Discontinued

10/1958

DO NOT REMOVE FROM THE MEDICAL DEPT.

Monsanto

PYDRAUL® F-9

for hydraulic equipment operating near possible sources of ignition

a FIRE-RESISTANT FLUID

equalling premium grade petroleum fluids in lubricity, stability and service life.

NOTE

DEPOSITION EXHIBIT
Papageorge-OMC
2-ID 8 27 81

PENGAD-Bayonne, N. J.

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QUESTION:

WHY A FIRE-RESISTANT FLUID?

ANSWER:

FLUIDS SPRAY FARTHER THAN YOU'D THINK!

When a hydraulic system fails—and the best of them can fail—fluids at pressures of 1000 p. s. i. and above can jet surprising distances. In one disastrous fire a hydraulic line broke and the fluid was ignited by a flame *40 feet away.*

The smaller the break, of course, the farther the fluid may travel. And through a pin-point leak, flammable fluids can be atomized to an explosive vapor-air mist—potentially an even greater hazard.

Around every hydraulic machine and line in your plant there is a danger zone.

ALSO . . . FLUIDS CAN BE IGNITED IN WAYS YOU'D NEVER SUSPECT.

In addition to obvious means—open flames, molten or red hot metals, electric sparks, etc.,—there are many other ignition sources. One fire was started when a jet of flammable fluid broke an ordinary electric bulb and was ignited by the incandescent filament. Sometimes the source—like the maintenance man's welding torch—is only in the danger zone occasionally.

The safest way to guard against these dangers is to keep a fire-resistant fluid in your hydraulic system. And PYDRAUL F-9 is the preferred fluid.

PYDRAUL: Reg. U. S. Pat. Office. Monsanto trade-mark for fire-resistant industrial hydraulic fluid.

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Besides being **FIRE-RESISTANT**

PYDRAUL F-9 is a

TOP GRADE HYDRAULIC FLUID

excellent lubricity

Very high film strength and antiwear properties give component life equal to or better than that from premium oils.

high stability

Extreme resistance to heat, air and water means years of service life.

noncorrosive

No adverse effect on metals found in hydraulic systems.

water-free

A straight synthetic. Does not evaporate or require constant quality checks.

economical

Long service life. Can be reclaimed for use again and again.

safe to use

Both liquid and vapor are safe in industrial hydraulic operations. No special handling is required.

THE FIRE-RESISTANCE OF PYDRAUL F-9 HAS BEEN ATTAINED WITHOUT SACRIFICING ANY IMPORTANT HYDRAULIC FLUID SERVICE CHARACTERISTIC.

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Introduction

Hydraulic power is a vital and growing factor in our industrial picture. Its versatility and many advantages have led to its adoption by practically every industry.

Many of the applications of hydraulic power involve fire hazards such as open flames, molten metals and glass, sparks, etc. Since flammable petroleum fluids are widely used in hydraulic equipment, there have been serious fires when such fluids were accidentally released and ignited.

PYDRAUL F-9 was developed by Monsanto Chemical Company to provide industry with a fire-resistant hydraulic fluid which combines safety with the operational qualities of a premium grade petroleum fluid. This combination of safety and utility plus proved performance has brought wide acceptance of PYDRAUL F-9.

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Section I: Where is PYDRAUL being used?

TYPICAL APPLICATIONS

The excellent performance record of *Pydraul* F-9 has resulted in its use in a wide variety of equipment in many industries. Following is a short list of typical applications in which *Pydraul* F-9 is now being used.

- Diecasting Machines
- Hydraulic Presses
- Furnace Tilters
- Furnace Door Openers
- Ingot Loaders
- Furnace Regulators
- Rotary Furnaces
- Molten Salt Baths
- Extrusion Presses
- Forging
- Plating Machines
- Permanent Mold Casting
- Injection Molding
- Electric Furnaces
- Elevators and Hoists
- Hydromotors
- Scarfers
- Stampers
- Hydraulic Jigs
- Compressor Lubrication

DIECASTING MACHINES

The final test of a hydraulic fluid is its use in a machine. *Pydraul* F-9 is now being used in practically all types of diecasting machines including those made by the following well-known manufacturers:

- A-C Spark Plug Co.
- B. & T. Engineering Co.
- Cast-Master, Inc.
- Cleveland Automatic Machine Co.
- Cuyahoga Industries
- Hydraulic Press Manufacturing Co.
- Kux Machine Company
- Lake Erie Engineering Corp.
- Lester-Phoenix, Inc.
- Lewis Welding and Engineering Co.
- Reed Prentice Corp.
- Schultz Diecasting Co.

HYDRAULIC PUMPS

The high film strength and excellent lubrication characteristics of *Pydraul* F-9 make possible its use wherever a petroleum fluid of comparable viscosity can be used. *Pydraul* has been pumped at temperatures over 200° F. and at pressures up to 10,000 p.s.i. Some of the commonly encountered hydraulic pumps in which *Pydraul* F-9 is being used include the following:

- Adel
- Barnes
- Denison
- Hydraulic Press Manufacturing
- Imo-De Laval
- Northern
- Oilgear
- Racine
- Roper
- Tuthill
- Vickers
- Worthington

Pydraul F-9 was developed primarily for use in the diecasting and metals industries where hydraulics are used with hot metal. Its unique combination of properties recommend *Pydraul* F-9 for uses even more diversified than the current applications in which it has proved so successful.

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Section II: Safety

During several years of industrial use *Pydraul* F-9 has been accidentally discharged over molten metal, red hot ingots, arcs, open flames and sparks. In no case has a fire resulted from such contact.

Most materials, even metals, can be made to burn under some conditions. If *Pydraul* F-9 is heated until decomposition products are formed, some burning can occur if an ignition source exists. But this is likely to happen only around high temperature sources like furnaces, molten metal, etc. Under conditions of industrial use, extraneous burning in hot areas is not important because excessive heat has already been provided for. What *is* important is keeping flames from leaving such areas, thereby spreading fires. Thus a hydraulic fluid which is used in high temperature areas or which can reach these by line breaks, **should not carry flames outside the high temperature zone.** *Pydraul* F-9 excels in this important flame resistance.

Below are some of the test data which demonstrate the safety of *Pydraul* F-9 under conditions of industrial hydraulic operation.

