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DATE 2/23/70

JOB PYDRAUL® FACT FINDER - Fire Resistant Lubricants for Air Compressors.

INSIDE FRONT COVER: Contents (to be determined)

PAGE 1

HEAD: The ~~PYDRAUL~~ Pydraul Air Compressor Fact Finder

COPY: . . . is designed to make the many facts about Pydraul® fire resistant lubricants for air compressors--~~Pydraul AC,~~ Pydraul AC-A ~~Pydraul AC~~ Pydraul AC-A Winter Grade 28 and ~~Pydraul 625~~ Pydraul 625A--easy to find.

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

* Safety from Fire and Explosion

Pydraul eliminates combustible mists and minimizes carbonaceous residues -- greatly reducing the threat of compressor fires and explosions.

* Lower Maintenance Costs

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

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Monsanto

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Head: How Compressor Fires & Explosion Occur

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

Subhead: Petroleum Oil Mists & ~~Films~~ 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.

Subhead: The Shortcomings of Safety Devices

Safety devices do not completely eliminate fire and explosion possibilities. ~~A recent study on "The~~ 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.[2] 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.

Subhead: Explosion Tests at 1300 ~~psi~~ 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.

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

(2)

Substitute fire- and explosion-resistant Pydraul.

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TABLE 1 → New Data from Dave

	PYDRAUL 625	PYDRAUL AC	PYDRAUL AC WINTER GRADE 28
PHYSICAL PROPERTIES			
Appearance	Cloudy Blue Liquid	Clear Blue Liquid	Clear Blue Liquid
Spec. Gravity 25°/25°C.	1.360—1.400	1.345—1.385	1.275—1.295
Neutralization No. (acidity) (mg KOH/gm) max.	0.30	0.15	0.15
Moisture (max.)	0.15%	0.15%	0.15%
VISCOSITY			
Centistokes @ 100°F.	125 to 145	82 to 92	26 to 30
210°F.	5.7 to 6.2	4.6 to 5.0	3.5 to 3.9
Saybolts as @ 100°F.	625.7 SSU	408.8 SSU	132.5 SSU
measured: 210°F.	45.9 SSU	42.1 SSU	38.2 SSU
"Absolute Saybolts" @ 100°F.	845 SSU	550 SSU	180 SSU
(SSU x Density) 210°F.	59 SSU	50 SSU	52 SSU
Pour Point	+30°F.	+20°F.	0°F.
Compressibility x 10^{-4} sq. in./lb.	2.66	2.66	2.66
Maximum Exit Air Temperature	350°F.	350°F.	350°F.
Boiling Point °F. at 760 mm Hg.	724°F.	688°F.	688°F.
Coefficient of Thermal Expansion per °F.	0.00040	0.00040	0.00040
Specific Heat (BTU/lb./°F.) (@ 77°F.)	0.28	0.32	0.32
Thermal Conductivity BTU/hr./ft./°F.	0.065	0.066	0.066
Vapor Pressure Hg @ 200°F.	0.09mm	2.0×10^{-1}	2.0×10^{-1}
Bulk Modulus (Room Temp. 1000-6000 psi)	375,000	375,000	375,000
Surface Tension Dynes/cm @ 25°C.	40.2	45.0	41.0
Solubility in Water	Negligible	Negligible	Negligible

COMPATIBILITY WITH METALS

Pydraul air compressor lubricants are 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 lubricants.

TABLE 2 → New Data Dave | VAPOR PRESSURE

Temperature		Vapor Pressure mm Hg		
°C.	°F.	PYDRAUL AC	PYDRAUL 625	PYDRAUL AC-WINTER GRADE 28
0	32	2.0×10^{-6}	1.0×10^{-6}	
10	50	6.8×10^{-6}	3.0×10^{-6}	1×10^{-6}
20	68	2.0×10^{-5}	9.3×10^{-6}	1×10^{-6}
40	104	1.5×10^{-4}	7.3×10^{-5}	8×10^{-6}
60	140	9.6×10^{-4}	4.8×10^{-4}	6×10^{-5}
80	176	4.7×10^{-3}	2.5×10^{-3}	3×10^{-4}
100	212	2.0×10^{-2}	1.0×10^{-2}	1.5×10^{-3}
150	302	0.8	0.3	6.5×10^{-2}
200	392	6.1	8.5	10

