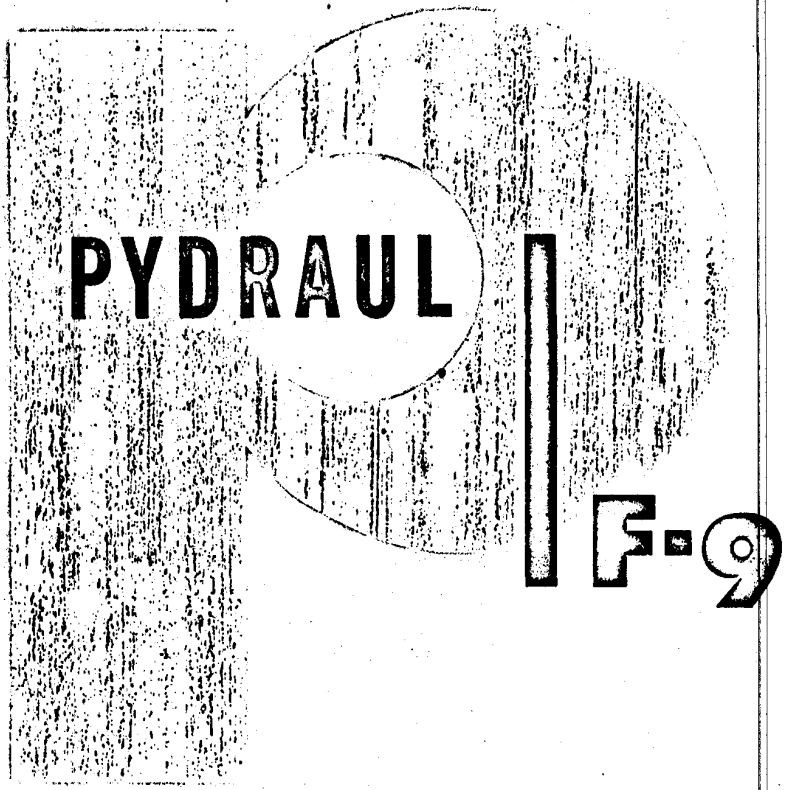



MONSANTO

*A report to engineering executives on a new nonflammable type hydraulic fluid.*

0221183

TOWOLDMON0025851




0221184

TOWOLDMON0025852

Monsanto Pydraul F-9 is an altogether new type hydraulic fluid developed primarily for use in die-casting machines, hydroelectric turbines, glass drawing machinery, hydraulic presses, and in other equipment where a nonflammable-type pressure transfer liquid is required.

Pydraul F-9 has nine major properties that recommend it as an outstanding hydraulic fluid. Chief among these is its safety. In a growing number of hydraulic applications where a flammable fluid is hazardous, Pydraul F-9 is recognized as another forward step in the development of pressure transfer fluids.

Engineers are specifying Pydraul F-9 for uses that extend over a wide range of applications. It is apparent that its unique combination of properties recommend Pydraul F-9 for uses more diversified than the current applications for which it has proved so successful.

Since hydraulic fluids are essential to so many diverse types of equipment, this booklet has been prepared to acquaint engineers, maintenance men, and manufacturers with Pydraul F-9. It describes those characteristics of Pydraul F-9 which may recommend it for use in applications known only to engineering executives whose projects require a nonflammable-type, pressure-transfer medium. For further information on Pydraul F-9, itself, or for data that may be available from experience with its present applications, you are cordially invited to write or call Monsanto.

# PYDRAUL F-9*

1. Fire Resistant
2. Exceptionally High Lubricity
3. Noncorrosive
4. Chemically Stable
5. Nonreactive
6. Excellent Pumpability
7. Contains No Water or Inorganic Salts
8. Insoluble in Water
9. Nonvolatile—Does Not Evaporate

*Trade Mark Reg. U.S. Pat. Off.

0221185



TOWOLDMON0025853

## Chemical and Physical Characteristics

**APPEARANCE**
Clear, oily liquid

**COLOR**
Light amber (APHA 350)

**SPECIFIC GRAVITY**
1.266

**WEIGHT PER GALLON**
10.56

**ACIDITY (mg. KOH/mg.)**
Less than 0.1

**ODOR**
Mild, pleasant

**POUR POINT**
+5°F.

**HYDROLYSIS STABILITY**
Neutralization Number: Less than 0.1 before and after hydrolysis.

**VISCOSITY AT 100°F.**
49.5—58.0 Centistokes
229—268 S. U. S.

**AT 210°F.**
5.6—6.0 Centistokes
44.5—45.8 S. U. S.

## F I R E

Pydraul F-9 resists ignition under conditions that far exceed what would normally be encountered in use. For this reason, Pydraul F-9 can be considered nonflammable for all conditions normally encountered in use as a hydraulic fluid.