TABLE 1: Flammability Data

TEST	RESULTS
AUTOGENOUS IGNITION TEMPERATURE (ASTM Method D:286-30)	Greater than 1,100° F.
MOLTEN METAL IGNITION TEMPERATURE *Pydraul* F-9 was sprayed, dripped and flooded onto the surface of a molten alloy at approximately 1500° F.	Fluid did not flash or ignite.
HIGH-PRESSURE IGNITION TEST The mist from spraying *Pydraul* F-9 through a small orifice under 1,000 p.s.i. was subjected to the flame of an oxyacetylene welding torch.	Even when exposed to the hottest portion of the oxyacetylene flame (approximately 6,000° F.) the fluid did not flash or ignite.
HOT MANIFOLD TEST *Pydraul* F-9 was dripped onto the surface of a hot manifold.	Did not burn at 1,300° F., nor when the surface temperature was increased to 1,475° F., the limit of the equipment.
ARC IGNITION TEST *Pydraul* F-9 was sprayed through a 1/8" petcock at varying pressures up to 200 p.s.i. through a carbon arc that had a free arcing distance of approximately 1½".	At no time was a flash observed, nor did the fluid burn.
STATIC CARBON ARC TEST A metal pan was filled to a fluid depth of approximately ¾" and the arc struck between the electrode and the bottom of the pan, passing through the fluid. The arc was sustained for approximately 30 seconds during which time the carbon electrode became white hot.	No flash was observed, nor did the fluid burn.

Independent Tests Conducted by Factory Mutual Laboratories resulted in the following report:

> "On the basis of these tests and ones previously conducted with petroleum base hydraulic oils and other types of less hazardous fluids, we consider that *Pydraul* F-9 fits into the category of acceptable less hazardous fluids."
>
> (Factory Mutual Laboratories)

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Section III: General properties of PYDRAUL F-9

TYPICAL ANALYSIS OF *PYDRAUL* F-9

Appearance:	Amber, oily liquid	Neutralization Number (mg. KOH/gm.):	0.1
Odor:	Mild, pleasant	Pour Point:	−5° F.
Specific Gravity:	1.27 at 75° F.	Viscosity Index:	+32
Pounds Per Gallon:	10.56 at 75° F.	Viscosity:	
Flash Point (C.O.C.):	430° F.	100° F.	222 S.U.S. or 48 cps.
Fire Point (C.O.C.):	675° F.	210° F.	44.4 S.U.S. or 5.56 cps.

OTHER PROPERTIES

Specific Heat:

Temperature	cal./gm./° C. or BTU/lb./° F.
23° C. (73.4° F.)	0.31
59° C. (138.2° F.)	0.33
107° C. (224.6° F.)	0.36

(Specific Heat $= 0.2959 + 6.28 \times 10^{-4} t$)

Thermal Conductivity:

Temperature	cal./cm./° C./sec.
28° C.	27.5×10^{-5}
81° C.	26.6×10^{-5}

Coefficient of Thermal Expansion: 0.00041/° F. between 80° F. and 400° F.
0.00073/° C. between 25° C. and 200° C.

Bulk Modulus: 387,000 p.s.i. (room temperature, between 1000 and 6000 p.s.i. applied pressure)

Compressibility: 2.58×10^{-6} sq. in./lb.

Solubility of PYDRAUL F-9 in water: Negligible

Solubility of Water in PYDRAUL F-9: 0.2% at 75° F; 0.6% at 210° F.

Miscibility: Completely miscible with oil, with 10-15% of tricresyl phosphate. Does not mix with water.

Surface Tension: 32 dynes/cm.

Specific Resistivity: 0.15×10^{5} Megohm-cm.

Dielectric Constant: 6.25 at 1000 cps. and 25° C.

Dissipation Factor: at 60 cps. = 32.9%
at 1000 cps. = 2.2%

Dielectric Strength: 33 KV (1 sq. cm. electrodes)

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FIG. 1: Specific Gravity of PYDRAUL F-9, 60°—300° F.