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

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FIGURE 1
SPECIFIC HEAT

PYDRAUL 625

PYDRAUL AC

PYDRAUL AC WINTER GRADE 28

Temp °F.	Pydraul 625	Pydraul AC	Pydraul AC Winter Grade 28
30	0.320	0.310	0.298
60	0.325	0.314	0.305
100	0.335	0.320	0.310
200	0.350	0.335	0.330
300	0.390	0.350	0.345

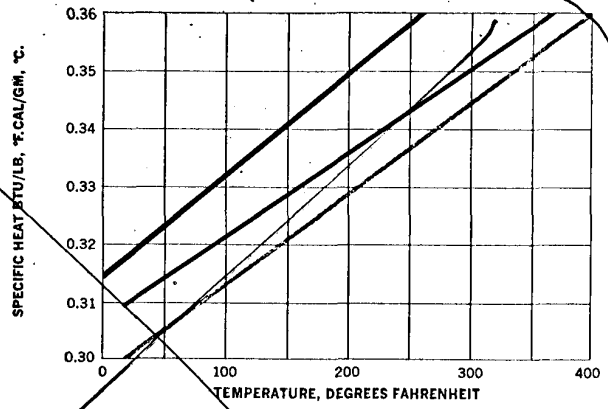

FIGURE 2
SPECIFIC GRAVITY PLOT:

Pydraul—Oil Mixtures at 60°F.

PYDRAUL 625

PYDRAUL AC

PYDRAUL AC WINTER GRADE 28

TO USE CHART . . .
Obtain specific gravity of mixture, then read horizontally along specific gravity line to intersection of graph. Read down to composition of mixture (% Pydraul in italics).

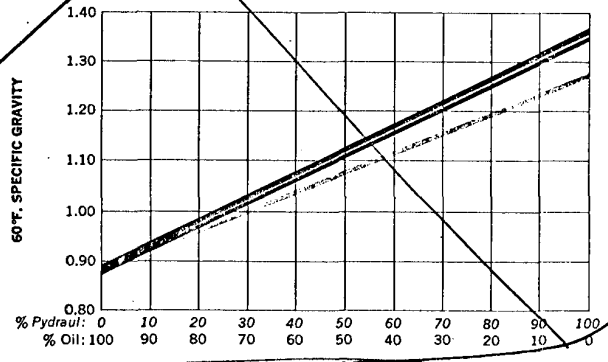

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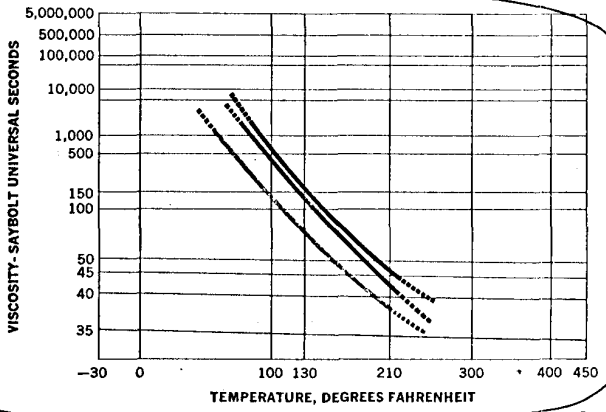
FIGURE # 1
TYPICAL VISCOSITIES

PYDRAUL 625-A

PYDRAUL AC-A

PYDRAUL AC-A WINTER GRADE 28

New Figure From Dave (Low).



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Atomized Spray

~~This~~ procedure ~~is~~ (essentially ~~that of the~~ same procedure as used by Factory Mutual Engineering Division.)

TEST Fluid ~~is~~ at 140°F. is sprayed at 1000 psi. ~~[illegible]~~ from ~~an~~ atomizing cone type nozzle of ~~a~~ specified size. ~~A~~ Torch is placed in ~~this~~ spray at 2 feet from ~~the~~ orifice and at 2 to 4 inches from ~~the~~ orifice. Observations: ~~are made to~~ See if burning continues when torch is removed; size of flame when torch is present, ~~and~~ length of burning after torch is removed.