Pydraul F-9 was subjected to the following tests and performed with the results indicated:

0221186



TOWOLDMON0025854

# PYDRAUL F-9

## RESISTANT

| TEST | RESULTS |
|---|---|
| **AUTOGENOUS IGNITION TEMPERATURE**<br>(ASTM Method D:286-30) | Greater than 1,100°F. |
| **MOLTEN METAL IGNITION TEMPERATURE**<br>Apex Alloy No. 39* was heated until molten (approximately 1,500°F.) and Pydraul F-9 was sprayed, dripped and flooded onto the surface of the molten metal. | Fluid did not flash or ignite. |
| **HIGH-PRESSURE IGNITION TEST**<br>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. |
| **LOW-PRESSURE IGNITION TEST**<br>Pydraul F-9 was sprayed at low pressure (approximately 100 p.s.i.) across a flame produced by a burning rag saturated with engine oil. | Did not increase the intensity of the fire. |
| **CONTACT IGNITION TEST**<br>Pydraul F-9 was dripped onto the surface of a hot manifold. | Did not burn at 1,100°F., nor when the surface temperature was increased to 1,475°F. |
| **ARC IGNITION TEST**<br>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 free arcing distance of approximately 1 1/2". | At no time was a flash observed, nor did the fluid burn. |
| **STATIC CARBON ARC TEST**<br>A metal pan was filled to a fluid depth of approximately 1/4" 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. |

*Apex Smelting Company
2537 West Taylor
Chicago 12, Illinois

0221187



TOWOLDMON0025855

## HIGH LUBRICITY

Pydraul F-9 can be depended upon for outstanding lubricity, reducing wear on moving parts to a minimum. High film strength, instant mobility and good viscosity index insure longer life for bearings and mating surfaces. The film strength of Pydraul F-9 as determined by seizure load on a Timken machine is 17,000 p.s.i.

The following data shows the lubricating ability of Pydraul F-9 when tested in a Vickers vane pump, Type V-105A. Two pumps were operated in parallel; one was operated on a standard petroleum-base hydraulic fluid, the other with Pydraul F-9.

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 1000 p.s.i. delivering 4.76 gallons per minute. After 400 hours, the Pydraul-operated pump 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 this operation, the pump was dismantled and the parts checked for weight loss. The summarized results shows that the weight change was less than the margin for experimental error.

Vickers conducted an accelerated life test in a piston-type pump at 2000 p.s.i. They reported results indicating no more than normal pump wear in this test.



0221188

TOWOLDMON0025856

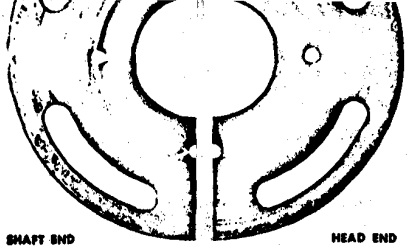
# PYDRAUL F-9

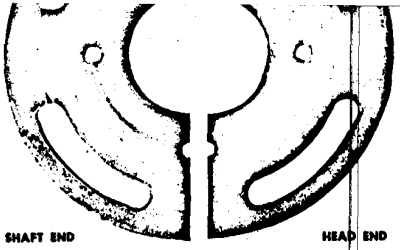
| PYDRAUL F-9 PUMP TEST RESULTS SHOWN ON COLOR<br>PETROLEUM HYDRAULIC FLUID PUMP TEST RESULTS SHOWN ON WHITE | | | | | | |
|---|---|---|---|---|---|---|
| | ACCUM. TIME (Hrs.) | 0 | 200 | 400 | 526.8 | 800 |
| | | 0 | 200 | 400 | | |
| | PUMP SPEED (RPM) | .... | 1200 | 1200 | 1200 | 1800 |
| | | .... | 1200 | 1200 | | |
| | PUMP PRESS. (PSI) | .... | 1000 | 1000 | 1500 | 1500 |
| | | .... | 1000 | 1000 | | |
| PUMP COMPONENT—WT. LOSS (gm.) | VANES (total) | 37.208gm | —.002 | —.010 | —.016 | —.016 |
| | | 34.168 | —.003 | —.004 | | |
| | ROTOR RING | 202.6gm | +0.4 | +0.1 | +0.2 | 0.0 |
| | | 199.0 | —0.1 | —0.1 | | |
| | ROTOR | 322.9gm | 0.0 | —0.1 | —0.1 | —0.1 |
| | | 325.1 | —2.9 | —2.9 | | |
| | SHAFT END (Bushing) | 176.982gm | +.009 | —.014 | —.016 | —.016 |
| | | 160.448 | —.014 | —.019 | | |
| | HEAD END (Bushing) | 178.433gm | —.002 | —.019 | —.035 | —.039 |
| | | 179.831 | —.015 | —.017 | | |
| FLUID CONDITION | VIS. (cks.) at 100°F. | 56.8 | 43.0 | 41.3 | .... | 39.9 |
| | | 64.0 | 62.6 | 62.5 | | |
| | VIS. (cks.) at 210°F. | 5.98 | 4.37 | 4.53 | .... | 4.15 |
| | | 6.97 | 6.89 | 6.98 | | |
| | NEUT. No. mg. KOH per gr. | 0.04 | 0.05 | 0.08 | .... | 0.18 |
| | | 0.02 | 0.04 | 0.08 | | |

