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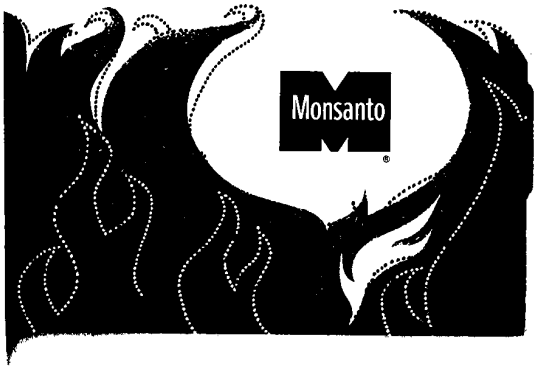
PYDRAUL® AC

FIRE-RESISTANT LUBRICANT FOR AIR COMPRESSORS

FACT FINDER



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PYDRAUL AC

FACT FINDER

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THE PYDRAUL AC FACT FINDER

. . . is designed to make the many facts and features about Pydraul®AC fire-resistant lubricant for air compressors quick and easy to find. Just flip the pages in front of the tabs on the right to lead you directly to the information you want.

A special safety lubricant for air compressors, Pydraul AC provides three important advantages over petroleum oil: safety from fire and explosion; virtual elimination of valve deposits, and lower maintenance costs. By eliminating combustible mists and minimizing carbonaceous residues, Pydraul AC reduces the threat of compressor fires and explosions.

Pydraul AC also reduces compressor maintenance costs. By eliminating deposits on exhaust valves, in coolers, and in piping, Pydraul AC greatly reduces the costs of compressor down-time and cleaning. These lower maintenance costs alone usually justify Pydraul AC for air compressors.

For air compressors which operate in low ambient temperatures, Pydraul AC Winter Grade 28, a low temperature lubricant, is recommended. Pydraul 625 is recommended for compressors requiring a high viscosity lubricant. For data and information on Pydraul 625, ask your man from Monsanto for the bulletin "Pydraul® Fire-Resistant Hydraulic Fluids Selector".

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HOW COMPRESSOR FIRES & EXPLOSIONS MAY OCCUR

There are several theories concerning the mechanisms of fires and explosions in air compressor systems, but one point is common in every case: petroleum oil lubricants are directly involved.

Mist and accumulated films from petroleum oil in compressor systems can under a variety of conditions break down into combustible gases and carbonaceous residues that can ignite and produce an explosion, a receiver fire—or both. The U. S. Bureau of Mines[1] found that carbon deposits in air compressors lubricated with petroleum oil form a "carbon-oxygen complex." Oxidation forms this complex, and accelerated by heat, this oxidation process can lead to an explosion.

Safety devices do not completely eliminate fire and explosion possibilities. A recent study on "The Mechanism of Explosions In Starting Air Lines,"[2] based on an exhaustive survey of compressor operations at 53 companies, reports that a stuck or leaking air check valve permits the engine being started to pack the section of line between the check and air timing valve with an explosive "oil residue-air" mixture. A pressure wave will force this mixture upstream into the main air line—and coupling this with good flame propagation in the power cylinder, the condition is laid for explosion in the pipe system.

Air line explosions and fires may even occur without the engine being started or before the ignition is turned on.[2] Carbon and rust particles in a "hot" air line, due to operating an overheated compressor too long—hardly

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an improbable condition—can become saturated with oil, and with the flow of starting air, can cause these oil-saturated particles to flame.

The Walter Kidde Company, makers of fire extinguishing equipment, warns in a study[3] that users of high pressure air should guard against introducing a shock wave into high pressure lines by suddenly opening a plug cock in air compressor systems using petroleum oil. This report showed that in a 1-inch diameter tube, the inside walls filmed with oil, a sudden admission of air at pressures above 1300 psi caused combustion.

The variety of fire and explosive conditions that may occur in air compressors lubricated with petroleum oil are many and unpredictable. This danger and unpredictability raises the need for eliminating the *source* of carbon deposits, the basic cause of most air compressor fires and explosions.

Fire- and explosion-resistant Pydraul AC essentially eliminates this basic cause by minimizing carbon deposits. Its superior oxidation resistance adds to its ability to prevent explosions. And by its inherent ability to resist burning in air, Pydraul AC substantially reduces the threat of fire.

1. "The Carbon-Oxygen Complex as a Possible Initiator of Explosions and Formation of Carbon Monoxide in Compressed Air Systems," by Busch, Berger, and Schrenk, Bureau of Mines paper R.I.4465, June 1949.