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PYDRAUL
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 during these 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.

Their introduction in 1954 has only Pydraul fire-resistant air compressor lubricant caused a compressor fire or explosion.

FIRE-RESISTANCE TESTS OF PYDRAUL AC

TEST	RESULTS*
High Pressure Spray Test AMS-3150C and Federal Test Method Std. 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.
Low Pressure Spray Test (AMS-3150C). 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 (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.

Results on reformulated AC from Dave

RESULTS

ATOMIZED SPRAY—

LOCAL BURNING BY TORCH AT 6 INCHES AND 2 FEET FROM ORFICE. FLAME SELF-EXTINGUISHING IMMEDIATELY WHEN TORCH REMOVED.

See copy

ok

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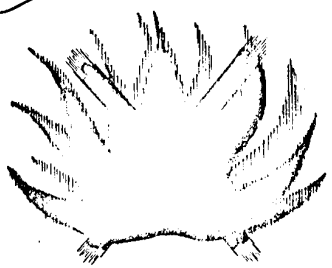
Tests Dec.

*TEST RESULTS ON ALL THREE FLUIDS: PYDRAUL ACA, PYDRAUL 625A, PYDRAUL AC A WINTER GRADE OF IT

*Results are the same for Pydraul 625 and Pydraul AC Winter Grade 28.



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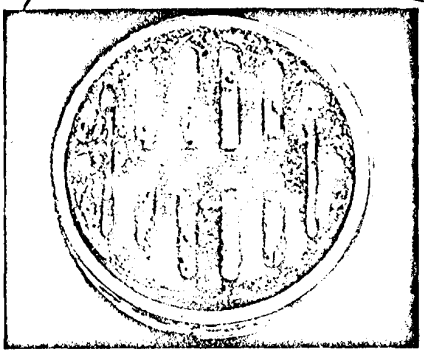
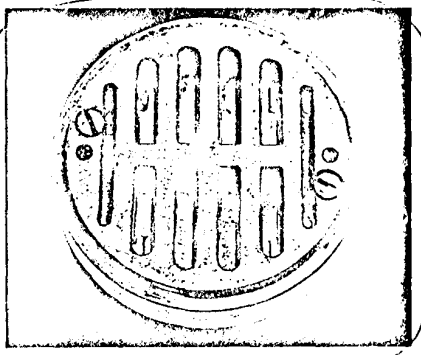
PYDRAUL AC Virtually Eliminates Valve Deposits

drop black backgrounds

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



500 hours on premium petroleum oil



500 hours on Pydraul AC

New Photo from Dave.

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.

*No photographs available of Pydraul 625 and Pydraul AC Winter Grade 28, but results are at least identical.

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Converting To PYDRAUL 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. 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
Engineering Sales Department
800 North Lindbergh Blvd.
St. Louis, Mo. 63166
Telephone: (314) 694-2286
(~~Joseph A.~~ J.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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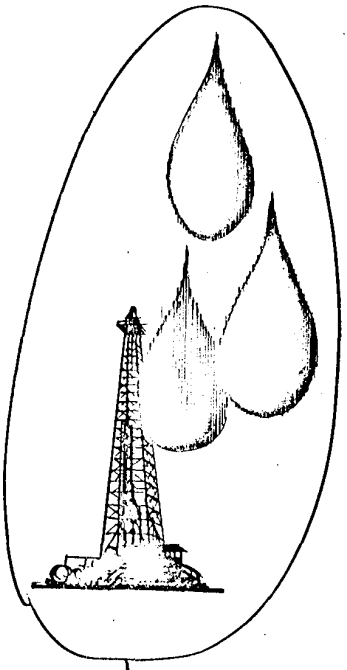
PYDRAUL Provides The Lubricating Qualities Of Premium Petroleum Oil

Long years of service in air compressors of almost every type have proved the lubricating qualities of Pydraul air compressor lubricants equivalent to those of premium petroleum oil.

Typical are the statements below from engineers reporting the performance of Pydraul 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

O.K. Can move to next pg. to replace [illegible]

Cut entirely.

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