustibles.

3504.1.2 Openings. Openings or cracks in walls, floors, ducts or shafts within the *hot work area* shall be tightly covered to prevent the passage of sparks to adjacent combustible areas, or shielded by metal fire-resistant guards, or curtains shall be provided to prevent passage of sparks or slag.

3504.1.3 Housekeeping. Floors shall be kept clean within the *hot work area*.

3504.1.4 Conveyor systems. Conveyor systems that are capable of carrying sparks to distant combustibles shall be shielded or shut down.

3504.1.5 Partitions. Partitions segregating *hot work areas* from other areas of the building shall be noncombustible. In fixed *hot work areas*, the partitions shall be securely connected to the floor such that gaps do not exist between the floor and the partition. Partitions shall prevent the passage of sparks, slag, and heat from the *hot work area*.

3504.1.6 Floors. Fixed *hot work areas* shall have floors with noncombustible surfaces.

[S] 3504.1.7 Precautions in hot work. *Hot work* shall not be performed on containers or equipment that contain or have contained flammable liquids, gases or solids until the containers and equipment have been thoroughly cleaned, inerted or purged; except that "hot tapping" shall be allowed on tanks and pipe lines where such work is to be conducted by ((~~*approved*~~)) qualified personnel. *Hot work* on flammable and *combustible liquid* storage tanks shall be conducted in accordance with Sections 3504 and 3510.

3504.1.8 Sprinkler protection. Automatic sprinkler protection shall not be shut off while *hot work* is performed. Where *hot work* is performed close to automatic sprinklers, noncombustible barriers or damp cloth guards shall shield the individual sprinkler heads and shall be removed when the work is completed. If the work extends over several days, the shields shall be removed at the end of each workday. The *fire code official* shall approve *hot work* where sprinkler protection is impaired.

3504.1.9 Fire detection systems. *Approved* special precautions shall be taken to avoid accidental operation of automatic fire detection systems.

3504.2 Fire watch. Fire watches shall be established and conducted in accordance with Sections 3504.2.1 through 3504.2.6.

3504.2.1 When required. A fire watch shall be provided during *hot work* activities and shall continue for not less than 30 minutes after the conclusion of the work. The *fire code official*, or the responsible manager under a *hot work program*, is authorized to extend the fire watch based on the hazards or work being performed.

Exception: Where the *hot work area* has no fire hazards or combustible exposures.

3504.2.2 Location. The fire watch shall include the entire *hot work area*. *Hot work* conducted in areas with vertical or horizontal fire exposures that are not observable by a single individual shall have additional personnel assigned to fire watches to ensure that exposed areas are monitored.

3504.2.3 Duties. Individuals designated to fire watch duty shall have fire-extinguishing equipment readily available and shall be trained in the use of such equipment. Individuals assigned to fire watch duty shall be responsible for extinguishing spot fires and communicating an alarm.

3504.2.4 Fire training. The individuals responsible for performing the *hot work* and individuals responsible for providing the fire watch shall be trained in the use of portable fire extinguishers.

3504.2.5 Fire hoses. Where hoselines are required, they shall be connected, charged and ready for operation.

3504.2.6 Fire extinguisher. Not less than one portable fire extinguisher complying with Section 906 and with a minimum 2-A:20-B:C rating shall be provided with *ready access* within 30 feet (9144 mm) of the location where *hot work* is performed.

3504.3 Area reviews. Before *hot work* is permitted and not less than once per day while the permit is in effect, the area shall be inspected by the individual responsible for authorizing *hot work* operations to ensure that it is a fire safe area. Information shown on the permit shall be verified prior to signing the permit in accordance with Section 105.6.

3504.3.1 Pre-hot-work check. A pre-hot-work check shall be conducted prior to work to ensure that all equipment is safe and hazards are recognized and protected. A report of the check shall be kept at the work site during the work and available upon request. The pre-hot-work check shall determine all of the following:

1. *Hot work equipment* to be used shall be in satisfactory operating condition and in good repair.
2. *Hot work* site is clear of combustibles or combustibles are protected.
3. Exposed construction is of noncombustible materials or, if combustible, then protected.
4. Openings are protected.
5. Floors are kept clean.
6. Exposed combustibles are not located on the opposite side of partitions, walls, ceilings or floors.
7. Fire watches, where required, are assigned.
8. *Approved* actions have been taken to prevent accidental activation of suppression and detection equipment in accordance with Sections 3504.1.8 and 3504.1.9.
9. Fire extinguishers and fire hoses (where provided) are operable and available.