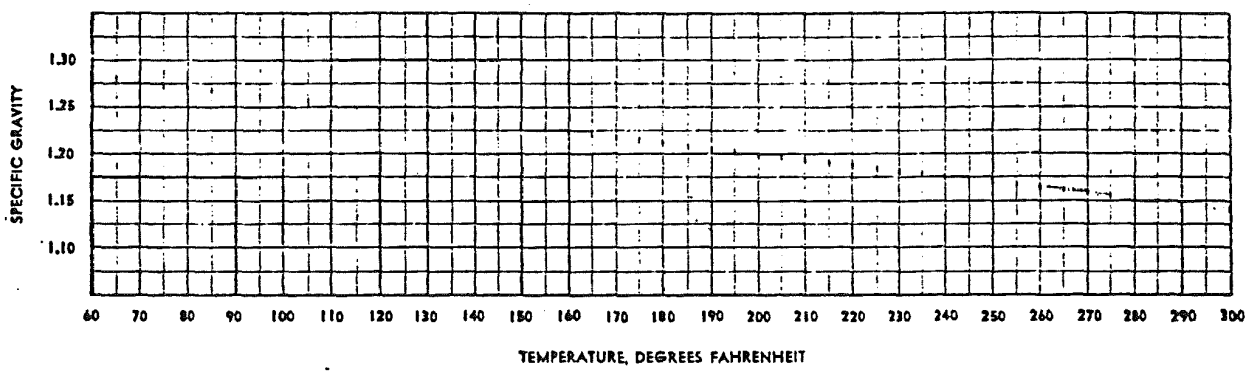

FIG. 2: Approximate Vapor Pressure of PYDRAUL F-9

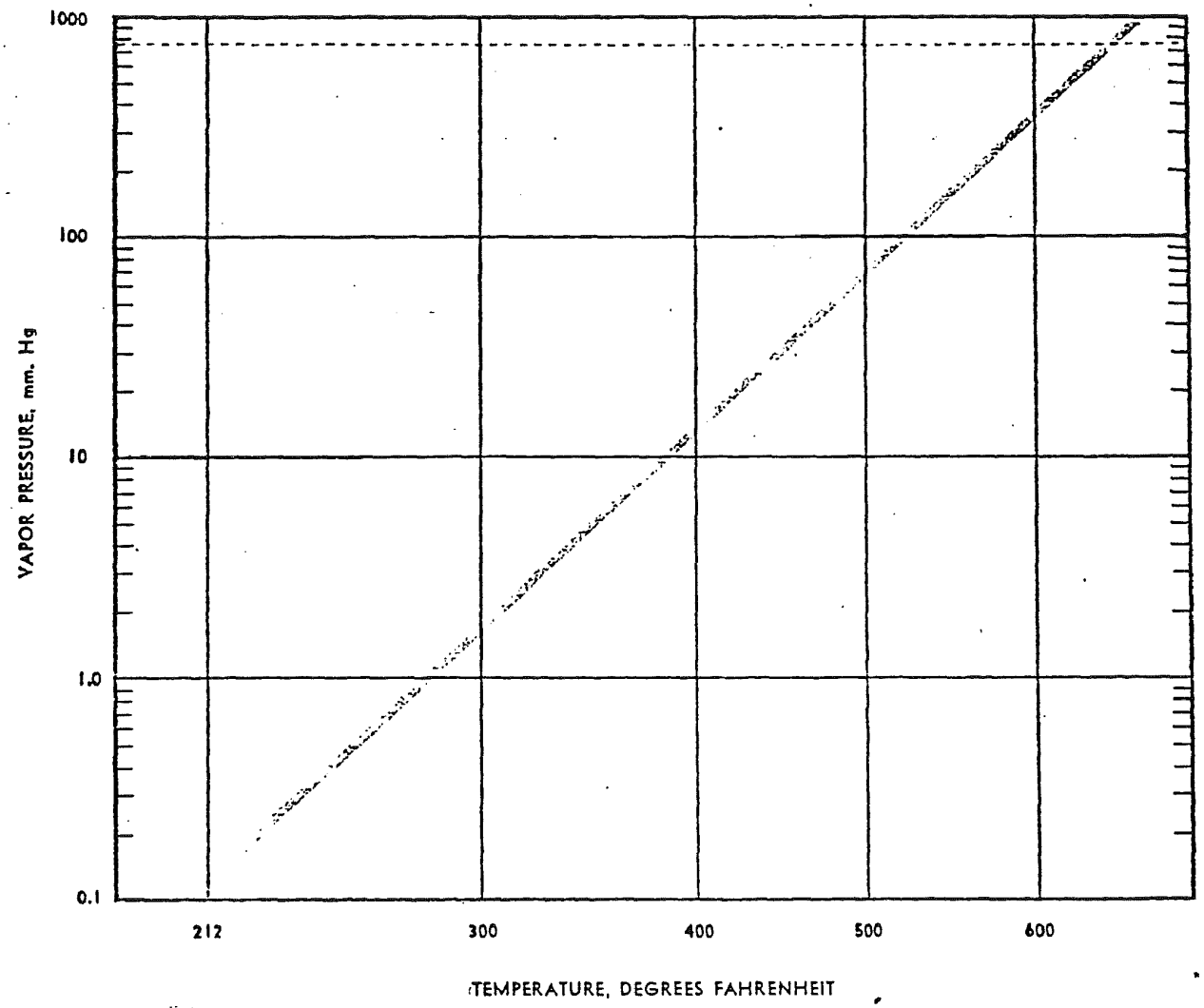

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FIG. 3: Saybolt Viscosity of PYDRAUL F-9

