STEEL SHIELD TECHNOLOGIES

Marine System

Extra 5~15% thermal efficiency from your ship engine ?
YES, we, STEEL SHIELD can do !

THE **ABF** Technology

www.steelshieldtech.com.hk
Serving the Industry since 1985

World's 1st Ionic-Maglev Lubrication Technology

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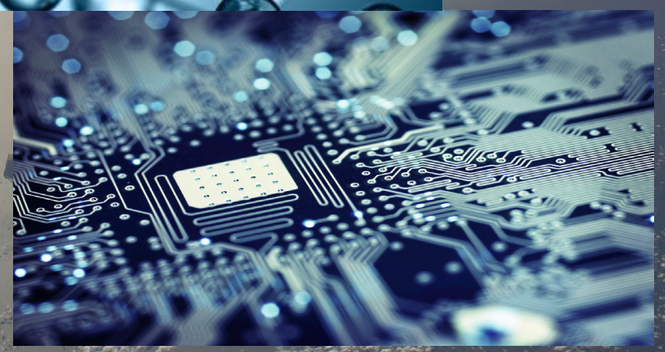
World's 1st Ionic-Maglev Lubrication Technology

WORLD'S 1ST IONIC-MAGLEV
LUBRICATION TECHNOLOGY



1. MAKING A DIFFERENCE IN LUBRICATION

"It is our conviction that to be the best is not sufficient, we are here to make a new World Standard in Lubrication."

Company Vision & Commitment

Steel Shield Technologies sole purpose is to manufacture premier quality metal treatments, additives, greases and lubricant oils that have been tested to exceed the normal parameters of extreme pressure and anti-wear products in the aftermarket, hereby offering matchless performance and unsurpassed protection against wear while saving maintenance costs, downtime, energy and improving overall functionality of your machineries.

Steel Shield, Not Just Oil, It's Technology which makes a difference to the World of Lubrication.

Steel Shield aims at helping customers to achieve the highest return on investment (ROI). Steel Shield is committed to strengthening business and global commerce through manufacturing and distributing, World-wide, the full line of ABF Technology products made in the USA, Singapore and Hong Kong.

2. THE CORPORATION & FACILITIES

Steel Shield Technologies Inc. (USA) with its history traced back to 1985 when in USA, Pennsylvania the scientist Dr. George C Fennell in the research and development of high-end specialty lubricants invented the unique ABF Formula – Ionic Levitation. In the same year Muscle Product Corporation trading as MPC was founded by George Fennell, brother Jay Fennell and father, Richard Fennell and the purpose was to market his invention MT-10. In 2006 at a board meeting held on 22nd May George resigned all his duty from MPC. In the same year George found STEEL SHIELD TECHNOLOGIES INC and renamed his invention MT-10 as Steel Shield. As of then MPC and its products are no longer being supported by George either in performance or quality.

The Company's blending and manufacturing capabilities are state of the art and the ability to produce limitless volume of product is unsurpassed as well as the product quality. The equipment is all stainless steel including the flow lines, pipes and couplers. All pumps and gauges are digitally interpreted and of the highest quality and accuracy to ensure production of the most superior quality lubricants.

STEEL SHIELD TECHNOLOGIES (ASIA PACIFIC) LIMITED WAS INCORPORATED IN 2012 IN HONG KONG AND IS THE OFFICIAL REPRESENTATIVE OF STEEL SHIELD TECHNOLOGIES (USA) TO PROVIDE DISTRIBUTION AND TECHNICAL SUPPORT FOR THE ENTIRE ASIA-PACIFIC RIM.

3. INVENTOR SCIENTIST - DR. GEORGE C FENNELL

Father of ABF Technology
Doctor of Astronomy and Astrophysics

Accreditation:

SAE (Society of Automotive and Aerospace Engineers) Member

ASNE (American Society of Naval Engineers) Member

NCMA (National Contract Management Association) Member

STLE (Society of Tribologists and Lubricant Engineers) Member

In 1985, Dr. George C Fennell, a former scientist in Astronomy and Astrophysics doing consulting and contract work in advanced lubrication and surface Tribology, formulated a revolutionary metal treatment oil additive which can activate "ABF" (Advanced Boundary Film) through a proprietary and unique "electro-chemical ionization" (ECI) process. He has been known in the industry as the "Father of ABF Lubrication".

On the basis of ABF technology, a series of specialty lubricants have been developed to meet the stringent requirements of various purposes and working conditions, as to date is still the most advanced formula in lubrication.

Over the years, there have been countless people trying to resemble Dr. Fennell's unique formula and advanced chemistries, none was found even remotely close. To this date, Dr. Fennell is still the leader in tribology and lubrication.

4. THE BIRTH OF STEEL SHIELD TECHNOLOGY

BIO-ORGANO LUBRICATION TECHNOLOGY

During World War II, the German Science and Technology Research Institute was commissioned to develop a new lubricant technology in meeting the stringent demand for heavy duty military application such as artillery, armored vehicles, tanks, battleships and fighter-aircrafts to avail them in performing their maximum fighting capacity with minimal maintenance.

The scientists proposed the concept of Zero friction, i.e. Faraday's Law Like-Charge-Repel.

Shortly after WW II, a great number of intelligent scientists migrated to the United States from Europe. One of them was the grandfather of Dr. George Fennell, who came to USA along with him a large volume of research data and material about Zero friction. The old scientist continued to pursue his scientific research and eventually in 1986 his grandson Dr. George Fennell came with a breakthrough in the technology. Through Electro Chemical Ionization (also known as Reactive Chemical Bonding) Dr. Fennell was able to realize Maglev between two metallic surfaces and to achieve a close to Zero Friction Coefficients.

The great accomplishment was the result of relentless efforts of 3 generations scientists over half a century. In recognition of the excellent contribution of Fennell's family to the country, the US Government has named the street outside their old factory Fennell Avenue as a compliment.

SOMEWHERE,SOMETHING INCREDIBLE IS WAITING TO BE KNOWN.

~Carl Sagan

5. ABOUT ABF TECHNOLOGY

BOUNDARY FILM LUBRICATION THROUGH ADVANCED HALOGENATION TECHNIQUES: OXIRANE ACID SCAVENGING AND ORGANO-METALLIC SUBSTITUTION

BY GEORGE C. FENNELL

Steel Shield Technologies' mechanism of operation is based upon Tribology methods that improve lubricity and load carrying capacity by improving surface characteristics and creating a stable chemical, corrosion controlled halide-based boundary film. Steel Shield's active components react with each other and the contacting asperities of the metallic surfaces to provide five mechanisms of improvement.

1. Advanced chemical boundary film formation through reactive chemical bonding.
2. Ring opening, oxirane acid scavenging and advanced corrosion inhibition.
3. Organo-metallic substitution of surface metal and free radical reactionaries.
4. Improved surface smoothness and rolling out of irregular contacting asperities.
5. Re-conditioning and molecular reconstruction of the original contacting metal surfaces.

The process of advanced boundary film formation is accomplished with an advanced combination of halogens that are controlled and rendered non-corrosive to the base metals of the system and pose no threat to the ozone layer or waste oil recovery systems due to their origins and long chain molecular lengths. These halogens initially react under thermal conditions with the organo-metallic reagents to form surface attaching compounds, thereby limiting and controlling the formation of halides from the base metals themselves. These surface attaching reagents or "electro-negative compounds" seek out and affix themselves to the lower surface areas referred to as micro-pores and fissures, as all metals are crystalline in structure and exhibit a lattice type matrix. This complex process also incorporates Van der Waal forces and dipole-dipole surface reactions. During this process, surface lapping and asperity (irregular microscopic contacting and opposing surfaces) roll-out is also achieved, yielding improved spread characteristics of the surfaces themselves. Due to the increase of film strength by the filling of the micro-pores and fissures, along with thermal modification of the asperities, the resulting effect is a gradual rolling out or flattening of the metal asperities rather than a breaking off or chip-away process, which would create metallic debris in the lubricant leading to abrasive wear from wear metal particles. The resulting improvement in the opposing metal surfaces further increases the fluid film strength, which is dependent on the degree of surface roughness and viscosity.

Viscosity, however, is a lesser consideration when incorporating boundary additives or halogenation techniques.

In general, boundary friction and wear consists of two components, a shear or adhesion component and a plowing or deformation component. Considering the following equation:

$$Fs = SAr$$

Where Fs is the shear component, which predominates except when asperities sink too deeply into a boundary lubricant film or a soft opposing surface. When movement or sliding occurs, the shear friction force depends on the shear resistance per unit area, S, of any "boundary film" in the real load-supporting area between asperities. Dividing by the load, W gives the shear contribution to the friction coefficient, becoming independent of total load and apparent area of contact:

$$fs = S * Ar / W = S / Pp \text{ or } S / Pe$$

The boundary film shear resistance, S, is assumed equal to the plastic flow shear stress, Tp, of an ideal elastic, plastic solid. Such a solid gives shear stress independent of strain and strain rate at strains sufficiently large enough to cause plastic flow. The conditions that produce the "glass transition" from liquid to plastic-like behavior are dependent on the viscosity of the material at normal temperatures and pressures and the variation of viscosity with temperature and pressure. In other words, glass transition depends strongly on chemical composition.

These results show that liquid lubricants act like plastic solids in the films between asperities. Therefore, S=Tp in the previous equation and the friction coefficient is Tp/Pp or Tp/Pe. Since Tp is a weak function of temperature and pressure, and Pp or Pe are independent of apparent contact load, the frictional coefficient for a given combination of lubricant and sliding surfaces tends to be independent of operating conditions.

Elasto-hydrodynamic lubrication (ELH) on an asperity scale deposits film material between sliding surfaces in "micro-rheodynamic" (micro-RHD) lubrication. As one surface slides, each asperity carries with it an aggregation of SST additive. Sufficient pressure and temperature is developed within the film to elastically deform the asperity and to force the extreme pressure reagent between the surfaces or into the micro-pores and fissures. During this time, high thermal conditions involving pressure and asperity contacts initiate a re-conditioning of the surfaces utilizing the existing oil to quench and cool the surfaces in the same process. A thermal restructuring of these asperity contact areas creates a deviation from the normal crystalline structure of the metal, expanding it into an austenitic crystalline pattern, which is more evenly structured and allows the SST additive to bond to the actual lattice of the metal, endowing it with new and unique properties upon cooling.

Organo-metallic substitution is a technique developed and designed to inhibit the process of halide formation from the base metals of the system under reaction. For example, instead of the halogen reacting with the iron in the system to form iron halides, a boundary surface salt, it reacts with a reagent having very similar properties to the iron atom itself, thereby forming a organo-metallic complex without scavenging the target metal surface itself, and depleting the metal in a chemically corrosive wear syndrome.

The process is very similar or analogous to the saponification of organo-metallic compounds in the manufacturing of greases. During this reaction or saponification, compounds react at a certain catalytic temperature and exchange characteristic components to form new compounds. These new chemical compounds are then used to aid in a boundary regime by providing an added protection to the actual surfaces being lubricated. Ring opening oxirane acid scavenging and corrosion inhibition is another chemical technique used to neutralize acids and inhibit oxidation and corrosion. This technique involves the use of specifically engineered complex ethylene oxide; oxirane rings, that possess reactive reagents which will cause a cleavage of the ring when encountering acids or strong alkaline. These reactions occur in the presence of both anionic- and cationic-type catalysts. Anionic catalysts can include alkoxide ions, hydroxides, metal oxides, and some organo-metallic derivatives while Lewis acids and protonic reagents initiate cationic reactions.

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n H2C - CH2 n

The lubricity, load carrying capacity, surface improvement, and wear reduction are greatly improved while corrosive aspects of halogenation are virtually eliminated.

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CRC "Handbook Of Lubrication, Theory And Practice", Volumes 1 & 2, by E. Richard Booser, Ph.D., Society of Tribologists and Lubrication Engineers (STLE), copyright 1992, Eighth Printing.
"Organic Chemistry" 4th Edition, by Robert Morrison, Ph.D. and Robert Boyd, Ph.D., copyright 1983 by Allen & Bacon.
"Lubrication - A Tribology Handbook", edited by M.J. Neale OBE, BSc(Eng), published by Society of Automotive Engineers (SAE), copyright 1993, Butterworth-Heinemann, Ltd.
CRC "Handbook Of Chemistry and Physics", 1986 Edition, by CRC Press, edited by David R. Lide, copyright 1986 by CRC Press.

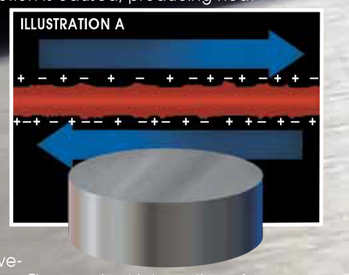
Steel Shield Technologies Has Redefined Lubrication.

Webster's Dictionary defines lubricants as substances capable of reducing friction, heat and wear when introduced between two solid surfaces. From the initial development and use of lubricants, chemical technology has constantly advanced to make them more effective. From changes in refinement processes to the development of additives, the concentration has always been to increase the ability of the lubricant to reduce the friction, heat and wear. **Steel Shield Technologies** has changed the approach to lubrication and, in essence, given new definition to the term. First, there are a few points to consider.

Metal Against Metal

The structure of all metals creates a surface characterized by a series of sharp peaks and valleys, some microscopic and some larger. As two metal surfaces contact each other and move in opposite directions, friction is caused, producing heat and metal deterioration. This friction-causing physical dynamic is heightened by the electromagnetic field created on the surfaces of each metal. The sharp peaks, known as asperities, and valleys, referred to as micro-pores and fissures, have opposite electro-magnetic charges. **Illustration A** shows a new metal with positive-charged asperities and negative-charged micro-pores and fissures. The constant interaction of these opposite-charged features works to weaken the structure of the metal, causing eventual deterioration of the surface of the part.

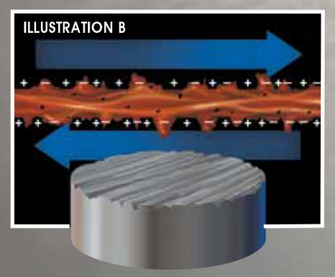
ILLUSTRATION A



Normal Lubricants Help

All lubricants help to slow this process to different degrees. **Illustration B** shows the results after a period of time of use of a typical oil lubricant. The constant friction and electro-magnetic interaction has caused the weakened metal to break off or chip away creating metallic debris in the lubricant leading to abrasive wear from wear metal particles. This fact is evidenced in the need to change the engine oil of automobiles frequently as the lubricant "breaks down" due to the heat and metallic debris.

ILLUSTRATION B



ABF TECHNOLOGY™

Advanced Boundary Film Technology- There Is No Better Protection Against Wear.

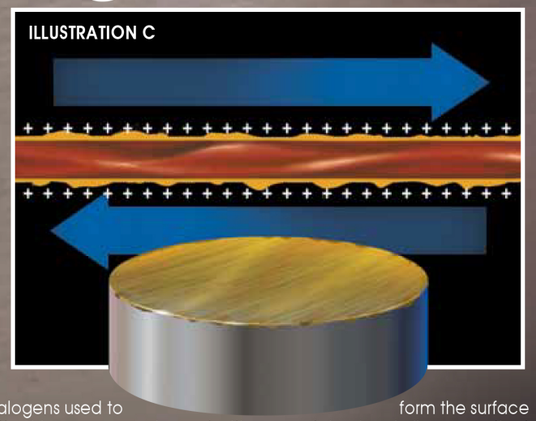
See Extreme Condition Lubrication Test At www.steelshieldtech.com

Steel Shield Technologies has redefined lubrication by breaking away from the standard approach to making the lubricant more effective through adjusting the refinement process or through the use of additives. Instead, **Steel Shield Technologies** approaches lubrication by improving the surface characteristics of the metal through the process of **Advanced Boundary Film** formation. This technological breakthrough is accomplished by addressing the naturally formed asperities, micro-pores and fissures and the electro-magnetic charges they create.

Steel Shield products consist of an advanced combination of halogens which react under thermal (heated) conditions to form electro-negative surface attaching compounds. They seek out and affix themselves to the lower surface areas, filling the micro-pores and fissures. As this process is working, the thermal conditions are effecting the asperities. Instead of breaking off because of a weakened metal state, the asperities gradually roll out or flatten. So while the micro-pores and fissures are filling up, the asperities are flattening for an end result of a metal surface that is greatly improved. Created in this process is a total positive state of polarity. When the metal surface polarity becomes uniform in charge, there is a reduction in friction due to the Faraday reaction of like-charges. This electrochemical process continues at the molecular level to form an **Advanced Boundary Film** on the surface of the metal. **Illustration C** shows the end result of the production of the **Advanced Boundary Film** and the resulting uniform positive polarity.

Another aspect of this advanced technology is the organo-metallic substitution which is the chemical process designed to inhibit halide formation. Here, the

ILLUSTRATION C



halogens used to form the surface attaching compounds react with reagents having similar properties to the iron atom. The halogens, therefore, do not scavenge the target metal surface to find iron with which to react, forming halides and creating a chemically corrosive wear syndrome. Instead, an organo-metallic complex is formed as the basis of the **Advanced Boundary Film.**

Industrial Success Comes To The Consumer

Steel Shield Technologies is now bringing this breakthrough technology to the consumer after great success on the industrial level. The level of commitment to the Steel Shield product in the railroad industry is an indication of its performance in the most extreme conditions imaginable. This same technology is now available to you.

As has been explained, the **Advanced Boundary Film Technology** is a redefining approach to lubrication which provides outstanding benefits to the user.

Practical Elimination Of Metal-To-Metal Wear

Steel Shield Technologies addresses the three areas that cause the weakening and deterioration of the metal surfaces:

- The physical friction of rough surfaces
- The opposite electro-magnetic charges that exist on the metal surface
- The chemical reactions that produce corrosive agents.

Advanced Boundary Film Technology instead strengthens the metal and practically puts an end to metallic debris in the lubricant.

Reduced Operating Temperatures

Friction is reduced so significantly that the operating temperature in treated mechanisms is notably reduced. The end result is a stronger metal that maintains its original specifications and performance level. An example of the reduction of operating temperatures is found in the independent tests that show a drop of an average of 30 Fahrenheit degrees in treated automobile engines.

Increased Effectiveness Of The Lubricant

Whatever lubricant is used as the carrier of the **Steel Shield Technologies** additive, that lubricant is allowed to perform at its maximum efficiency. Lubricant flow will be enhanced with the elimination of rough metal surfaces; the reduction of heat and elimination of metal debris will protect the lubricant from "break down."