SECTION 3505
GAS WELDING AND CUTTING

3505.1 General. Devices or attachments mixing air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall not be allowed unless *approved*.

3505.2 Cylinder and container storage, handling and use. Storage, handling and use of *compressed gas* cylinders, containers and tanks shall be in accordance with this section and Chapter 53.

3505.2.1 Cylinders connected for use. The storage or use of a single cylinder of oxygen and a single cylinder of fuel gas located on a cart shall be allowed without requiring the cylinders to be separated in accordance with Section 5003.9.8 or 5003.10.3.6 when the cylinders are connected to regulators, ready for service, equipped with apparatus designed for cutting or welding and all of the following:

1. Carts shall be kept away from the cutting or welding operation in accordance with Section 3505.5 or fire-resistant shields shall be provided.
2. Cylinders shall be secured to the cart to resist movement.
3. Carts shall be in accordance with Section 5003.10.3.
4. Cylinder valves not having fixed hand wheels shall have keys, handles or nonadjustable wrenches on valve stems while the cylinders are in service.
5. Cylinder valve outlet connections shall conform to the requirements of CGA V-1.
6. Cylinder valves shall be closed when work is finished.
7. Cylinder valves shall be closed before moving the cart.

3505.2.1.1 Individual cart separation. Individual carts shall be separated from each other in accordance with Section 5003.9.8.

3505.3 Precautions. Cylinders, valves, regulators, hose and other apparatus and fittings for oxygen shall be kept free from oil or grease. Oxygen cylinders, apparatus and fittings shall not be handled with oily hands, oily gloves, or greasy tools or equipment.

3505.4 Acetylene gas. Acetylene gas shall not be piped except in *approved* cylinder manifolds and cylinder manifold connections, or utilized at a pressure exceeding 15 pounds per square inch gauge (psig) (103 kPa) unless dissolved in a suitable solvent in cylinders manufactured in accordance with DOTn 49 CFR Part 178. Acetylene gas shall not be brought in contact with unalloyed copper, except in a blowpipe or torch.

3505.5 Remote locations. Oxygen and fuel-gas cylinders and acetylene generators shall be located away from the *hot work area* to prevent such cylinders or generators from being heated by radiation from heated materials, sparks or slag, or misdirection of the torch flame.

3505.6 Cylinders shutoff. The torch valve shall be closed and the gas supply to the torch completely shut off when gas welding or cutting operations are discontinued for a period of 1 hour or more.

3505.7 Prohibited operation. Welding or cutting work shall not be held or supported on *compressed gas* cylinders or containers.

3505.8 Tests. Tests for leaks in piping systems and equipment shall be made with soapy water. The use of flames shall be prohibited for leak testing.

SECTION 3506
ELECTRIC ARC HOT WORK

3506.1 General. The frame or case of electric *hot work* machines, except internal-combustion-engine-driven machines, shall be grounded. Ground connections shall be mechanically strong and electrically adequate for the required current.

3506.2 Return circuits. Welding current return circuits from the work to the machine shall have proper electrical contact at joints. The electrical contact shall be periodically inspected.

3506.3 Disconnecting. Electrodes shall be removed from the holders when electric arc welding or cutting is discontinued for any period of 1 hour or more. The holders shall be located to prevent accidental contact and the machines shall be disconnected from the power source.

3506.4 Emergency disconnect. A switch or circuit breaker shall be provided so that fixed electric welders and control equipment can be disconnected from the supply circuit. The disconnect shall be installed in accordance with NFPA 70.

3506.5 Damaged cable. Damaged cable shall be removed from service until properly repaired or replaced.

SECTION 3507
CALCIUM CARBIDE SYSTEMS

3507.1 Calcium carbide storage. Storage and handling of calcium carbide shall comply with Chapter 50 of this code and Chapter 9 of NFPA 51.

SECTION 3508
ACETYLENE GENERATORS

3508.1 Use of acetylene generators. The use of acetylene generators shall comply with this section and Chapter 15 of NFPA 55.