2. "The Mechanism of Explosions in Starting Air Lines," by Ridgway, Robert S., *Petroleum Refiner*, June 1958.

3. "Oil Combustion Phenomena in High Pressure Air Systems," M. W. Weibel, Walter Kidde & Co., Inc., Report R-831, copyright 1952.

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PHYSICAL PROPERTIES

Appearance	Clear blue liquid
Spec. Gravity 25°/25°C	1.340-1.360
Neutralization No. (acidity) (mg KOH/gm) max.	0.15
Moisture	0.15%
Viscosity As measured: 100°F 210°F	408.8 SSU 42.1 SSU
"Absolute Saybolts" 100°F	550 SSU
(SSU x Density) 210°F	50 SSU
Pour Point	+20°F
Compressibility x 10^{-6} sq. in./lb.	2.66
Bulk temperature max.	300°F
Boiling Point °F at 760mm Hg.	688°F
Coefficient of Thermal Expansion per °F.	0.00040
Specific Heat (BTU/lb./°F (@77°F)	0.32
Thermal Conductivity BTU/hr./ft./°F	0.066
Bulk Modulus (Room Temp. 1000-6000 psi)	375,000
Solubility in Water	Negligible

COMPATIBILITY WITH METALS

Pydraul AC is compatible with all construction metals including aluminum. In most operations, aluminum bearing surfaces that have been anodized will wear as long as any other metal bearing lubricated with Pydraul AC.

SURFACE TENSION

45 dynes/cm at 25°C

Film strength (measured by Timken EP)—24,200 psi

Petroleum oil film strength (measured by Timken EP)—5,000 to 7,000 psi

VAPOR PRESSURE

Temperature		
°C	°F	mm Hg
0	32	2.0×10^{-4}
10	50	6.8×10^{-4}
20	68	2.0×10^{-3}
40	104	1.5×10^{-4}
60	140	9.6×10^{-4}
80	176	4.7×10^{-3}
100	212	2.0×10^{-2}
150	302	0.8
200	392	6.1

Vapor density=11.2 compared to value for air of one (1).

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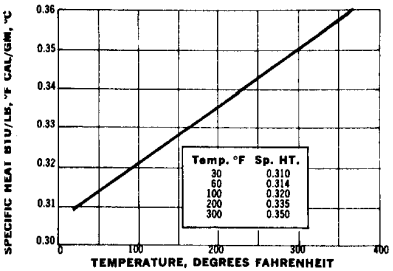
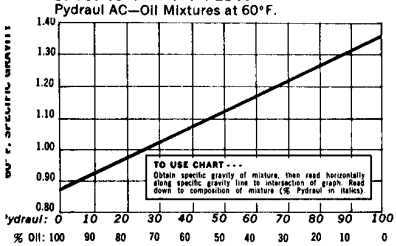
SPECIFIC HEAT

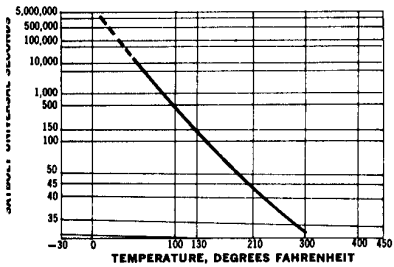


SPECIFIC GRAVITY PLOT:

Pydraul AC—Oil Mixtures at 60°F.



TYPICAL VISCOSITIES



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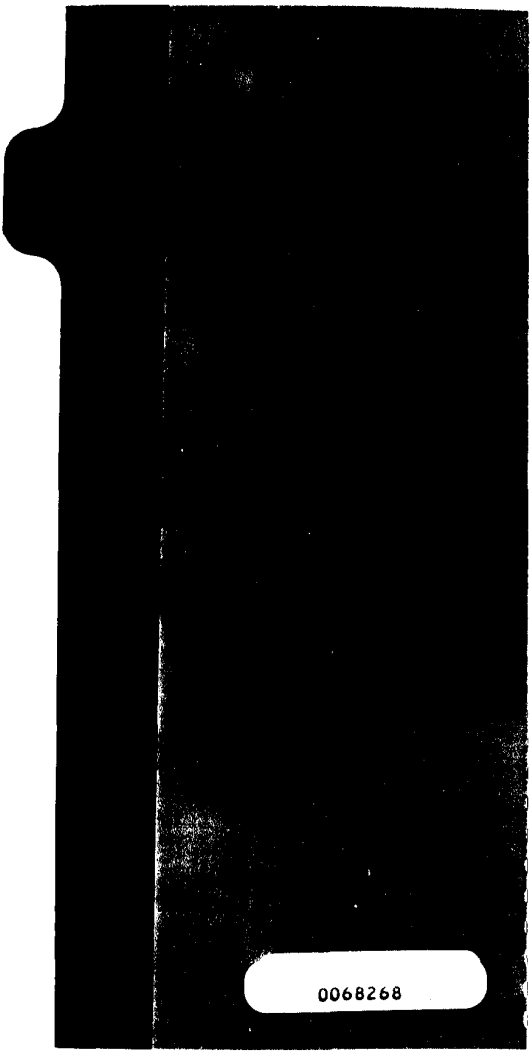