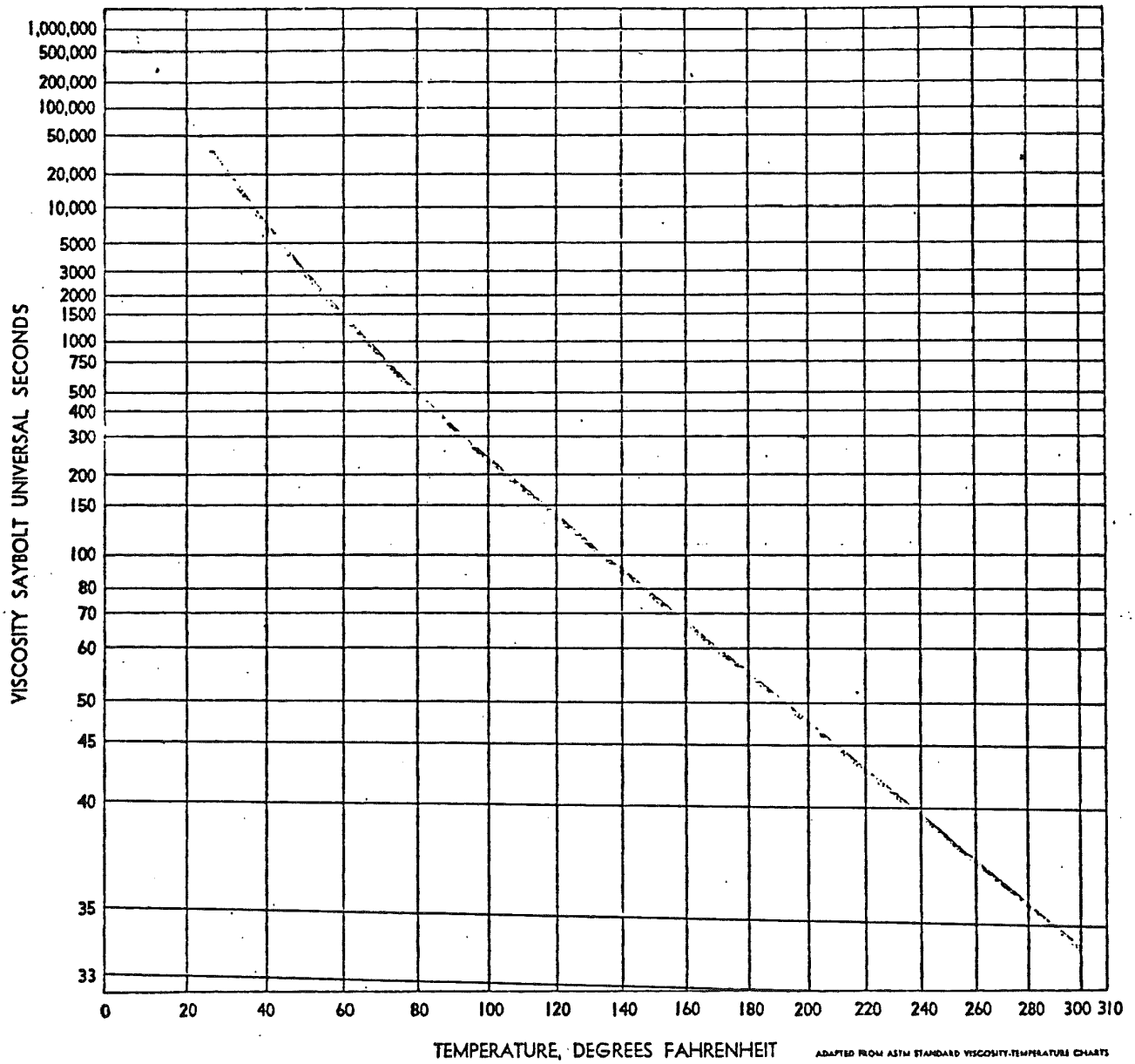

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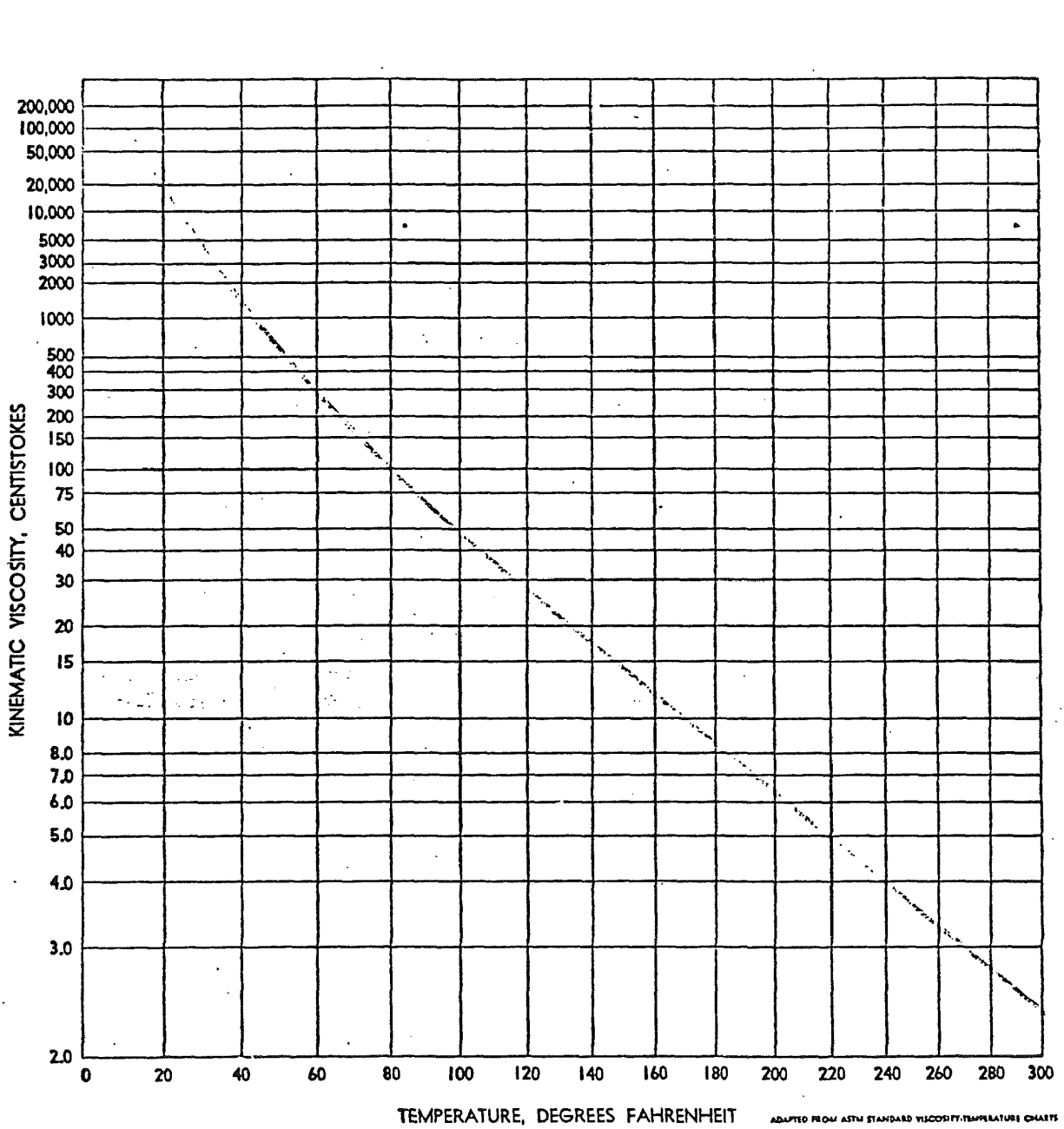
FIG. 4: Kinematic Viscosity of PYDRAUL F-9



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Section IV: Stability of PYDRAUL F-9

Pydraul F-9 is a highly stable fluid under all normal conditions of industrial hydraulic use. It has excellent resistance to heat, water and oxygen, and is noncorrosive to metals. Examination of *Pydraul* F-9 after several years of use has shown that the fluid retains its desirable properties almost indefinitely.

THERMAL STABILITY

The fire resistance of *Pydraul* F-9 is inherent and is not due to the presence of water or other additives. *Pydraul* F-9 contains no readily volatile components, the loss of which can alter fluid composition during use, nor does it break down under temperatures encountered in most systems. Where necessary, *Pydraul* F-9 can be operated for long periods of time at temperatures as high as 300° F.

CORROSION AND OXIDATION STABILITY

Pydraul F-9 does not react with the various metals found in hydraulic systems nor does it allow electrolytic corrosion. Good oxidation stability is to be expected due to the fire-resistant nature of *Pydraul* F-9, since burning is simply rapid oxidation.

The following tests were run according to procedures for determining corrosion and oxidation stability as given in the Military Specification MIL-0-5606 (Oil, Hydraulic, Aircraft, Petroleum Base). In this procedure, strips of copper, iron, magnesium, aluminum and cadmium plated steel are all immersed in the test fluid. The fluid is heated to 250° F. and held there for 168 hours while air is bubbled through. The fluid and metal strips are then examined for changes.

TABLE 2. Results of Corrosion and Oxidation Stability Tests of PYDRAUL F-9 by Specification MIL-0-5606

Property	Initial Value	Final Value	Actual Change	Change Allowed by Specification
Viscosity at 130° F. (Centistokes):	20.9	20.4	−2.4%	−5 to +20%
Neutralization No.:	0.03	0.00	−0.03	+0.20
Fluid Evaporation:	.....	1.32%	1.32%	8.0%
Fluid Separation:	.....	None	None	None

Effect on Metals: Metal	Wt. Change (mg./cm.²)	Allowable Wt. Change	Visual Examination
Copper	−0.08	±0.60	Light coating
Iron	+0.01	±0.20	Light coating
Aluminum	+0.04	±0.20	Light coating
Magnesium	+0.05	±0.20	Light coating
Cadmium/Steel	−0.03	±0.20	Light coating

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HYDROLYTIC STABILITY

In Military Specification MIL-F-7100, 25 grams of water and 75 grams of test fluid are placed in a beverage bottle along with a strip of pure copper. The bottle is capped and rotated end-over-end for 48 hours at 200° F. The liquids and metal are then observed for changes.

TABLE 3: Hydrolytic Stability of PYDRAUL F-9 by Specification MIL-F-7100

Property	Initial Value	Final Value	Actual Change	Change Allowed by Specification
Viscosity at 130° F., Centistokes:	20.91	20.13	—3.7%	—5% to +15%
Acidity:				
Fluid Layer (Neut. No.)	0.08	0.08	.....	+0.5
Water Layer (total acidity, mg. KOH)	.....	2.25	2.25	+10.0
Wt. Change of Copper (mg./cm.²):	.....	—0.05	—0.05	±0.50
Sludge:	.....	0.0016 gm.	+0.003%	+0.5

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Section V: Lubrication and pump tests

An essential characteristic of a hydraulic fluid is the ability to properly lubricate moving parts under critical loading. *Pydraul* F-9 is outstanding in this respect, and field use has shown that in some instances it has reduced wear even below that encountered with high grade petroleum base fluids.

Pydraul F-9 has been tested and used in most of the hydraulic pumps commercially available. Pump manufacturers have expressed their approval of *Pydraul* F-9 because its characteristics help their pumps attain maximum service life. *Pydraul* F-9 is even being used successfully in pumps where normally a petroleum fluid of much higher viscosity would be required.

