Operating requirements

According to the standards set by the Joint Industries Conference (see Hydraulic Fluids listing under "References"), reservior temperatures should be maintained at less than 130 F (54 4 C)

Tests made during the operation of mining machines with hydraulic systems using petroleum fluids have indicated reservoir temperatures of 180 F (82 2 C) and higher Such high temperatures may lead to serious wear and leakage, thus increasing the cost of hydraulic operation and reducing its productivity

The temperature of fire-resistant fluids of the emulsion type tends to remain lower during operation than that of the petroleum fluids, in some instances as much as 20 degrees F lower Use of the emulsions, therefore, makes it easier to maintain the reservoir temperature below the recommended maximum of 150 F (65 5 C)

The fire resistance of the water-in-oil emulsions depends upon the quenching action of the steam that is generated in the presence of heat Normally, the water content must be maintained at around 40 per cent to assure that enough steam will be produced for effective fire resistance

Depending upon the design of the hydraulic system, high operating temperatures may cause some of the water in an emulsion to evaporate, thereby lowering its resistance to fire Field tests indicate that this loss is not alarming since water in the makeup fluid used will keep the water content above the acceptable safe limits

Nevertheless, to maintain a safe percentage of water, excessive evaporation should be prevented Tests indicate that this is not a difficult problem if the reservoir temperature is kept below 150 F (65 5 C)

Producers of each hydraulic fluid approved by the U S Bureau of Mines are required to furnish a method of determining the water content of the fluid during use Such testing should be done in the manner and at the intervals recommended by the producer Instructions for adding water when such addition is necessary are also available from the producer and should be followed

Design of equipment

Most ordinary hazards from hydraulic fluids can be eliminated through design A factor of safety of at least 8 over normal working pressures is recommended for piping and tubing

Equipment such as flexible tubing, which has a definite life under specific operating conditions, should be replaced at predetermined intervals

To prevent it from vibrating, piping should be securely fastened to the machine, and all machines should be securely anchored to their bases It should be placed where it will not interfere with the adjustment, repair, or replacement of control valves Piping should not be used to support valves or other equipment where vibration might damage the piping Exposed pipes which might be used as steps should be protected with a suitable cover

Hydraulic equipment should be designed to meet the following additional safety requirements

1 Flexible lines should be restrained or confined if their failure might constitute a hazard to personnel

2 The operator should not be required to reach past revolving spindles, moving tools, or moving machine or equipment to reach manual controls

3 Hydraulic circuits using accumulators should be interlocked to vent or isolate accumulator fluid pressure when the power is shut off Full information for proper servicing without hazard to personnel should be posted on or near the accumulator

4 In hydraulic systems containing flammable fluids and using gas at pressures in excess of 250 psi, nitrogen or other inert gas should be used

Another possible source of injury results when air becomes trapped in the hydraulic lines and creates in effect an air "hammer" This effect has been known to rupture lines or connections with such force that persons have been killed by pieces of flying metal Such accidents can be prevented by proper filling and bleeding of hydraulic systems

Heavy-duty pipe and fittings used to withstand the pressures of hydraulic fluids should