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Pydraul fire-resistant fluids and lubricants have worked in industry since 1951, providing over one billion machine hours of fire-free operation. Never during these billion hours of machine operation has a Pydraul fluid contributed to a fire—and never since its introduction in 1954 as a fire-resistant compressor lubricant has Pydraul AC caused an air compressor fire.

FIRE RESISTANCE TESTS OF PYDRAUL AC

TEST	RESULTS
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.
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.	Very slight increase in flame intensity.
Hot Manifold Test (MIL-F-7100.) Test fluid dripped on tube at 1300°F.	Does not flash or burn.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200°F., to test for spontaneous ignition.	Does not ignite.

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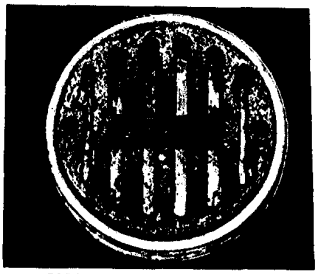

500 hours on premium petroleum oil

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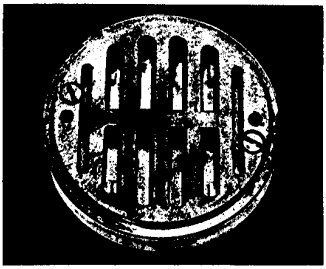
PYDRAUL AC

VIRTUALLY ELIMINATES VALVE DEPOSITS

Compressor Data: 142 CFM, 6" LP Bore, 5" HP Bore, 5" Stroke, 870 RPM, 100 psi air



500 hours on Pydraul AC

The photos compare exhaust valve deposits formed during individual 500-hour operations on two lubricants: a premium grade petroleum oil . . . and Pydraul AC.

A glance at the photo of the valve lubricated with petroleum oil shows considerable carbon deposit build-up after 500 hours operation. The improvement in the valve condition in the photo on the right is obvious—virtually no carbon deposits after 500 hours operation with Pydraul AC. In the particular case, the compressor operator expects to get 7500 to 10,000 hours of service from Pydraul AC without shutting down—a 15- to 20-fold increase in operating time without a shutdown. Result: substantial maintenance savings in time and money—and virtual elimination of the fuel source of most air compressor fires and explosions.

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CONVERTING TO PYDRAUL AC IS EASY

First, simply drain the petroleum oil and wipe the crankcase or lubricator.

Thoroughly clean the exhaust valves and interstage equipment before filling the crankcase or lubricator with Pydraul AC. Pydraul AC will loosen carbonaceous deposits, varnishes and sludge. Unless these loosened deposits are cleaned from the system, they could clog pipelines and components, requiring additional downtime and production loss. Once the valves have been thoroughly cleaned of potentially dangerous carbon deposits, Pydraul AC will keep them clean—and let compressors run longer between maintenance shutdowns.

STANDARD CHECK FOR COMPRESSORS

Plastic separator bowls. Not all plastic separator bowls are suitable for Pydraul AC service. Certain plastics are "crazed" or softened when exposed to Pydraul AC. Bowls made of glass, brass, steel, and these plastics—polycarbonate, polyethylene, or nylon—are recommended for use with Pydraul AC. If you have a question regarding the resistance of a particular plastic, Monsanto will be happy to advise you.

Diaphragm valves. Pydraul AC has a softening effect on neoprene and buna N rubber diaphragms normally used for petroleum oil service. These diaphragms should be replaced with butyl rubber, EPR (ethylene propylene rubber), fluoroelastomer, silicone or other compatible elastomer materials resistant or Pydraul AC. Diaphragm sheeting is available from normal sources of supply.

