Obsolete 9/12/68

T E C H N I C A L B U L L E T I N

PYDRAUL®

Fire-Resistant Hydraulic Fluid

SELECTOR I

A guide to selecting the correct Pydraul fluid for your hydraulic system.

O-FF/3

Monsanto

0237425

TOWOLDMON0027637

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FUNCTIONAL FLUIDS

Monsanto

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PYDRAUL® FLUIDS

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since served industry with millions of machine hours of fire-free operation. Pydraul fluid has never contributed to a fire — not even when sprayed from the broken ends of high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. The first Pydraul fluid, general-purpose Pydraul F-9, has grown to a family of six, specially tailored, fire-resistant hydraulic fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out — from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits —

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines that operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines that use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month — or even replaced from year to year.

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Converting to Pydraul is Easy

No matter what type of hydraulic fluid you now use in your equipment, you can easily convert to Pydraul. Virtually every type of hydraulic machinery requiring a fire-resistant hydraulic fluid has been converted to Pydraul. Equipment manufacturers are experienced in converting machinery to Pydraul and should be consulted for their specific recommendations. Some manufacturers will tell you exactly what seals to change. Most can supply the correct seals.

Machines operating on a *straight synthetic*, fire-resistant fluid can be converted to Pydraul without interrupting your production. When converting to Pydraul A-200, Pydraul 625, or Pydraul AC, simply add Pydraul as make-up. To convert to other Pydraul fluids, drain the old fluid and refill with the Pydraul fluid. No flush is necessary. For best seal performance, make your future seal selection according to recommendations in the booklet "Converting to Pydraul® Hydraulic Fluids."

Machines operating on oil or water-based hydraulic fluids require the few simple steps outlined below. These steps are necessary to clean the system of the old fluid and to change to dynamic seals compatible with Pydraul.

CHECK FOR LEAKS

Check your entire system for leaks before you shut down. Mark any leaks for sealing after the system is drained.

DRAIN THE SYSTEM

Drain your present fluid as completely as possible from reservoir, lines and cylinders. Flush system with steam or warm water to avoid residual oil and water-glycol sludge that can reduce Pydraul fluid fire-resistance. You may also be able to do this by opening unions at low spots in your system and blowing out with clean dry air. Seal any leaks.

CLEAN RESERVOIR AND FILTERS

If your reservoir is painted, use a commercial paint remover or scrape out the interior to prevent paint deterioration later on. Wipe your reservoir clean with lint-free rags. Clean or change the cartridge in your filter.

CHECK PUMPS

Check your pumps thoroughly for wear. Replace any worn parts.

CHANGE SEALS, PACKINGS AND HOSES

Change your dynamic seals to seals compatible with Pydraul hydraulic fluid. If you use reinforced type hoses that are in good condition, you normally won't need to change them. If your hoses undergo severe flexing, we recommend butyl or Teflon-lined hoses. Your accumulator diaphragms should be of butyl, fluoroelastomers, EPR or silicone. Avoid buna elastomers, neoprene and natural rubber.

RECONNECT LINES

Reconnect your lines, and tighten firmly. Fill your system with Pydraul to the manufacturer's recommended level.

START AND STOP PUMP

With the hydraulic controls in neutral, start and stop your pump several times, without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system up to working pressure.

RUN THROUGH CYCLE

Run through the full operating cycle several times to use all parts of your system. Bleed any trapped air through the petcocks. Check your fluid level and add Pydraul if necessary.

ASK FOR THE BOOKLET

"Converting to Pydraul® Hydraulic Fluids," for complete information.

HOW TO EQUIP NEW MACHINERY WITH PYDRAUL

When ordering new hydraulic equipment, simply specify, "For use with Pydraul hydraulic fluid" and state the specific Pydraul you will use.

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See attached sheets for data for these columns.