Results of some of the laboratory and field tests on the lubricating characteristics of *Pydraul* F-9 follow.

TABLE 4: Shell Four Ball Wear Test

Metals and Load	Average Scar Diameter in Millimeters	
	With Premium Grade Hydraulic Fluid	With Pydraul F-9
Steel on Steel		
1 Kg.	0.198	0.155
10 Kg.	0.226	0.250
40 Kg.	0.799	0.696
Steel on Bronze		
1 Kg.	0.964	0.299
10 Kg.	1.730	0.578
40 Kg.	2.710	1.080

Timken Extreme Pressure Test:

OK load=50 lbs.

Film strength=17,500 p.s.i.

Almen Wear Test:

Weight loss at 4000 p.s.i. bearing load — 2.0 mg. (Approximately equivalent to SAE 10 lubricating oil)

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PUMP TESTS

Vickers Vane Pump, Type V-105A

Two parallel tests were run using *Pydraul* F-9 in one pump and a standard petroleum base hydraulic fluid in the other.

During the test, the pumps were operated at 150° F. (±5°) for 16 hours a day, 5 days a week. This interrupted operation was deemed more stringent than 24-hour operation because of the greater wear to be expected from frequent cold starts. For the first 400 hours, both pumps operated at 1200 r.p.m. at 100 p.s.i. delivering 4.76 gallons per minute. After 400 hours, the pump handling *Pydraul* F-9 was stepped up to 1500 p.s.i. for 126 hours; then for the next several hundred hours to 1800 r.p.m. at 1500 p.s.i. delivering 6.5 to 7.0 gallons per minute. After 800 hours of total operation, the pump was dismantled and the parts checked for weight loss.

After only 200 hours of operation the rotor of the pump operated on petroleum fluid showed a weight loss of 2.9 grams due to wear. The rotor with *Pydraul* F-9 lost no weight in the first 200 hours, and only 0.1 gram after 800 hours. The weight loss of vanes and rings with either fluid was negligible.

Vickers Piston Pump, Type PV 2008

This pump was tested with *Pydraul* F-9 at 2000 p.s.i. for 1118 hours, and the parts were inspected. *Pydraul* F-9 was judged quite suitable for this type of pump.

In numerous field installations the service life of the above two pumps operating with *Pydraul* F-9 ranges between 25,000 and 40,000 hours—equivalent to the service with premium petroleum fluids.

Laboratory and field tests have been made on the pumps of other manufacturers with equally good results. For a list of the pumps in which *Pydraul* F-9 is now being used see page 2.

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Section VI: Change-over to PYDRAUL F-9

The conversion to *Pydraul* F-9 of equipment which has previously contained petroleum or other hydraulic fluid is relatively simple and follows logical engineering practice. The steps below are given simply as a check list. Where possible, it is desirable to obtain recommended procedures from the manufacturers of the machine and pump on hand since the makers will be most familiar with the best method of handling their own equipment.

Pydraul F-9 is an excellent flushing compound in its own right: it will loosen tars, varnish and residues left by the previous fluid. *Pydraul* F-9 will also loosen and remove paint from the interior of the machine. These contaminants can be most easily removed from the circulating *Pydraul* F-9 by a filter in the system. If there is no filter, or if it is difficult to reach for cleaning, it may be advisable to use a portable filter which can be connected into the fluid return line. This portable filter can be left in the line for two or three days of operation and then moved to the next machine to be converted. Since it is considered good hydraulic practice to filter hydraulic fluids during normal operation, the portable filter can be used routinely, after conversion, to filter the fluids on a regular basis.

Following are the general steps for converting a hydraulic system to *Pydraul* F-9.

1. Before shutting down the machine for conversion, *check* the entire system while in operation for fluid *leaks*. Mark these for correction later.
2. *Drain* the previous fluid from the reservoir, lines and cylinders as completely as possible. Sometimes this can be done by opening unions at low spots in the system, and in other cases blowing out with air will help.

   If the previous fluid was petroleum oil it will mix readily with *Pydraul* F-9. However, *the more completely the oil is drained, the safer the new fluid will be.*
3. Clean the *reservoir* carefully and completely. It is desirable to remove interior paint at this time if possible, and this can be done by scraping or with a commercial paint remover. When the reservoir is clean it should be wiped dry with clean rags or towels that are free from dirt or grit. Waste is likely to contain grit particles and lint that will later damage the pump or valves.
4. If a *filter* is used, remove and clean or change the cartridge.
5. Check the *pump assembly* and replace any parts that are seriously worn.
6. As to *packings*, either of two courses may be followed. Many have converted with no change in packings and then have later replaced leaking packings, if any, with resistant materials. The other method is to change part or all of the packings to materials resistant to *Pydraul* F-9 at the time of conversion. Neoprene, a commonly used packing, swells in *Pydraul* F-9. In static or fixed packings this is no problem since the swelling usually makes a tighter seal. However, when the joint is later dis-assembled the swelled packing usually has to be replaced with a new one.

   For dynamic or sliding seals, a neoprene part is more likely to fail and these moving seals should be replaced with packings made of resistant materials. (Most packing manufacturers can now supply packings for use with *Pydraul* F-9. If the regular supplier does not have these, a list of manufacturers is shown in Section VII.)
7. In most machines, if *hose* is used, it is usually of neoprene. In previous installations, this hose has apparently presented no problem. Swelling does not seem to occur nor have there been failures other than from normal wear. However, it is recommended that when hose is replaced, a hose resistant to *Pydraul* F-9 (Butyl lining will suffice) should be used.
8. If a nitrogen bottle *accumulator* is used, no change is necessary. If a bladder type accumulator is used, a Butyl rubber bladder should be used instead of neoprene.
9. *Reconnect* all lines and tighten, particularly those joints previously noted leaking. Fill with *Pydraul* F-9 to the proper level.
10. With the hydraulic controls on neutral, *start and stop* the pump several times, without allowing the system to reach working pressure. This will provide the necessary pump lubrication. The pump may then be left on and the system brought up to working pressure.
11. *Run through* the cycle several times to use all parts of the hydraulic system. Bleed the air through the petcocks or valves provided from any parts in which air can collect.
12. Check the *fluid level* and add *Pydraul* F-9 if necessary.

