**TECH TALK**
Volume 4

ALLIANZ GLOBAL CORPORATE & SPECIALTY®

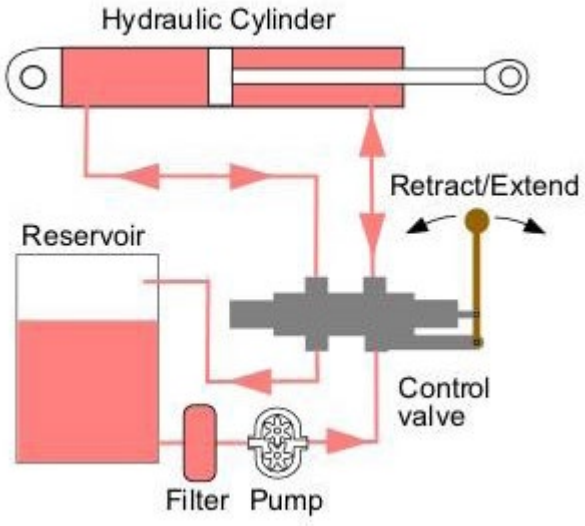
# HYDRAULIC FLUIDS

ALLIANZ RISK CONSULTING

## INTRODUCTION

Most industries use hydraulic systems and hydraulically operated equipment. A large percentage of metal and plastics forming equipment has some form of hydraulic system. The development of such systems saw the replacement of water with mineral oil based systems. Mineral oils are excellent hydraulic fluids in that they are stable, lubricate well and can be custom blended for a variety of uses. They do not corrode equipment and generally are inexpensive and in plentiful supply. The down-side is that mineral oils burn. In fact they burn particularly well especially when under pressure and forming an atomized spray leaking from a hose, gasket or pipe joint.

Although the number of losses involving fires in hydraulic equipment has not increased significantly over the past 25 years, the increasing reliance on such systems has had a major impact on the overall severity of any such incident.




Simple Hydraulic Oil Circuit

Allianz

## HYDRAULIC OIL SYSTEM FIRES

Studies of losses involving hydraulic oils showed that around 50% of incidents occurred in metalworking processes, 17% in plastics forming and almost 10% in woodworking operations.

Hydraulic oil becomes hot during operations. Heated petroleum based hydraulic oil presents a significant fire hazard, particularly in those processes where ignition sources are usually present. A typical petroleum based hydraulic oil has a flash point that ranges from 300 to 600°F (150 to 315°C) and an auto-ignition temperature of 500 to 750°F (260 to 400°C).

If pressurized hydraulic oil is atomized from a leak in a pipe or hose, it will readily burn if exposed to an ignition source. This atomized spray or mist of oil droplets typically becomes a torch-like fire with a very high rate of heat release that can extend as far as 40 ft (12.2 m) from the break and ignite surrounding combustibles.

## CAUSES OF FAILURE

High pressure pipe with welded and screwed joints, steel and copper tubing and metal reinforced rubber hose are used to distribute oil at pressures up to 10,000 psi (689.5 bar). Failure of any of these components or sections has been the principle causes of oil release. Lack of adequate supports or anchorage allowing vibration or movement of piping has been a factor in some of these failures. Repeated flexing and abrasion of rubber hose against other hose or machine parts have created weak spots which eventually end in ruptures.

Hydraulic system with motor, pump and valves

## LESS FLAMMABLE HYDRAULIC FLUIDS

The best way to control any hazard is to eliminate it. However, hydraulic systems need hydraulic fluids and some fluids have been developed that are less flammable than petroleum based oils. Using a less flammable fluid can reduce the overall risk and the amount of fixed fire protection required to control the fire hazard. The main types are:

**High Water Content Fluids (HFA):** Contain 80% or more water with soluble oil additives. Often referred to as 95:5 fluids due to the 5% concentration used. Designed primarily for light duty applications with pressures less than 1000 psi (69 bar). Compatible with most seals and gaskets, except those made from paper, cork, leather and synthetic fibers. HFAE fluids are oil in water emulsions, HFAS fluids are chemical solutions or blends of additives and water.

