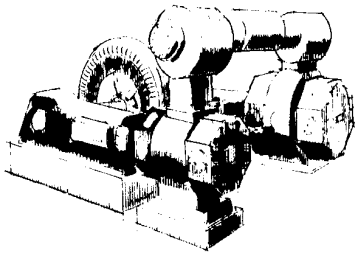
Pydraul® fact finder

AIR COMPRESSOR LUBRICANTS

Bulletin number IC/FF-2



The Pydraul® Air Compressor Fact Finder . . . is designed to make the many facts about Pydraul® fire resistant lubricants for air compressors—Pydraul 30E, Pydraul 90E and Pydraul 115E—easy to find.

These safety lubricants for air compressors were specially developed to offer you:

Safety from Fire and Explosion
Pydraul reduces combustible mists and minimizes carbonaceous residues—greatly reducing the threat of compressor fires and explosions.

Lower Maintenance Costs
Pydraul reduces deposits on exhaust valves, in coolers and in piping. You save the costs of compressor downtime and cleaning. Many compressor users find these savings alone justify using Pydraul lubricants.

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PYDRAUL

AIR COMPRESSOR LUBRICANTS BY **Monsanto**

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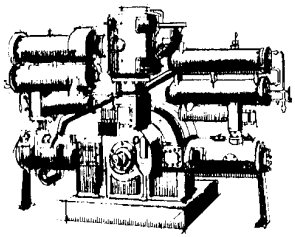
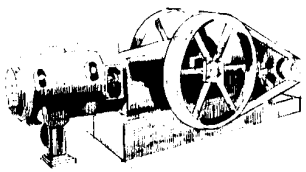
HOW COMPRESSOR FIRES & EXPLOSIONS OCCUR





Every theory about the mechanisms of compressor fires and explosions hold one idea in common: petroleum oils are directly involved.

Petroleum Oil Mists & Films

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.

The Shortcomings of Safety Devices

Safety devices do not completely eliminate fire and explosion possibilities. A 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. Carbon and rust particles in a "hot" air line, due to operating an overheated compressor too long—hardly an improbable condition—can become saturated with oil, and with the flow of starting air, can cause these oil-saturated particles to flame.

Explosion Tests at 1300 PSI

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.

How can you eliminate the conditions that cause fires and explosions in air compressors? Eliminate the *source* of carbon deposits, the basic cause of most air compressor disasters—petroleum oil.

Substitute fire- and explosion-resistant Pydraul.

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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Table 1

PHYSICAL PROPERTIES	PYDRAUL® 30E	PYDRAUL 90E	PYDRAUL 115E
Appearance	Clear Blue Liquid	Clear Blue Liquid	Clear Blue Liquid
Spec. Gravity 25°/25°C.	1.150-1.170	1.145-1.165	1.145-1.165
Neutralization Number (Acidity) (mg KOH/gm) max.	0.15	0.15	0.15
Moisture (max.)	0.10%	0.10%	0.10%
VISCOSITY			
Centistokes @ 100°F.	30-34	85-95	115-125
Centistokes @ 210°F.	4.6-5.0	7.7-8.1	8.9-9.3
Saybolts @ 100°F.	150 SSU	415 SSU	565 SSU
210°F.	42 SSU	52 SSU	56 SSU
"Absolute Saybolts" @ 100°F.	173 SSU	473 SSU	695 SSU
(SSU x Density) @ 210°F.	47 SSU	57 SSU	61 SSU
Pour Point	—15°F.	+10°F.	+10°F.
Compressibility x 10^{-6} sq. in./lb.	2.56	2.53	2.52
Maximum Exit Air Temperature	350°F.	350°F.	350°F.
Boiling Point °F. at 760 mm Hg.	725°F.	805°F.	820°F.
Coefficient of Thermal Expansion per °F.	0.00035	0.00035	0.00035
Specific Heat (BTU/lb. °F.) (@ 77°F.)	0.36	0.38	0.38
Thermal Conductivity BTU/hr./ft./°F.	0.0737	0.0723	0.0721
Bulk Modulus (Room temp. 1000-6000 psi)	390,000	396,000	397,000
Solubility in water	Negligible	Negligible	Negligible

Table 2—Vapor Pressure

Temperature		Vapor Pressure mm Hg		
°C.	°F.	PYDRAUL® 30E	PYDRAUL 90E	PYDRAUL 115E
0	32	5.0×10^{-6}	2.4×10^{-6}	1.0×10^{-6}
10	50	1.6×10^{-5}	8.0×10^{-6}	3.8×10^{-6}
20	68	4.5×10^{-5}	2.4×10^{-5}	1.1×10^{-5}
40	104	3.1×10^{-4}	1.9×10^{-4}	1.0×10^{-4}
60	140	1.4×10^{-3}	9.2×10^{-4}	5.1×10^{-4}
80	176	5.6×10^{-3}	4.3×10^{-3}	2.6×10^{-3}
100	212	2.0×10^{-2}	1.6×10^{-2}	1.0×10^{-2}
150	302	0.3	0.25	0.2
200	392	2.2	2.0	1.8

Vapor Density— 11.2 compared to value for air of one (1).