All diaphragms in unloading valves or downstream control valves should be replaced at the time of changeover. Diaphragms in valving downstream from separator systems or drying systems need not be replaced at changeover time, but should be changed on a preventative maintenance schedule as soon as practicable after operation on Pydraul AC is begun.

For air compressors supplying air for instrumentation functions, mist eliminator systems are recommended to remove lubricant mists and moisture from air streams. A Monsanto development,

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a Brink® mist eliminator is a particularly effective system, available from Monsanto in a series of low-cost mist eliminator systems to operate at all capacities. For information on a Brink series suitable for your compressor system, write to:

Monsanto
Engineering Sales Department
800 North Lindbergh Blvd.
St. Louis, Mo. 63166
Telephone: WYdown 3-1000

SPECIAL CHECK FOR SPLASH-LUBRICATED COMPRESSORS

Crankcase paint. Pydraul AC will soften and loosen some paints from crankcase interiors. These paint particles could block the lubricant passages. For this reason, it is a good practice to remove paint from crankcase interiors *before* Pydraul AC is added to the system. Standard paint removers are adequate for removing this paint.

SPECIAL CHECK FOR FORCE-FEED LUBRICATORS

Sight-glass fluid. If a separate force-feed lubricator of the type normally filled with water and glycerine is used, one of two changes is necessary: either replace the sight-glass fluid with one heavier than Pydraul AC or insert a metal bobber in the sight-glass. Pydraul AC is heavier than water or glycerine and will not rise through these standard sight-glass liquids. Fluorochemical 101, a clear liquid supplied by the Minnesota Mining and Manufacturing Company, has a higher density than Pydraul AC and is a completely satisfactory replacement.

Metal bobbers. The alternate to using Fluorochemical 101 is to modify the sight-glass lubricator by inserting a simple metal bobber. The bobber is installed by draining the sight-glass liquid, removing the guide wire and inserting the bobber. Operation of the lubricator is then indicated by movement of the bobber with each stroke of the pump plunger instead of counting the drops as with guide wires. Bobbers are available for either McCord, Manzell, or Lincoln Engineering lubricators. Modification of the Madison-Kipp lubricator requires replacement of the entire sight-glass.

Vacuum-sight lubricators. Vacuum-sight lubricators require no modification for Pydraul AC usage.

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PYDRAUL AC

PROVIDES THE LUBRICATING QUALITIES OF PREMIUM PETROLEUM OIL

Over ten years' service in air compressors of almost every type have proved the lubricating qualities of Pydraul AC equivalent to those of premium petroleum oil.

Typical are the statements below from engineers reporting the performance of Pydraul AC as a lubricant.

"Lubricating properties of Pydraul AC have been very satisfactory. Wear measurements on Molypak rings taken approximately five months later indicate 0.003" wear. This is normal and considered very good. No corrosion of cylinder liners, valves and piping has been experienced, and service is very satisfactory."

Compressor equipment: Cooper-Bessemer JM5

"Pydraul AC—outside of reducing the fire hazard—also provides very satisfactory lubrication and protection of valves . . . It seems rather logical to assume that the complete absence of deposits due to progressive oil oxidation and consequent high temperatures, shall help improve valve performance and maintenance. The higher gravity of Pydraul seems to result in better mechanical separation, and its water-like permanent cleanliness does not interfere with the cleanliness of surfaces contacted."

Compressor equipment: Joy Manufacturing WN-112-E

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LUBRICATING PROPERTIES

FALEX TESTS

FILM STRENGTH

Jaw Load Lbs.	Torque Lbs. Inches
3600	98

WEAR UNDER CONTINUOUS LOAD

Wear In Inches At 1,000 Lbs.

1st 10 Minutes	2nd 10 Minutes
0.000428	0.000285

WEAR UNDER INTERMITTENT LOAD

Time Mins.	Jaw Load Lbs.	Torque Lb. Inches	Wear (Inches)
1	1000	24	None
1	1500	41	None
1	1750	49	None
1	2000	50	0.000142
1	2250	53	0.000428
1	2500	60	0.000380
1	2750	72	0.000428
1	3000	76	0.000675

TIMKEN (EXTREME PRESSURE) 24,200 psi

SHELL FOUR-BALL WEAR

(167°F., 1 hour, 630 rpm., mm scar diameter)
Steel on steel

10 kg	0.32
40 kg	0.70

PUMP TEST (Vickers V-105-E., 140°F., 1000 hours)

Ring, grams (loss or gain)	−0.0076
Vane, grams (loss or gain)	+0.0014
Bushing 2015 grams (loss or gain)	+0.0040
Bushing 2016 grams (loss or gain)	+0.0045

DROP SIZE

Drop size of a lubricant is important to determine an adequate lubricant injection rate to insure proper compressor lubrication. The rate of lubrication is controlled by noting the drops per unit of time.