STEEL SHIELD TECHNOLOGIES™

7. MAJOR BREAKTHROUGHS IN LUBRICATION TECHNOLOGIES

1. VIRTUAL ZERO FRICTION - RCB IONIC LEVITATION

Faraday's Law like-charges Repel & Dipole-Dipole Reaction

2. DYNAMIC HEAT TRANSFER

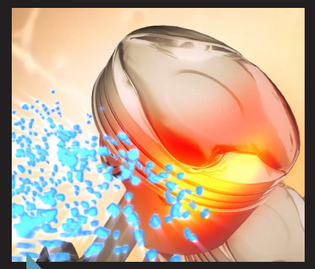
Lubricant accumulates at the hot spot automatically

3. NON CORROSIVE CLEANSING

Metal sludge repelled via induction and removed

Virtual Zero Friction Technology

Lubricants Accumulate at Hot Area & Protect



Clean Engine By Repelling Metal Debris

4. METAL SURFACE RE-HARDENING

From Shear Friction to Surface Lapping

5. ELIMINATE SYSTEM DYSFUNCTION

Not Just Oil, It's Technology

Metal Surface Hardened & Stronger

Engine Keep Running at High Efficiency

8. RCB ELECTROCHEMICAL IONIZATION ADVANCED LEVITATION TECHNOLOGY

Metal Surface Positively Charged

Metals Repel Each Other

Magnetic Levitation

Near Zero Friction

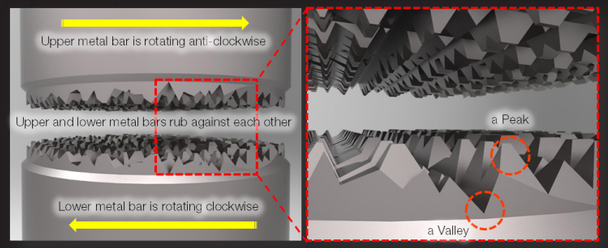
Positively Charged Metal Surface

Repel Each Other

9. ABF TECHNOLOGY DETAILED EXPLANATIONS

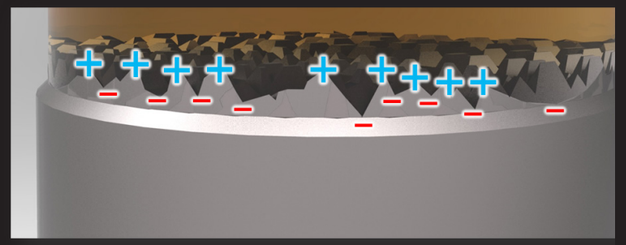
1. METAL SURFACE

Under microscope, metal surface characterized by series of peaks and valleys, Peaks (known as “asperities”), and Valleys (referred to as “micro-pores” and “fissures”).



2. CHARGES OF THE METAL SURFACE

Peaks are positively charged and Valleys are negatively charged.

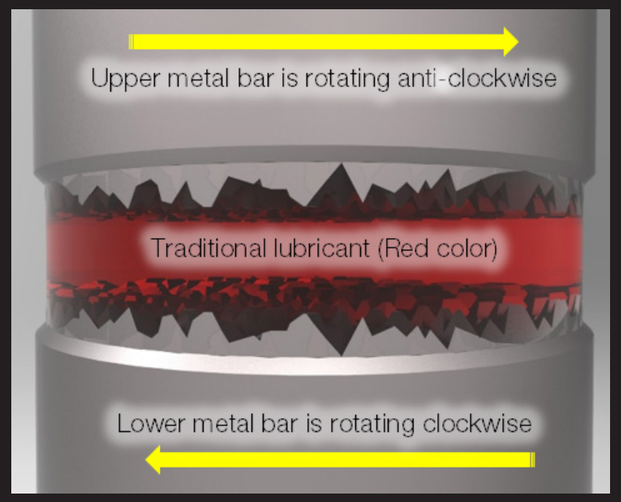


3. TRADITIONAL LUBRICANTS

A. Traditional lubricants help slow the process of heat and friction to some degree.

B. When 2 metal surface contact each other and move in opposite directions, friction is caused, producing heat & metal deterioration.

C. Constant friction & electromagnetic interaction causes the weakened metal to break off creating metallic debris & particles in the lubricants



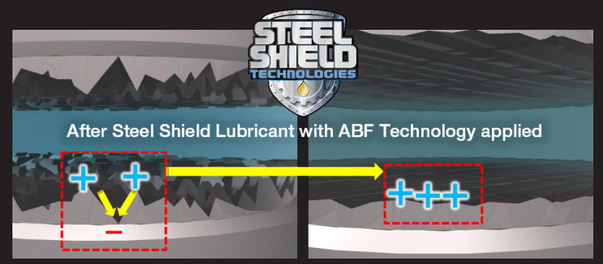
4. STEEL SHIELD TECHNOLOGY

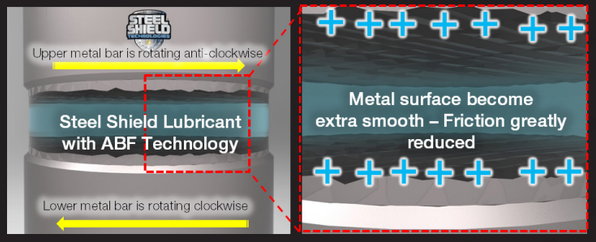
A. Forms electro-negative surface attaching compounds to seek out & affix themselves to lower surface areas filling the micro-pores & fissures.

B. Asperities roll out or flatten creating greatly improved metal surfaces.

C. Created in this process is a total positive state of polarity.

D. When metal surface become uniform in charge, there is a reduction in friction due to Faraday reaction of like-charges.





5. ADVANCED BOUNDARY FILM

A. Advanced methods of tribology that improve lubricity and load carrying capacity

B. Reacts chemically under thermal conditions with the contacting metal surfaces to form a complex surface-attaching film of protection

C. Surface smoothing is accomplished resulting in improved spread characteristics of the surfaces themselves

D. Increases fluid film strength resulting in greatly reduced wear while imparting extreme pressure properties (EP)

10. ADVANTAGES & TARGETED INDUSTRIES

1. Concept

Van der Waals Forces
Dipole-Dipole Surface Reactions

2. Advantages

Reduces Friction and Wear
Provides Smoother Operation
Improves Lubrication
Non-Toxic and Helps Build Green Environment
Improves Machinery Functionality
Improves Fuel Economy
Reduces Operating Temperatures
Protects Moving Metal Parts
Eliminates Cold Start Problems
Reduces Maintenance & Downtime
Extends Component Reliability & Parts Life

4. Targeted Industries

Automotive & Racing, Airlines & Ground Equipment,
Rail & Mass Transit, Shipping
Gas, Oil & Energy Industries, Mining & Drilling
Lifts, Air Conditioning & Cold Storage Systems
Industrial, Agriculture, Construction & Naval Engineering
Military & Law Enforcement units

II. HOW STEEL SHIELD SOLVE PROBLEMS IN MARINE OPERATIONS

Most marine engines are running at low rpm and at low thermal efficiency. More than 50% of the energy in the fuel is not converted to motion. The average Brake Specific Fuel Consumption (BSFC) at maximum power is about 0.158 g/kw-hr.

Power Sources:

1. *Steam Turbine – LNG & Nuclear-powered*
2. *Reciprocating diesel engines*
3. *LNG engines*
4. *Gas turbines*
5. *Stirling engines*

Steel Shield, the ultimate lubricant, cleaner, penetrant, and SALTWATER protectant, has been aggressively designed and formulated for the Marine Industry. It penetrates to the internal moving parts and shields against corrosion in extreme saltwater environments better than any other products to date.

Steel Shield protects moving metal parts from wear and damage due to boundary conditions of frictional abrasion, extreme pressure torque, dry startup and engine shutdown.

Steel Shield reduces coefficients of friction between the gears and other moving metal parts in the entire power system allowing for improved reliability, better thermal efficiency and significant savings in operation and maintenance costs.

11A. CRANKSHAFT

Crankshaft is the backbone of a 2-stroke engine. Technically, it's a long and heavy part which undergoes severe fluctuating loads because of the gas pressure generated in the combustion chamber and high bending and torsional loads from heavy moving objects (piston, connecting rod etc.)

The crankshaft is built such that the crank angle of one unit lies at an angle different than that of the adjacent unit. The difference in angles depends on the number of units and strokes of the engine.

TYPES OF CRANKSHAFT

Following are four main types of crankshafts used in marine engines depending on the construction methods:

Fully Forged: In this method, the full crankshaft is a single piece, forged in a casting. The disadvantage of such type of crankshaft is the chance of twisting or bending.

Fully Built: In this type, all the components of the crankshaft i.e. crank pin web and journal pin are manufactured separately in steel casting. They are then shrink-fitted together to form a single unit.

Semi Built: Instead of all components, only journal pin and crank throw are manufactured separately and then shrink-fitted as a unit. This type of crankshaft has better fatigue resistance and grain strength. Moreover, less number of shrink-fits are used and it is cheaper than the fully built crankshaft.

Fully Welded: As the name suggests, the crankshaft is built by continuous feed submerged arc welding for joining journal pin and webs.

REASONS FOR FAILURE OF CRANKSHAFT

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
1	**Fatigue Failure:** Majority of steel crankshaft failures occur because of fatigue failure, which may originate at the change of cross-section area such as at the lip of oil-hole bored in the crankpin.	Steel Shield ABF Technology treats the metal and the metal surface becomes much more smoothed and harderned. Damage due to fatigue can be greatly reduce by less friction and workload concentrations on crankshaft.
2	**Failure Due to Vibration:** If the engine is running with heavy vibration especially torsional vibration, it may lead to crack in the crankpin and journal.	Engine components can be well protected from vibrations by ABF Technology because metal surface are smoothed and hardened. It dramatically reduce the opportunities of cracks formations.
3	**Insufficient lubrication:** If the lubrication of bearing in the crankshaft is starved, it may lead to wipe out of the bearing and failure of the crankshaft.	With the application of correct lubricant viscosity, Steel Shield ABF Technology can protect metal surface where lubricant is insufficient. This is because the effect of ions on metal surface are still in active statue after a long period.
4	**Over-Pressurized Cylinder:** It may happen that there is hydraulic lock (water leakage) inside the liner and due to extreme pressure the crankshaft may slip or even bent (if safety valve of that unit is not working).	~~(Machine / Operation problems, not related to lubrications)~~
5	**Cracks:** Cracks can develop at the fillet between the journal and the web, particularly between the position corresponding to 10 o'clock and 2 o'clock when the piston is at T.D.C.	Cracks are formed by over concentrated stress in corner areas of components. Steel Shield ABF greatly reduces crankshaft frictions and workloads on components. Corner stresses also reduced, and the efficiency of engine increased.

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
6	**Reasons for Crankshaft Misalignment:** Crankshaft is a massive component when all its parts are assembled together in the marine engine. Initially, the complete crankshaft is aligned in a straight line (Connection drawn from the center of the crankshaft makes a straight line) before setting it on the top of main bearings. But with time due to various factors, the straight line may deviate and misalign. A degree of misalignment within limit is acceptable but if the value goes beyond that rated by the manufacturer; it may lead to damage or even breakage of the crankshaft. Following are the reasons for misalignment of crankshaft:	
	a. Damage or wipe-out of the main bearing	Steel Shield ABF Technology treats the metal surface and the suface becomes hardened and smoothed. It also enables bearings to work under extreme presure loadings, and therefore, metal wear reduces. With lesser metal debris formed in the oil, damages on bearings also reduced. This can also prevent misalignments from happened.
	b. Loose engine foundation bolt leading to vibrations	~~(Assemble problems, not related to lubrications)~~
	c. Deformation of ship's hull	~~(Structural problems, not related to lubrications)~~
	d. Cracks in the bearing saddle	Steel Shield ABF Technology treats the metal surface of bearings and prevent cracks formations as mentioned previously.
	e. Loose main bearing bolt, leading to damage of main bearing	~~(Structural problems, not related to lubrications)~~
	f. Very high bending moment on the crankshaft due to excessive force from the piston assembly	Steel Shield ABF Technology reduces the coefficient of friction of piston and cylinder surface. The power loss due to friction and heat greatly decreases. Therefore, the efficiency of the engine increase, and the piston can provide enough useful power by generating less pressure and torque on the crankshaft. Thus, the bending moment on the crankshaft can be reduced.
	g. Grounding of the ship	~~(Operation problems, not related to lubrications)~~
	h. Crankcase explosion or fire	~~(Operation failure, not related to lubrications)~~
	i. A defective or worn out stern tube or intermediate shaft bearings	Steel Shield ABF Technology can greatly reduce wear and damage as mentioned previously.
	j. Loose / broken chokes in foundation	~~(Component problems, not related to lubrications)~~
	k. Cracked Bearing pockets Cracked Bearing pockets	Steel Shield ABF Technology can greatly reduce wear and damage as mentioned previously.
	l. Bedplate deformed – transverse girder damaged	~~(Structural problems, not related to lubrications)~~
	m. Slacken tie bolts or broken	~~(Assemble problems, not related to lubrications)~~
	n. Weakening of structure due to corrosion	Steel Shield lubricants do not contain any solid additives and do not corrode components. Steel Shield ABF Technology is based on bio-chemical science and ionic technology which treats metal surface, not treats the oil by additives. Also, the Non Corrosive Cleansing of ABF Technology can positively charges BOTH the inner surface of metal pipes / tubes and the metal-containing sludge. The results are cleansing / repelling of existing sludge on the tube surface and the prevention of the new sludge formations. This effect can greatly reduce the formation of acidic / undesirable substances by debris, and protect metal surface from corrosion. Finally, Steel Shield lubricants are very stable under high operating temperature, it will not form cause harmful effects to any metal or engine system.

11B. CONNECTING ROD

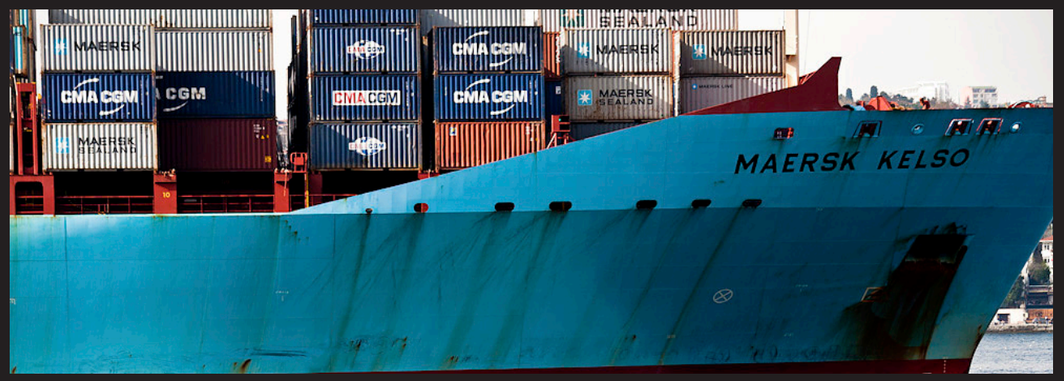
Connecting rod in a two stroke marine engine is used to connect the crankshaft and the piston (via crosshead and piston rod) for transmitting the piston force to the crankshaft.

In 2 Stroke engines, the con-rod is one of the most stressed part as it undergoes high compressive forces.

The 2 stroke con-rod is constructed in round section with flat palm at both ends to accommodate bearings.

REASONS FOR FAILURE OF CONNECTING ROD

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
1	As connecting rod is one of the most stessed components in the marine engine, the failure of connecting rod can be due to:	
a.	Very high peak pressure inside the combustion chamber	~~(Operation problems, not related to lubrications)~~
b.	Water inside the cylinder while starting the engine	~~(Machine problems, not related to lubrications)~~
c.	Crankpin bearing seizure	Test reports of the Southwest Research Institute evidenced that, Lithi Shield and Steel Shield lubricants outperform other reputed lubricants in the market. The weld points in the Four-Ball Tests (ASTM D2783) and OK Load in the Timken Tests (ASTM D2782) of Steel Shield lubricants and greases are much higher than other premium lubricants. Thus, Steel Shield lubricants are proven to demonstrate a dramatic reduction in seizure of metal components, such as crankpin bearing or others.
d.	Piston or liner seizure due to lack of lubrication or cooling	Steel Shield ABF Technology Like-Charge-Repel keeps the components from minimum metal-to-metal contact, friction is thus reduced to minimum and simultaneously lesser heat is generated in due respect. Together with its active heat transfer mechanism the working temperature of the entire system can be significantly reduced. ABF Technology upholds its reliability even under insufficient lube oil. Seizure of piston and liner can be 100% eliminated. The result is dramatic.
e.	Wrong or loose assembly of connecting rod parts	~~(Assembly problems, not related to lubrications)~~



11C. CROSS HEAD, GUIDE & GUIDE SHOE

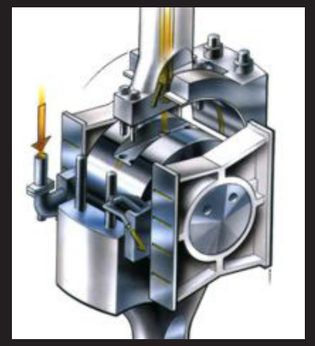
Crosshead is attached on the upper part of the connecting rod, which connects the con-rod to the piston rod. The guide and the guide shoe runs on the guide rail to support the crosshead pin and to transfer the side thrust of the crosshead to the engine frame.

In some old MAN B&W engines and SULZER RND engines, the piston rod passes through a bore in the crosshead and is bolted from the bottom by means of fine threaded nut.

In the new design engines such as MAN SMC/ ME and SULZER RTA/ RT flex, the pison rod palm rests on the crosshead flat surface and four hydraulic bolts are used to tie them together.

Guide and guide shoe, along with the connecting rod and crosshead, is an important arrangement as the guide directs the guide shoe in reciprocating direction while absorbing the side thrust produced during the motion of the connecting rod.

The guide comprises of guide rail (normally integrated/ bolted with the frame) and guide plates, in which, the guide shoe moves up and down.



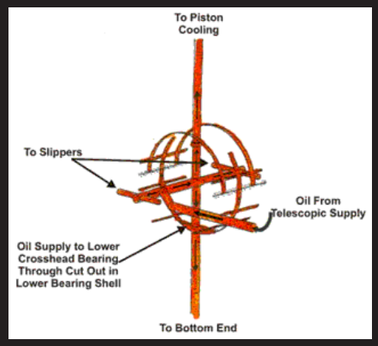


FIGURE 1 - CROSS HEAD SYSTEM & LUBE

- Left: MAN B&W MC Engine Crosshead
- Right: Crosshead oil supply system: The lower half of the bearing housing is formed by the top end of the connecting rod. It supports the crosshead pin over its entire length, the piston rod being bolted to the top half of the crosshead pin through a cut out in the bearing top half. Oil supply to the crosshead is via a telescopic pipe from the main LO supply at a pressure of about 2.5 bar.

CROSSHEAD MATERIALS & LUBRICATIONS

	Components	How STEEL SHIELD Lubricants Work?
1	CROSSHEAD: The crosshead bracket is made up of steel casting in which the pin is shrink-fitted to form complete crosshead unit.	Steel Shield ABF Technology is unique and beats any brands in the aftermarket. Faraday's Law Like-Charge-Repel and Dipole-Dipole effect is the ultimate solution for reducing metal-to-metal friction which is the main cause of many problems in a mechanical system. ABF Technology reduces friction, heat, noise and provides complete protection to the metal components especially during cold start. The entire system will operate under the most favorable condition, extended parts life and lubricant oil change interval, and most important of all its highly efficient with minimal maintenance and repair expenses.
2	CROSSHEAD PIN: The crosshead pin is made of high strength nitride steel with excellent surface finish which helps in lubrication of crosshead bearing.	
3	GUIDE PLATE: Guide plates are made up of cast iron. Sometimes shims are provided for adjustment of guide plates.	
4	GUIDE SHOES: Guide shoes which are accommodated in the A frame, and fitted both forward and aft of crosshead, are normally made of white metal lining with slipper surface. Lubricating oil grooves are cut into the guides for lubrication.	

