CUTTING FLUIDS

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1.0 SCOPE

This data sheet includes information on fire and associated hazards involving ignitable cutting fluids and their recommended safeguards. For general information on the prevention of and protection against fires and explosions in occupancies handling, processing, and transferring ignitable liquids, see Data Sheet 7-32, *Ignitable Liquid Operations*.

1.1 Hazards

Ignitable cutting fluids burn as vapor, as do the vapors of all ignitable liquids. The majority of ignitable cutting fluids have flash points in the range of 200°F to 300°F (93°C to 149°C), such that a substantial ignition energy or a physical change (i.e., formation of small droplets in a liquid spray) is necessary to ignite the fluid. One or both of these characteristics are present in the equipment that uses ignitable liquid cutting fluids. Cutting fluids are typically applied in the form of a stream or spray, while ignition sources, such as sparks, friction, and overheating of parts, are inherent to many machining processes.

Once ignited, an ignitable cutting fluid fire creates a significant fire challenge. If the liquid escapes the equipment area, it can spread in the form of a pool and the fire will follow wherever the liquid spreads. The fire's heat release rate will increase with the surface area of the pool, and sprinklers will operate well beyond the actual pool fire area. A fire that is in the form of a pressurized spray can be even more challenging to protect. These conditions require controls beyond sprinkler protection in order to limit the overall fire severity. Measures to stop the flow of liquid and to limit the pool size of released liquids are needed to control sprinkler operating areas and limit potential thermal damage to equipment and buildings.

Machining operations that previously used multiple pieces of equipment are now frequently consolidated into one piece of equipment. This equipment is typically large and of a high value, with long associated business interruption in the event of a loss. Further, the enclosed machine tool area is obstructed from sprinkler discharge at the ceiling. In addition to the safeguards described above, fire detection and/or sprinkler protection within the enclosed equipment is needed to limit equipment damage. The use of special protection systems as a supplemental form of protection may also reduce damage.

1.2 Changes

January 2021. This document has been completely revised. Major changes include the following:

A. Added guidance to be consistent with Data Sheet 7-32, *Ignitable Liquid Operations*. This includes the addition of a definition for very high flash point liquids, and guidance on the frequency of safety shutoff valve and interlock testing.

B. Clarified guidance on automatic shutoffs and when safety shutoff valves are appropriate (Section 2.5.4).

C. Added guidance on heat detector placement (Section 2.5.5).

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

2.1.1 Use FM Approved equipment, materials, and services whenever they are applicable and available. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1.2 Equipment using cutting fluid may also contain hydraulic fluid and/or lubricating oil. Evaluate these hazards using the applicable data sheets.

2.1.3 Use a non-ignitable liquid (e.g., water) rather than an ignitable liquid such as mineral oil.

2.1.3.1 If it is not possible to use a non-ignitable liquid, to the following:

A. Use a very high flash point liquid (see Appendix A for definition). Alternatively, use a liquid with as high a flash point as possible.

B. Provide additional safeguards to adequately protect the hazard, as outlined in this data sheet.

2.1.4 Where magnesium or other combustible metals are machined, refer to Data Sheet 7-85, *Combustible and Reactive Metals*, for information on the selection of an appropriate cutting fluid.

2.2 Construction and Location

2.2.1 Locate equipment using cutting fluids in buildings of noncombustible construction.

2.2.2 Where central supplies of cutting fluid are fed to multiple pieces of equipment, separate the supply from surrounding occupancies with minimum one-hour fire-rated walls. Provide a minimum 3 in. (7.6 cm) of containment in the room to control the liquid release.

2.2.3 Do not locate equipment and piping containing cutting fluid in below-grade locations.

2.2.4 Isolate equipment that uses cutting fluid from storage areas.

2.2.5 Design, locate, and arrange piping and transfer systems in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*.

2.2.6 Design, locate, and arrange equipment, piping, and storage tanks so they are protected against physical damage, as follows:

A. Locate equipment so the potential for vehicle impact damage is eliminated.

B. Provide noncombustible equipment and piping materials with high resistance to mechanical damage.

C. Locate piping overhead or in covered trenches in the floor.

2.2.7 Shield adjacent machines to prevent splashing or spraying of cutting fluid into adjacent areas.

2.2.8 Provide the following for electric discharge machining (EDM):

A. Provide a 1-hour fire-rated cutoff area for EDM equipment having central EDM oil filtration systems.

B. Provide at least 5 ft (1.5 m) separation between individual electric discharge machines.

2.3 Occupancy

2.3.1 If the potential exists for the generation of vapor (e.g., the cutting fluid is heated or atomized), provide ventilation systems in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, designed to confine, dilute, and remove the maximum amount of flammable vapor released during normal operations.