Compatibility With Metals

Pydraul air compressor lubricants are compatible with all construction metals including aluminum. *Aluminum load bearing surfaces should be hard-anodized for maximum equipment life.*

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FIRE RESISTANCE

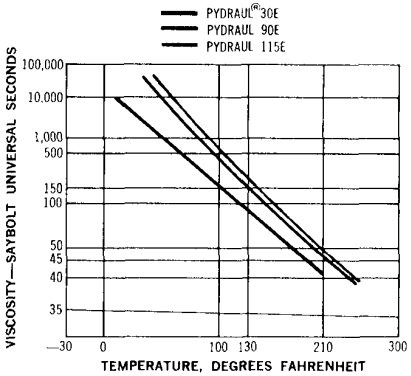


Pydraul fire-resistant fluids and lubricants have worked in industry since 1951, providing many millions of machine hours of fire-free operation. Never since their introduction in 1954 has any Pydraul fire-resistant compressor lubricant caused a compressor fire or explosion.

FIRE-RESISTANCE TESTS OF PYDRAUL 30E, PYDRAUL 90E AND PYDRAUL 115E

TEST	RESULTS
High Pressure Spray Test AMS-3150C and Federal Test Method St. 791. 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.
Atomized Spray Test (procedure used by Factory Mutual Engineering Division). Test fluid heated to 140°F. sprayed at 1000 psi from atomized cone type nozzle. A torch is passed through this spray 2 feet and 2 to 6 inches from the orifice.	Local burning by torch at 6 inches and 2 feet from orifice. Flames self-extinguish immediately when torch removed.
Hot Manifold Test (Federal Test Method Std. 791). 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.

Figure 1—Typical Viscosities



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CONVERTING TO PYDRAUL IS EASY

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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. Pydraul 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 lubricants 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 service. Certain plastics are "crazed" or softened when exposed to Pydraul. Bowls made of glass, brass, steel, and these plastics—polycarbonate, polyethylene, or nylon—are recommended for use with Pydraul. If you have a question regarding the resistance of a particular plastic, Monsanto will be happy to advise you.

Diaphragm valves. Pydraul lubricants have 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 to Pydraul fluids. 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 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, 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 Enviro-Chem Systems, Inc.
800 North Lindbergh Blvd.
St. Louis, Mo. 63166
Telephone: (314) 694-2286
(Joseph A. Brink)

SPECIAL CHECK FOR SPLASH-LUBRICATED COMPRESSORS

Crankcase paint. Pydraul air compressor lubricants 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 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 or insert a metal bobber in the sight-glass. Pydraul fluids are 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 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 usage.

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LUBRICATION DATA

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 90E	39

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.

Table 3

Falex Wear Test		
	WT. LOSS, PIN (mg.)	WT. LOSS, BLOCKS (mg.)
Pydraul® 30E	0.1	0.2
Pydraul 90E	0.7	1.0
Pydraul 115E	1.0	0.3

Table 4

Shell Four-Ball Wear (167°F., 1 hour, 630 rpm., mm scar diameter)			
STEEL ON STEEL	PYDRAUL® 30E	PYDRAUL 90E	PYDRAUL 115E
4 kg	0.47	0.28	0.29
10 kg	0.50	0.32	0.39
40 kg	0.64	0.54	0.56
STEEL ON BRONZE			
10 kg	0.46	0.35	0.45
40 kg	0.97	0.65	0.66

MIXING COMPATIBILITY

Pydraul 30E, Pydraul 90E and Pydraul 115E are completely miscible in all proportions with competitive synthetic phosphate ester lubricants.

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USES BY MAJOR MANUFACTURERS

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

American Messer Corporation

Atlas Copco

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

TOXICITY AND SAFE HANDLING

Acute animal studies indicate that the Pydraul E Series Fluids can be classed as practically non-toxic when considered as an industrial fluid. They are non-irritating when the skin is exposed to the fluid.
However, this product should not contact or in any way contaminate food, animal feed, food products, food packaging materials, pharmaceuticals or any items which may directly or indirectly be ultimately ingested by humans. Any contact may contaminate these items to the extent that their destruction may be required.

Due to their low order of toxicity, the Pydraul E Series require no special handling precautions. However, as in handling any chemical, good hygienic procedures should be followed. In case of skin contact, wash off with soap and water. In the case of eye contact, flush with copious amounts of water.

While Pydraul E Series (Pydraul C Series, also AC Series, Santosafe W/G) fluids pose no serious problems with respect to the environment, as a concerned supplier to industry, Monsanto urges the user to maintain a tight system, to correct leakage promptly and to exercise care in the handling and disposal of this and all other such products.

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Everett Station
Tel. (617) 387-5010

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Des Plaines, Illinois 60018
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