DIFFERENCE BETWEEN MAN B&W AND SULZER CROSSHEADS

SULZER Crosshead:

1. Crosshead bearing surface area is smaller
2. Bearing shell is smooth
3. surface
4. The lube oil is supplied by separate crosshead pump
5. The lube oil pressure is maintained at 12-16 bar
6. Lube oil is injected once in one cycle @ 20 deg. Before TDC
7. Lube oil is supplied to crosshead by means of swinging or articulated pipe at crosshead

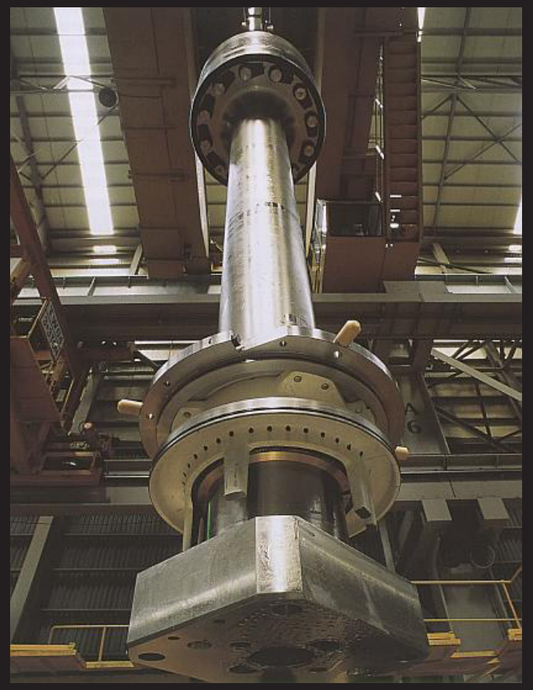
MAN Crosshead:

1. Large crosshead bearing surface area
2. Grooves with machined channel to retain lubricating oil
3. The lube oil is supplied by same main lube oil system pump
4. The oil pressure is maintained at 2-4 bar i.e. system pressure
5. Injected twice every engine cycle
6. Lube oil is supplied to crosshead by means of telescopic pipe connected to the guide

1 1 D. PISTON

Piston is the only moving component in the combustion chamber and is responsible for converting the generated gas forces into mechanical reciprocating motion, which finally drives the propeller.

Piston Crown is normally casted from chrome nickel molybdenum alloy steel as it exposes to high temperature and thermal stresses.



DESIGN & MATERIAL

A two-stroke piston comprises of:

1. Piston crown: which forms the top most part, exposed to the combustion chamber
2. Piston skirt: which acts as a guide inside the liner and also opens and closes the air intake or scavenge ports in the liner for combustion air entry
3. Piston rod: which connects the piston to the crosshead

The top land of the piston is designed in convex or concave shape as it makes a hemispherical combustion chamber in conjunction with the cylinder head, resulting in higher efficiency. The top land is sometimes coated with temperature resistant material to protect the crown from overheating. Piston Rod is made up of forged steel. Nowadays, Sulzer and MAN engine pistons have chromium-coated grooves for long operating life. Both these engine pistons are equipped with two or more bronze band rings integrated in the skirt part, for assisting the piston in running-in phase.

"It is highly recommended to apply STEEL SHIELD lubricants in the piston run-in phase. Because ABF Technology treats the metal which hardens and smooths the metal surface. It minimizes the creation of metal wear and debris. The most important point is the tolerance of the engine components can be protected, the tolerance of the engine parts remain intact so as the dynamic mass. The result is: Engine always like NEW with improved thermal efficiency !"

COOLING METHOD

The main engine piston is cooled by either oil or water. Water-cooled pistons were mainly used in old MAN engines and Sulzer RND engines. Nowadays both MAN and Sulzer engines prefer oil cooling to conventional watercooling piston as the former reduces the risk of lube oil contamination in case of leakage.

In MAN engine: The cooling oil comes from main bearing to the crosshead pin and then reaches the crown through the bores provided in the piston rod. A return line bore is also provided in the rod, which connects to crosshead pin sides and the oil goes to the sump.

In SULZER engine: The cooling oil comes to the piston from an articulated or swinging arm supplying lube oil at system pressure. A separate manifold runs throughout the engine, from which oil is supplied to the articulated arm of each unit.

TYPES OF 2-STROKE PISTON

Every engine maker, especially the big players such as MAN and Sulzer are introducing new piston designs to improve the overall efficiency of the combustion space and to increase the working life of the piston.

SULZER Piston: The new SULZER piston with concave crown comes with Jet-Shaker cooling design, wherein the jet nozzles are attached to the cooling passage of piston rod. The piston crown design which comprises of bores and nozzles (for supplying cooling oil with high pressure), provides better uniform cooling and reduces crown thickness and overall piston weight. This is known as jet shaker method as during downward movement of piston, the nozzle sprays the oil jet inside the bore and when the piston moves upward, the oil inside the piston crown shakes for efficient cooling.

MAN B&W Piston: The new MAN engine uses simple bore cooling piston and jet nozzels, which comprises of oil passage within the piston crown for uniform cooling. The MAN engine also uses a top layer thermal coating over the crown, known as INCONEL 625 coat, which is 8mm thick and protects the crown surface from overheating.

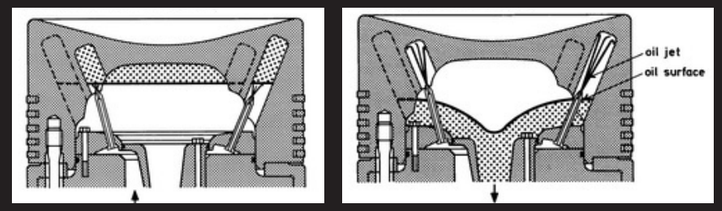


FIGURE 1 - PISTON COOLING

- Left: Shaker Cooling, Piston at TDC
- Right: Jet Cooling, Piston at BDC

The latest development in MAN engine pistons is OROS Piston, which has top land with double convex valleys. The main advantage of this type of piston over the conventional designed piston is :

1. Reduction in the thermal load and temperature of piston crown
2. Increase in the overall working life of the piston
3. Formation of better combustion chamber, leading to efficient combustion

The max temperature reached in gas side of a piston during combustion process in conventional shape piston is 510 ℃ but it reduces to 420 ℃ in OROS type piston.

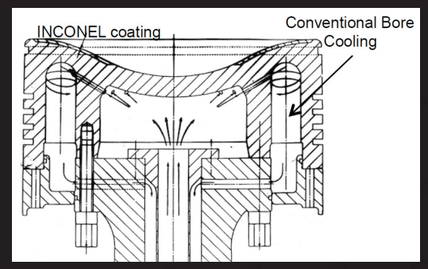


FIGURE 2 - INCONEL PISTON COATING

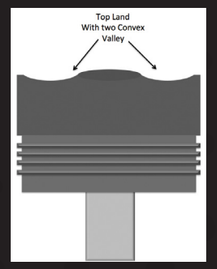


FIGURE 3 - OROS PISTON

- Top land with 2 convex valley

"STEEL SHIELD Lubricants are suitable for both shaker and jet cooling, and any other method. The efficiency of cooling highly depends on the cleaness of the surface and the flow of lubricants. STEEL SHIELD ABF Technology can clean the engine and ensure unrestricted flow of oil. The result is: ULTRA LOW OPERATION TEMPERATURE"

MAJOR PROBLEMS IN PISTON

The most common problems experienced in a marine engine piston are:

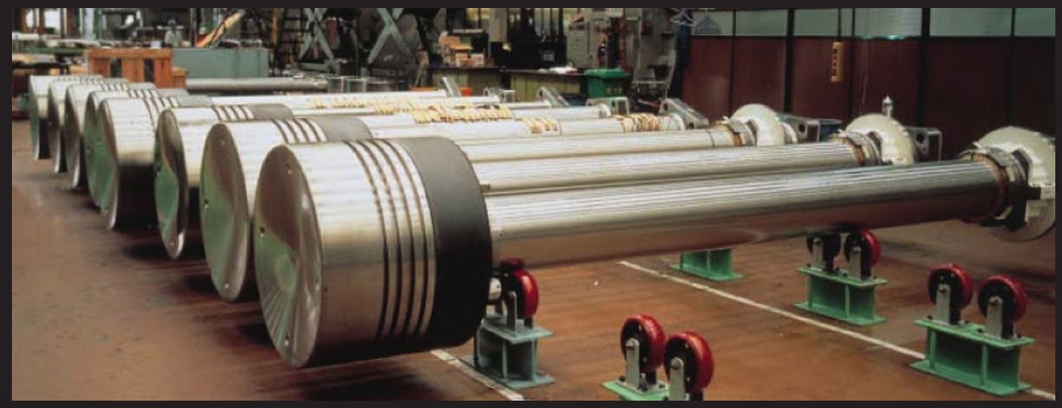
1. Cracks on the surface
2. Deformation of piston crown top
3. Burning off of piston crown top
4. High temperature of piston while running
5. Scuffing of piston
6. Worn-out piston ring grooves

REASONS FOR FAILURE OF PISTON

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
1	Inadequate circulation of coolant	~~(Machine / Operation problems, not related to lubrications)~~
2	Excessive deposits inside the cooling space	The Non Corrosive Cleansing of ABF Technology can positively charges the inner surface of piston, cylinder, oil flow channels and the metal-containing sludge. The results are cleansing / repelling of existing sludge on the tube surface and the reduction of the new sludge formations.
3	No or poor water treatment	~~(Machine / Design problems, not related to lubrications)~~
4	Poor cylinder lubrication	Steel Shield ABF Technology treats the metal and the metal surface becomes smooth and harderned. Damage due to poor cylinder lubrications can be greatly minimized by improved coefficient of friction.
5	Faulty piston ring	~~(Machine problems, not related to lubrications)~~
6	Liner distortion	~~(Machine / Design problems, not related to lubrications)~~
7	Piston wrongly aligned	~~(Maintenance problems, not related to lubrications)~~
8	Overloading during combustion	~~(Machine / Operation problems, not related to lubrications)~~
9	Excessive water in fuel	~~(Machine / Operation problems, not related to lubrications)~~
10	Insufficient air	~~(Machine / Operation problems, not related to lubrications)~~
11	Late fuel injection	~~(Machine / Operation problems, not related to lubrications)~~
12	Faulty fuel injector leading to more penetration of fuel	~~(Machine / Operation problems, not related to lubrications)~~
13	Wrong running-in after major overhaul	~~(Operation problems, not related to lubrications)~~
14	Scavenge fire: Occurs because of the overload of engine / pistons which lead to overheat of pistons.	Steel Shield lubricants with ABF Technology treats the metal surface, the surface becomes hardened and smoothed which lower the operatiing temperature due to friction. Also, the entire machine operation becomes much smoothed which can increase the efficiency of the engine, and the piston can provide the required pushing force by generating much lesser pressure. Therefore, the piston life extended dramatically, and the cooling requirement reduced. Furthermore, the Non Corrosive Cleansing of ABF Technology can positively charges the surface of piston, cylinder, oil flow channels and the metal-containing sludge. The results are cleansing / repelling of existing sludge on the surface of oil flow channel and the prevention of the new sludge formations. This helps the lubricant flow much more effective and the entire operating temperature drop down dramatically.
15	Thermal stresses due to cold starting or low temperature of scavenge air: Lubricants have very viscosity at low temperature which resists the movements of pistons. Pistons may be weared or even damaged if the operation is forced to start which also lead to high thermal stresses.	Steel Shield lubricants with ABF Technology can actively protect the metal surface. Assumed that the Steel Shield lubricant with the correct viscosity for that particular engine application is selected, the lubricant can retain adequate flowability at low temperature. This prevents engine wear during cold start. Majority of the premium lubricants depend on their additives to attact on the engine surface. After few days, the oil will flow down to the bottom reservoir which leave the engine unprotected and cause damage during start. However, Steel Shield utilize ionic technology which treats and "activate" the metal surface. The engine can still be protected for 90 days (learned by experience) after downtime (90 days without any engine operation).

DIFFERENCE BETWEEN SULZER AND MAN PISTON

	SULZER	MAN
1	Crosshead bearing surface area is smaller	Large crosshead bearing surface area
2	Bearing shell is of smooth surface	Bearing shell has grooves with machined channel to retain lubricating oil
3	The lube oil is supplied by separate crosshead pump	The lube oil is supplied by main lube oil system pump
4	The lube oil pressure is maintained at 12-16 bar	The oil pressure is maintained at 2-4 bar i.e. system pressure
5	Lube oil is injected once per cycle @ 20 deg. Before TDC	Lube oil is injected twice every engine cycle
6	Lube oil is supplied to crosshead by means of swinging or articulated pipe attached to the crosshead	Lube oil is supplied to the crosshead by means of telescopic pipe connected to the guide



11E. PISTON RINGS

The main function of piston rings inside the combustion chamber is to seal the space and prevent the escape of gases into the lower portion of the engine i.e. under piston area and crankcase. If the rings are sealing the combustion chamber properly, then it will assist the piston to compress the air fuel mixture efficiently.

Other important functions of piston rings are:

1. To help the cylinder oil spread properly on the liner surface
2. To prevent the cylinder oil entry inside the combustion room

The most common problem in the piston assembly is breaking of piston rings. Following are the main reasons:

FIGURE 1 - PISTON RING INSPECTION FROM SCAVENGE PORT

REASONS FOR FAILURE OF PISTON RINGS

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
1	Excessive thermal load on the ring	Steel Shield utilizes ABF Technology which treat the metals and enhances the hardness and smoothness of metal surface. So, temperature due to frictions reduced.
2	Piston cooling is insufficient	Like-charge repels, with the ABF Technology the metal-containing sludge will be completely repelled from the metal surface of piston, cylinder and oil flow path. These areas remain clean will be advantageous to the heat transfer between metal and oil, and the efficiency of cooling will be significantly improved.
3	Distorted piston crown	Steel Shield with ABF Technology greatly less frictions (as mentioned previously). The probability of piston crown being distorted due to friction is dramatically reduced.
4	Excessive or loss of cylinder lubrication	Excessive lubrication is caused by machine or operation problems, not related to lubricants. Steel Shield ABF Technology treats the metal which enables maglev between the cylinder and other engine components. Therefore, when there is a sudden loss of cylinder lubrication, the machine can still be protected (the degree of protections depends on the actual situation).
5	Excessive piston ring clearance	Steel Shield with ABF Technology can protect piston rings from wear (as mentioned previously). The clearance can still be maintained within the expected design tolerance after long operation period.
6	Increase in groove height and width, leading to fluttering of rings	~~(Machine problems, not related to lubrications)~~
7	Sticking of piston rings	The problem is caused by deterioration of materials, and the debris sticks on the piston rings. The Non Corrosive Cleansing of ABF Technology can repel and remove debris via ionization keeping the piston ring always clear from sludge and move free.

11F. CYLINDER LINER

Liner in the combustion chamber of the marine engine carries the piston and transfers the heat generated during combustion to the jacket with the help of cooling water. With the development of engines, the material used for liner and construction methods have also evolved. Since the upper section of the liner is always exposed to the combustion gases, it is subjected to highest temperature and pressure fluctuations. Hence it is important to control the temperature and pressure of the liner to avoid thermal cracking.

CYLINDER LINER TYPES

In early marine engine models, cooling of SULZER and MAN engine liners mainly depended on the jacked cooling efficiency. Liners used in this engine were slim and had good thermal property, as the temperature variation in the liner surface (top and bottom) was not much. With the use of turbocharger and increase in engine power the mechanical stresses on this slim liner resulted in cracks and other mechanical failures.

The 2nd generation liner comprises of cooling passages or cooling bores drilled at an angle, which carries cooling water within the liner and then to the cylinder head. This design allows to increase thickness of the liner without increase in thermal stresses and also assist in stable lubrication.

CYLINDER LINER MATERIALS

The most common materials used in construction of a two stroke marine engine liners are:

1. Cast Iron with alloys of nickel
2. Chromium
3. Molybdenum
4. Vanadium
5. Copper
6. Titanium

Various engine makers use different materials due to increased demands for higher outputs:

1. Wartsila NSD RTA: Lamellar or vermicular graphite cast iron
2. Wartsila NSD 32/46 : Grey cast iron alloy
3. MAN-B&W MC : Tarkalloy, a lamellar graphite cast iron with boron and phosphorous

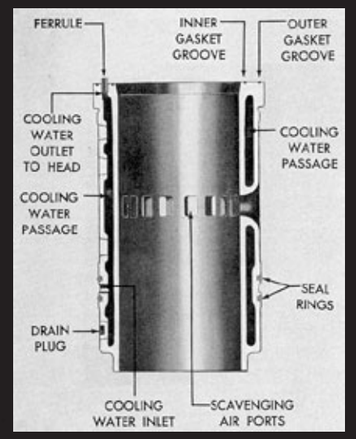


FIGURE 1, 2
- Fig.1 (top): Liner interior
- Fig.2 (bottom): Liner details

"STEEL SHIELD Lubricants cause no harm to any of the cylinder liner materials. In addition, the unique ABF Technology can protect the metal coatings of the liner which makes the metal surface more durable and smooth without loosing the design tolerance."