2.4 Protection

2.4.1 Area/Building Protection

2.4.1.1 Where non-ignitable liquids are used exclusively, determine the need for automatic sprinkler protection based on the surrounding occupancy.

2.4.1.2 Provide non-storage automatic sprinkler protection over equipment containing ignitable cutting fluid.

2.4.1.3 Use a wet, deluge, or single interlock preaction system. The use of a dry system is acceptable if the equipment is designed and arranged in accordance with this data sheet.

2.4.1.4 Install the sprinkler system in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.4.1.4.1 Arrange sprinklers on a maximum 100 ft^2 (9 m^2) spacing at the ceiling and below grated or solid mezzanines.

2.4.1.4.2 Arrange sprinklers with a maximum on-line spacing of 10 ft (3 m). A variation of 1 ft (0.3 m) is permitted on either dimension to avoid obstructions by structural elements.

2.4.1.4.3 If FM Approved K25.2 EC (K360 EC) sprinklers (pendent or upright) are used, install them on a minimum 13 ft (3.9 m) to a maximum 14 ft (4.2 m) spacing. At this spacing, treat them as standard response sprinklers.

2.4.1.4.4 Do not use ordinary or light hazard, extended coverage sprinklers.

2.4.1.4.5 Provide standard response, ordinary temperature-rated, K5.6 (80) or larger sprinklers under any obstruction that exceeds 3 ft (0.9 m) in width or diameter, or 10 ft^2 (0.9 m^2) in area (e.g., tanks or equipment).

2.4.1.4.6 Provide a single quick response sprinkler within 2 ft (0.6 m) vertically of pumps used for central cutting fluid systems.

2.4.1.5 Design the sprinkler system as follows:

A. If the equipment is designed in accordance with this data sheet (e.g., proper piping design and construction, the use of noncombustible equipment components, automatic interlocks to shut down the pumping system in the event of a fire, etc.), design the system to provide 0.3 gpm/ft^2 over 2500 ft^2 (12 mm/min over 230 m^2).

B. Protect cutoff rooms containing central supplies of fluid, or equipment areas where the potential for a large pool fire exists, as follows:

1. Design the sprinkler system to provide 0.3 gpm/ft^2 over 4000 ft^2 (12 mm/min over 370 m^2) where the ceiling height is less than or equal to 15 ft (4.6 m).

2. Design the sprinkler system to provide 0.4 gpm/ft^2 over 4000 ft^2 (16 mm/min over 370 m^2) where the ceiling height is greater than 15 ft (4.6 m).

C. Use a minimum K-factor of 8.0 gpm/psi$^{0.5}$ (115 L/min/bar$^{0.5}$).

D. Use high temperature-rated, standard response automatic sprinklers.

E. Provide a water supply capable of meeting the design sprinkler discharge flow rate plus 500 gpm (1900 L/min) for hose streams, for a duration of 60 minutes.

F. Design sprinklers located below tanks and equipment to provide at least 30 gpm (114 L/min) and maintain a minimum sprinkler discharge pressure of at least 7 psi (0.5 bar).

G. Design sprinklers located over pumps to provide at least 20 gpm (76 L/min) and maintain a minimum sprinkler discharge pressure of at least 7 psi (0.5 bar).

H. Balance all sprinklers installed in the area with the ceiling demand at the point of connection.

2.4.1.6 Protect hoods, ducts, and scrubbing equipment that have combustible construction or significant oily deposits in accordance with Data Sheet 7-78, *Industrial Exhaust Systems*.

2.4.2 Equipment Protection

2.4.2.1 Provide automatic sprinkler protection or a special protection system within enclosed equipment areas containing ignitable cutting fluids and/or combustible deposits.

2.4.2.2 Design sprinklers to provide at least 30 gpm (114 L/min) and maintain a minimum sprinkler discharge pressure of at least 7 psi (0.5 bar).

2.4.2.3 Design fixed special protection systems (e.g., water mist) in accordance with Data Sheet 7-32, *Ignitable Liquid Operations*, and other applicable FM data sheets.

2.4.2.3.1 Arrange special protection systems to automatically actuate using FM Approved flame and/or heat detectors that are compatible with the extinguishing system and arranged in accordance with Data Sheet 5-48, *Automatic Fire Detectors*. Ensure the detection devices will provide fire detection at least as fast as a quick response sprinkler.