Pydraul® Selector

	PYDRAUL F-9	PYDRAUL 60
PHYSICAL PROPERTIES Appearance	Cloudy Blue Liquid	Cloudy Blue Liquid
Spec. Gravity 25°/25°C	1.280—1.295	1.088—1.091
Neutralization No. (acidity) (mg KOH/gm) max.	0.12—0.35	0.25
Moisture (max.)	0.20%	0.10%
VISCOSITY See attached (1) for this section ⟷		
As measured: 100° F.	225 SSU	60 SSU
(Corrected) 210° F.	43.3 SSU	35 SSU
"Absolute Saybolts" 100° F.	327 SSU	60.5 SSU
(SSU X Density) 210° F.	52 SSU	35 SSU
Pour Point	−5° F.	−70° F.
Compressibility X10⁻⁶ sq. in./lb.	2.58	3.05
Bulk Temperature Max. (for a continuous operation)	~~300° F.~~ 225°F	~~200° F.~~ 175°F
Boiling Point °F at 760 mm Hg.	644° F.	707° F.
Cofficient of Thermal Expansion per °F.	0.00041	0.00044
Specific Heat (BTU/lb./° F.) (@ 77° F.)	0.32	0.42
Thermal Conductivity BTU/hr./ft./° F.	0.067	0.047
Vapor Pressure Hg @ 200° F.	0.1mm	0.01mm
Bulk Modulus (Room Temp. 1000-6000 psi)	387,000	328,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST (C)		
High Pressure Spray Test AMS-3150B and MIL-F-7100. Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 6000° F.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing
Low Pressure Spray Test (AMS-3150B). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity. (C)	No increase in flame intensity.	Slight increase in flame intensity.
Hot Manifold Test (MIL-F-7100). Test fluid dripped on tube at 1300° F.	Does not flash or burn.	Intermittent flashing and burning. Does not burn after leaving tube.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.	Does not ignite: flashes by spark.	Does not ignite.

Fire-resistance Advantages of Pydraul

Pydraul fluids protect hydraulic equipment and personnel with *permanent* fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their more than one billion machine hours of use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks —without causing fire. Pydraul fluids have never caused or contributed to a hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance.

FEDERAL TEST METHOD STD. 791.

Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is now used in every major type of die-casting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line *proven* performance to offer.

Low viscosity Pydraul 60 flows freely at −20° F. It retains its properties and thermal stability at temperatures up to 200° F. In hydraulic operations that require precision flow *instantly*, Pydraul 60 supplies smooth operation from machine start to stop; it offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

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1.120 - 1.132 OMIT THIS COLUMN 1.360 - 1.400

PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625
Cloudy Blue Liquid	Cloudy Blue Liquid	Blue Green Liquid	Cloudy Blue Liquid
~~1.119—1.135~~	1.415—1.430	1.100—1.115	~~1.340—1.360~~
0.17	0.80—1.10	0.30	0.30
~~0.15%~~ — 0.10%	0.05%	0.10%	0.15%
145.9 SSU 52.5 SSU 183 SSU 56 SSU	144 SSU 35.7 SSU 204 SSU 48 SSU	312 SSU 50.9 SSU 346 SSU 56.5 SSU	625.7 SSU 45.9 SSU 845 SSU 59 SSU
−55° F.	+15° F.	−10° F.	+ 30°F. ~~+20° F~~
3.13	2.28	2.74	2.66
~~200° F. 175°~~	~~300° F. 252°~~ F	225° F.	225°F (max exit air Temp 350°F)
617° F.	620° F.	615° F.	724° F.
0.00042	0.00040	0.00036	0.00040
0.40	0.28	0.36	0.28
0.072	0.068	0.069	0.065
0.1mm	0.2mm	0.1mm	0.09mm
319,000	438,000	365,000	375,000
Negligible	Negligible	Negligible	Negligible
elf-extinguishing.	Does not flash or ignite up to 3½ feet from orifice.	Intermittent flashing but self-extinguishing.	Does not flash or ignite up to 3½ feet from orifice.
ight increase in flame intensity.	Slight increase in flame intensity.	Slight increase in flame intensity.	Very slight increase in flame intensity.
ermittent flashing and burning. ttle burning in pan below.	Does not flash or burn.	Intermittent flashing but does not propagate to pan below.	Does not flash or burn.
es not ignite.	Does not ignite.	Does not ignite spontaneously. Flashes intermittently with ignition source.	Does not ignite.
Pydraul 150 is ~~currently~~ used ~~in more than seven~~ hundred ~~G.P.E.~~ (formerly Askania) regulators to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Pydraul A-200 is one of the most widely used, general-purpose, fire-resistant hydraulic fluids in industry. Introduced in 1959, it was the first fire-resistant, straight synthetic hydraulic fluid to break the "price/performance barrier." Pydraul A-200 performs like premium-grade petroleum oil in a wide variety of industrial applications, from die-casting to aluminum extrusion. It protects plants and personnel with chemically "inherent" fire-resistance, yet costs less than other straight synthetic fluids.	The newest fire-resistant hydraulic fluid. A break through in medium viscosity fluids that offers high performance and lubricity at the lowest cost in the industry. Pydraul 312 hydraulic fluid is a unique marriage of synthetic fluids with specially chosen petroleum fractions. The result is a fire-resistant hydraulic fluid that matches or excels the properties of existing synthetic and water-containing fluids . . . even the "anti-wear" petroleum oils. Today, Pydraul 312 can be used in all major types of die casting machines, hydraulic presses, automatic welding machines, and injection molding equipment with excellent results.	High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics that have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proven to be a top-grade lubricant.