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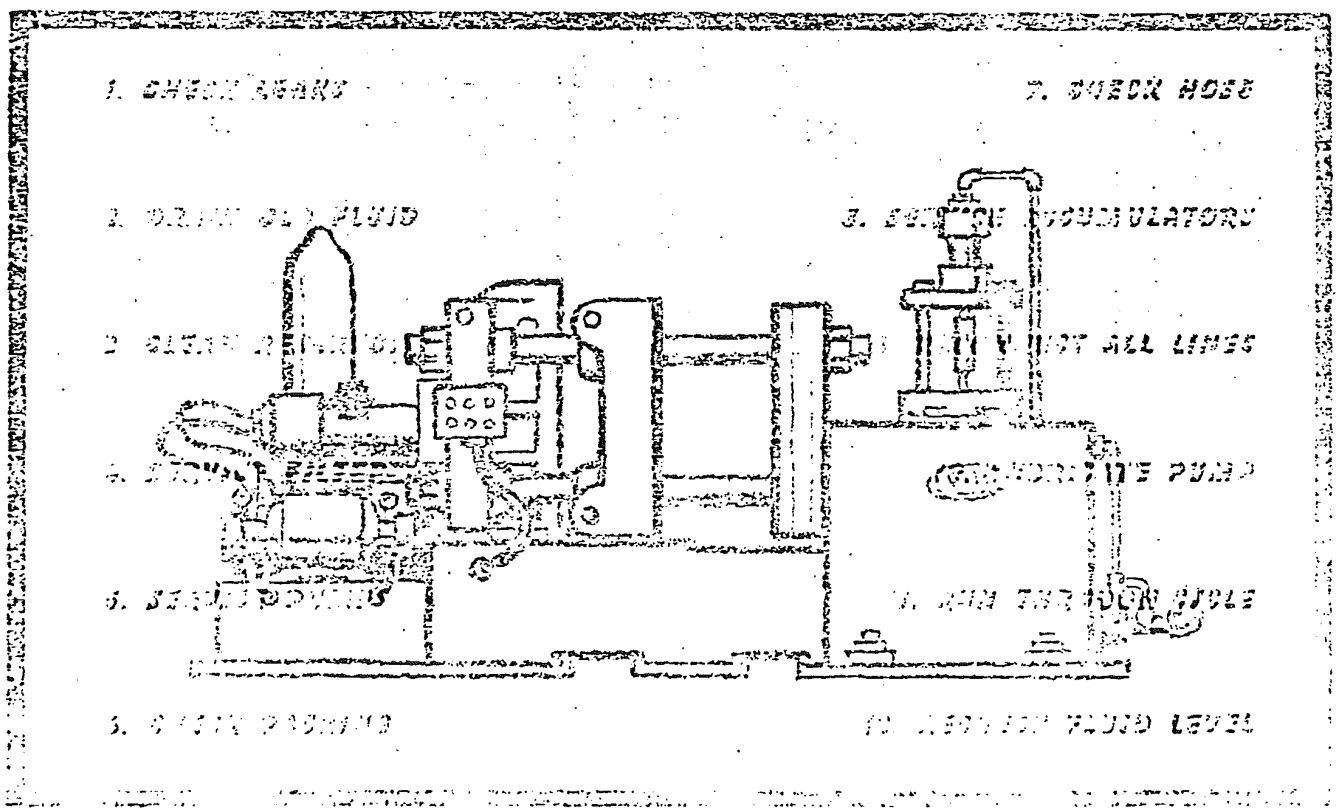
About Fluid Makeup . . .

The technique of holding down the makeup requirement for *Pydraul* F-9 is the same as with any fluid; namely, *adequate maintenance*. The normal loss of *Pydraul* F-9 in a properly converted system will be no more than that for a petroleum fluid, and in a great many cases it has been considerably less. With proper maintenace *Pydraul* F-9 losses in *diecasting* machines have been held to as little as a pint per 8 hour shift. If a fluid reclaiming system is added—a relatively simple matter with *Pydraul* F-9—the total use of fluid can be cut even further. It is not unusual to find that where *Pydraul* F-9 has been installed, the daily cost of hydraulic fluid used has *actually gone down.*



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Section VII: Packings and seals data

Packings and seals suitable for use with *Pydraul* F-9 are available from a large number of manufacturers and in all configurations. No "special" materials are needed for packings or seals — simply certain kinds of standard materials.

Packings resistant to *Pydraul* F-9 are generally required only for moving (dynamic) seals. Static seals may be made of resistant materials or not, as the user prefers. In a static packing, swelling usually gives an even tighter seal. Best practice, however, dictates replacement of nonresistant seals with suitable packings during normal maintenance and routine overhaul.

Table 5 lists the manufacturers who have indicated the availability of packings resistant to *Pydraul* F-9.

TABLE 5: Packings Reported Suitable For Use With PYDRAUL F-9

Supplier	Type and Designation	"O" Rings	"V" Rings	"U" Packings	Flat Gaskets	Oil Seals	Back-up Rings	"U" Cups	Flange Packings	Other
Acushnet Process Co. New Bedford, Mass.	Silicone: SCX-2286	X	X	X	X	X			X	
Anchor Packing Co. 401 N. Broad St., Philadelphia, Pa.	Silicone AP-1	X			X					X
	Teflon		X	X	X		X			
	#450 Hydroll				X					
	Impregnated Duck			X					X	
	Impregnated Asbestos									X
Chicago Rawhide Mfg. Co. 1301 Elston Ave., Chicago 22, Ill.	Sirvene		X	X	X	X	X	X	X	X
Crane Packing Co. 1800 Cuyler Ave., Chicago 13, Ill.	Butyl: 3332	X								
	Butyl: 3342		X							
	Teflon: Chemlon		X		X		X			X
	Vegetable Fiber				X					
Dow - Corning Corp.* Midland, Michigan	Silicone: 50, 80, 152, 250 7-170, 8-170, 8-164, 675	X	X	X	X	X		X	X	X
Garlock Packing Co. Palmyra, New York	Silicone: 9471, 9034	X								
	Silicone: 8859		X	X	X			X	X	X
	Silicone: 8773, 9478		X	X	X	X		X	X	X
	Butyl: 9188, 8783		X	X	X	X		X	X	X
	Asbestos: 900, 950				X					
	Impregnated Duck: 7857, 7059		X	X						
	Teflon	X	X	X	X	X	X	X	X	X
General Electric Co.* Waterford, New York	Silicone: SE 450, SE 360	X	X	X	X	X		X	X	X