2.4.2.3.2 Provide capability for remote manual activation of special protection systems from an area that will be accessible during a fire.

2.4.2.4 Interlock all protected equipment to shut down upon operation of the automatic sprinklers or special protection system.

2.5 Equipment and Processes

2.5.1 Design and install equipment to confine the fluid within the system, keep escaping material to a minimum, and prevent its spread. Design and construct equipment using cutting fluids, heating equipment, measurement and observation instruments, piping systems, and transfer systems in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*.

2.5.2 Tightly enclose cutting fluid return troughs from machines to fluid-cleaning systems. Alternatively, use standard piping designed in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*. Ensure return lines are trapped.

2.5.3 Provide return tanks with provisions for overflow if flooded by excessive cutting fluid or by water from sprinklers or other sources.

2.5.4 Where ignitable cutting fluids are used, provide an automatically actuated means for shutting down the pumping system and shutting off flow from equipment, in the event of fire.

2.5.4.1 Provide safety shutoff valves where there is the potential for gravity release from the system.

2.5.5 Arrange for automatic shutdown using one of the following methods:

2.5.5.1 Actuation by use of a fire detection system (i.e., heat detector, flame detector, or video detector) arranged to ensure prompt detection of a fire and installed in accordance with Data Sheet 5-48, *Automatic Fire Detection*, and in accordance with the applicable Approval listing.

A. For ceiling heights up to 60 ft (18 m), install ordinary temperature spot or linear detectors in accordance with the following:

1. Space heat detectors located below solid barriers or ceilings up to 30 ft (9 m) above the fire hazard in accordance with the manufacturer's Approved spacing.

2. Space heat detectors located below solid barriers or ceilings between 30 ft (9 m) and 60 ft (18 m) above the fire hazard at not more than 10 ft x 10 ft (3 m x 3 m) spacing.

B. For ceiling heights greater than 60 ft (18 m) or where the ceiling is obstructed by piping or equipment, provide local area heat detection or flame/video detectors in accordance with the following:

1. Provide intermediate heat detector(s) within 10 ft (3 m) above the fire hazard. Place the detectors near potential leak points. Provide at least two detectors near each potential leak point with a horizontal spacing between detectors of no more than 4 ft (1.2 m).

2. Locate flame or video detectors in positions that provide a clear line of sight to the fire hazard. Flame or video detectors must be Approved for use with the hydraulic fluid expected to be involved in the fire.

3. Locate additional heat detectors within any shielded equipment areas.

C. Operation of the automatic sprinkler system. Arrange the system to permit protection system alarm testing without unwanted production shutdown by providing a push button switch that requires constant attendance to bypass the interlock.

2.5.6 Provide one or more stop buttons or switches within the operation area (arranged for easy access by operators and at points of egress from the building or structure) and at accessible remote locations (e.g., control room, security station) to allow for manual shutoff of the cutting fluid systems.

2.5.7 Protect electrical control and protective devices from oil, chips, and dirt by enclosing them in well-designed metal cabinets or in compartments in the base of the machine. Completely enclose or isolate motors that drive machine tools to protect the windings from oil and chips.

2.5.8 Install liquid level switches on EDM equipment, interlocked to de-energize the electric discharge machine at a safe oil level above the sparking electrode to prevent ignition of the oil.

2.6 Operation and Maintenance

2.6.1 Operate, maintain, test, and inspect equipment and piping systems in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*, and the manufacturer's instructions. Establish a complete preventive maintenance program designed to ensure equipment is operating as it has been engineered to operate.

2.6.2 Refer to Data Sheet 9-0, *Asset Integrity*, for the development and implementation of loss prevention asset integrity programs for systems and equipment.

2.6.3 Perform annual tests of safety shutoff valves in clean service. For safety shutoff valves in fouling service (resins) or for those exposed to fouling conditions, conduct more frequent tests (e.g., a monthly frequency may be appropriate).

2.6.3.1 The tests should confirm that the valve can be closed by simulated actuation (e.g., signal the fire detection system).

2.6.4 Maintain and test all system safety interlocks at least annually or in accordance with manufacturer's recommendations, if more frequent. Maintain records of these tests.

2.6.5 Develop and implement a formal operator audit procedure to ensure compliance with established standard operating and emergency response procedures. Conduct these audits at least semi-annually.

2.6.6 Implement a management of change program. Conduct a full review of all planned changes conducted by qualified loss prevention consultants, as well as other authorities having jurisdiction, before the project begins.