The drop size for the fluids tabulated below were determined by noting the number of drops formed at room temperature (75°F.) on a 1 mm I.D. by 3½ mm O.D. glass tip. (Larger or smaller drops will result if different sized tips are used.)

Fluid	Drops per cubic centimeter
Medium weight petroleum oil	33
Pydraul AC	39

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PYDRAUL AC

IS USED AS A LUBRICANT FOR AIR COMPRESSORS MADE BY ALL MAJOR MANUFACTURERS

New air compressors of most types and sizes produced by major compressor manufacturers can be manufactured for lubrication with Pydraul AC. The manufacturers listed below have manufactured compressors equipped for Pydraul AC, upon specification of the buyer, for over ten years. Many compressors have operated on Pydraul AC continually with exhaust air temperatures of 350°F. Pydraul AC is also used to lubricate cylinders in compressors operating at pressures over 4500 psig.

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American Messer Corporation
Bury Compressor Company
Carrier Corporation
Chicago Pneumatic Tool Company
Clark Brothers Company, division of Dresser Industries
Cooper-Bessemer Corporation
DeLaval Steam Turbine Company
Gardner-Denver Company
Ingersoll-Rand Company
Joy Manufacturing Company
Kinney Manufacturing, division of The New York Air Brake Company
Norwalk Company, Incorporated
Schramm, Incorporated
Worthington Corporation

When installing new equipment, it is best to start with an increased lubricant feed rate and reduce this rate by successive increments. Inspection of cylinder walls and valves will indicate the proper degree of wetting.

COMPRESSORS
Using Pydraul AC

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SAFE HANDLING

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There has been no reported case in over ten years of service to indicate any special health hazard with Pydraul AC. However, as with all specialized industrial fluids, certain precautions are advisable.

Skin contact. Repeated or continuous skin contact with Pydraul AC should be avoided. Pydraul AC acts as a solvent and repeated or prolonged skin contact can cause dry skin and chapping.

Eye contact. Although eye irritation studies using Pydraul AC at full strength indicate Pydraul AC to be an irritant, there is no evidence to show Pydraul causes permanent eye tissue damage. If Pydraul AC is splashed or sprayed into the eyes, moderately severe pain and irritation may result. 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.

Vapor inhalation. At room temperatures, there is no vapor inhalation hazard from Pydraul AC. Although there has been no problem with high concentrations of vapors, inhalation of vapors at high temperatures should be prevented.

Air samples were taken from the line of a Joy Manufacturing air compressor which had operated on Pydraul AC for three years. Filter paper and silica gel samples were collected and analyzed using a Beckman Spectrophotometer after iso-octane or isopropanol extraction. No concentrations of the major components of Pydraul AC could be detected.

No serious hazard is anticipated from vapors of Pydraul AC; however, if the compressed air is to be used for air line masks, respirators, and other inhalation equipment, it is always recommended that a commercial filter cartridge for air-supplied masks be incorporated in the compressor air line to remove any foreign matter. This is simply good industrial practice for any compressor fluid or lubricant.

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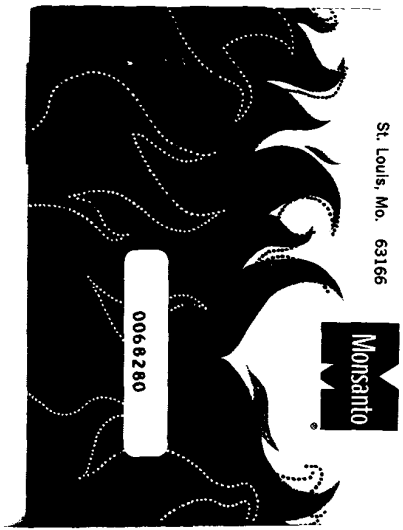

St. Louis, Mo. 63166

Monsanto

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JOB COST ANALYSIS

unit cost .65

NO. PRODUCED: 2000

REC'D:

SPACE PHASE	COST	VENDOR
LAYOUT		
F/A	22	
TYPE	50	
PRINT	1228	
OTHER		
TOTAL	1300	

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