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Bill Lubic

TURBINOL® - - FIRE RESISTANT TURBINE LUBRICANTS

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INCREASED FIRE SAFETY IN INDUSTRIAL TURBINE OPERATION

Over the past quarter century, owners and operators of capital equipment have become increasingly aware of the potential fire hazards from flammable energy transfer fluids and lubricants. Concern has ranged from electrical transformers to aircraft operation, to die-casting machines, hydraulic presses, air compressors, electronic control equipment, and, to turbines. In every industry utilizing such equipment, the move to fire-resistant fluids and lubricants was initially stimulated by the incidence of costly fires directly related to the flammable fluids and lubricants being used.

The same history is repeating itself in the operation of industrial turbines and their related power take-off equipment. The development of unattended gas turbine power package units has made the need for fire-resistant lubricants and control-actuating fluids more pressing and--in some installations--almost mandatory.

Monsanto was one of the first chemical manufacturers to recognize the need for fire-resistant hydraulic fluids and lubricants. Over a quarter century Monsanto research has developed a variety of functional fluids for specific applications, all sharing the common property of fire resistance; all physically and chemically stable; all designed for optimum operation in specific equipment.

The first synthetic lubricants with fire resistance and other suitable properties for turbine applications were offered by Monsanto in 1953. Since that time, continuing research in fundamental properties and formulation has developed a series of improved fluids with progressively higher operating performance. This research and development has yielded the current series of Monsanto turbine lubricants for lubricating industrial turbine bearings and for hydraulic controls - - Turbinol® fire-resistant turbine lubricants.

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GENERAL DESCRIPTION

*Turbinol fire-resistant fluids are stable phosphate-ester fluids selectively formulated to possess maximum resistance to oxidation and hydrolysis.

*Turbinol fluids have higher oxidation resistance and greater thermal stability (by test and by actual use) than either petroleum oils or other synthetic lubricants offered for turbine and turbine-related use.

*Turbinol fluids offer excellent lubricity, providing high performance turbines with minimum-wear lubrication to assure long-term, trouble-free operation at high operating temperatures.

*Turbinol fluids are fire resistant and pass the currently-recognized tests for determining the fire resistance of this type product when used as intended.

APPLICATIONS

*Three Turbinol fluids are currently available, each specially formulated with the viscosities and performance properties that fit them for a variety of applications, including the following:

Turbinol 50	A 220 SSU viscosity fluid specially designed for electro-hydraulic control systems on steam turbines where bearing lubrication is provided by other fluids in a separate system.
Turbinol 1122	A 150 SSU viscosity high performance fluid designed for gas turbine bearing lubrication and for bearings on connected load equipment, such as gas compressors and electrical generators.
Turbinol 1223	A 220 SSU viscosity fluid for turbine bearing lubrication and for use in associated electro-hydraulic control systems.

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TYPICAL PERFORMANCE

The performance of a lubricant in any application is related not only to the characteristics of the lubricant but to the system itself, the duty cycle and the operating environment. A number of standard laboratory and bench tests are used to predict lubricant performance, but such data must be supported by full-scale rig tests and/or actual field use.

Turbinol fluids show excellent results in a range of tests as shown by the following data:

	TURBINOL®		
	50	1122	1223
LUBRICATION DATA			
Four-Ball Wear Test, (scar diameter in mm.) 625 rpm, 167°F., 1 hr.			
Steel/Steel			
10 Kg. load	0.45	0.40	0.44
40 Kg. load	0.62	0.58	0.58
Steel/Bronze			
10 Kg. load	0.39	0.42	0.42
40 Kg. load	0.63	1.01	0.65
FOAM TEST			
ASTM D-892			
Sequence 1,2,3	Pass	Pass	Pass
RUST TEST			
ASTM D-665			
24-Hr. Distilled Water	Pass	Pass	Pass
ALCOR DEPOSITION TEST (Oil at 250°F., 48 hrs. 1000 ml./min. air flow)			
Tube temperature, °F.	450°	450°	450°
Overall rating	25.2	22.7	29.5
Critical temperature, °F.	510°	515°	>460°
Filter deposit, mg.	0.1	0.8	0.4

(In this test, fluid and air are passed over an electrically heated tube at various temperatures. The thermal stability is rated by the amount and type of deposition on the tube and the amount that flakes off and is caught by the filter.)