Last 400 hours test conditions were accelerated up to 1,500 p.s.i., 1,800 r.p.m.



TOWOLDMON0025857

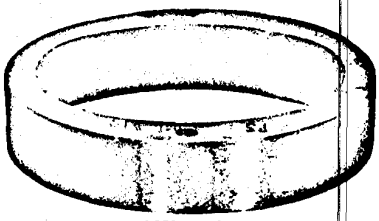


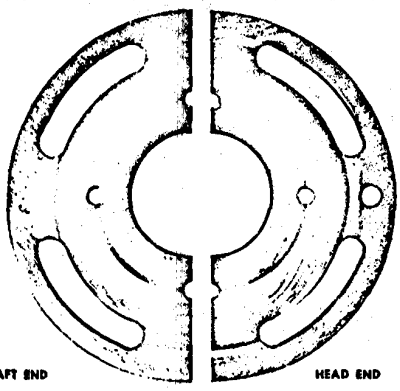



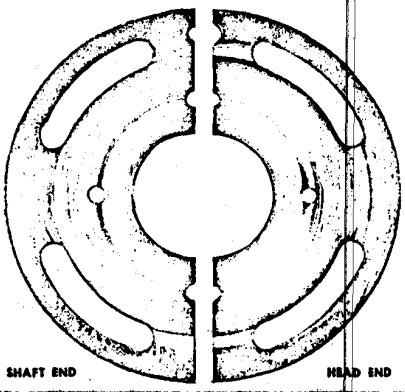

200 HRS.

400 HRS.

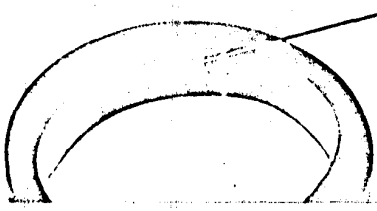


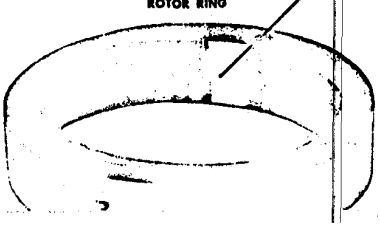




Manufacturer's representative examined slight wear spot and stated




0221190

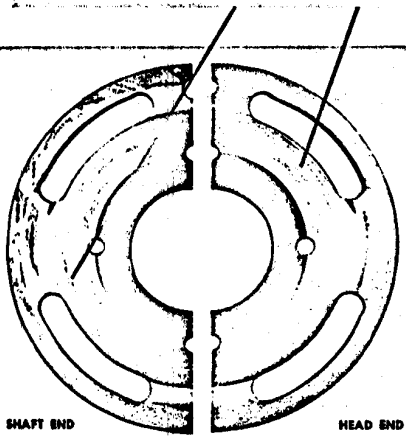
TOWOLDMON0025858

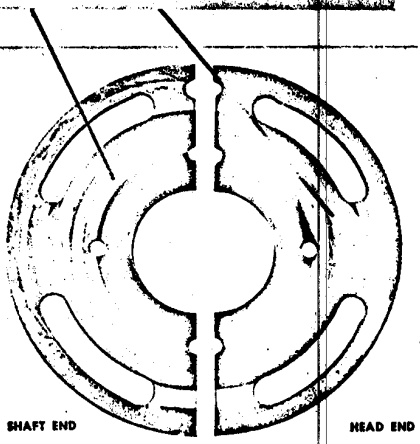
**Photographic record of results of pump test referred to on page 4 and table, page 5.**

Parts shown, were examined and photographed at 200, 400, 526.8 and 800 hours. Parts of pump tested with Pydraul F-9 are illustrated in color panel below. Wear on control pump parts is illustrated at top.