3508.2 Portable generators. The minimum volume of rooms containing portable generators shall be 35 times the total gas-generating capacity per charge of all generators in the room. The gas-generating capacity in cubic feet per charge shall be assumed to be 4.5 times the weight of carbide per charge in pounds. The minimum ceiling height of rooms containing generators shall be 10 feet (3048 mm). An acetylene generator shall not be moved by derrick, crane or hoist while charged.

3508.3 Protection against freezing. Generators shall be located where water will not freeze. Common salt such as sodium chloride or other corrosive chemicals shall not be utilized for protection against freezing.

SECTION 3509
PIPING MANIFOLDS AND HOSE SYSTEMS FOR FUEL GASES AND OXYGEN

3509.1 General. The use of piping manifolds and hose systems shall be in accordance with Section 3509.2 through 3509.7, Chapter 53 and Chapter 5 of NFPA 51.

3509.2 Protection. Piping shall be protected against physical damage.

3509.3 Signage. Signage shall be provided for piping and hose systems as follows:

1. Above-ground piping systems shall be marked in accordance with ASME A13.1.
2. Station outlets shall be marked to indicate their intended usage.
3. Signs shall be posted, indicating clearly the location and identity of section shutoff valves.

3509.4 Manifolding of cylinders. Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be located not less than 20 feet (6096 mm) away from combustible material such as oil or grease, and gas cylinders containing flammable gases, unless the gas cylinders are separated by a *fire partition.*

3509.5 Identification of manifolds. Signs shall be posted for oxygen manifolds with service pressures not exceeding 200 psig (1379 kPa). Such signs shall include the words:

LOW-PRESSURE MANIFOLD
DO NOT CONNECT HIGH-PRESSURE CYLINDERS
MAXIMUM PRESSURE 250 PSIG

3509.6 Clamps. Hose connections shall be clamped or otherwise securely fastened.

3509.7 Inspection. Hoses shall be inspected frequently for leaks, burns, wear, loose connections or other defects rendering the hose unfit for service.

SECTION 3510
HOT WORK ON FLAMMABLE AND COMBUSTIBLE LIQUID STORAGE TANKS

3510.1 General. *Hot work* performed on the interior or exterior of tanks that hold or have held flammable or *combustible liquids* shall be in accordance with Sections 3504, 3510.2 and Chapters 4, 5, 6, 7 and 10 of NFPA 326.

3510.2 Prevention. The following steps shall be taken to minimize hazards where *hot work* must be performed on a flammable or *combustible liquid* storage container:

1. Use alternative methods to avoid *hot work* where possible.
2. Analyze the hazards prior to performing *hot work*, identify the potential hazards and the methods of hazard control.
3. *Hot work* shall conform to the requirements of the code or standard to which the container was originally fabricated.
4. Test the immediate and surrounding work area with a combustible gas detector and provide for a means of continuing monitoring while conducting the *hot work*.
5. Qualified employees and contractors performing *hot work* shall use an industry-approved *hot work permit* system to control the work.
6. Personnel shall be properly trained on *hot work* policies and procedures regarding equipment, safety, hazard controls and job-specific requirements.
7. On-site safety supervision shall be present where *hot work* is in progress to protect the personnel conducting the *hot work* and provide additional overview of site-specific hazards.

[S] SECTION 3511
THERMIT WELDING

3511.1 General. *Thermit welding* shall be in accordance with Sections 3511.1.1 through 3511.1.3.

3511.1.1 Mold. In *thermit welding*, the mold shall be dried thoroughly before the charge is ignited and provided with a cover. The molds shall not be removed until sufficient cooling has taken place in accordance with the manufacturer's published instructions.

3511.1.2 Storage. The storage of *thermit welding* materials shall be in accordance with the following:

1. Bulk storage of *thermit welding* materials shall be maintained in a detached shed at least 15 m (50 ft) from the main buildings.
2. Storage sheds shall be maintained dry, posted as a "No Smoking" area, and kept locked.
3. Containers for the starting material shall be closed tightly immediately after each use.

3511.1.3 Smoking restrictions. Smoking shall not be permitted in areas where *thermit welding* material is being used or stored.