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Goshen Rubber Co. P. O. Box 517, Goshen, Ind.	Silicone: S-1219	X		X	X	X	X	X	X
Graef Engineering Co. P. O. Box 416, Paramount, Calif.	Teflon, Kel-F	X					X		X
Greene, Tweed, & Co. North Wales, Pa.	Butyl: 190	X	X	X	X			X	X	X
International Packing Co. Bristol, New Hampshire	Silicone: L 85-1	X	X	X	X	X			X	X
	Butyl: P 64-2	X	X	X	X	X			X	X
	Leather: KK104A, LA-7		X	X	X	X	X	X	X	
Kirkhill Rubber Co. Brea, Calif.	Butyl: 670-X-682D & 670-X-682G	X	X	X	X	X				X
	Silicone: 950-Y-343 & 970-A-185	X	X	X	X	X				X
Linear, Inc. State Road & Levick St., Philadelphia, Pa.	Butyl: PAA-70	X	X	X	X			X	X	X
	Butyl: PAB-85	X	X	X	X			X	X	X
	Impregnated Duck: 865		X	X					X	X
National Motor Bearing Co. 11634 Patton Rd., Downey, Calif.	Butyl: L-14	X								
Parker Appliance Co. 17325 Euclid Ave., Cleveland 12, Ohio	Silicone: 2082-1	X	X	X		X		X	X	X
Plastic & Rubber Products Co. 2100 Hyde Park Blvd., Los Angeles 47, Calif.	Butyl: 805-70	X						X		
Precision Rubber Products Co. 3110 Oakridge Drive, Dayton 7, Ohio	Butyl: 907-70	X								
Raybestos-Manhattan Packing Div. Manheim, Pa.	Asbestos-Neoprene: K-68				X					
	Teflon		X	X	X			X	X	X
W. S. Shamban Co. 11617 W. Jefferson Blvd., Culver City, Calif.	Teflon, Kel-F, Nylon	X	X	X	X		X	X	X	X
	Polyethylene	X	X	X	X		X	X	X	X
Stillman Rubber Co. 5811 Marilyn Ave., Culver City, Calif.	SR 602-A-70	X						X		X
United States Gasket Co. Camden 1, New Jersey	Teflon, Kel-F	X	X	X	X	X	X	X	X	X
United States Rubber Co. Rockefeller Center, New York 20, N. Y.	Butyl: I-8728				X					
	Asbestos-Teflon: 135									X
	Asbestos-Neoprene: 19069				X					
	Butyl: L-14	X								
Vellumoid Co. Rockdale St. & Beaman Ave., Worchester 6, Mass.	Vellumoid				X					

*(Supplier of silicone stock only. Packings are supplied by a number of packing manufacturers.)

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Section VIII: Other hydraulic components

Filters, hose, couplings and other hydraulic system components for use with *Pydraul* F-9 are readily available. Often these are the same units that are used with petroleum fluids. Paints resistant to *Pydraul* F-9 can be supplied by several manufacturers.

Manufacturers who have reported having suitable components for use with *Pydraul* F-9 are listed below.

FILTERS

Standard oil filters can usually be used satisfactorily. Earth type filters are also suitable where excessive quantities of moisture are not present. Manufacturers of such filters include—

Briggs Filtration Co.
Capital Engineering Co.
Cuno Engineering Corp.
Dollinger Corp.
Hilliard Corp.
Honan-Crane Corp.
Marvel Engineering Co.

HYDRAULIC HOSE

Although both neoprene and Buna N type rubber swell in *Pydraul* F-9, hoses of both materials have been used widely and are apparently satisfactory. In practice it would probably be preferable to use a more resistant rubber such as Butyl if new hoses are to be installed. Those supplying hose lined with Butyl rubber include—

Aeroquip Corp.
Anchor Coupling Co.
B. F. Goodrich Co.
Eastman Manufacturing Co.
Electric Hose & Rubber Co.
Resistoflex Corp.
Weatherhead Corp.

SWIVEL COUPLINGS

Pydraul F-9 is being used satisfactorily in systems containing swivel couplings supplied by such companies as—

Barco Mfg. Co.
Chicksan Co.

PIPE JOINT SEALERS

The following products have been reported satisfactory as sealing compounds for pipe joints:

John Crane Plastic Lead Seal No. 2; Crane Packing Co., Chicago, Illinois.

Glyptal 1201 Red Enamel; General Electric Co., Schenectady, N. Y.

Permatex Special Sealant No. 1282; Permatex Co., Brooklyn 35, New York.

Silastic 6127 Putty; Dow Corning Corp., Midland, Mich.

Epon Adhesive VI; Shell Chemical Co., New York 36, N. Y.

ACCUMULATORS

Hydraulic accumulators are found on many systems and in some of these a bladder is used to separate the fluid from the air pressure system. A Butyl rubber bladder is necessary with *Pydraul* F-9.

Companies supplying satisfactory accumulators include—

Greer Hydraulics, Inc.
Hydramotive, Inc.
Superior Pipe Specialties Co.

HEAT EXCHANGERS

Many hydraulic systems, particularly on diecasting machines, use a heat exchanger (oil cooler) to control fluid temperature. These exchangers are metal and can be used with *Pydraul* F-9 quite satisfactorily. Standard thermostats are also compatible with *Pydraul* F-9.

PAINTS

The following paints have been recommended by their manufacturers as being satisfactory for use with *Pydraul* F-9:

Amercoat Corp., South Gate, California: Amercoat #77.

Andrew Brown Co., Irving, Texas: Chemical Resistant Enamel.

Carboline Co., St. Louis 19, Missouri: Phenoline 300, Phenoline 305 (Gray and orange available. Other colors available on order).

E. I. du Pont de Nemours & Co., Kansas City 11, Missouri: Crankcase Sealer 681-8004, Buff Enamel C-100-X-71680.

Finch Paint & Chemical Co., Torrance, California: Cat-A-Lac Primer #454-1-1, Cat-A-Lac Top Coat.

W. P. Fuller & Co., Los Angeles 54, California: 162-Y-63 Primer, 172-A-54 Aluminized Finish Coat, 173-W-57 White Coat Finish, 173-K-55 Sea Blue Finish Coat, 173-B-51 Black Finish Coat. (Other colors available on order.)

Lowe Brothers Co., Dayton 2, Ohio: Thermo Spravinl Finish.

Pittsburgh Plate Glass Co., Milwaukee 1, Wisconsin: Chemical Resistant Enamel 66442.

Rinshed Mason Co., Anaheim, California: H-4537 Red.

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Section IX: Reclaiming PYDRAUL F-9

The exceptional stability of *Pydraul* F-9 and its resistance to water makes possible its recovery from leaks and spills. Careful recovery can result in considerable savings in the cost of the fluid. Therefore fluid recovery should be a definite part of the maintenance program where fluid losses are appreciable. *Pydraul* F-9 can be readily reclaimed by removing the usual contaminants in two steps: separation of the water, and filtration of the dirt.