2.6.7 Create a series of routine checkpoints with normal condition limits to be inspected by the operator for prompt detection of abnormal conditions. Conduct frequent inspections to detect and repair leakage. Determine the frequency of the checks based on the process conditions and severity of the consequences of a process upset.

2.6.8 Monitor the condition of the cutting fluid for impurities and/or degradation. Conduct this analysis according to the manufacturer's specifications, but at least annually.

2.7 Training

2.7.1 In addition to other recommended emergency organization responsibilities (refer to Data Sheet 7-32, *Ignitable Liquid Operations)*, train equipment operators in the following areas:

A. The location, function, and proper operation of emergency shutoff switches

B. Precautions for avoiding accidental rupture of piping, tubing, and hose

C. Procedures for prompt cleanup of spills and leaks

2.8 Human Factor

2.8.1 Establish an emergency response plan at locations that use cutting fluid, with a focus on the following items:

- Prompt fire service notification
- Shutdown of ignitable liquid pumping systems
- Availability of provided fire protection features
- Spill response procedures aimed at limiting the cutting fluid release size (e.g., prompt shutdown of liquid flow), containing released liquid, and eliminating all ignition sources that may be exposed by the release.

2.8.2 Familiarize the facility's emergency response team members and the local fire service with the location of processes that use ignitable cutting fluids as well as the emergency response plan. Use emergency response drills to reinforce the employee training programs (including prompt shutdown of equipment) and assist the fire service in pre-incident planning.

2.8.3 Establish excellent housekeeping standards for areas containing cutting fluid equipment (including pits).

2.9 Ignition Source Control

2.9.1 Eliminate or control ignition sources in accordance with the recommendations in Data Sheet 7-32, *Ignitable Liquid Operations*.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

Cutting fluids are typically applied in the form of a stream or spray; if ignited, the ensuing fire can typically be contained to the equipment area if the equipment is properly arranged and the pumping system is promptly shut down. However, if the fluid escapes the equipment area, the occupancy will be exposed to an ignitable liquid fire scenario similar to that described in Data Sheet 7-32, *Ignitable Liquid Operations*. One of the protection challenges involving cutting fluids is that the fluids have the ability to spread if they are released from the equipment. This makes it possible for the liquid to travel beyond the point of ignition, and the severity

of an ignitable liquid pool fire is directly proportional to the surface area of the pool. Therefore, the intent of this data sheet is to minimize the amount of ignitable liquid that can become involved in a fire and limit the event to the equipment of origin.

The consequences of an upset condition in a process involving cutting fluid are dependent on a number of factors, including the following:

- The quantity and type of fluid involved
- What is exposed to the fire (high-value equipment, storage, or important building structural elements)
- The pressure and flow rate
- The equipment/piping arrangement and location
- The equipment/piping construction

Properly designed equipment will shut down quickly and prevent the release of additional cutting fluid into the fire. In occupancies where well-arranged equipment with automatic shutoffs are in use, the provision of basic sprinkler protection (at the ceiling and within any enclosed areas) will provide adequate protection for most expected fire scenarios. However, in cases where cutting fluid pumping systems are not shut down in the event of a fire, even a small fire within the equipment can result in the loss of that equipment, regardless of the fire protection provided. Similarly, where combustible equipment is in use (e.g., rubber hoses, combustible day tanks), the release of additional fluid into the fire is possible regardless of the presence of automatic interlocks to shut down the equipment.

3.2 Description of Cutting Fluids

Cutting fluids and compounds are used in metal cutting, machining, grinding, and related operations. They include such materials as kerosene, fuel oil, grease, soap solutions, and fluids of the mineral, soluble, and fatty types. In addition, there are many compounded materials containing sulfur, chlorine, phosphorus, or other additives whose purpose is to increase the ability of the cutting fluid to do its intended work.

Many cutting fluids are ignitable liquids. Their use, particularly in the large amounts required for the high production rate of automatic machine tools, introduces a considerable fire hazard, and often creates a condition favorable to the rapid spread of fire.

Water alone is rarely used as a cutting fluid because it promotes rust and has little lubricating properties, although it is an effective coolant.

The ″soluble fluids″ are not actually soluble in water but form emulsions that impart desirable lubricating, anti-friction, and anticorrosion properties to water without destroying its cooling ability. They are used principally for grinding or for light machining of soft metals. As emulsions, they are more difficult to ignite than straight mineral fluids, although they will burn, especially if discharged at pressure on strong ignition sources. If the emulsion breaks down, the hazard becomes that of the ignitable constituent. They are not used on magnesium alloy because fines that are wet with animal or vegetable fluids may ignite spontaneously. Fines wet with water, water-soluble fluids, or fluids containing fatty acids may generate explosive hydrogen gas. For these materials, a light, non-viscous mineral oil having a minimum closed-cup flash point of 275°F (135°C) is usually used.

