Tribology Inc./Tech-Lube

35 Old Dock Road, Yaphank, NY 11980 Phone: 631-345-3000 Fax: 631-345-3001

INTRODUCTION

Tribology/Tech-Lube (TTL) is a Synthetic and Specialty Lubricant Company with over twenty years experience in the production of compressor oil formulations. TTL actively markets and sells this successful family of oils throughout the United States and in fifteen countries abroad. Currently, it is estimated that over 100,000 compressors, of all designs, operate efficiently and reliably on TTL Compressor Oils.

PERFORMANCE EVALUATION

TTL Ultima Coolant has been carefully evaluated in a series of bench tests in a side-by-side comparison to a locally purchased virgin sample of the SSR Ultra Coolant.

PHYSICAL PROPERTIES

The physical properties of each lubricant are listed below. The TTL lubricant has been formulated to be the viscometrics required in the operating specification. The viscosity of ***TTL Ultima Coolant*** was also evaluated, as shown, at 80°C/176°F since this temperature more accurately reflects actual operating temperatures of the unit. (NOTE: Other ISO/SAE viscosity grades available upon request.)

	Viscosity (cSt)			Viscosity Index	Pour Point (°C)	Flash Point (°C)	Thermal Conductivity (W/mK)#
	40°C	80°C	100°C				
SSR Ultra Coolant	48.2	13.8	8.74	162	-41	262	0.14
TTL Ultima Coolant	49.9	14.8	9.99	192	-42	267	0.14

Note: The thermal conductivity of each lubricant was measured at 80°C since cooling efficiency is an important factor in obtaining compressor energy efficiencies. As tested, the ***TTL Ultima Coolant*** and the SSR Ultra Coolant have identical thermal conductivities.

DEMULSIBILITY

TTL Ultima Coolant has been formulated with demulsibility as a key consideration. ASTM D1401 test is the standard test procedure used to accurately access demulsibility, worldwide. Test procedures are described in Appendix 1.

	Demulsibility ASTM D1401	Merit Rating
SSR Ultra Coolant	1-8-71 (60)	Poor
TTL Ultima Coolant	40-40-0 (5)	Excellent

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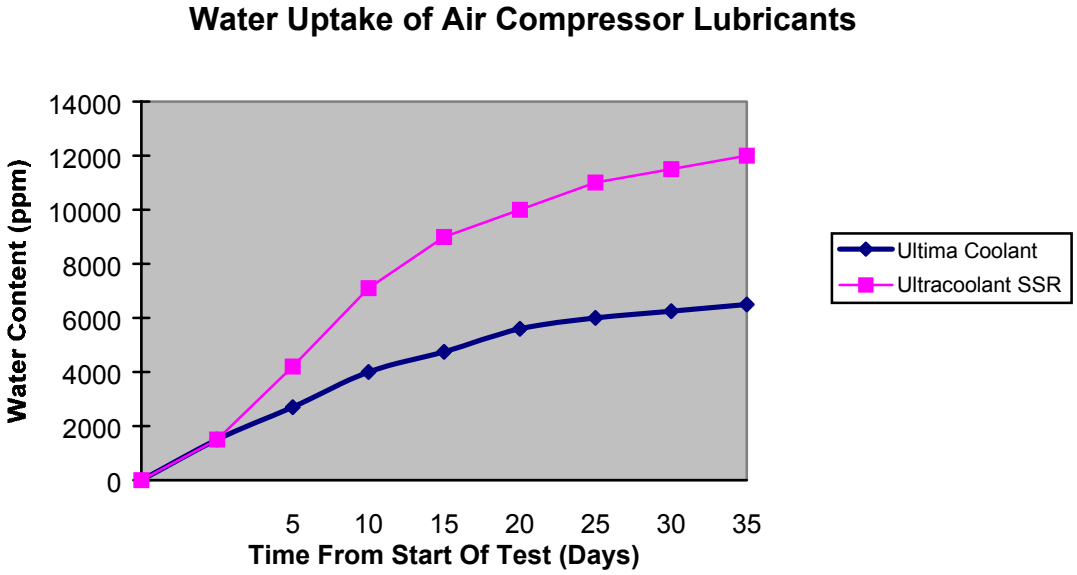
WATER UPTAKE

Another key consideration in the formulation of the ***TTL Ultima Coolant*** is Water Uptake. Briefly defined, water uptake indicates the ability of the fluid to pick up less water and measure of oil/water separation. ***TTL Ultima Coolant*** possesses superior quality in this important area of operation. The coolant has approximately ½ the moisture uptake of the competitive fluid, making its use in humid atmospheres even more desirable.

In summary, the TTL lubricant picks up less water and gives superior water separation.



STABILITY

Air compressor lubricants degrade as a result of oxidation (effect of heat) and hydrolysis (effect of water).

The effects of oxidation and hydrolysis on compressor reliability are well known and can be summarized as:

- a change in viscosity
- an increase in acidity leading to corrosion
- an increase in the amount of deposits and varnish formed.

