intensity of the penetrating radiation into visible images are X-ray film fluorescent screens, geiger porportional end window scintillation counters, and ionization gauges.

All sources of ionizing radiation are potentially dangerous X-ray and gamma ray sources may also produce hazardous secondary radiation In addition, X-ray units involve both low- and high-potential electrical hazards.

Full details of a radiation safety program applicable to all industries that use radiographic testing methods are given in Chapter 42, "Ionizing Radiation" Chapter 42 also discusses the biological effects of radiation, gives tolerance limits, and recommends personnel protection practices

Hydraulic Fluids and Equipment

Hydraulic fluids are used as the motive power for many types of mechanical equipment The fluids are not hazardous unless part of the circuit—pipes, hose, or connections—fails

Although water was the first fluid used in hydraulic systems, it was soon replaced by petroleum-base oils because water lacked lubricity and had a corrosive effect on metallic machine parts

In addition to mineral oils, water containing a water soluble oil to reduce corrosion was used Recently, fire-resistant fluids* have come into widespread use

There are three basic types of fire-resistant hydraulic fluids

1 Water-glycol fluids, which consist of glycols with up to 50 per cent water, together with various additives to serve as thickeners, increase oiliness, and inhibit corrosion The water makes the solutions fire-resistant
2 Nonaqueous synthetic fluids, which generally have a phosphate-ester base Chlorinated hydrocarbons have also been used, alone or in combination with certain phosphate esters
3. Water-oil emulsions, which are stabilized mixtures of water and oil containing emulsifying agents to accomplish proper mixing. Such fluids may contain additive amounts of other constituents to meet specific conditions and requirements There are two types
   a The oil-in-water emulsion is a dispersion of oil in a continuous phase of water This is a regular emulsion, and the amount of oil is much less than the amount of water
   b The water-in-oil emulsion is a dispersion of water in a continuous phase of oils, the water content is between 40 and 50 per cent

Under pressures which range from 150 psi to over 5,000 psi, oil from a broken fitting or leak is discharged in the form of a spray or mist, which on contact with a source of ignition is certain to result in a fire For this reason, only fire-resistant fluids should be used on operations involving open flames or other sources of heat, such as open pots or tanks of molten metal, and on machinery such as die-casting machines and welding presses

Hazards

Compared to most petroleum products, fire-resistant hydraulic fluids generally, and the emulsions particularly, do not present a toxic hazard and therefore do not require special handling

Special precautions must be taken in the handling of some of the synthetic fluids to guard against toxicity In all such cases, however, the proper instructions are included in the literature provided, and the containers are plainly marked

Producers of fire-resistant hydraulic fluids approved by the U S Bureau of Mines under Schedule 30** (approved December 11, 1959) are required to include a caution statement on the labels affixed to the containers when precautions of any kind are necessary, regardless of their similarity or dissimilarity to those required for petroleum hydraulic fluids

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*Also see Industrial Data Sheet 543, *Fire-Resistant Water-in-oil Emulsion Hydraulic Fluids*, published by the National Safety Council

**U.S. Bureau of Mines, Department of the Interior Schedule 30, "Fire-Resistant Hydraulic Fluids," *Code of Federal Regulations*, Title 30, Mineral Resources, Part 35, Subchapter E Available from the Superintendent of Documents, U S Government Printing Office, Washington, D C