3.3 Functions of Cutting Fluids and Application Methods

Cutting fluids and compounds have the following principal functions:

A. To act as a lubricant and reduce friction, improving the smoothness of the cut and prolonging the life of the cutting edge

B. To cool the work and cutting tool

C. To flush chips from the surfaces being machined

The character of the metal being cut, the shape of the tool, the amount of metal removed per cut, and the speed of the machine all influence the amount of heat generated.

The quality and quantity of lubricant delivered to the work, and the method of application, should be selected to prevent the buildup of excessive frictional heat.

The cooling effect of cutting fluid depends on its rate of flow over the tool and work. This rate depends chiefly on viscosity; fluids of low viscosity carry heat away more rapidly than those of high viscosity.

There are various methods for cutting fluid application:

- Flood application – A continuous flow of fluid is delivered using a low pressure nozzle. The fluid floods the tool, workpiece and cutting zone.
- Jet application – A nozzle is used to deliver cutting fluid as a jet at high pressure and high speed.
- Mist application - Atomized fluid is discharged as a mist on to the workpiece surface. Air under pressure may be used for atomization.

To facilitate housekeeping, excess droplets or vapor may be exhausted through hoods and ducts. The fluid is usually recovered and returned to the cooling system. Hoods and ducts usually have cutting fluid deposits.

3.4 Cutting Fluid Fire Characteristics

Ignitable cutting fluid fires, like other ignitable liquid fires, burn only in the vapor phase. Cutting fluid must be heated above its flash point in order to generate sufficient vapor to sustain a fire. The feedback of heat from the fire generates more vapor.

Fire tests and loss experience show that a cutting fluid fire on a flat surface, such as a spill on the floor, a cutting fluid pan, or tank, can be extinguished by water from automatic sprinklers or hose by cooling the cutting fluid to below its flash point. Cutting fluid deposits on a vertical surface, such as the side of a machine, building column, or duct, burn upward rapidly because feedback from the fire to unburned fuel above is easier. Fire on cutting fluid deposits on the underside of a large surface, such as a hood or ceiling, can spread rapidly because feedback is greatest and there may be less sprinkler discharge for cooling. The duration of such fires may be short if the fuel supply is limited.

The most severe cutting fluid fire is a spray fire, where droplets of cutting fluid are suspended in air. The fuel surface area is very large, the feedback of heat to the fuel is substantial, and cooling by sprinkler discharge is inefficient. Fire tests and loss experience show that it is not possible to extinguish such fires even using high sprinkler discharge densities.

It is important to prevent the spray from increasing or multiplying by using piping or hose that is resistant to failure when exposed to fire. Fire control must be achieved by shutting off the fuel supply, while protecting other combustibles and structural members in the area.

3.5 Electric Discharge Machining (EDM)

3.5.1 General Description

EDM is a process of removing metal by electric arcing regulated from a control console. The piece to be machined is submerged in dielectric oil within an open work tank (up to 180 gal [680 L]), where the electric arc discharge creates a customized metal shape by eroding away unwanted metal. A flow of dielectric oil is maintained across the work surface to remove the metal residue.

The electric discharge machines may have self-contained (one machine) or central (multiple machines) oil filtration to remove metal residue from the oil for recirculation. Capacity of the systems will vary from over 1000 gal (3800 L) in a central system to less than 100 gal (380 L) in a self-contained system. Each open work tank has an overflow line to the filtration system to maintain the oil level when clean oil is introduced across the work surface. In one typical arrangement, the oil is gravity fed from a clean oil reservoir to the EDM work tanks, and then to a dirty oil reservoir where the oil is pumped through a filtering system and recirculated to the clean oil reservoir (see Figure 3.5.1).