Oxidation stability of a lubricant is measured using the Hot Tube and High Pressure Oxidation Tests. Deposit forming tendencies of compressor oils are evaluated accurately using the Panel Coker Test.

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The greater oxidative stability and the superior resistance to deposit formation of the ***TTL Ultima Coolant*** are clearly established by the Hot Tube Test and Panel Coker Test results.

	Hot Tube Oxidation Test		Panel Coker
	Visocosity (% Change)	TAN (mgKOH/g)	Demerit Rating
SSR Ultra Coolant	3.1	0.54	3.71
TTL Ultima Coolant	0.6	0.01	1.98

Hydrolysis of lubricants is assessed using the Extended Beverage Test. Synthetic esters in the presence of water can undergo hydrolysis. ***TTL Ultima Coolant*** shows excellent stability and has superior anti-hydrolysis properties over the SSR Ultra Coolant formulation.

	Hydrolysis Stability Beverage Bottle Test	
	Viscosity (% Change)	TAN (mgKOH/g)
SSR Ultra Coolant	-0.8	+0.38
TTL Ultima Coolant	+0.4	+0.13

(Standard ASTM Test 48 hrs., test extended to 336 hrs.)

CORROSION

Corrosivity to steel and copper can be assessed using standard ASTM tests. All lubricants passed the corrosion test with both water and seawater.

	Steel Corrosion		Copper Corrosion
	Method A	Method B	
SSR Ultra Coolant	No Rust	No Rust	1A
TTL Ultima Coolant	No Rust	No Rust	1A

WEAR TESTS

Bench Wear Tests are notoriously inaccurate at predicting wear in compressors. The Four-Ball Wear Test has been used as the comparison-screening test for both coolants. ***TTL Ultima Coolant*** has recorded 30% improved anti-wear performance.

	Four Ball Wear Scar (mm)
SSR Ultra Coolant	0.66
TTL Ultima Coolant	0.46

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COMPATIBILITY

The elastomer compatibility for both formulations are listed.

Sealing Materials	
Compatible	**Not Compatible**
Butyl Rubber	Low Nitrile Buna N
EPT, EPDM, EPR	Natural Rubber
High Nitrile Buna N	Polyurethane elastomers
Medium Nitrile Buna N	
Neoprene	
Polyurethane Foam	
Silicone Rubber	
Teflon[1]	
Viton[1]	
Plastics	
Compatible	**Not Compatible**
Celcon[2]	ABS
Delrin[1]	Acrylic
Epoxy Resins	Polycarbonate
Nylon (Polyamide)	PVC
Polyethylene	
Polypropylene	
Teflon[1]	
[1] Registered trademark of E.I. DuPont Corporation [2] Registered trademark of Celanese Corporation	
Paints	
Compatible	**Not Compatible**
Baked Phenolics	Acrylic
Epoxy	Lacquer
Oil Resistant Alkyd	Latex
	Polyurethane
	Varnish
The above shows compatibility with **cured** paints.	

PAGs *(Polyalkylene Glycol)* tend to have poor miscibility with mineral oil. This can cause potential problems in retrofitting systems, which previously ran on mineral oil, or in situations where mineral oil is inadvertently added to the system. The compatibility of each lubricant was therefore tested with mineral oil at 70°C. ***TTL Ultima Coolant*** was found to have much better miscibility with mineral oil than SSR Ultra Coolant.

	Mineral Oil Miscibility
SSR Ultra Coolant	10%
TTL Ultima Coolant	25%

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FIELD SERVICE COMPATIBILITY

It would be impossible to test the ***TTL Ultima Coolant*** against all products available for field changeover compatibility. However, the ***TTL Ultima Coolant*** is compatible with the SSR Ultra Coolant making changeover a simple drain and refill procedure. If the compressor has displayed any unusual operating conditions, then a full flushing procedure with the ***TTL Ultima Coolant*** is strongly recommended.

Product Compatibility Guide

TTL Ultima Coolant

SSR Ultra Coolant	√
SSR Coolant	√
Sullube 32	√
Sullube 60	√
TTL Coolant	√
Diester Compressor Oils	√
PAO Compressor Oils	-
Mineral Oil	-
Ultra Chem Coolant	√
Supra Coolant	√

√ Compatible

- Not Compatible

O Testing required to determine full compatibility

When replacing other unlisted lubricants contact TTL for a compatibility status.

CONCLUSION

In all the areas tested ***TTL Ultima Coolant*** out performed or matched SSR Ultra Coolant. The most striking difference is in water interaction. ***TTL Ultima Coolant*** picks up less water, more slowly and can separate more efficiently. This will effectively increase compressor efficiency and drain intervals. ***TTL Ultima Coolant*** is highly superior in humid atmospheres. The improved mineral oil solubility of ***TTL Ultima Coolant*** over SSR Ultra Coolant makes it suitable for use in retrofit applications.

Total Acid Number (TAN) ASTM-D664

Test method covers procedures for the determination of acidic constituents in a lubricant. This test method may be used to indicate relative changes that occur in an oil during use under oxidizing conditions, regardless of the color or other properties of the resulting oil.