REASONS FOR FAILURE OF CYLINDER LINERS

	Reasons of Failure	How STEEL SHIELD Lubricants Solve the Problem
1	Frictional Wear: Whenever two surfaces slide over each other, friction is produced which leads to wearing down of both the surfaces. In liner wear the surfaces are piston rings sliding over the cylinder liner. The frictional wear depends upon various factors such as speed of movement between the surfaces, material involved, temperature, load on engine, pressure, maintenance, lubrication, and combustion efficiency.	Steel Shield utilizes ABF Technology which treats the metal and enhances the hardness and smoothness of metal surface. So, frictional wear dramatically reduces. In addition, large amount of energy is saved by reduced frictions.
2	Corrosion: The wear due to corrosion is caused due to the burning of heavy fuel oil in the combustion chamber. This happens because heavy fuel oil contains high sulphur content. During combustion, acids formed inside the space should be neutralized by cylinder oil, which is alkaline in nature. The production of acids will be more if the sulfur content is more, leading to the formation of sulphuric acid. Sulphuric acid is formed due to absorption of the condensate or moisture present inside the combustion chamber. Sulphuric acid corrosion is found more in the lower part of the liner as the temperature of jacket water is very low. Corrosion due to sulphur will be high because of the presence of water in fuel and condensate in the air. This wear is generally seen between the quills. The wear near the quills enlarge and gives a characteristic of the clover leaf shape to the wear pattern. This phenomenon is called clover leafing	Most of the premium lubricants in the market contain huge amount of unknown additives. Many of them are corrosive or can be easily deteriorated under temperature and form corrosive substances which will cause permanent damages to the engine. Steel Shield Lubricants with ABF Technology do not contain any corrosive additives. They remain stable under high temperature and pressure which are safe to engines. If there is any damage happen on the surface of the cylinder liner due to corrosion, the ABF Technology can stop the situation getting worse by treating the metal surface which includes surface hardening and smoothing (the effectiveness depends on the degree of metal damage). This can only be done by ABF Technology.
3	Abrasion: This type of wear is due to the soot and debris present and formed during combustion. Catalytic fines in the fuel and the ash formed during the combustion causes abrasive wear.	Steel Shield utilizes ABF Technology which treats the metal and enhances the hardness and smoothness of metal surface. This can prevent abrasion wear of metal effectively.
4	Adhesion or Scuffing: This is a form of local welding between the particles of piston rings and the liner surface. As the piston is moving inside the liner, the welding that has occurred breaks and leads to the formation of abrasive material. The abrasive material will increase the rate of wear of the liner. This is generally caused by insufficient lubrication due to which large amount of heat is produced and microscopic welding of rings and liner surface takes place. Due to this type of wear, the liner loses its properties to adhere cylinder oil to the surface. One more reason for this phenomenon is polishing of the surface by scuffing, giving liners a mirror finish.	According to the test reports issued by the most famous lubricant research organization - the SouthWest Research Institute, Lithi Shield and Steel Shield lubricants outperform other reputed lubricants in the market. The weld points in the Four-Ball Tests (ASTM D2783) and OK Load in the Timken Tests (ASTM D2782) of Steel Shield lubricants and greases are much higher than other premium lubricants. Thus, Steel Shield lubricants are provened to dramatically eliminate the probability of adhesion or scuffing of cylinder liners. Also, the Steel Shield ABF Technology utilizes ionic bonding to adhere to cylinder surface to protect and treat the metal. The effectiveness of adhesion is not directly related to the smoothness and degree of wear of metal surface.
5	Lacquering: Lacquering is caused due to organic and inorganic salts, which result in calcium deposits built up in the honing grooves of the liner. These salts can result in smooth or glazed liner surface which in-turn increases the oil consumption rate significantly. If unchecked, these calcium deposits, along with carbon deposits, may lead to scoring or polishing of the liner. *"Calcium PPM in ISO 8217 fuel oil specification is 30 ppm."*	The Non Corrosive Cleansing of ABF Technology can repel and remove debris via ionization keeping the cylinder liner always clear from sludge and lacquering. Steel Shield Lubricants can also clean any calcium deposits.
7	Apart from the above listed problems, the liner top surface is subjected to maximum wear because of the following reasons:	
	A. High temperature exposure due to hot combustion gases	(Operation problems, not related to lubrications)
	B. Loss of lubrication until oil reaches the top portion	Steel Shield ABF Technology treats the metal (as mentioned previously) in which an ionic-maglev force is initiated, which will always uphold the liner free from direct metal to metal contact with the piston even insufficient oil lubrication occurs.
	C. Corrosion is maximum in this area	(Please see the solution of the second point (Corrosion) of this table)
	D. Direction change of piston starts in this area	Steel Shield utilizes ABF Technology which treats the metal and enhances the hardness and smoothness of metal surface.

CYLINDER LINER WEAR RATE

Typically, the wear down rate can be described as the wear surface in mm per 1000 engine running hours:

Old engine liner wear rate : 0.1mm/1000 hrs.

Modern engine liner wear rate : 0.03-0.04 mm/ 1000 hrs.

The stated wear rate can be achieved by following points:

	Solutions to achieve the stated wear rate	How STEEL SHIELD Lubricants Solve the Problem
1	Load dependent jacket cooling water control system	
2	Good design piston ring profile	
3	Good and even lube oil distribution in the liner surface	Steel Shield Lubricants are made of premium grade base oils enhanced with ABF Technology. Via ionic bonding it ensures even distribution of oil in the liner surface. ABF Technology re-hardens and smooths the liner surface giving advantage to greater reliability, longer durability and good oil flow in the system.
4	Multilevel lube oil injection inside liner	
5	High alkalinity lube oil	Steel Steel Lubricants are made by alkaline stocks which can neutralize acidic substances.
6	Good quality cast iron with hard liner face	Steel Shield ABF Technology rehardens the cylinder liner surface for better load carrying capability and upholds its reliability even in the most rigorous and severe working demand.

"STEEL SHIELD Lubricants can dramatically reduce the wear rate of any metallic cylinder liner surface. It is an all-round lubricant which can solve any oil related problems. Additionally, STEEL SHIELD ABF TECHNOLOGY add value to your machine, it makes your machine stronger, running smoother and quieter."

11G. EXHAUST VALVE

The Exhaust Valve of a 2 stroke marine engine is centrally installed over the top of cylinder head to allow all the exhaust generated inside the chamber during combustion process to be transferred to the exhaust trunk. The exhaust valve can be divided in 3 important parts:

Exhaust valve body: The outer body of the exhaust valve comprises of bores for passage of cooling water, guide for spindle of valve, cage for valve seat and other attachments for valve operation. It also comprises of compartments for power piston, which is operated by hydraulic and air pressure.

The body generally is made up of cast iron, which has good manufacturing property along with strength. The valve guide is made up of perlite cast iron.

Exhaust valve with spindle: The valve with spindle can be separated from the body in order to grind and recondition after a period of time or when required. The spindle is provided with rotary vanes attached above the valve in the stem. When exhaust gases pass through these vanes, it rotates the valve to avoid local distortion of the valve and valve seat. The modern age exhaust valve is made

from nickel-based alloy, precipitated hardened steel, austenitic steel or siliconchrome steel. For big engines, normally Nimonic spindle and a steel bottom piece with a surface-hardened seat to match the greater hardness of the Nimonic spindle at high temperatures are used. The face of the valve is stellite coated to increase thermal resistivity.

Exhaust Valve Seat: The Exhaust valve seat is a detachable part, which can be reconditioned or replaced in case of damage. The seat is stellite coated as it is also prone to high temperature wear.

COMMON PROBLEMS IN MARINE EXHAUST VALVES

1. High temperature corrosion of complete valve and valve seat
2. Reduction in the valve lift
3. Failure of spring
4. Erosion of valve and valve seat
5. Bending of valve spindle
6. Localised burning of valve and valve seat
7. Breakage of valve rotater vanes
8. Carbon or molten salt deposits in the exhaust passage and valve surface
9. Poor cooling of valve cage
10. Reseating failure leading to exhaust leakage
11. Banging of valve while closing

TYPES OF EXHAUST VALVES

With development of engines, the exhaust valves have also been enhanced in terms of construction, mode of operation and reduction in maintenance period. Following are the types of exhaust valves used in a 2 stroke marine engine:

Rocker arm and push rod operated valve: Old engines (MAN and SULZER) used rocker arm and push rod to operate the exhaust valve. Small size engine with small size exhaust valve were good in operation with such arrangement. With increase in size of the engine and cylinder bore, this mechanical operating system was not efficient and generated many problems.

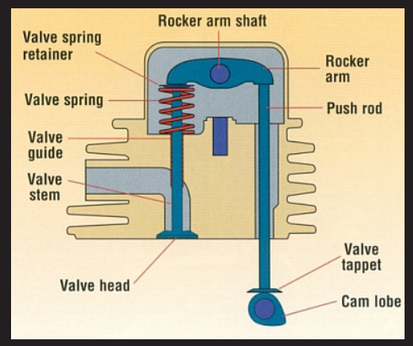


FIGURE 1 - ROCKER ARM VALVE

Hydraulic operating exhaust valve: The rocker arm arrangement was replaced by hydraulic operating system with no tappet and no tappet clearance to be set. With better operating condition and reduced wear, this system is now used in modern marine engines.

Hydraulic operated exhaust valve with mechanical spring: In some exhaust valves, springs are fitted on top of the hydraulic actuation system. The spring generates the additional required force to ensure positive closing of the valve.

Hydraulic operated exhaust valve with Pneumatic spring: In modern engines, the mechanical spring is replaced by pneumatic spring system. This eliminates the problems of valve bounce and spring breakage.

"W" seat exhaust valves: The latest technology from MAN engines with "W" shape seat profile reduces the burnout of valve and valve seat.

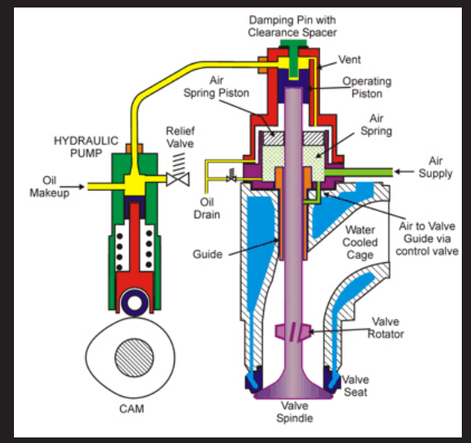


FIGURE 2 - HYDRAULIC VALVE

REASONS FOR KNOCKING OF EXHAUST VALVES

	Reasons of Failure		How STEEL SHIELD Lubricants Solve the Problem
1	Deficiency in the Oil System: The knocking can be due to problems arising in the hydraulic oil system which is responsible for the operation of the valve:		
	A	Air in oil or air being drawn at pump suction side	Steel Shield Hydraulic Lubricants have excellent anti-foam and air-release abilities which ensure the stability of the hydraulic system and protect the metal from being oxidized by the oxygen in the air. Steel Shield hydraulic oils also extend the life of hydraulic components upto 400% (conditional to the physical status).
	B	Supply pressure of oil is too low	~~(Operation / Machine problems, not related to lubrications)~~
	C	Oil temperature is high leading to reduction is viscosity	~~(Operation problems, not related to lubrications)~~
2	Deficiency in the air system:		
	A	Incorrect spring air supply pressure	~~(Operation problems, not related to lubrications)~~
	B	Defective or malfuctioning drain valve in the air chamber	~~(Machine problems, not related to lubrications)~~
	C	Defective or malfuctioning of safety valve in the air chamber	~~(Machine problems, not related to lubrications)~~
3	Leakage in hight pressure oil system:		
	A	Wrongly adjusted or defective throttle screw	~~(Machine problems, not related to lubrications)~~
	B	Oil cylinder piston ring in the exhaust valve leaking	Steel Shield utilizes ABF Technology which treats the metal and enhances the hardness and smoothness of metal surface. That protects the oil cylinder piston rings from wears and damage.
	C	Oil cylinder safety valve on cam side leaking	~~(Machine problems, not related to lubrications)~~
	D	High pressure pipe is damaged	~~(Machine problems, not related to lubrications)~~
	E	Leakage in vent valve at the top	~~(Machine problems, not related to lubrications)~~

11H. ENGINE BEARINGS

The rotational power of a ship's propeller is determined by the power produced by the marine engine to rotate the crankshaft. The crankshaft of the main engine is supported and connected to the connecting rod via main bearings whose main function is to transmit the load without any metal-to-metal contact. This is achieved by choosing special materials for manufacturing main bearings, which floats the journal pin of the rotating crankshaft when lube oil is supplied to it.

PROPERTIES OF MAIN BEARING MATERIALS

1. It must be anti-friction type
2. It must be of anti-corrosive type
3. Good running in and grinding in ability
4. Good load carrying capacity
5. Good embeddability property
6. Must support the oil film
7. Good tensile and compressive strength
8. Must not react with the lube oil
9. It must have thermal resistant property to avoid any damage in case it's running hot

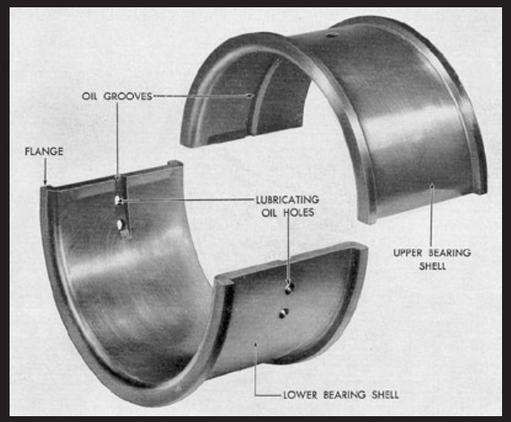


FIGURE 1 - A TYPICAL ENGINE BEARING

3 FAMOUS TYPES OF MAIN BEARING

Lead Bronze Bearing: They consist of the following layers:

Flash layer: It is the top most layer with thickness of 0.035mm made up of tin and lead. It protects the bearing from corrosion and dust when not in use. This layer flashes off when bearing is running.

Nickle Barrier: It is the second layer made up of nickel with thickness of 0.02mm. Its main function is to prevent corrosion and avoid diffusion of tin into bearing metal.

Lead Bronze: The third layer composed of lead bronze which has an excellent anti seizing property and is the principle component which acts as a bearing out of all layers.

Steel back: Steel back is the last and backing part of the bearing used for shape and support over, all the layers are bonded together.

Bi-metal Bearing: This bearing consists of following layers:

Aluminium Tin: The first layer consists of Al and Sn with thickness of 0.5 to 1.3 mm. It is the main layer of this type of bearings.

Bonding Layer: The bonding layer is made of aluminum and has 0.1mm thickness. The main function of the bonding layer is to obtain a good bond between the shell and the top layer.

Steel Back: The steel back part is used for shape and support.

Tri Metal Bearing: These bearings are called tri metal bearing because they consist of three main layers (excluding flash layer as it flashes off) and a steel back. It consists of:

Flash Layer: It is the top most layer with thickness of 1 micron and is made up of tin and lead. It is used to protect the bearing from corrosion and dust when not in use. This layer flashes off when bearing is in running-in period.

Overlay: The second layer is made up of white metal, (Tin Antimony Copper) which is the main component in this type of bearing. Its thickness is 20 microns.

Interlay: It is the third layer used as anti corrosive layer for overlay. It is of 5 microns thickness.

Lining: It is the lining layer between interlay and steel back with thickness of 1 mm and is made up of lead and bronze.

Steel Back: The backing part used for shape and support.

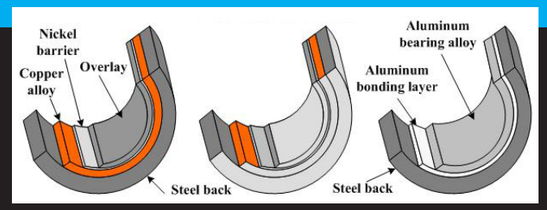


FIGURE 2 - ENGINE BEARING STRUCTURES

- Left : Tri-metal bearing
- Middle: Tri-metal bearing with cosmetic tin flash
- Right: Bi-metal bearing

REASONS OF FAILURE OF ENGINE BEARINGS

Reasons of Failure			How STEEL SHIELD Lubricants Solve the Problem
1	Impurities		
	A	Impurities in the lubrication system are not totally filtered which lead to wears of metals. At the same time, solid impurities (debris) can be attached on the inner bearing walls that are hard to be cleaned	Make sure the lubrication system functions normally. Steel Shield ABF Technology reduces friction to the minimum which improves machine efficiency and gives way to lesser debris is generated. Oil stays cleaner all the time, bearings will run smoother with less tear and wear. ABF re-hardens the metal surface and doubles the bearings life and even more.
	B	Debris trapped behind the bearing and cause wearings or even deformations	Majority of these impurities are metal debris caused by lack of lubrications, and they wear off the surface. Steel Shield ABF Technology Like-Charge-Repel keeps debris nowhere to hide and away from the hidden areas. No trapped debris and lesser wear can be achieved.
2	Lack of lubrications		
	A	Malfunction of lubrication system	~~(Machine problems, not related to lubrications)~~
	B	Oil seal damaged: Due to continuous wearing of bearing, the groove (act as a oil sealer) also wears which is unable to trap lubricant. This causes machine damage and metal weldings.	According to the test results performed by the most famous lubricant research organization - the SouthWest Research Institute, Lithi Shield and Steel Shield lubricants outperform other reputed lubricants in the market. The weld points in the Four-Ball Tests (ASTM D2783) and OK Load in the Timken Tests (ASTM D2782) of Steel Shield lubricants and greases are much higher than other premium lubricants. Thus, Steel Shield lubricants are provened to dramatically reduce seizure of metal components, such as crankpin bearing or others. Also, Steel Shield utilizes ABF Technology which treat the metals and enhances the hardness and smoothness of metal surface, and thus protects bearings from wearings.
3	Assembly mistake of bearing systems		~~(Assembly problems, not related to lubrications)~~
4	Metal working / manufacturing problems		
	A	Vibrations due to machine operations cause bearings deformations or dislocations, or any problems from assemblies	~~(Machine / Operations / Assembly problems, not related to lubrications)~~
	B	The fillets of the engine bearing edges are different from those of the crank pins in the crankshaft	~~(Machine problems, not related to lubrications)~~
5	Overloading		Steel Shield lubricants ensure smooth operations of engine and bearings. Power loses due to frictions dramatically reduced which means the engine can deliver the required output with reduced loadings on the bearings. This greatly reduced the risk of bearing overloadings.
6	Corrosions: Due to degradations of lubricants which create many unknown chemicals. They corrode metals and dilute lead inside metals, and causes corrosions		Most of the premium lubricants in the market contain huge amount of unknown additives. Many of them are corrosive or can be easily deteriate under temperature and form corrosive substances which damage the engine. Steel Shield Lubricants with ABF Technology do not contain any corrosive additives. They remain stable under high temperature and pressure which are safe to engines. If there is any damage happen on the surface of the bearings due to corrosion, the ABF Technology can recover it by treating the metal surface which includes surface hardening and smoothing (the effectiveness depends on the degree of metal damage). This can only be done by ABF Technology.
7	Cavitation: Due to the operation problems, oil pressure decreases and creates bubbles in the oil which makes oil supply unstable and causes metal wears		Steel Shield lubricants have excellent anti-foaming abilities which ensure stable oil flows and prevents bubble formations. At the same time, it protects oil pumps and extends their lifes. Also, Steel Shield utilizes ABF Technology which treat the metals and enhances the hardness and smoothness of metal surface, and thus protects bearings from wearings due to bubbles or foams.

12. MARINE HVAC SYSTEMS & LUBRICATIONS

“Compressor lubricant is a necessary component in any air conditioning system that uses compressor in its compression system. There are three main purposes of the oil. They are used for lubrication, removal of heat and for sealing. Lubrication cooling is needed in reciprocating compressor as the piston compresses the refrigerant gas. The sealing of the piston in the cylinder needs to be cooled as well.”

I 2A. REFRIGERATION AND AIR CONDITIONING INTRODUCTION

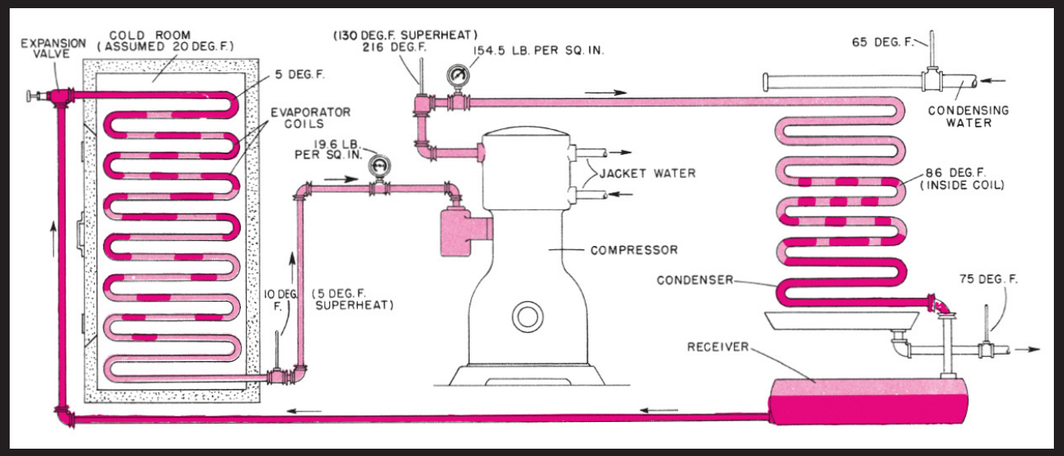
The basic principles of the refrigeration compression cycle are shown in Figure 1. The five essential parts basic to every system are shown: evaporator, compressor, condenser, receiver, and expansion valve (or capillary). Liquid refrigerant flows from the receiver under pressure through the expansion valve to the evaporator coils, where it evaporates, absorbing heat and resulting in a cooling action. The vapor is then drawn into the compressor, where its pressure and temperature are raised. At the higher pressure in the discharge of the compressor, the condensing temperature of the refrigerant is higher than it would be at atmospheric pressure. When the hot, high pressure vapor flows from the compressor to the condenser, the cooling water (air in some applications) removes enough heat from it to condense it. The heat removed from the refrigerant in the condenser is equal to the amount of heat removed from the cold room (cooling action) plus the heat resulting from the mechanical work done on the refrigerant in the compressor that is not removed by the jacket cooling of the compressor. In many commercial installations, the evaporator cools a heat transfer fluid such as brine, which is then pumped through the area to be cooled. Smaller units, such as home refrigerators and freezers, room air conditioners, and automotive air conditioners, have air-cooled rather than water-cooled condensers.