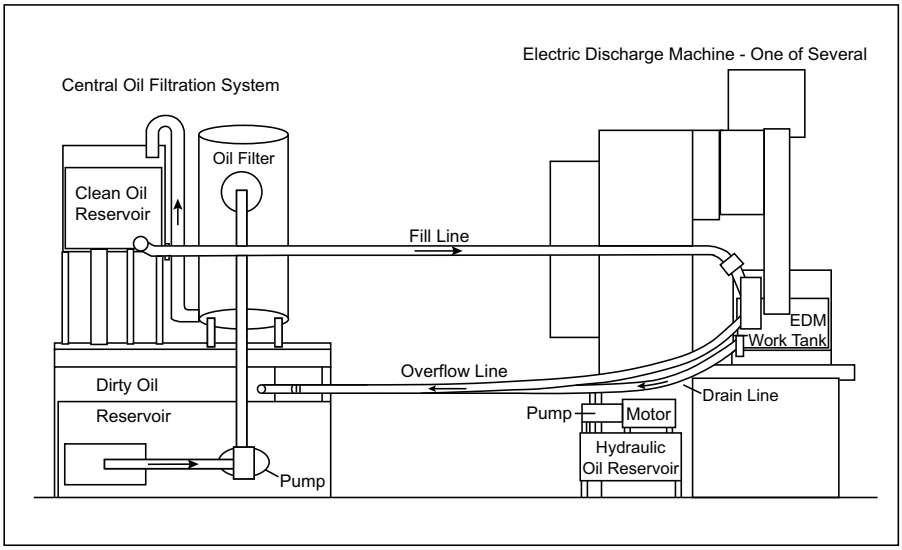

Fig. 3.5.1 Typical EDM oil system arrangement.

3.5.2 Hazards

The primary hazard associated with EDM is fire involving the oil used as the dielectric medium. EDM oil is particularly susceptible to ignition from arcing under low oil level conditions in the open-top work tank. Reported flash points for typical EDM fluids are in the 250°F (121°C) to 300°F (149°C) range. Small hydraulic oil systems for positioning and moving EDM components also are normally present.

4.0 REFERENCES

4.1 FM

Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-85, *Combustible and Reactive Metals*
Data Sheet 9-0, *Asset Integrity*

APPENDIX A GLOSSARY OF TERMS

FM Approved: Products and services that have satisfied the criteria for FM Approval. Refer to the Approval Guide, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

Ignitable liquid: Any liquid or liquid mixture that has a measurable flash point. The hazard of a liquid depends on its ability to sustain combustion or create a flammable vapor-air mixture above its surface. Flash point is one way of understanding if a liquid can create that flammable vapor-air mixture. For a liquid to burn in a pool, it must have a fire point as well as a flash point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, and any other term for a liquid that will burn.

Very high flash point liquid: Treat liquids that meet one of the following criteria as very high flash point liquids:

A. Unheated liquids with a flash point at or above 414°F (212°C)

B. Heated liquids with a flash point at or above 414°F (212°C) that have an operating temperature that meets the following equation:

Closed cup flash point - operating temperature > 324°F (180°C)

C. Vegetable oils and fish oils with a closed cup flash point of 450°F (232°C) and greater, that are heated to less than or equal to 150°F (65°C)

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

January 2021. This document has been completely revised. Major changes include the following:

A. Added guidance to be consistent with Data Sheet 7-32, *Ignitable Liquid Operations*. This includes the addition of a definition for very high flash point liquids, and guidance on the frequency of safety shutoff valve and interlock testing.

B. Clarified guidance on automatic shutoffs and when safety shutoff valves are appropriate (Section 2.5.4).

C. Added guidance on heat detector placement (Section 2.5.5).

April 2018. Interim revision. Minor editorial changes were made.

July 2013. The following major changes were made:

A. Revised terminology and guidance related to ignitable liquids to provide increased clarity and consistency. This includes the replacement of references to “flammable” and “combustible” liquids with “ignitable” liquids throughout the document. The title of the data sheet was changed to “Cutting Fluids”.

B. Reorganized the document to provide a format that is consistent with other data sheets.

C. Provided information to assist in evaluating the fire hazard scenario associated with equipment using cutting fluids, including an evaluation of the specific cutting fluid used.

D. Added additional information on the use of FM Approved industrial fluids.

E. Included guidance on the construction and location of equipment using cutting fluids.

F. Provided recommendations on the proper location and construction for central supplies of cutting fluids.

G. Provided information on protection of piping and equipment from mechanical damage.

H. Added reference to Data Sheet 7-32, *Ignitable Liquid Operations,* for the appropriate design of piping systems.

I. Revised the sprinkler protection recommendations for equipment using cutting fluids.

J. Updated the methods for automatically shutting down cutting fluid systems to reflect current technologies and practices.

K. Added information related to human factor, ignition source control, and housekeeping.

May 2000. This revision of the document has been reorganized to provide a consistent format.

July 1991. Revised.