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for hydraulic systems

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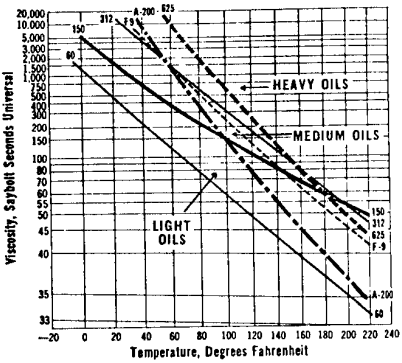
Pydraul Viscosities

Laboratory viscosity measurements of SSU (Saybolt Seconds Universal) are affected by fluid density. Because all petroleum oils used for hydraulic operations have similar densities, their measured viscosities can be compared; however, the densities of synthetic fluids differ from one another and from petroleum oils. To compare viscosities, measured viscosities of synthetic fluids must be corrected for density.

Each curve on the chart shows the viscosity-temperature relationship modified for the difference in density of the indicated Pydraul fluid. By comparing these curves with viscosity curves of light, medium, and heavy grades of petroleum oils, it can be seen that Pydraul fluids virtually duplicate viscosities of petroleum oils at normal operating temperatures.



Absolute Saybolt Viscosity= Measured SSU × Density of Pydraul

Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent — they never evaporate or wear out.

	PYDRAUL F-9	PYDRAUL 60	PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 825	PYDRAUL 17C*
Timken Load (Passing)	50 lbs. 17,500 psi	14 lbs. 7,400 psi	40 lbs. 18,200 psi	50 lbs. 16,300 psi	55 lbs. 18,000 psi	55 lbs. 21,200 psi	50 lbs. 23,250 psi
Almen Wear	2.0 mg@ 4,000 psi	—	3.9 mg@ 4,000 psi	1.3 mg@ 4,000 psi	—	2.2 mg@ 4,000 psi	—
Almen Load	43 lbs. 25,000 psi	48 lbs. 25,000 psi	46 lbs. 23,000 psi	44 lbs. 24,000 psi	—	50 lbs. 23,000 psi	—
Falex Load—Jaw Load—lbs.	4100	2300	2000	4200	1800	4100	3600
—Torque—lb. inches	93	73	64	90	35	89	98
Falex Wear (Under continuous load @ 100 lbs., loss in inches)							
1st 10 minutes	0.000428	0.000475	0.000428	0.000380	—	0.000618	0.000425
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	—	0.000332	0.000285
Shell Four-Ball Wear (167°F. 1 hr., 1200 rpm, mm scar) Steel on Steel							
10 kg	0.28	0.27	0.36	0.29	0.25	0.26	0.32
40 kg.	0.67	0.48	0.51	0.43	0.44	0.62	0.70
Steel on Bronze							
10 kg.	1.18	0.82	0.80	1.40	0.87	1.10	—
40 kg.	1.28	2.35	1.58	1.70	—	1.19	—
Pump Test—Vickers (V-105-E, 140°F. 1000 hrs.)							
Ring, grams (loss or gain)	−0.0084	−0.0037	−0.1212	−0.0848	−0.0013	−0.0013	+0.0076
Vanes, grams (loss or gain)	−0.0011	−0.1859	−0.0378	−0.0191	−0.0021	−0.0015	+0.0014
Bushing 2015 grams (loss or gain)	+0.0120	+0.0008	−0.1601	−0.0151	+0.0081	−0.0045	+0.0040
Bushing 2016 grams (loss or gain)	−0.0063	−0.0020	−0.1134	−0.0217	−0.0057	−0.0050	+0.0045

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Mixing Compatibility

Tighten this chart to include 17C and 17C-W62B as indicated.

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	200	312	625	17C	17C-W62B
CELLULUBE								
90	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
150	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
220	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
300	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
550	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
HOUGHTO-SAFE								
1010	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
1055	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
1120	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES
1130	**NO**	YES	**NO**	YES	**NO**	YES	YES	YES

PYDRAUL WITH OTHER PYDRAULS FLUIDS

F9	—	**NO**	YES	YES	YES	YES	YES	YES
60	**NO**	—	**NO**	YES	**NO**	YES	YES	YES
150	YES	**NO**	—	YES	YES	YES	YES	YES
200	YES	YES	YES	—	YES	YES	YES	YES
312	YES	**NO**	YES	YES	—	YES	YES	NO
625	YES	YES	YES	YES	YES	—	YES	YES

WATER-GLYCOL and **WATER-OIL EMULSION** Fluids — Pydraul hydraulic fluids are not compatible with these fluids.