In commercial installations, two or three stages of compression may also be used. If system pressures or cooling capacities dictate the use of two stages of compression, two-stage compressors are used, or a combination of separate single-stage compressors. Rotary sliding vane, scroll, or rotary screw compressors are sometimes used at low to moderate pressures or for booster purposes. Multistage reciprocating compressors are used for large air conditioning installations, with a trend toward the use of more scroll compressors. Reciprocating compressors are commonly used for refrigeration systems, with a trend toward the use of rotary vane. Centrifugal compressors are also used on some commercial refrigeration systems as well as in chillers. Reciprocating, sliding vane, and scroll compressors are used for automotive air conditioning systems, with some screw and axial piston compressors also used. Some very small units such as dehumidifiers may be equipped with diaphragm-type compressors. Reciprocating compressors are used in most other applications.

Most reciprocating compressors for commercial installations are of the single-acting, trunk piston type and have closed crankcases. As a result of refrigerant leakage past the pistons, the crankcases are filled with a refrigerant atmosphere. The same is true of axial piston units used for automobile air conditioning. Crosshead and double-acting compressors have open crankcases. The majority of small to medium-sized electric motor driven refrigeration and air conditioning units are hermetically sealed, with all the operating parts, including the electric motor, inside the sealed unit. Evaporators may operate either dry or flooded. In dry evaporators, only refrigerant vapor is present, while flooded evaporators have both liquid and vapor present.

FIGURE 1 - BASIC SINGLE-STAGE COMPRESSION REFRIGERATION SYSTEM

- The elements shown are common to all compression refrigeration systems, whether refrigeration or air conditioning



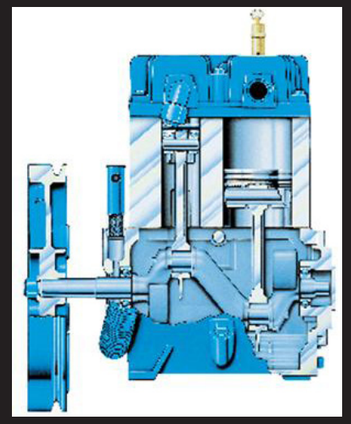
I 2B. COMPRESSOR FACTORS AFFECTING LUBRICATION

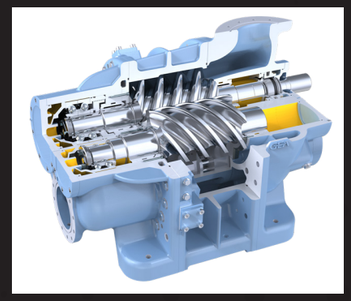
CYLINDER CONDITIONS

The oil film on the cylinder walls of a reciprocating refrigeration compressor is subjected to low temperatures at the suction ports and to moderately high temperatures near the cylinder head. Since viscosity decreases with temperature, the oil near the suction ports will have considerably higher viscosity than the oil near the cylinder head. Nevertheless, the oil must spread in a thin film over the entire working surface. Spreading is accomplished by the piston rings (or the piston itself in small compressors without piston rings) as the pistons move back and forth. The oil must distribute rapidly, but to do this it must not be too high in viscosity. On the other hand, an oil too low in viscosity will not protect against wear.

Oil carried out of the cylinders to the valves and discharge piping is subjected to the temperature of the discharging refrigerant. Ordinarily the temperature of the discharging refrigerant is not high; for example, the discharge temperature of a single-stage ammonia compressor with a compression ratio of about 51 should not be much in excess of 250F (121C). Some single-stage units operate at higher ratios, and higher discharge temperatures; but in most small compressors, the valve temperatures remain moderate because of the relatively large cooling area in proportion to cylinder volume. The discharge temperatures of compressors operating on fluorocarbon refrigerants are lower than those of equivalent machines operating on ammonia, although the compressors of automobile air conditioning systems may operate at quite high discharge temperatures.

When two or more stages of compression are used, the operating temperature in each stage usually is lower than in single-stage machines. In rotary compressors, the discharge temperatures are also usually moderate because of low compression ratios.





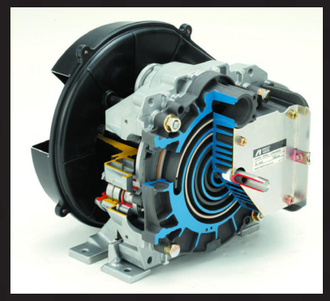


FIGURE 1 - COMMON COMPRESSOR TYPES

- Top Left: Reciprocate compressor
- Top Right: Centrifugal compressor
- Bottom Left: Screw rotary compressor
- Bottom Middle & Right: Scroll compressor

OXIDATION

In compressors with enclosed crankcases, temperatures are normally moderate and the entire machine is filled with refrigerant vapor. Very little, if any, air is present. Under these conditions, oxidation in the usual sense does not occur, although it is doubtful that it can be avoided entirely. Limited oxidation does not impair the lubricating value of an oil because the initial oxidation products formed are soluble in the oil. If oxidation progresses too far, eventually some of the soluble oxidation products become insoluble when the oil is cooled. These products could plug or restrict capillary tubing or orifices inside the system.

FIGURE 2 - OXIDATION OF A COMPRESSOR INTERNAL SURFACE

BEARING SYSTEM CONDITIONS

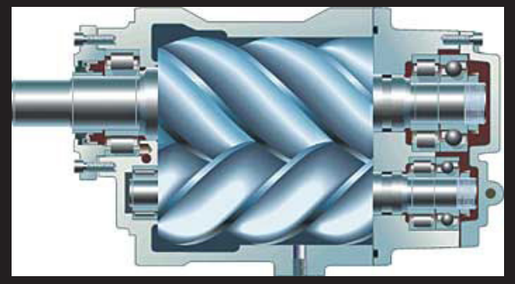
The general requirements of the bearing systems of refrigeration compressors are similar to those of other comparable compressors. However, some special factors must be considered. In the compression of air or gases such as hydrocarbon gases, it is desirable that the oil not be miscible with the gases, whereas in closed refrigeration systems, the oil must be somewhat miscible with the oil to be able to circulate throughout the system and get to all the components in need of lubrication.

In compressors with closed crankcases, there is very little exposure to oxygen, and thus oxidation stability of the oil is not a major concern. If the same oil is used for both bearings and cylinders, as in many small units, however, the oil must have oxidation stability adequate for the cylinder conditions.

When ammonia is used as the refrigerant in compressors with closed crankcases, any additives used in the oil must be types that are not affected by ammonia. A refrigerant that is soluble or partially soluble in the oil, as are the majority of the fluorocarbon refrigerants, will dilute the oil and reduce its viscosity, a sequence of events that must be considered in the selection of the oil viscosity.

The motor in a hermetically sealed unit is completely surrounded by a mixture of refrigerant and oil. Thus the oil must have good dielectric properties, must not affect the motor insulation, and must not react with the copper motor windings or other system materials at elevated temperatures. Since most such units are operated on fluorocarbon refrigerants, the dilution effect of the refrigerant on the viscosity must be considered.

When the crankcase and cylinders are completely isolated from each other, as in compressors having crosshead construction, the oil in the crankcase is exposed to air and there is intimate mixing of the warm oil with air. These conditions are favorable to oxidation and require a chemically stable oil to resist oxidation.



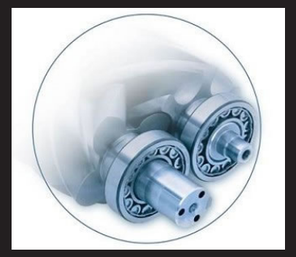


FIGURE 3 - COMPRESSOR BEARINGS

- Top: General bearing locations of a screw compressor
- Bottom: Roller bearings application in a screw components

If the oil carried out of the compressor cylinder forms gummy deposits in the condenser, or congeals or forms waxlike deposits in the evaporator, capillary tube, or expansion valve, there may be serious reduction in the heat exchange capacity. Heat insulating deposits in the evaporator make it necessary to carry a lower evaporator temperature to produce the required refrigeration effect. This in turn requires a lower evaporator pressure and increases the power required by the compressor for a given refrigeration duty, owing to the increased pressure range through which the gas must be compressed. In addition, at the lower suction pressure, the vapor density is lower, forcing the compressor to handle a greater volume of vapor and thus reducing refrigeration capacity. Heat insulating deposits in the condenser increase the temperature difference between the cooling medium (water or air) and the condensing refrigerant. The resulting higher condensing temperature makes higher compression necessary and increases power consumption.

Whether heat insulating deposits will be formed depends on the properties of the lubricating oil, the refrigerant in use, the evaporator temperature, and the equipment used in the system. The effects of some of the common refrigerants are considered separately.

FLUOROROCARBONS

Chlorofluorocarbons (CFCs) are being phased out for use in air conditioning and refrigeration systems because of their potential negative effects on the ozone layer. As a result, more environmentally friendly non-CFC refrigerants are being developed. Several alternative refrigerants have been around for many years, such as ammonia, hydrocarbons, carbon dioxide, methyl chloride, and others that do not pose problems from the ozone depletion standpoint. These will be continued to be used in many applications. Non-CFC fluorocarbon refrigerants such as R-134a, R-123, and blends such as R-404A, R-407C, and R-410A are replacements for the CFCs. The use of these alternative refrigerants is increasing rapidly.

Each of the alternative materials has specific properties and operating characteristics that must be understood and handled appropriately to ensure maximum system performance as well as the safety of the people working with them and the public potentially exposed to them. In many systems, CFCs are and will remain in service. The Montreal Protocol banned the production of CFCs as of January 1, 1996, and hydrochlorofluorocarbons (HCFCs) were limited to production levels as of the same date, with a cease production date in the year 2030.

Air conditioners in older automobiles, as well as, many home refrigerators and air conditioners, were filled with CFCs, and many of these units are still in service. When systems containing CFCs need servicing, they must be refilled with CFCs manufacture before January 1, 1996, use reclaimed CFCs from older systems, or retrofit the systems to accept R-134a or one of the alternative environmentally friendly refrigerants. Gradually, all the CFCs and HCFCs will be replaced by alternative HFC materials, as well as by other gases such as isobutane, propane, and ammonia.

With the refrigerants that are miscible or partly miscible with oil, enough of the refrigerant dissolves in the oil to depress the pour point of the oil sufficiently to prevent congealing of the oil on evaporator surfaces in most cases. However, there is a temperature at which a heavy, flocculent precipitate first appears when a mixture of Freon 12 and 10% of the oil is chilled. The temperature at which this occurs depends on the refrigerant, the percentage of oil in the refrigerant, and on the oil. Refrigeration systems using fluorocarbon refrigerants are often designed to ensure that approximately 10% oil is present in the evaporator. In some cases, the evaporator is actually charged with this amount of oil. Under these conditions, the floc point of the oil (also known as the critical separation temperature) represents the lowest temperature that can be used with that oil.

The waxy materials that precipitate from these oil–refrigerant mixtures can also clog expansion valves and capillary control tubes, preventing their proper functioning. However, the concentration of oil in the refrigerant at the expansion valve is usually lower than in the evaporator, so the floc point is depressed below what it would be at a 10% concentration. As a result, if the oil selected has a low enough floc point for conditions in the evaporator, it usually will not cause difficulties in the expansion valve or capillaries. Difficulties in these areas attributed to mineral oils are frequently due to ice crystals formed by minute quantities of water in the system.

Oil selection can go a long way to minimizing problems related to lubrication in systems using fluorocarbons. The use of highly refined naphthenic or paraffinic mineral oils works satisfactorily with both the CFCc and HCFCs. The base stocks for these oils are usually severely hydroprocessed or acid-treated to remove wax and other materials undesirable from a refrigeration oil standpoint. For HCFCs, alkyl benzene synthetic lubricants provide excellent performance, as does mineral oil. Widely used products for HFCs are polyol esters, polyalkylene glycol, and polyvinyl ether.

AMMONIA, CARBON DIOXIDE

Oil is slightly miscible in anhydrous ammonia and carbon dioxide. Generally, not enough of the gas dissolves in the oil to have a significant effect on the pour point of the oil. Thus, if the pour point of the oil is above the evaporator temperature, oil will congeal on the evaporator surfaces and form an insulating film that interferes with heat flow and efficient performance of the system. To remove the oil, the evaporator must be periodically warmed, liquefying the oil so that it will drain from the surfaces to a location from which it can be removed. With flooded evaporators, refrigerant flow may be so rapid that there is little or no opportunity for the oil to collect on evaporator surfaces, and the pour point of the oil may not be a major concern. Ammonia is not compatible with copper or brass and cannot be used in systems containing these metals. As with CFCs and HCFCs, ammonia works well with highly refined mineral oil. CFCs and HCFCs also can use polyalphaolefins (synthesized hydrocarbons), polyalkylene glycols, and polyol esters.

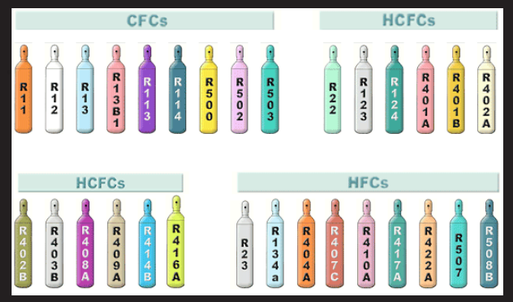


FIGURE 1 - ANSI/ASHRAE STANDARD 34-2010

- Designation and Safety Classification of Refrigerants

HYDROCARBON REFRIGERANTS

Isobutane and propane gases are being used as replacements for CFC refrigerants in some applications. These gases are primarily used in smaller units such as hermetic household refrigerators.

SULFUR DIOXIDE

Sulfur dioxide has a selective solvent action that with conventional lubricating oils results in sludge. It, therefore, requires the use of highly refined white oils or group III base stocks with low levels of additive.

LUBRICATING OIL RECOMMENDATIONS

Table 1 shows general lubricant recommendations by refrigerant type. The lubricants are classified according to base type. The requirements of oils for refrigeration systems can be summarized as follows.

1. The oil should be of proper viscosity to distribute readily at the system's lowest temperatures yet provide adequate films to protect against wear in the cylinders and crankcases.
2. The oil should have chemical stability adequate to resist oxidation and the formation of deposits in crankcases open to the atmosphere, and to resist the deteriorating influence of high temperatures at compressor discharge.
3. In closed systems without oil separators, the oil should be miscible with the refrigerant, to ensure that the oil will circulate through the system and return to lubricate the compressor. In closed systems with separators, it is desirable that the oil not be miscible with the refrigerant, to facilitate separation. In open crankcase systems, it is desirable that the oil not be soluble or miscible with the refrigerant, to minimize dilution.
4. The oil should be able to withstand system temperatures without breakdown, and it should not inhibit the heat transfer characteristics of the refrigerant.
5. The oil must be chemically stable and must not react with the refrigerant or system components. Some additives in the oil can react with the refrigerant to form deposits or sludges.
6. The oil must reduce friction and minimize wear.
7. The oil must keep the system clean and stay in service for extended intervals.

Oil viscosities recommended vary from as low as ISO VG 7 to as high as ISO VG 150.

Refrigerant	Lubricating Oil	
	Mineral Oil [A]	Synthetic [B]
Fluorocarbons		
CFC- 11, 12, 113, 114, 500, 502	Yes	PAO, POE
HCFC- 22, 123, 125, 408A (blend)	Yes	PAO, AB
HFC- 134a, 143a	No	POE, PAG, PVE
Blends 404A, 407C, 410A	Yes	POE, PVE
Ammonia	Yes	PAO, PAG, POE
Carbon dioxide	Yes	PAO

TABLE 1 - LUBRICATING OIL RECOMMENDATIONS BASED ON REFRIGERANTS

Notes:

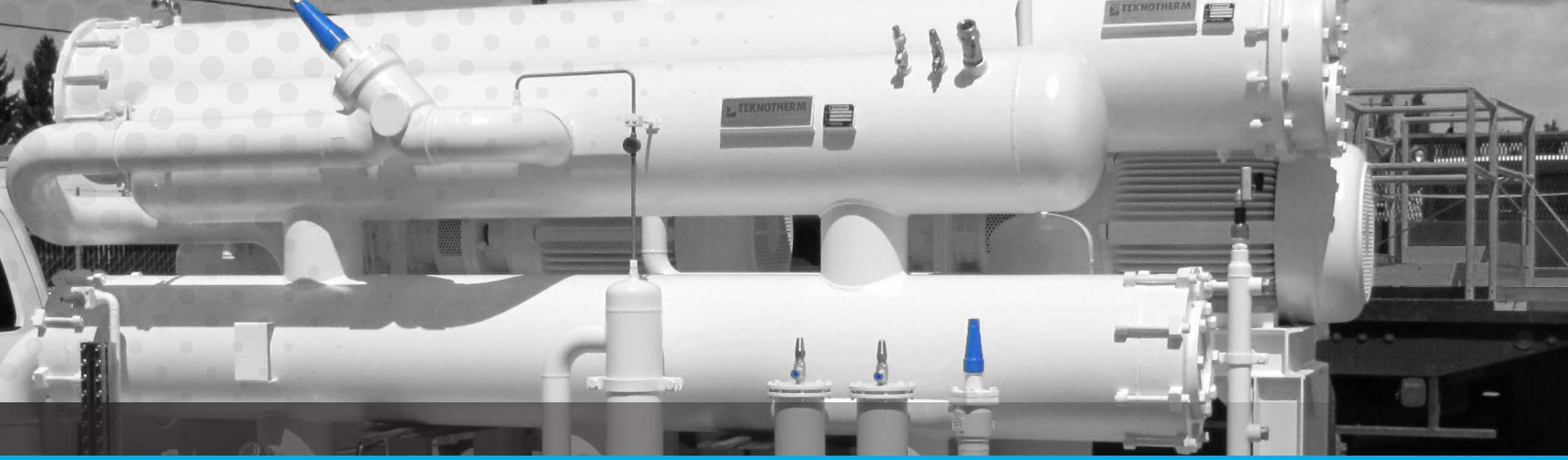
- A: Mineral oils are to be highly refined paraffinic or naphthenic. White oils or severely hydroprocessed base stocks should be used.
- B: PAO, Polyalphaolefin; POE, polyolester; AB, alkylbenzene; PAG, polyalkylene glycol; PVE, polyvinyl ether.