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STABILITY & CORROSION DATA

(Oxidation and Corrosion Tests by Federal Test Method Standard Number 791a, Method 5308.)

	TURBINOL®		
	50	1122	1223
168 hrs., 5ℓ/hr. air, 250°F.			
Viscosity			
% change @100°F.	+6.9	+3.6	+4.6
Acidity, TAN			
Change	0.00	+0.02	0.00
Metal weight change, mg./cm^2			
Magnesium	0.00	-0.02	0.00
Aluminum	+0.01	+0.02	+0.01
Cadmium	+0.03	+0.04	+0.03
Steel	+0.04	-0.01	+0.04
Copper	-0.16	-0.16	-0.16
72 hrs., 5ℓ/hr. air, 347°F.			
Viscosity			
% change @100°F.	+13.6	+7.8	+19.8
Acidity, TAN			
Change	+ 2.23	+3.50	+2.18
Metal weight change, mg./cm^2			
Magnesium	+ 0.04	+0.04	+0.04
Aluminum	+ 0.03	+0.01	+0.01
Cadmium	+ 0.04	+0.03	+0.04
Steel	0.00	+0.04	+0.04
Copper	- 0.25	0.00	0.16

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TYPICAL PROPERTIES

	TURBINOL® 50	TURBINOL® 1122	TURBINOL® 1223
GENERAL PHYSICAL PROPERTIES			
Appearance	Bluish-green oil	Clear amber oil	Clear amber oil
Specific Gravity 25°/25°C.	1.150	1.173	1.142
Pour Point, °F.	-5	-20	-5
Moisture, %, Maximum	0.10	0.10	0.10
Acidity, mg KOH/g, Maximum	0.15	0.10	0.10
Vapor Pressure, mm Hg.@200° F.	0.002	0.002	0.002
Solubility in Water	Nil	Nil	Nil
PHYSICAL PROPERTY VARIATION WITH TEMPERATURE			
Viscosity, SSU			
40°F.	3000	1480	3460
60°F.	1000	525	1150
100°F.	231	150	240
150°F.	80	62	76
210°F.	46	42.1	45.9
Viscosity, cs.			
40°F.	725	320	750
60°F.	200	120	240
100°F.	49	31.9	51.7
150°F.	14.5	11.0	15.5
200°F.	6.5	5.4	6.9
210°F.	5.90	4.82	6.02
Density, g./ml.			
40°F.	1.145	1.20	1.14
100°F.	1.115	1.17	1.11
210°F.	1.075	1.13	1.07
Specific Heat, Btu./lb. °F.			
60°F.	0.37	0.36	0.37
100°F.	0.38	0.38	0.38
150°F.	0.40	0.39	0.40
200°F.	0.42	0.41	0.42
Thermal Conductivity, Btu./Hr. ft°F.			
60°F.	0.073	0.074	0.073
100°F.	0.073	0.074	0.073
150°F.	0.073	0.073	0.073
200°F.	0.072	0.073	0.072

(Above data to be made into graphs of SSU and CS Viscosity vs. Temperature)

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FIRE RESISTANCE PROPERTIES

The fire resistance of Monsanto phosphate-ester fluids has been widely proven in diverse applications ranging from turbine lubricants to hydraulic fluids to air compressor lubricants - - this last requiring fire resistance in mist form. A variety of basic tests have been developed to demonstrate fire resistance. As the following data show, Turbinol fluids possess excellent fire resistance properties.

		TURBINOL®	
	50	1122	1223
Flash Point, COC., °F.	480°	470°	480°
Fire Point, COC., °F.	620°	650°	620°
Autoignition, °F., (ASTM D-2155)	910°	1050°	910°
Autoignition, °F., (ASTM D-286)	>1000°	>1000°	>1000°
High Pressure Spray Test (AMS 3150C)	------	Intermittent Flashing Self extinguishing	------
Hot Manifold Test (Federal Test Method Std. 791a)			
@ 1300°F.	------	Flashes, does not propagate	------
@ 950°F.	------	Does not flash nor burn	----------
Molten Metal Test @ 1300°F.	------	No Ignition ------	
Factory Mutual Spray Test (Fluid sprayed at 1,000 psi from oriface and passing through flame of propane torch)	------	Pass	Pass
Factory Mutual Channel Iron Test (Fluid sprayed at 1,000 psi through oriface on to hot channel iron @ 1,300°F.)	------	Pass	Pass

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COMPATIBILITY WITH OTHER MATERIALS

Metals & Other Lubricants

Turbinol lubricants are compatible with all commonly used metals of construction and with tin babbit bearing alloys.