**Water-in-Oil Emulsions (HFB):** Consist of 35% to 40% water dispersed in mineral oil with emulsifiers and additives. Seal and gasket compatibility are the same as HFA fluids above.

**Water Polymer (Glycol) Solutions (HFC):** Glycol, polyglycol or water glycol solutions containing 35% to 50% water. Seal and gasket compatibility are the same as HFA fluids above.

**Synthetic Fluids (HFD):** Include fluids based on chlorinated hydrocarbons and phosphate esters. Often require special seals and hoses as they are strong solvents and are incompatible with natural rubber and neoprene.

All of the above fluids will burn under certain conditions, as a flaring fire can occur when sprayed onto very hot surfaces. However, if less flammable hydraulic fluids are properly maintained, they can significantly reduce the fire hazard. See ISO 7745, *Hydraulic Fluid Power–Fire Resistant (FR) Fluids–Requirements & Guidelines for Use,* for additional guidance on the use of less flammable hydraulic fluids.

## ARC RECOMMENDATIONS

While not all inclusive, the following basic loss prevention features can greatly reduce the potential for property damage and resulting business interruption caused by hydraulic fluid fires:

1. Use a less flammable hydraulic fluid when possible.
2. Use welded pipe (avoid threaded pipe) and steel reinforced rubber hose when possible.
3. Establish a comprehensive preventive maintenance program following the equipment manufacturer's guidelines and include the following:
   a. Daily inspections for leaks, worn or damaged parts (e.g. cracks, abrasion, loose connections, etc.), etc.
   b. Repair and clean up spills and leaks promptly
   c. Replace worn or damaged hose & piping with material suitable for service (e.g. fluid compatibility, pressure & temperature ratings, etc.)
   d. Test or replace fluid as recommended by manufacturer
4. Provide automatic sprinkler protection over and at least 20 ft (6 m) beyond the hydraulic equipment and piping designed in accordance with NFPA 13, *Standard for Installation of Sprinkler Systems*, or equivalent standards. Complete sprinkler protection is recommended if combustible construction or occupancy extends beyond. Sprinkler protection should also be provided in areas shielded from ceiling sprinklers, such as in pits or below platforms.

Note: Automatic sprinklers may be omitted over a single hydraulic system or multiple adjacent systems within 20 ft (6 m) of each other if all of the following criteria are met:

- Total oil capacity does not exceed 100 gallons (380 L)
- Building construction and adjacent occupancy is non-combustible
- There are no ignition sources normally present (e.g. hot surfaces, heaters, molten metal, spark producing equipment, open flames, etc.)
- Potential for business interruption is low
- Automatic or prompt manual shutdown of the system

5. Automatic shutdown should be provided for hydraulic systems with individual oil reservoirs greater than 100 gallons (380 L). Shutdown can be activated by a sprinkler waterflow alarm, heat detection, or oil level switch interlocked with the power supply for the oil pump. The oil level interlock option should be used only if the oil release can be limited to 25 gallons (95 L) or less.

Note: If adequate sprinkler protection is provided for the area, automatic shutdown is not needed if loss of the machine does not present a significant business interruption potential or the area is constantly attended by well trained operators who can manually shutdown the machine using a remote switch.

**References:**


- FM Global Property Loss Prevention Data Sheet 7-98, *Hydraulic Fluids*
- *NFPA Fire Protection Handbook,* 20th Edition, Section 8, Chapter 11, Fluid Power Systems
- ISO 7745, *Hydraulic Fluid Power–Fire Resistant (FR) Fluids–Requirements & Guidelines for Use*


## QUESTIONS OR COMMENTS?

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Reference 04/22/02

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Design: AGCS Graphic Design Centre