13. STEEL SHIELD APPLICATIONS IN MARINE HVAC

“Lubrication and the knowledge of lubricants not only are subjects of interest to all of us but they are also critical to the cost effective operation and reliability of machinery that is part of our daily lives. Most marine HVAC systems have a compressor which relies upon lubricating oil to function. During the course of the refrigeration process, ½%~ 8% of the compressor's lubricating oil is circulated throughout the system along with the refrigerant. One of the common factors of marine HVAC faulty and performance degradation is oil fouling arises as the compressor oil builds up on the metallic walls of the refrigeration tubing reducing the heat transfer from the refrigerant to the walls of the refrigerant tubing.”

STEEL SHIELD helps to restore your system like New !

A New Engineering Concept in Lubrication Technology that marks the start of a new era – Steel Shield ABF Technology !



APPLICATIONS OF STEEL SHIELD

The ABF Technology of Steel Shield lubricants treats the metal surface. It flattens and rolls out metal surface and greatly reduces friction and metal wear of any mechanical system. Therefore, the pistons, screws, rotary parts or any types of bearing can last much longer, and energy loss due to frictions decreases dramatically. The power factor of electric motors and any power system optimized means less energy loss - Cost Savings.

When Steel Shield lubricants are applied continously, the system can achieve:

1. *Reduces energy consumption by 3 to 18%*
2. *Protects metals during operation, and suppresses maintenance cost to minimum*
3. *Enhances and extends the life of metal components like bearings to 2 times or much more*
4. *Reduces noise allowing the system to operate quieter*
5. *Reduces and eliminates oil fouling to restore heat exchange efficiency*
6. *Boosts the entire HVAC system efficiency to maximum*

NON CORROSIVE CLEANSING IN HVAC

Steel Shield ABF Technology induces positive charge on the inner surface of metal pipes / tubes and the metal-containing sludge. It repels the existing sludge from the tube surface and prevents new sludge formations. These greatly improve the overall efficiency of HVAC system by enhancing the heat conduction efficiency.

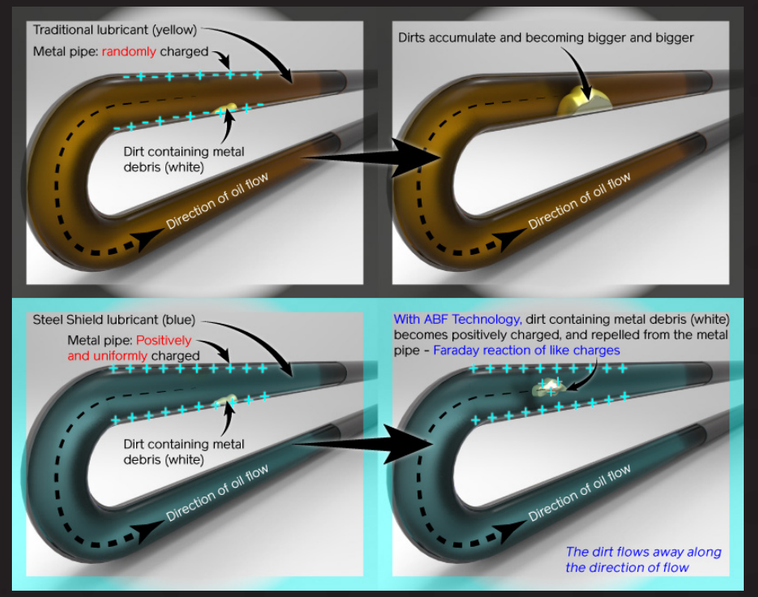


FIGURE 1 - HVAC PIPE WITHOUT TRADITIONAL LUBRICANT

FIGURE 2 - HVAC PIPE WITH STEEL SHIELD LUBRICANT

14. DECRYPTION OF HUGE POWER CONSUMPTION OF CENTRAL HVAC SYSTEM

“ The goal of using STEEl SHIELD lubricant is to reduce the amount of energy required to provide products and services. To meet the increasing demand for economies of scale, it is possible to cut a huge amount of maintenance and repair cost with STEEL SHIELD products.”

I 4A. LET STEEL SHIELD TELLS YOU THE TRUTH !

WHY THE CENTRAL AIR-CONDITIONING SYSTEM COST IS HUGE?

A Perspective on the Power Consumption of a Central Air-Conditioning Plant. Very often most of the building owners only know from the accounting figures that they are paying hundreds and thousands of dollars for the electricity fees each month. They are unware of the fact that a large portion of the electricity fees is for the power consumption of the central air-conditioning plant of the building. In order to have a clearer picture on the amount of money spent on air-conditioning electricity fees, you are invited to spend a few minutes and go through the following context.

It would be natural for building owners to focus on the leasing part of business ever since the opening of the new building. However, after the building is occupied, a large amount of money is spent on the various building facilities, such as management fees, electricity fees, water fees, etc. It is always the case that electricity fees is the highest of all other fees. And out of this large portion of electricity fees, believe it or not, 70% or more belongs to the central air-conditioning plant while the other 30% is for lighting, lifts, controls, etc.

Now let us take a further step and try to work out an estimation on the expenditure of the power consumption of a central A/C plant. Several assumptions are made for calculation purpose:

1. Cooling capacity of the plant is 500TR
2. Operating 12 hours a day
3. Chiller efficiency is 1.5Kw/TR and
4. Overall average operating load is 75% accounting for chillers down time and times when chillers run below full load.

At this moment, it is perhaps worthy of pointing out that the compressor motor of most of the chillers are of the constant speed type. In fact they are drawing 70% or more of the full load current (FLA) even though running at as low as 50% of it's cooling capacity. Which means it would be fair enough to assume that the chillers are running at 75% cooling capacity all the year round. This can also be illustrated by the following:

Since, Power (Kw) = Current^2 (I) x Resistance(R)

i.e. Kw = I^2 R and I = $\sqrt{(Kw/R)}$

Also, Tons of Refrigeration(TR) = Kw • hr,

We have $I_2 = I_1 \times \sqrt{(TR_2/TR_1)}$

Therefore, current is proportion to the square root of cooling capacity which is shown in the table using a 300TR chiller:

Capacity	100%	90%	80%	70%	60%	50%
TR	300	270	240	210	180	150
Amp, A	400	379	358	335	310	283
FLA	100%	95%	89%	84%	77%	71%

The amount of electricity fees

= 500 (TR) x 1.5 (Kw / TR) x 0.94 ($ / Kw • hr)

x 12 (hr / day) x 30 (day / month) x 12 (month / year)

x 0.75 (% of capacity)

= HK$ 190,350 per month, or (HK$ 2,284,200 per year)

This is in reality a huge amount of money bearing in mind that this is only the electricity fees for a 500TR A/C plant. We can just imagine what it would be for a 1,000TR or 2,000TR air-conditioning plant……A lot more than we can expect!

15. STEEL SHIELD ORIGINAL USA ADDITIVES FOR MARINE

STEEL SHIELD EPA

REEL SHIELD

MARINE SHIELD

TOOL SHIELD

LITHI SHIELD

REEL SHIELD GREASE

STRIKE SHIELD

SPRAY SHIELD

ABF TECHNOLOGY™
Not Just Oil...
IT'S TECHNOLOGY

STEEL SHIELD EPA

STEEL SHIELD Extreme Pressure Anti-Wear (EPA)™ is the ultimate protection for the moving metal parts for industry. Utilizing the most Advanced Boundary Film (ABF) Technology, it protects moving metal parts from heat, friction and wear in engines, transmissions, differentials, transfer cases, hydraulic pumps and motors, gear boxes, and other enclosed lubrication systems, due to boundary conditions of frictional abrasion, extreme pressure torque, dry startup and shutdown. Increased performance and greatly reduced maintenance and downtime are the results. These performance goals are achieved through ABF Technology by lowering the operating temperatures, extending the life of component parts and increasing reliability.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN THE USA

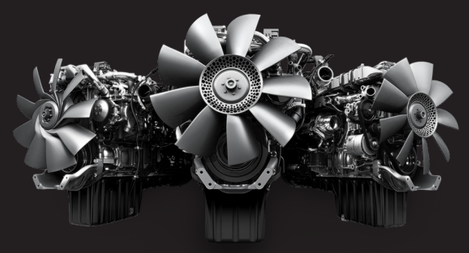
Advantages

- Dramatically reduces wear
- Extends parts life and component realibity
- Improves lubrication
- Protects moving metal parts
- Reduces friction
- Reduces maintenance and downtime
- Reduces operating temperatures
- Smoother operation

Properties	Standard	Unit	Result
Flash Point		˚C	226
Boiling point		˚C	238
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.07

Applications

- All Engines, Transmissions & Differentials
- Hydraulic Systems
- Open Gears
- Gear Boxes
- Gear Reducers
- Gear Couplings
- Electric Motors
- Heavy Machinery
- Weapon Systems



Directions of Usage

- Sasoline And Diesel Engines: Add 2 oz. per quart of oil.
- Auto Transmissions: Add 1 oz. per quart of fluid.
- Manual Transmissions & Differentials: Add 2 oz. per quart of gear lube/oil.
- Gear Boxes: Add 2-3 oz. per quart. Hydraulics: Add 1 oz. per quart of fluid.
- Contains no volatiles or solvents. Contains synthetic hydrocarbons and advanced chemical additive technology. Non-toxic and environmentally friendly.

REEL SHIELD

REEL SHIELD™, the ultimate lubricant, cleaner penetrant, and saltwater protectant, has been aggressively designed and formulated for the Sport Fishing Industry. REEL SHIELD™ lubricates and protects against extreme pressure and wear in all moving metal-to-metal parts, in all types of fishing reel and drag systems. REEL SHIELD™ penetrates to the internal moving parts and shields against corrosion in extreme saltwater environments better than any other product to date. This distinguishes REEL SHIELD™ as the ultimate tool in the total care and maintenance of all fishing tackle in both fresh and saltwater fishing. REEL SHIELD™ has been tournament tested in harsh saltwater conditions and proved to be superior in its performance.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN THE USA

Advantages

- Cleans And Removes Dirt
- Extends Life Of Reel, Fishing Pliers, Tools And Equipment
- Frees Rusty Fishing Pliers And Tools
- Longer Conventional Casts
- Penetrates Remote Areas
- Protects Against Rust
- Quiets Gears And Reduces Gear Wear
- Shields Against Saltwater Corrosion
- Smoother Operation Of Roller Guides

Properties	Standard	Unit	Result
Flash Point		˚C	226
Boiling point		˚C	238
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.07

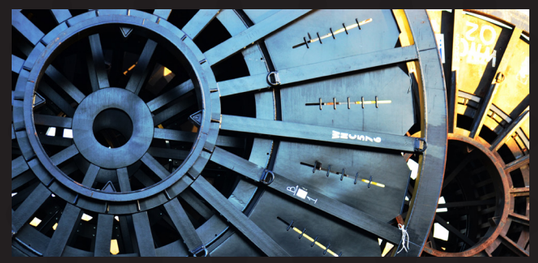
Applications

- Any reel equipments, machines, rollers, toos and engine systems
- Other mechanical systems on ships

Directions of Usage

- Use in accordance with machine / tool manufacturer's instructions.
- Apply to bearings and moving parts. Coat metal surfaces lightly and wipe excess off.
- Contains synthetic hydrocarbons. Non-Toxic. Contains no volatiles. If swallowed, do not induce vomiting due to aspiration in lungs.

"Additional testing has proven REEL SHIELD™ improves casting distances due to its Advanced Boundary Film (ABF) Technology, which reduces coefficients of friction between the gears and other moving metal parts in the reel and roller guides of the rod allowing for smoother casting and overall performance performance and operation."



MARINE SHIELD

MARINE SHIELD™ is the ultimate protection for the moving metal parts in your engine and transmission. Utilizing the most Advanced Boundary Film (ABF) Technology, it protects moving metal parts from wear and damage due to boundary conditions of frictional abrasion, extreme pressure torque, dry startup and engine shutdown. Other benefits include increased fuel savings due to reduced friction and increased oil flow, reduced maintenance and downtime, extended engine parts longevity and reduced operating temperatures an average of 30 to 50 Fahrenheit degrees.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN THE USA

Advantages

- Improves Oil Flow
- Increases Engine And Transmission Life
- Increases Fuel Savings
- Increases Horsepower
- Protects Diesel And Gasoline Engines
- Reduces Costly Repairs
- Reduces Friction
- Reduces Maintenance Dramatically
- Reduces Metal Debris In Oil
- Reduces Operating Temperatures
- Reduces Wear
- Ultra Smoother Shifting

Applications

- Any marine engine, transmission, gearing or other mechanical systems

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	Result
Flash Point		˚C	226
Boiling point		˚C	238
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.07

TOOL SHIELD

TOOL SHIELD™ is the ultimate protection for the moving metal parts for automotive and industrial tools. Utilizing the most Advanced Boundary Film (ABF) Technology, it protects moving metal parts from heat, friction and wear due to boundary conditions of frictional abrasion, extreme pressure torque, air line moisture and internal dirt. It works in all piston and rotarytype air tools, stationary and hand-held power tools and many hand tools. Increased power and performance and greatly reduced wear while removing dirt from tool are the results. TOOL SHIELD™ contains ABF (Advanced Boundary Film) for increased lubricity and boundary film lubrication.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN THE USA

Advantages

- Cleans & Removes Internal Dirt
- Dramatically Reduces Metal-To-Metal Wear
- Extends Tool Life
- Improves Tool Power & Performance
- Lubricates, Cleans & Protects
- Protects Moving Metal Parts
- Repels Air Line Moisture
- Smooths Tool Operation
- Stops & Inhibits Rust

Applications

- Air Cutting Tools, Air Drills, Air Grinders, Air Nailers, Air Ratchets, Air Sanders, Air Staplers
- Automatic Oilers
- Hand Tools
- Impact Wrenches
- Piston & Rotary Type Air Tools

Directions of Usage

- Use in accordance with tool manufacturer's instructions.
- Tools may need to be lubricated daily, or several times a day, depending on the frequency and prolonged use of the tool.
- Contains no volatiles or solvents. Contains synthetic hydrocarbons and advanced chemical additive technology. Non-toxic and environmentally friendly.

Properties	Standard	Unit	Result
Flash Point (PMCC)		˚C	61
Boiling point		˚C	186 - 201
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.02

LITHI SHIELD

LITHI-SHIELD™ is the ultimate in extreme pressure anti-wear lithium complex grease. It exceeds all other lithium complex greases due to the addition of ABF (Advanced Boundary Film)Technology, extreme pressure and antifriction additives added to its formula. LITHI-SHIELD™ treats, seals and smooths metal surfaces to dramatically reduce friction, as well as friction related heat and wear. LITHI-SHIELD's™ unique formulation allows it to exceed the performance of other greases while using smaller quantities. In fact, LITHI-SHIELD™ exhibits great oxidation resistance, over twice that of its nearest competitor.

ORIGINAL USA NLGI No. 2 GREASE

Not Just Oil... IT'S TECHNOLOGY

100% GREASE QUALITY

MADE IN THE USA

Advantages

- Maximum Protection Against Wear And Extreme Pressure
- Adheres To Metal Exhibiting Top Performance In Roll Stability
- Provides Constant Lubrication To All Areas
- Offers The Maximum In Friction Reduction
- Resists Water Washout

Applications

- All Extreme Pressure Applications
- Axles, Bearings, CV Joints, Universal Joints, Chassis Fittings, Conveyors, Pumps, Rotating Machinery
- Boat Trailers And Marine Applications
- Heavy Equipment, Mining Equipment, Railroad Equipment

Directions of Usage

- Follow the maintenance manuals of the machines

LITHI SHIELD Outperforms Top Class Greases Made by YAMAMOTO And ATLAS

- Check out the "SOUTHWEST RESEARCH INSTITUTE TEST REPORTS" to learn more

Test Item	Four-Ball Extreme Pressure Properties	Lithi Shield	Yamamoto EP Grease	ATLAS CHISEL LUBE
Loading Ability	Corrected Load	851.1	501.68	302.79
Anti-Wear Ability	Load Wear Index	92.27	66.73	41.23
High Temperature Loading	Weld Point	800	315	315
High Pressure Loading	LNSL	80	63	50

Properties	Standard	Unit	Result
NLGI Grade			No. 2
Penetration, Worked, 60s	D-217		265 - 295
Penetration, Unworked	D-217		265 - 295
Thickener Type	D-217		Lithium Complex
Thickener, %	D128		8 - 11
Color	D128		Light Amber
Texture	D128		Smooth
Dropping point	D-2265	˚C	500
Viscosity @ 40˚C	D-445	cSt	220
Viscosity @ 100˚C	D-445	cSt	19
Viscosity Index	D-2270		95
Flash Point	D-92	˚C	464
Fire Point	D-92	˚C	550
Timken OK load	D-2509	lbs.	60
Rust	D-1743		Pass
Copper Corrosion	D-4048		1B
4-Ball Wear Test	D-2266	mm	0.68
4-Ball EP Weld Test	D-2596	Kg Min.	800 / Pass
Oxidation Induction time @210˚C	D-5483	min	11.47

Properties	Standard	Unit	Result
Water washout @ 79˚C	D-1264		0.027
Mobility at 77˚C	US Steel Mobility Test	g/min	576
Mobility at 60˚C	US Steel Mobility Test	g/min	275.4
Mobility at 40˚C	US Steel Mobility Test	g/min	86.6
Mobility at 20˚C	US Steel Mobility Test	g/min	15.3
Mobility at 0˚C	US Steel Mobility Test	g/min	1.6

REEL SHIELD GREASE

The ultimate lubricant, cleaner, penetrant, and saltwater protectant, has been aggressively designed and formulated for the Sport Fishing Industry. Reel Shield Grease™ lubricates and protects against extreme pressure and wear in all moving metal-to-metal parts, in all types of fishing reel and drag systems. Reel Shield Grease™ penetrates to the internal moving parts and shields against corrosion in extreme saltwater environments better than any other product to date. This distinguishes Reel Shield™ as the ultimate tool in the total care and maintenance of all fishing tackle in both fresh and saltwater fishing. Reel Shield Grease™ has been tournament tested in harsh saltwater conditions and proved to be superior in its performance.

Additional testing has proven Reel Shield Grease™ improves casting distances due to its Advanced Boundary Film (ABF) Technology, which reduces coefficients of friction between the gears and other moving metal parts in the reel and roller guides of the rod allowing for smoother casting and overall performance and operation.

ORIGINAL USA NLGI No. I GREASE

Not Just Oil... IT'S TECHNOLOGY

100% GREASE QUALITY

MADE IN THE USA

Advantages

- Dramatically Reduce Gear Water
- Extends Life Of Fishing Pliers, Tools And Equipment
- Extends Reel Life
- Gears Run Smooth & Quiet
- Longer Conventional Casts
- Protects Against Salt Water, Rust & Corrosions
- Smoother Reel Operation

Applications

- All High Temperature Applications
- All Extreme Pressure Applications
- Axles
- Bearings
- Boat Trailers And Marine Applications
- Chassis Fittings
- Conveyors
- CV Joints
- Heavy Equipment
- Mining Equipment
- Pumps
- Railroad Equipment
- Reel, Ship Equipments
- Rotating Machinery
- Universal Joints

Directions of Usage

- Use in accordance with machine / tool manufacturer's instructions.
- Apply to bearings and moving parts. Coat metal surfaces lightly and wipe excess off.
- Contains synthetic hydrocarbons. Non-Toxic. Contains no volatiles. If swallowed, do not induce vomiting due to aspiration in lungs.