Insert before double line:

17C	YES	YES	YES	YES	YES	YES	—	YES
17C-W62B	YES	YES	YES	YES	NO	YES	YES	—

and Storage

specialized industrial fluids, certain e advisable when handling Pydraul blems will arise when Pydraul fluids commended.

d or continuous skin contact. Re- onged contact can lead to drying and g." Where prolonged skin contact ided, gloves should be worn.

eratures, there is no vapor inhala- om Pydraul; however, inhalation of temperatures should be prevented. imal experimentation, exposures to ie hour showed local respiratory hough no systemic effects were

irritation studies using Pydraul indicate Pydraul is a mild irritant, vidence to show Pydraul causes permanent damage to eye tissues. If Pydraul fluid is splashed or sprayed into the eyes, eyes should be thoroughly flushed with water and the workman referred to a physician. To relieve irritation, physicians have used 1% pontocaine solution, as well as the ophthalmic cortisone acetate solution.

Pydraul hydraulic fluids can be stored at sub-zero temperatures without fluid damage. Before using, simply allow the fluid to warm to room temperature. Drums stored outside should be sealed tightly and placed in a horizontal position to keep out moisture.

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2-2131-0466-6 LITHO IN U.S.A.

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Pydraul AC is a special safety lubricant for air compressors which provides several important advantages over petroleum oil for this use. Pydraul AC reduces the threat of compressor fires and explosions by eliminating combustible mists and minimizing carbonaceous residues.

Costs of compressor down-time and cleaning are greatly reduced, because Pydraul AC virtually eliminates deposits on exhaust valves, in coolers, and in piping. These lower maintenance costs alone usually justify Pydraul AC for air compressors.

Pydraul AC Winter Grade 28, a low temperature lubricant, is recommended for air compressors which operate in low ambient temperatures.

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PYDRAUL AC	PYDRAUL AC WINTER GRADE
clear blue liquid	clear blue liquid
1.345 - 1.385	1.275 - 1.295
0.15	0.15
0.15%	0.15%
~~8.2cs to 42cs~~ ~~4.6cs to 5.0cs~~ ~~40F SSU~~ ~~42.1 SSU~~ ~~150 SSU~~ ~~57 SSU~~	~~26.0cs to 30cs~~ ~~3.5cs to 3.7cs~~ ~~40F SSU~~ ~~42.1 SSU~~ ~~150 SSU~~ ~~52 SSU~~
+20°F	0°F
2.66	2.66
225°F (max. exit air temp. 350°F)	225°F (max. exit air temp. 350°F)
688°F	688°F
0.00040	0.00040
0.32	0.32
0.066	0.066
2.0×10^{-2}	2.0×10^{-2}
375,000	375,000
Negligible	Negligible
Does not flash or ignite up to 3½ feet from orifice	Does not flash or ignite up to 3½ feet from orifice.
very slight increase in flame intensity.	very slight increase in flame intensity.
Does not flash or burn	Does not flash or burn.
Does not ignite	Does not ignite.
A	B





See attached (1) for this section

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	PYDRAUL F-9	PYDRAUL 60	PYDRAUL 150	PYDRAUL A-200	PYDRAUL [illegible]	DRAUL AC	PYDRAUL AC WINTER GRADE 28
VISCOSITY							
Centistokes @ 100 F	43 to 53	9.6 to 10.4	29 to 34	30.0 to 33.0	125 to 1[illegible]	[illegible]2 to 92	26 to 30
210 F	5.0 to 5.8	2.3 to 2.5	6.9 to 8.1	2.8 to 3.0	5.7 to 6.[illegible]	[illegible]5 to 5.0	3.5 to 3.9
Saybolts as @ 100 F	225 SSU	60 SSU	145.9 SSU	144 SSU	625.7 S[illegible]	408.8 SSU	408.8 SSU
measured: 210 F	43.3 SSU	35 SSU	52.9 SSU	35.7 SSU	45.9 S[illegible]	42.1 SSU	42.1 SSU
"Absolute Saybolts" @ 100 F	327 SSU	60.5 SSU	163 SSU	204 SSU	845 S[illegible]	550 SSU	180 SSU
(SSU X Density) 210 F	52 SSU	35 SSU	56 SSU	48 SSU	59 S[illegible]	50 SSU	52 SSU

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