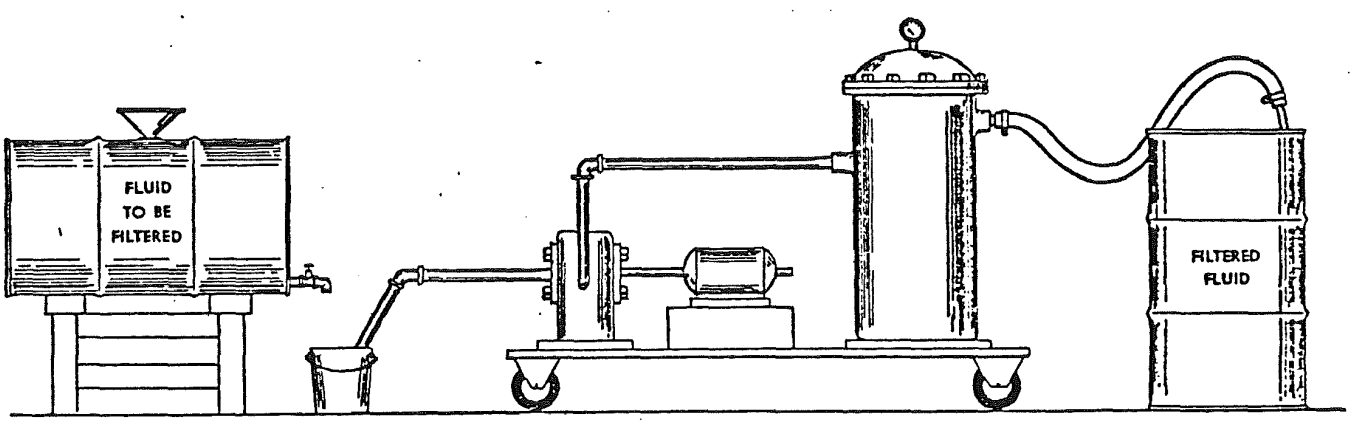
Since water is not soluble in *Pydraul* F-9 it can be easily separated by allowing contaminated fluid to stand until two layers form — water on top and *Pydraul* F-9 on the bottom. In the shop a drum can be reserved for collecting contaminated fluid. A drum with a side and end bung supported horizontally on a cradle about two feet above the floor is a simple and effective settling chamber. With the drum turned so the side bung is on top, salvaged fluid can be added through a large funnel left in the top opening. A drain valve in the end opening can then be used to periodically remove separated *Pydraul* F-9 for filtration. More elaborate methods using this same principle might use settling tanks with sight gauges and so on.

Another method of separating water from *Pydraul* F-9 involves the use of a centrifuge ("cream separator"). Suitable units are manufactured by De Laval and Sharples Co., among others. The advantages of the centrifuge are that large volumes of fluid can be processed rapidly and no settling-out period is necessary.

One caution should be noted. Oil will dissolve in *Pydraul* F-9 and cannot be removed. This will not harm the *Pydraul* F-9 but will increase fluid flammability and may affect packings. To maintain a fire-resistant fluid, contamination with oil should be avoided.

The final step is that of filtration and this can be done in any one of a number of commercial units. Filtering media such as cotton linters, felt, metal screens, etc. can be used and Fuller's earth and diatomaceous earth are satisfactory if water is not allowed to enter with *Pydraul* F-9. A small pump and motor are used to pick up the *Pydraul* F-9 after separation from the water, force it through the filter, and then into the drum for storage. Care, of course, should be taken that the final drum is clean. A salvage drum, portable filter unit and storage drum are shown in Fig. 5. Fig. 6 is a diagram of a typical

FIG. 5: Diagram of Filter Apparatus



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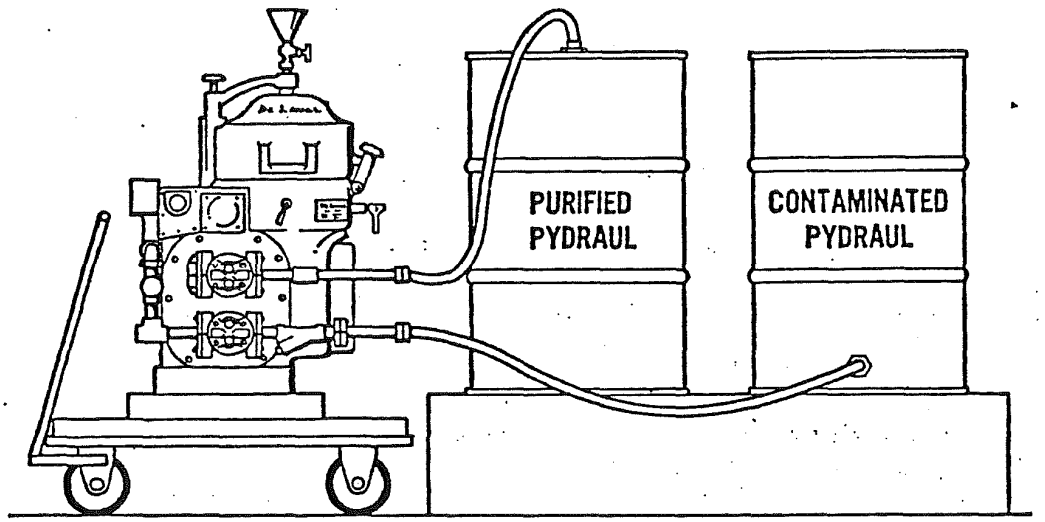
centrifuge unit for water separation. Centrifuged fluid which still contains dirt has to be filtered as in Fig. 5.

Several of the filter manufacturers put out a complete unit that includes the filter, motor and pump. These companies include Hilliard, Cuno, and Honan-Crane. Such a unit has value beyond its use for reclaiming *Pydraul* F-9, as some plants use such equipment to clean up all their hydraulic fluid every few weeks. For other filter manufacturers see page 16.

The quantity of *Pydraul* F-9 that can be reclaimed is usually surprising. Simply placing containers beneath leaks until they can be repaired can result in fluid savings of 10% or more. Where drip pans have been used beneath hydraulic machinery more than 50% of the Pydraul F-9 purchased has been reclaimed. Savings like these greatly reduce overall fluid cost and can make *Pydraul* F-9 the most economical fire-resistant fluid in actual use.

FIG. 6: Diagram of Portable De Laval Centrifuge and Fluid Tanks



Section X: Toxicity and safe handling information

Extensive animal experimental work has been done on *Pydraul* F-9. In the case of oral feedings it was found that the minimum lethal dose for rats was 10.6 to 15.8 grams per kilogram of body weight. In rabbits the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch-tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of *Pydraul* F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050° F. and 1250° F. In all cases the toxicity was roughly comparable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

When splashed or sprayed into the eyes, *Pydraul* F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of *Pydraul*, copius and prolonged washing is recommended. To relieve the irritation, physicians have used 1% pontocaine solution as well as opthalmic cortisone acetate solution.

Regarding the effect of *Pydraul* F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning off a machine following a breakdown, no such protection is necessary.

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AVAILABILITY

Pydraul F-9 is readily available and is supplied in 5 gallon cans, 53 gallon steel drums, tank trucks and tank cars. It is manufactured under strict quality control from materials in dependable supply. Test samples are available. Contact your nearest Monsanto sales office for further information.

SHIPPING INFORMATION

Shipping Classification in U.S.A.—Chemicals, NOIBN

Shipping Regulations —None

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