Properties	Standard	Unit	Result
NLGI Grade			No. 1
Penetration, Worked, 60s	D-217		310 - 340
Penetration, Unworked	D-217		310 - 340
Thickener Type	D-217		Lithium Complex
Thickener, %	D-128		6 - 8
Color	D-128		Light Amber
Texture	D-128		Smooth
Dropping point	D-2265	˚C	500
Viscosity @ 40 ˚C	D-445	cSt	220
Viscosity @ 100 ˚C	D-445	cSt	19
Viscosity Index	D-2270		95
Flash Point	D-92	˚C	464
Fire Point	D-92	˚C	550
Timken OK load	D-2509	lbs.	60+
Rust	D-1743		Pass
Copper Corrosion	D-4048		1B
4-Ball Wear Test	D-2266	mm	0.7
4-Ball EP Weld Test	D-2596	Kg Min.	800 / Pass

Properties	Standard	Unit	Result
Oxidation Induction time @210˚C	D-5483	min	95
Water washout @ 79 ˚C	D-1264		0.027
Mobility at 77 ˚C	US Steel Mobility Test	g/min	
Mobility at 60 ˚C	US Steel Mobility Test	g/min	515
Mobility at 40 ˚C	US Steel Mobility Test	g/min	257.1
Mobility at 20 ˚C	US Steel Mobility Test	g/min	78.9
Mobility at 0 ˚C	US Steel Mobility Test	g/min	5.4

STRIKE SHIELD

STRIKE SHIELD™ is the ultimate penetrant to rapidly pierce rusted and corroded metal surfaces using a distinctive spreading action to break lose frozen mechanisms while at the same time applying an advanced lubricating film to the surfaces of the metal delivering the highest quality lubrication available in penetrating oil. STRIKE SHIELD™ leaves a unique layer of film on surfaces that helps prevent rust and corrosion along with driving out and dispersing moisture on ignition wires, electrical contacts, circuit boards and other electrical connections to provide protection against future corrosion in extremely tough conditions.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

100% Quality SPRAY

MADE IN THE USA

Advantages

- Offers extremely fast penetration and lubrication into remote rusted /corroded areas especially for industrial and marine applications that have seized metal mechanisms
- Provides a quick durable long lasting lubricating film to a variety of different areas including mechanisms in extreme salt water environments
- Inhibits rust and oxidation on metal contacts and surfaces in all weather conditions
- Maximum performance as a moisture displacement on wet electrical switches/boards and electronic systems
- Helps start damp engines by dispersing moisture on ignition wires and electrical systems
- Protects circuit boards from corrosion in all weather conditions including salt spray
- Repels dirt and dust build-up
- Mild and pleasant fragrance

Applications

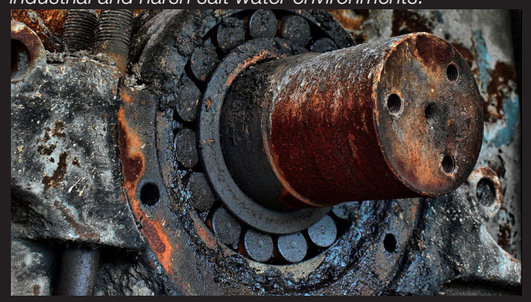
- Frozen or scaled nuts and bolts
- Sticky locks
- Squeaky hinges
- Sliding doors
- Wheels
- Conveyors
- Cables
- Linkages, Shafts, Bushings
- Sliding parts and mechanisms
- Any automotive, marine, farming industrial or commercial application that requires a fast acting penetrate, lubricant and moisture displacement all combined in one product

Directions of Usage

- Spray to any frozen mechanisms

Properties	Standard	Unit	Result
Flash Point (PMCC)		˚C	61
Boiling point		˚C	186 - 201
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.02

"STRIKE SHIELD delivers an all in one product that is a fast acting penetrant, extremely durable lubricant and long-lasting rust and corrosion protectant even in tough industrial and harsh salt water environments."



SPRAY SHIELD

SPRAY SHIELD™ is the ultimate multi-purpose lubricant that also penetrates metal surfaces while maintaining highest qualities in corrosive and extreme humidity environments. SPRAY SHIELD™ penetrates into remote areas and delivers long-lasting lubrication in many different applications. SPRAY SHIELD™ works quickly to provide excellent protection and long-lasting lubrication.

ORIGINAL USA ADDITIVE

Not Just Oil... IT'S TECHNOLOGY

100% Quality SPRAY

MADE IN THE USA

Advantages

- Creeps Into Remote, Inaccessible Areas
- Offers Quick, Long-Lasting Lubrication
- Penetrates To Loosen Seized & Corroded Metal Mechanisms
- Provides Free-Flowing Protection
- Provides Protection Against Rust & Corrosion

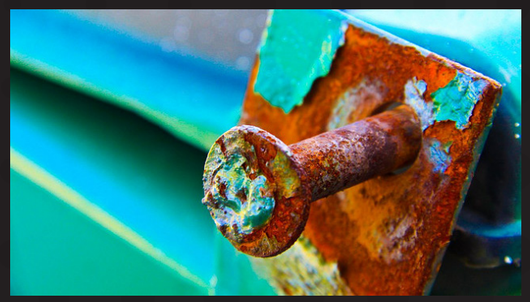
Applications

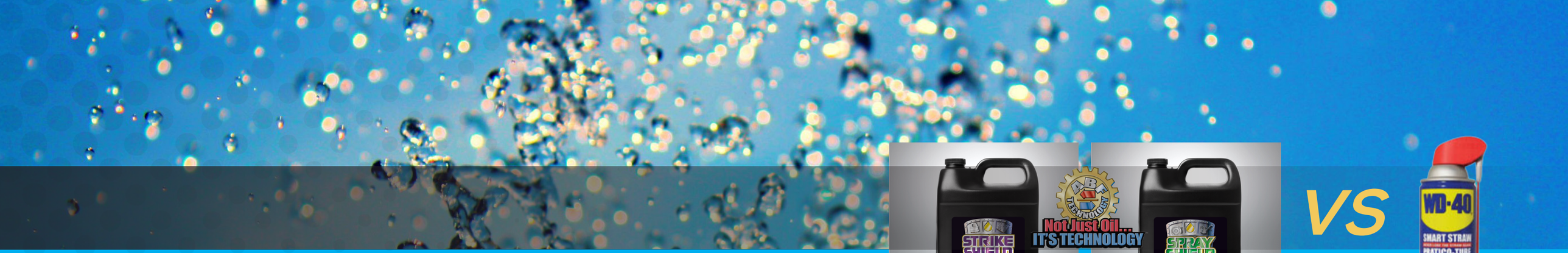
- Metal Mechanisms
- Metal-To-Metal Surfaces
- Chain Drives
- Drag Lines
- Bushings
- Pulleys
- Hinges
- Tools
- Sleeve Bearings
- Open Gears
- Steel Cables
- Couplings
- Linkages
- Wheels
- Augers
- Rusty Nuts & Bolts
- Any Automotive, Industrial or Commercial Areas Of Lubrication That Require An External Heavy-Duty Spray Lubricant For Accessible And Hard-To-Reach Areas

Directions of Usage

- Spray to any frozen mechanisms

Properties	Standard	Unit	Result
Flash Point		˚C	226
Boiling point		˚C	238
Evaporation rate			<0.01
Vapor pressure			<1@25 ˚C
Specific gravity			1.07





15A. STRIKE-SHIELD, SPRAY-SHIELD & WD-40 COMPARISON

VS

When comparing the characteristics of SPRAY-SHIELD (SS) & STRIKE-SHIELD (STKS) to those of WD-40, there are profound differences in product features and benefits.

WD-40 CLAIMS FIVE BASIC FUNCTIONS

CLEANS: WD-40 gets under dirt, grime and grease to clean. It also dissolves adhesives, allowing easy removal of labels, tape, stickers, and excess bonding material.

DISPLACES MOISTURE: Because WD-40 displaces moisture, it quickly dries out electrical systems to eliminate moisture-induced short circuits.

PENETRATES: WD-40 loosens rust-to-metal bonds and frees stuck, frozen or rusted metal parts.

LUBRICATES: WD-40's lubricating ingredients are widely dispersed and hold firmly to all moving parts.

PROTECTS: WD-40 protects metal surfaces with corrosion-resistant ingredients to shield against moisture and other corrosive elements.

SPRAY-SHIELD & STRIKE-SHIELD PROVIDE THE ABOVE FUNCTIONS PLUS MORE

CLEAN: SS & STKS lift and remove dirt, grime and grease from surfaces, including adhesive compounds and bonding agents.

SS & STKS keep surfaces clean by rejecting airborne contaminants, such as dust and smoke, due to its electrochemical surface bonding technique by causing a dipole-dipole interaction and cation exchange on the metal surfaces. This, in effect, creates a greater positive charge on the metal surfaces which react with positive charged airborne contaminants (+ ions) in causing a repulsion between the two.

DISPLACE MOISTURE: SS & STKS are a fast-acting drying agent for quick and thorough moisture displacement in damp or soaked electrical or electronic systems. A migrating film burrows under condensation and moisture, driving it to the surface where they dry or can be wiped off to reactivate circuits. After moisture is displaced, an ultra-thin residual film resists rust and corrosion. SS & STKS do not contain carbon tetrachloride and will not harm insulation.

Areas of Use: Wet or damp ignitions, electrical systems, motors, controls, starters, relays, radios, electronic equipment, etc.

PENETRATE: SS & STKS are the ideal solution to hundreds of different maintenance and production problems involving rust and corrosion. They work quickly and effectively on even the most severe cases of rusted equipment, parts and components. SS & STKS disperse quickly into rusted, corroded areas to loosen scale and free up working mechanisms, tight fitting parts and frozen fastenings. SS & STKS's low surface tension speed penetration even into normally inaccessible areas. SS & STKS will not affect painted surfaces.

Areas of Use: Rusted lugs or bolts, sliding parts, sluggish mechanisms, hinges, tools, products in storage, gear trains, wheels, rotating apparatus, linkages, cams, levers, industrial equipment, etc.

LUBRICATE: SS & STKS are a light, but lasting lubricant. They offer quick, positive, long-lasting lubrication on wide varieties of applications in industry, the shop and garage, the farm and at home. SS & STKS are ideal for automobiles and equipment, flowing and lubricating deeply into hard-to-reach internal areas.

Areas of Use: Metal mechanisms, gears, locks, linkages, wheel bearings, metal-to-metal surfaces, cams, levers, engines, motors, slides, hinges, garden equipment, etc.

PROTECT: SS & STKS stop rust dead in its tracks. These products' unique formulation uses a combination of the best rust and oxidation preventatives available. SS & STKS seek out rust, stop the oxidation process and prevent further rust from forming.

In addition, SS & STKS remove corrosion and corrosion bridges from printed circuit boards after a light spray and "toothbrush" scrubbing. This prohibits corrosion from also returning in the future. After corrosion is removed and excess SS & STKS are wiped from the board, a microfilm layer will remain on the surface of the metals to virtually eliminate the long-term effects of electrolytic bridging.

ADDITIONAL FEATURES OF SPRAY-SHIELD & STRIKE-SHIELD

SS & STKS contain Steel Shield EPA "ABF Technology"TM, one of the leading anti-friction, metal-treating products. EPA is a blend of petroleum products containing no graphite, PTFE, silicones, moly or synthetics. The dielectric strength of SS & STKS is rated at 45 KV (45,000 volts).

SS & STKS are not an aerosol - they are packaged in convenient hand pump spray bottles and conforms to DOT and OSHA regulations. The adjustable nozzle allows you to provide an overall misting of lubrication or pinpoint just the areas you want with jet spray. You can also use SS & STKS with Air Pressurized Sprayer, which works as well as an aerosol, but utilizes compressed air.

Please see the attached page for a quick reference chart on the comparison of these products.

Feature or Benefit	SS & STKS	WD-40
Loosens rusted parts	Within minutes	Within hours
Penetrates deep and fast	Immediately	Slowly
Keeps parts from freezing up	Long term	Short term
Protects metal against corrosion	Long term	Short term
Leaves a barrier film	Long term	Short term
Displaces moisture	YES	YES
Dries electrical equipment	YES	YES
Non-conductive	YES (45,000V DIELECTRIC)	YES (UNKNOWN)
Stops squeaks	Long term	Short term
Gummy residue	NONE	NONE
Long-lasting lubrication	YES	NO
Anti-wear properties	YES	NO
Extreme-pressure properties	YES	NO

TABLE 1 - SPRAY-SHIELD & STRIKE-SHIELD COMPARED TO WD-40

- Strike Shield and Spray Shield win

NOTE: The following disclaimer appeared on the WD-40 web site at the time of this writing: "The uses of WD-40 described on this Web site are provided to WD-40 Company by end-users of the product, and do not constitute recommendations or suggestions for use of WD-40 by WD-40 Company. These uses, including the 'Use of the Day', have not been tested by WD-40 Company. Consumers should exercise common sense whenever using WD-40. Always follow the instructions and take heed of any warnings printed on the WD-40 packaging." WD-40 is a registered trademark of WD-40 Company, San Diego, California, U.S.A.

I 6. GREASE APPLICATIONS OF BEARINGS

I 6A. STEEL SHIELD GREASE COMPATIBILITY

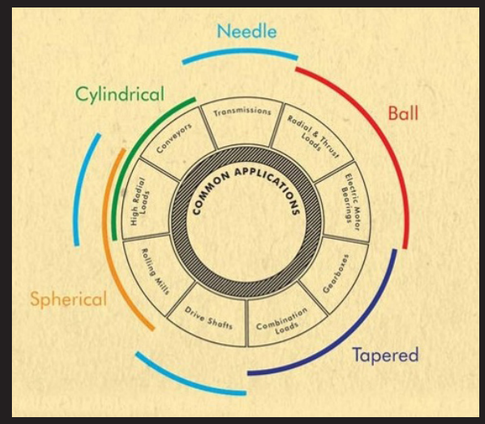
	Aluminum Complex	Barium Complex	Calcium Stearate	Calcium 12-Hydroxy	Calcium Complex	Calcium Sulfonate Complex	Clay (non-Soap)	Lithium Stearate	Lithium 12-Hydroxy	Lithium Complex	Polyurea (Conventional)	Polyurea (Shear Stable)
Aluminum Complex		I	I	C	I	B	I	I	I	C	I	C
Barlum Complex	I		I	C	I	C	I	I	I	I	I	B
Calcium Stearate	I	I		C	I	C	C	C	B	C	I	C
Calcium 12-Hydroxy	C	C	C		B	B	C	C	C	C	I	C
Calcium Complex	I	I	I	B		I	I	I	I	C	C	C
Caclium Sulfonate Complex	B	C	C	B	I		I	B	B	C	I	C
Clay (Non-Soap)	I	I	C	C	I	I		I	I	I	I	B
Lithium Stearate	I	I	C	C	I	B	I		C	C	I	C
Lithium 12-Hydroxy	I	I	B	C	I	B	I	C		C	I	C
Lithium Complex	C	I	C	C	C	C	I	C	C		I	C
Polyurea (Conventional)	I	I	I	I	C	I	I	I	I	I		C
Polyurea (Shear Stable)	C	B	C	C	C	C	B	C	C	C	C	

RELATIVE COMPATIBILITY RATING

- B = Borderline
- C = Compatible
- I = Incompatible
- Note: This chart is a general guide to compatibility. Specific properties of greases can dictate compatibility. Testing should be done to determine if greases are compatible.

I 6B. BEARING TYPES AND GREASES

COMMON APPLICATIONS OF DIFFERENT TYPES OF BEARINGS

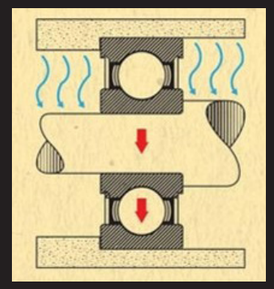


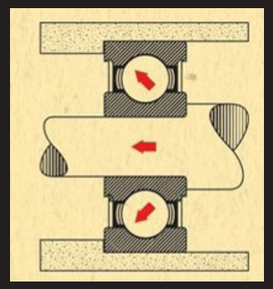
BEARING TYPE AFFECTS GREASE LIFE

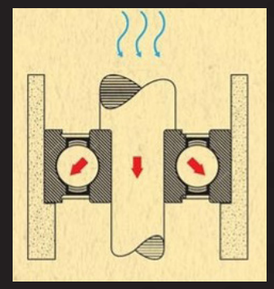
Bearing Type	Relative Type of Grease
Deep-groove, single-row ball bearing	1
Angular contact, single-row ball bearing	0.625
Self-aligning, single-row bearing	0.77 - 0.625
Trust ball bearing	0.2 - 0.17
Cylindrical, single-row roller bearing	0.625 - 0.43
Needle roller bearing	0.3
Tapered roller bearing	0.3
Spherical roller bearing	0.14 - 0.08

Larger bearings and high-speed bearings translate to short grease life. High DN grease is required.

BEARINGS UNDER DIFFERENT KINDS OF LOADS







Radial Load

- When the load is perpendicular to the shaft due to gravity

Axial or Thrust Load

- When the load is parallel to the shaft
- Left: Axial load in a horizontal pump
- Right: Axial load in a vertical pump or electrical motor due to gravity

I 7. HOW TO CHOOSE THE RIGHT GREASE

I 7A. SELECTION GUIDE

BASE OIL VISCOSITY

A common OEM grease specification might be to use an NLGI No. 2 lithium grease of good quality. Using this information alone, one could select the right consistency and thickener type. Other considerations include thickener concentration, consistency, dropping point and operating temperature range, worked stability, oxidation stability, wear resistance, etc.

A common mistake when selecting a grease is to confuse the grease consistency with the base oil viscosity. Because the majority of grease-lubricated applications are element bearings, one should consider viscosity selection for those applications. While most would not use an EP 220 gear oil for an oil-lubricated electric motor bearing, many people will use a grease containing that same oil for an identical grease-lubricated bearing. To determine minimum and optimum viscosity requirements for element bearings, one may use speed factors, commonly denoted as DN or NDm. Speed factors account for the surface speed of the bearing elements and are determined by the following formulas:

DN = (rpm) X (bearing bore)

NDm = rpm X ((bearing bore + outside diameter) / 2)

The NDm value uses pitch diameter rather than bore diameter because not all bearings of a given bore have the same element diameter, and thus have different surface speeds. Knowing the speed factor value and likely operating temperature, the minimum viscosity requirement can be read directly from charts like Figure 1. Figure 1 assumes the base oils' viscosity index. To be more precise, one would need to use a chart that identifies the viscosity at operating temperature, then determine the viscosity grade from a viscosity / temperature chart for a given lubricant.