**526.8 HRS.** **800 HRS.**

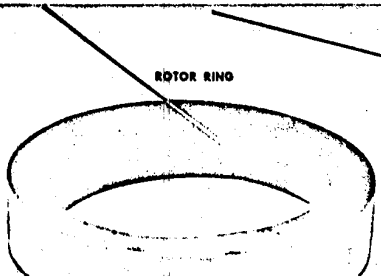
**Discoloration, no roughness could be observed.** After 800 hours of operation, the last 400 in two stages of increased pressure and faster speed, the weight change of the parts was less than the margin for experimental error.

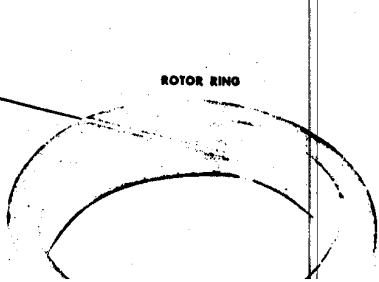



it was not unusual. Wear did not increase or affect quiet operation.

0221191




TOWOLDMON0025859

## NONCORROSIVE

## CHEMICALLY STABLE

## NONREACTIVE

Pydraul F-9 is inert to common metals of construction, and is so chemically stable that it does not break down under thermal or mechanical stress into degradation products which could attack metal surfaces. Pydraul F-9 can be operated continuously without chemical breakdown at temperatures up to 300°F.

The following tests were run according to procedures for determining corrosion and oxidation stability as specified by the Army-Navy Aeronautical Specification, Oil; Hydraulic Petroleum-Based. Spec. AN-VV-O-366b, Amend. 2, Section E 4e.

### CORROSION AND OXIDATION STABILITY

| | | |
|---|---|---|
| Viscosity at 130°F. | — Initial | 23.6 Centistokes |
| | — Final | 24.1 Centistokes |
| | — % Change | 2.12 |
| Neutralization Number | — Initial | 0.05 |
| | — Final | 0.07 |
| Fluid Evaporation | | 3.0% |
| Fluid Separation | | None |
| Effect on Metals | | |

| Metal | Wt. Change (mg./cm.²) | Visual Examination |
|---|---|---|
| Copper | —0.16 | Slight Darkening |
| Iron | +0.01 | Nil |
| Aluminum | +0.02 | Nil |
| Magnesium | +0.02 | Nil |

### SHELL FOUR BALL WEAR TESTS

(1 hour at 167°F. and 600 r.p.m.)

| Metals | Load (kg.) | Scar Diameter |
|---|---|---|
| Steel on Steel | 1 | 0.20 mm. |
| Steel on Steel | 40 | 0.71 mm. |
| Steel on Bronze | 1 | 0.50 mm. |
| Steel on Bronze | 40 | 1.32 mm. |



0221192

TOWOLDMON0025860

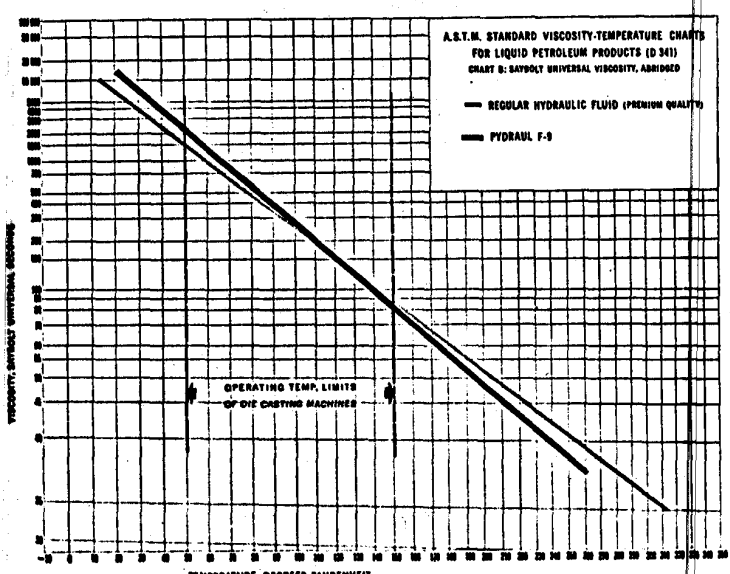
# PYDRAUL F-9

## EXCELLENT PUMPABILITY

Pydraul F-9 is highly mobile, even at the lowest temperatures normally encountered in machine operation. This property insures less wear on pumps which are subject to infrequent operation or intermittent cold starts. Pydraul F-9's viscosity characteristics are almost identical with those of a medium grade petroleum-base hydraulic fluid.