Turbinol fluids are miscible in all proportions with other phosphate-ester lubricants. They are not compatible with petroleum base lubricants. Turbinol fluids will dissolve only 3-5% of most types of petroleum oil.

Packings, Seals, Hose, Bladders, Wire Insulation

Turbinol fluids are compatible with a wide variety of elastomeric and polymeric materials. Components made of these are available from a variety of suppliers. For information purposes, Turbinol fluids are classed as straight synthetic fluids formulated with triaryl phosphate base stocks. Components made of the following materials are compatible with Turbinol fluids:

- Butyl rubber
- Ethylene-propylene rubber
- Ethylene-propylene terpolymers
- Nylon
- Polyethylene
- Polyimide
- Silicone
- Teflon
- Viton

Paints

Many paint suppliers offer coatings based on the following resins which (cured) are satisfactory for use with Turbinol fluids:

- Epoxy
- Nylon
- Phenolic
- Polyurethane

Filters

All turbine lubricants should be filtered free of particulate contamination to insure optimum performance. Turbinol lubricants are no exception. Most oil-type filters are suitable for use with Turbinol lubricants providing all components of the filter are constructed with compatible materials. Active earth filters are satisfactory and may be used to reduce the acidity normally developed over prolonged use.

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CONVERSION TO TURBINOL LUBRICATION & HYDRAULIC CONTROL

Adopting the fire-resistant Turbinol fluids for safer turbine operation is quite simple. However, in all cases the equipment manufacturer should be consulted to make sure compatible seals, hoses and paints have been used and/or to determine if any mechanical adjustments are warranted. Monsanto fluid specialists are also available for assistance in conversion.

Conversion from any currently available commercial fire-resistant fluid is simply direct replacement, by drain and re-fill or by using Turbinol as make-up. Detailed lubricant-lubricant compatibility is available from your Monsanto representative.

Conversion from petroleum lubricants is only slightly more complex. The following are the minimum requirements necessary for conversion:

1. Completely drain and clean the system. (Small amounts of oil left behind will not interfere with Turbinol performance but may separate and collect in certain areas of the system thus reducing the system's fire resistance.)

2. After draining system, blow out all pipes and manually clean bearing pedestals and reservoir.

3. Replace gaskets, packings, seals as required if they are not of compatible materials.

4. Add a partial charge of Turbinol fluid, circulate and check component functioning.

5. Inspect the fluid condition after circulation. If amounts of oil left behind by the clean out have deteriorated the partial charge, it should be considered a flush and discarded.

6. When the system is clean, add Turbinol lubricant to the correct level and check system operation.

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TOXICITY AND SAFE HANDLING

Acute animal studies indicate that Turbinols 50, 1122, and 1223 can be classified as practically non-toxic when considered as an industrial fluid.* ~~They are non-irritating to the skin when exposed to the fluid~~.

However, these products 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 Turbinol fluids require no special handling precautions. However, as in handling any chemical, good hygienic procedures should be followed. In case of skin contack, wash off with soap and water. In the case of eye contact, flush with copious amounts of water.

*Subsitute -- Appropriate irritation potential studies with animals showed that these fluids are non-irritating to the skin and only mildly irritating to the eyes. Prolonged and ~~repe~~ repeated skin contact should be avoided, however, since the fluids may act as "solvents" for the ~~natural~~ fats and oils normally present on the skin surface, and result in drying and chapping.

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Monsanto offers a complete line of functional fluids and lubricants for a wide variety of applications. For free information on any of these products just complete the following postage-free card and return it to Monsanto. Or write to: Monsanto, Dept. B1NB-45, 800 N. Lindbergh Blvd., St. Louis, Missouri 63166. Information and assistance is also available from any of the Monsanto district offices listed.

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MICC District Office Listing

MICC Address Line

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