The following types of equipment have proved in actual use that Pydraul F-9 gives excellent operating characteristics in addition to the greater safety from fire:

**DIE CASTING MACHINES**
**HYDRAULIC RIVETING MACHINES AND PUNCHES**
**HYDRAULIC PRESSES**
**HYDRAULIC OVEN DOOR ACTUATORS**
**HYDRAULIC RAMS**






0221193

TOWOLDMON0025861

## PACKING AND GASKET MATERIALS

## FOR USE WITH PYDRAUL F-9

With most standard packings and gaskets, ordinary fluids can simply be drained out, the system cleaned as thoroughly as is practical, and filled with Pydraul F-9. Experience has shown that although Pydraul F-9 may cause swelling in some types of gaskets and packings, unless the machine is dismantled such swelling is not objectionable.

Because of this swelling action it is impossible to reinstall standard packings removed from a Pydraul F-9 operated system. It is good practice to replace rather than reuse seals and packings and it is recommended that resistant materials be installed at this time.

Pydraul F-9 has a solvent action on certain paints.

Suitable packing and gasket materials and surface coatings are readily available. The following materials have been thoroughly tested; similar materials of other suppliers, although not listed specifically, should be equally suitable:



0221194

TOWOLDMON0025862

# PYDRAUL F-9

| SUPPLIER | MATERIAL | TIME OF IMMERSION | TEMP. | % SWELL |
|---|---|---|---|---|
| Thiokol Corp.,<br>780 North Clinton Avenue,<br>Trenton, New Jersey | Thiokol #FA<br>Thiokol #FA | 3 days<br>7 days | 160°F.<br>160°F. | 24.0<br>26.8 |
| Linear Inc.,<br>State Road and Levick Street,<br>Philadelphia 35, Pennsylvania | Linear PR70<br>Linear PR70<br>Linear PS85<br>Linear PS85<br>Linear ZB70<br>(silicone base)<br>("O" rings only) | 7 days<br>7 days<br>7 days<br>7 days<br>7 days | Rm. temp.<br>158°F.<br>Rm. temp.<br>158°F.<br>158°F. | 4<br>20<br>4<br>20<br>4 |
| Plastic & Rubber Prods. Co.,<br>2100 Hyde Park Blvd.,<br>Los Angeles 47, California | TC-315-70 | 70 hrs. | 158°F. | 10.5 |
| The B. F. Goodrich Co.,<br>Akron, Ohio | 147-GH-7<br>(butyl hose) | 7 days | 160°F. | 21.5 |
| Dow Corning Corp.,<br>1514 South Hope Street,<br>Los Angeles 15, Calif. | Silastic 250<br>Silastic 250<br>Silastic 250<br>Silastic 250<br>Silastic 181<br>Silastic 181<br>Silastic 7-170<br>Silastic 7-170 | 3 days<br>7 days<br>1 day<br>4 days<br>1 day<br>4 days<br>1 day<br>4 days | 160°F.<br>160°F.<br>392°F.<br>392°F.<br>392°F.<br>392°F.<br>392°F.<br>392°F. | 8.15<br>9.96<br>16.8<br>8.2<br>6.7<br>4.7<br>8.0<br>7.5 |
| E. I. du Pont de Nemours & Co. Inc.,<br>Wilmington 98, Delaware | Nylon (for protective coatings over wire and painted surfaces) and Teflon (for back up rings) are suitable for use with Pydraul F-9. | | | |

0221195



TOWOLDMON0025863

## READILY AVAILABLE

Pydraul F-9 is manufactured from raw materials that are in dependable supply. It is shipped under contract which protects the user from changes in quality, reduced quantity or shipping delays. Pydraul F-9 is manufactured under strict quality control and is uniform in quality and appearance from shipment to shipment.

*For further information on Pydraul F-9, simply write or call Monsanto. A sample suitable for testing will be sent on request.*




**MONSANTO CHEMICAL COMPANY**
*Organic Chemicals Division*
800 North 12th Blvd. • ST. LOUIS 1, MISSOURI
Birmingham • Boston • Charlotte, N. C. • Chicago • Cincinnati • Cleveland • Detroit
Houston • Los Angeles • New York • Philadelphia • Portland, Ore. • San Francisco
Seattle • Twin Cities • Monsanto Canada Ltd., Montreal, Toronto, Vancouver
Monsanto Chemicals (Australia) Ltd., Melbourne • Monsanto Chemicals Ltd., London


0221196



Printed in U.S.A. 2180—00000—1253—47

TOWOLDMON0025864



MONSANTO

SERVING INDUSTRY...WHICH SERVES MANKIND

0221197

TOWOLDMON0025865