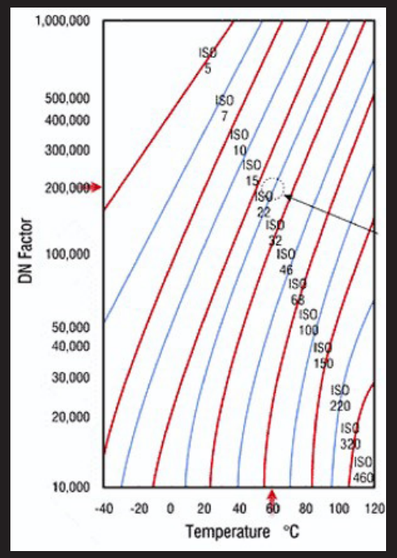


Figure 1
- The minimum viscosity requirement of oils

ADDITIVES AND BASE OIL TYPES

Figure 2 shows some common additive requirements by application. Most greases are formulated using API Group I and II mineral oil base stocks, which are appropriate for most applications. However, there are applications that might benefit from the use of a synthetic base oil. Such applications include high or low operating temperatures, a wide ambient temperature range, or any application where extended re-lubrication intervals are desired.

Additive	Journal Bearings	Ball Bearings	Thrust Bearings	Roller Bearings	Needle Bearings
Antioxidants	•	•	•	•	•
Antifoam Agents	•	•	•	•	•
Antiwear / EP		•	•	•	•
Rust Inhibitors	•	•	•	•	–
Extreme Pressure			–	–	
Demulsibility	•	•	•	•	–
VI Improvers	–	–	–	–	•
Corrosion Inhibitors	•	•	•	•	•

• Required;
– Depends on application

Figure 2
- Common additive requirements by applications

GREASE CONSISTENCY AND THICKENER TYPE

The NLGI has established a scale to indicate grease consistency which ranges from grades 000 (semifluid) to 6 (block grease). The most common NLGI grade is two and is recommended for most applications.

For bearings, speed factor and operating temperature can be used to determine the best consistency or NLGI grade for a given application. It may seem counterintuitive, but higher speed factors require higher consistency greases. Table 1 provides a general guide to selecting NLGI grade based on speed factor and operating temperature.

Numerous types of grease thickeners are currently in use, the most common types are simple lithium soaps, lithium complex and polyurea. Simple lithium soaps are often used in general-purpose greases and perform relatively well in most performance categories at moderate temperatures. Complex greases such as lithium complex provide improved performance particularly at higher operating temperatures. A common upper operating temperature limit for a simple lithium grease might be 250°F, while that for a lithium complex grease might be 350°F. Another thickener type that is becoming more popular is polyurea.

Like lithium complex, polyurea has good high-temperature performance as well as high oxidation stability and bleed resistance. Thickener type should be selected based on performance requirements as well as compatibility when considering changing product types.

Operating Temperature	DN (Speed Factor)	* NIGL No.
-30 to 100 °F	0 - 75,000	1
	75,000 - 150,000	2
	150,000 - 300,000	2
0 to 150 °F	0 - 75,000	2
	75,000 - 150,000	2
	150,000 - 300,000	3
100 to 275 °F	0 - 75,000	2
	75,000 - 150,000	2
	150,000 - 300,000	3

* Depends on other factors as well, including bearing type, thickener type, base oil viscosity and base oil type

PERFORMANCE PROPERTIES

If an application operates continuously at room temperature, properties like dropping and upper operating temperature limits are not as important. If an application operates under heavy loads at low speeds, load carrying tests such as four-ball EP or Timken OK load should be considered. It is also important to review these specifications on a periodic basis to guard against specification creep. While improving a lubrication program can be a tough job, lubricant specification is relatively easy. Armed with a little bit of knowledge and a few widely available tools, it is possible to rest easier knowing that the right grease is being used.

"With Steel Shield ABF Technology, the performance in stability, lubricity and interval of grease can be enhanced and improved to a much higher level."

NEVER USE GREASE OR OILS WITH SOLID ADDITIVES

"Solid additives such as Molybdenum will damage metal surface in the long term, never attempt to try those lubricants."

"Steel Shield lubricating oils and greases utilize unique ABF Technology which perform much better than any solid additives. Steel Shield is your wise choice."

Figure 3

- Upper: Steel Shield Grease - Lithi Shield does not contan any solid additive which have excellent performance in high loading operations without creating any undesire effects to metals
- Lower: Grease contains solid additive (Molybdenum). It will damage metal surface in the long term because it contans solid materials

18. SINGAPORE GEAR LUBRICANTS WITH ABF TECHNOLOGY

SST ECI POWER-AP PAG
GEAR OIL

SST ECI T-GEAR AP EP
GEAR OIL

SST ECI T-SHC AP EP
GEAR OIL

SST ECI HD-AP ATF DIII
AUTO TRANSMISSION FLUID

SST ECI HD-AP EP-GL-5
AUTO-GEAR OIL

SST ECI HD-AP PTF
TRANSMISSION FLUID

Not Just Oil...
IT'S TECHNOLOGY

SST ECI POWER-AP PAG Gear Oils

SST ECI POWER-AP PAG Gear Oils are high performance synthetic gear oils blended with polyglycols and special additives. The oils of natural extremely high viscosity index, and low pour point possess excellent high and low temperature performance and long term hydrolytic stability, exhibit superior anti-oxidation, anti-wear, and anti-corrosion properties. Enhanced with Steel Shield ABF Technology of low coefficient of friction reduces power consumption and operation temperatures effectively. It outperforms any of the aftermarket gear oils.

ISO 150, ISO 220, ISO 320, ISO 460

Advantages

- Reduce deposit and maintain system cleanliness
- Extended oil drain interval
- Low coefficients of friction and traction
- Superior anti-oxidation and anti-rust properties
- Excellent chemical and thermal stability
- Good compatibility with seal materials
- Long term hydrolytic stability
- Good filterability and air release property
- Reduced foam forming tendency
- Reduce downtime 200+%
- Extends the life of system parts up to 400% (conditional to the physical status)
- Reduce noise 3db~9db (conditional to system condition)
- Improves efficiency

Applications

- SST ECI POWER-AP PAG Gear Oils are recommended for worm reduction gear boxes under high temperature, high loads and wet working conditions. The oils are incompatible with most mineral and synthetic oils.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 150	ISO 220	ISO 320	ISO 460
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	150	220	320	460
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	23	34	51	72
Viscosity Index	ASTM D2270		185	202	220	230
Flash Point (COC)	ASTM D92	˚C	225	225	225	230
Pour Point	ASTM D97	˚C	-30	-30	-30	-27
FZG FAIL LOADING STAGE	DIN 51354-2		12+	12+	12+	12+

SST ECI T-GEAR AP EP Gear Oils

SST ECI T-GEAR AP EP are premium extreme pressure industrial gear oils containing anti-oxidation, anti-corrosion, anti-wear and anti-foam inhibitors. These oils meet the performance requirements of ISO 12925-1:1996 Category CKD, AISE 224, ANSI/AGMA 9005-E02, DIN 51517 Part 3, Cincinnati Lamb P-59 series, Textron David Brown S1.53 101 and pass FZG 12th stage test, etc.

ISO 150, ISO 220, ISO 320, ISO 460,
ISO 680, ISO 1000, ISO 1500

Advantages

- Excellent anti-rust and anti-corrosion properties
- Extended oil drain interval
- Extends the life of engine parts up to 300% (conditional to the physical status)
- Good thermal and oxidation stability
- Improves efficiency in terms of usable output energy
- Outstanding protection against wear and shock
- Prolongs gear equipment life
- Reduce deposit and maintain system cleanliness
- Reduce downtime 200% and more
- Reduce noise 3db~9db (conditional to system condition)
- Superior load-carrying EP capability

Applications

- SST ECI T-GEAR AP EP are recommended for all types of industrial gear both enclosed and open. Also suitable for lubrication of systems containing worm gears, bearings, sliding parts, etc.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 150	ISO 220	ISO 320	ISO 460	ISO 680	ISO 1000	ISO 1500
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	150	220	320	460	680	1000	1500
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	14.8	19	24	30	38	44	61.2
Viscosity Index	ASTM D2270		95	95	95	95	90	90	90
Flash Point (COC)	ASTM D92	˚C	240	245	247	250	250	252	255
Pour Point	ASTM D97	˚C	-10	-9	-9	-9	-6	-3	-3
COPPER CORROSION	ASTM D130		1B	1B	1B	1B	1B	1B	1B

SST ECI T-SHC AP EP
Gear Oils

SST ECI T-SHC AP EP are all season high performance synthetic extreme pressure industrial gear oils fortified with sulphur-phosphorous and ashless dispersant additives and with ABF Technology to enhance anti-oxidation, anti-corrosion, demulsification, anti-wear and anti-foam properties. These oils meet the performance requirements of API, GL-5, MT-1 and SAE J2360, MIL-PRF-2105E, Scania STO 110, Mack GO-J, etc and particularly for hypoid gears under severe operating conditions.

SAE 75W90,
SAE 75W140

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN SINGAPORE

Advantages

- Anti-weld superior load-carrying EP capability
- Excellent anti-rust and anti-corrosion properties
- Excellent shear stability
- Extended oil drain interval
- Improves efficiency in terms of usable output energy and fuel economy
- Outstanding good thermal and oxidation stability at high temperature
- Outstanding protection against wear and shock
- Prolongs gear equipment life up to 300% (conditional to the physical status)
- Reduce deposit and maintain system cleanliness
- Reduce downtime 200% and more
- Reduce noise 3db~9db (conditional to system condition)

Applications

- SST ECI T-SHC AP EP are recommended for all types of industrial gear both enclosed and open as well as automotive hypoid gear in manual transmissions, rear axles, differentials, transfer cases, overdrive units, oil lubricated wheel bearings, oil lubricated universal joints, steering gear boxes, etc particularly under low temperatures and critically severe conditions.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	SAE 75W90	SAE 75W140
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	110	193
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	15.5	26.3
Viscosity Index	ASTM D2270		154	171
Flash Point (COC)	ASTM D92	˚C	200	200
Pour Point	ASTM D97	˚C	-57	-36

SST ECI HD-AP ATF DIII AUTO TRANSMISSION FLUID

SST ECI T-GEAR AP EP are premium extreme pressure industrial gear oils containing anti-oxidation, anti-corrosion, anti-wear and anti-foam inhibitors. These oils meet the performance requirements of ISO 12925-1:1996 Category CKD, AISE 224, ANSI/AGMA 9005-E02, DIN 51517 Part 3, Cincinnati Lamb P-59 series, Textron David Brown S1.53 101 and pass FZG 12th stage test, etc.

SAE DIII

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN SINGAPORE

Advantages

- Eliminate spitfire effects to maintain the integrity of the gear components
- Excellent low temperature performance
- Excellent modifying friction
- Good protection against corrosion and wear
- High shear stability
- Reduce deposit and maintain system cleanliness
- Superior thermal and oxidation stability

Applications

- SST ECI HD-AP ATF DIII is a heavy duty oil recommended for use in modern passenger cars and light trucks where Dexron III is required. It can also be used as hydraulic fluid in many automatic systems and Vickers pumps.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	SAE 75W90
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	34
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	7.6
Viscosity Index	ASTM D2270		176
Flash Point (COC)	ASTM D92	˚C	170
Pour Point	ASTM D97	˚C	-35

SST ECI HD-AP EP-GL-5 Auto-Gear Oils

SST ECI HD-AP EP-GL-5 are premium grade automotive gear oils enhanced with unique ABF technology to out-perform any aftermarket products in extreme-pressure, anti-corrosion, antioxidation, demulsification and anti-foam properties. These oils are environmental friendly containing no lead, and meet the performance requirements of API GL-5, MIL-L-2105D, ZF TE-ML 05A, 7A, 12E, 16B, 16C, 16D, 17B, 19B, 21A and MAN 342 Type 2.

SAE 90, SAE 140,
SAE 80W90, SAE 85W140

Advantages

- Eliminate spitfire effects to maintain the integrity of the gear components
- Excellent rust and corrosion inhibition
- Exceptional load-carrying capability
- Extending gear life
- Good oxidative and thermal stability
- Outstanding protection against wear and shock

Applications

- SST ECI HD-AP EP-GL-5 are suitable for automotive hypoid gears, spiral bevel axles, steering boxes, heavy duty axles with final drive and other gears under severe operating conditions.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	SAE 90	SAE 140	SAE 80W90	SAE 85W140
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	197	450	156	425
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	18	30	15.4	30
Viscosity Index	ASTM D2270		96	95	100	97
Flash Point (COC)	ASTM D92	˚C	212	222	205	222
Pour Point	ASTM D97	˚C	-10	-9	-27	-18

SST ECI HD-AP PTF TRANSMISSION FLUID

SST ECI HD-AP PTF is a premium power transmission fluid designed for transmission and Drive Train Oil. The oil enhanced with ABF Technology possesses outstanding anti-wear, anti-rust and anti-oxidation properties, exhibits excellent friction control, less brake noise, good elastomeric compatibility. SST-ECI HD-AP PTF meets and complies with specification requirements of Caterpillar TO-4, Caterpillar TO-4M, Allison C-4, Komatsu 07.868.1, ZF TE-ML 01, 03C and API CF, CF-2, etc.

SAE 10W, SAE 30, SAE 40,
SAE 50, SAE 60

Advantages

- Eliminate spitfire effects to maintain the integrity of the system components
- Excellent friction control
- Good elastomer compatibility
- Prolong the life of brakes and transmissions
- Reduced brake noise
- Superior gear wear protection
- Superior thermal and oxidation stability

Applications

- SST ECI HD-AP PTF is recommended for use in modern Caterpillar transmissions, final drive, oil immersed brake and hydraulic systems fitted to heavy-duty off-road equipment. It can also be used as hydraulic fluid in some automatic systems and Vickers pumps.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	SAE 10W	SAE 30	SAE 40	SAE 50	SAE 60
Kinematic Viscosity @ 40 ˚C	ASTM D445	cSt	42	97	141	228	318
Kinematic Viscosity @ 100 ˚C	ASTM D445	cSt	6.5	11.3	14.7	19.2	24
Viscosity Index	ASTM D2270		105	98	97	95	95
Flash Point (COC)	ASTM D92	˚C	205	210	215	225	230
Pour Point	ASTM D97	˚C	-30	-25	-25	-9	-9

I 9. SINGAPORE HYDRAULIC LUBRICANTS WITH ABF TECHNOLOGY

SST ECI TV T-POWER

SST ECI HD-AP

ISO 32, ISO 46,
ISO 68, ISO 100

SST ECI TV T-POWER

SST ECI TV T-Power Hydraulic Oil is a premium quality anti-wear hydraulic oils intended for industrial and mobile service application where anti-wear lubricants are required. The oils are formulated with enhanced ABF technology and high quality base oils that results in products that provides many features to improve and prolong equipment life.

Advantages

- Excellent anti-wear performance reducing pump wear and extending pump life
- Exceptional corrosion protection reduces the negative effects of moisture on system components
- Extends the life of hydraulic components upto 400% (conditional to the physical status)
- Good oxidation stability and good filterability
- Improves efficiency in terms of smoothness
- Reduce downtime 300% and more
- Reduction of sludge and deposit formation in close tolerance components such as servo valves

Applications

- Most of the hydraulic systems under light to moderate operation conditions, particularly for older machines that oil change is more often
- System employing gear, vane, radial and axial piston pumps where anti-wear hydraulic oils are required
- System requiring a high degree of load-carrying capability and anti-wear protection
- System containing gears and bearings where mild and anti-wear characteristics are required

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 32	ISO 46	ISO 68	ISO 100
Density @ 15		Kg / L	0.872	0.874	0.881	0.89
Kinematic Viscosity @ 40°C	ASTM D445	cSt	30.4	46	68.5	98.5
Kinematic Viscosity @ 100°C	ASTM D445	cSt	5.23	6.75	8.7	11
Viscosity Index	ASTM D2270		100	100	99	97
Flash Point (COC)	ASTM D92	°C	219	225	230	239
POUR POINT	ASTM D97	°C	-20	-20	-18	-15

ISO 32, ISO 46,
ISO 68, ISO 100

SST ECI HD-AP

SST ECI HD-AP Hydraulic Oil is a Heavy Duty general purpose anti-wear hydraulic oils formulated with enhanced ABF technology. The oils possess good anti-wear, anti-corrosion and anti-oxidation properties and meet Park Denison HF-0, HF-2 and DIN 51524 Part I, II specifications.

Advantages

- Excellent protection against wear, rust and corrosion
- Extends the life of hydraulic components upto 400% (conditional to the physical status)
- General purpose economy oils
- Good filterability
- Good oxidation stability
- Improves efficiency in terms of smoothness
- Reduce downtime 300% and more

Applications

- SST ECI HD Hydraulic Oil is recommended for use in most of the hydraulic systems, particularly for older machines that oil change is more often. They are not suitable for use in systems with silver plated components.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 32	ISO 46	ISO 68	ISO 100	SAE 150
Kinematic Viscosity @ 40°C	ASTM D445	cSt	30	45	67	98	145
Kinematic Viscosity @ 100°C	ASTM D445	cSt	5.3	6.7	8.6	10.9	14.5
Viscosity Index	ASTM D2270		99	99	98	97	96
Flash Point (COC)	ASTM D92	°C	212	220	228	245	250
Pour Point	ASTM D97	°C	-12	-12	-10	-10	-10

20. SINGAPORE COMPRESSOR LUBRICANTS WITH ABF TECHNOLOGY

SST ECI AP COMPRESSO LOW ASH 0.5
AIR COMPRESSOR OIL

SST ECI CAT-TV GC AF
GAS COMPRESSOR OILS

SST ECI CAT-TV GC
GAS COMPRESSOR OILS

Not Just Oil...
IT'S TECHNOLOGY

SST ECI AP COMPRES-SO LOW ASH 0.5

Air Compressor Oil

SST ECI AP Compresso Low Ash 0.5 are air compressor oils blended with highly refined mineral base oils together with Steel Shield ABF advanced technology additives. The oils reduce internal friction, protect metal parts, exhibit good oxidation stability, excellent rust and corrosion protection and demulsificationproperties, meet the requirements of DIN 51506 VD-L.

ISO 32, ISO 46,
ISO 68, ISO 100, ISO 150

Advantages

- Energy Saving average 5~12%
- Excellent chemical stability
- Excellent demulsifibility
- Excellent thermal stability
- Extend oil change interval
- Extend the life of all metal parts
- Good anti-oxidation and anti-rust properties
- Improve efficiency
- Less downtime and save maintenance cost
- Reduce noise
- Resistance to sludge deposit

Applications

- AP COMPRESSO are recommended for the lubricating of rotary sliding vane, screw air compressors as well as reciprocating air compressors.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150
Kinematic Viscosity @ 40˚C	ASTM D445	cSt	29	46	68	97	150
Kinematic Viscosity @ 100˚C	ASTM D445	cSt	5.4	6.8	8.5	11	14.8
Viscosity Index	ASTM D2270		108	105	97	97	97
Flash Point (COC)	ASTM D92	˚C	215	220	230	245	248
Pour Point	ASTM D97	˚C	-15	-12	-10	-10	-9
POUR POINT	ASTM D97	˚C	-20	-20	-18	-15	

SST ECI CAT-TV GC AF

Gas Compressor Oil

SST ECI CAT-TV GC AF are ash-free compressor oils formulated with specially refined oils containing oxidation inhibitor and ash-free anti wear additives for low carbon-forming tendencies. Enhanced with Steel Shield ABF technology the oils demonstrate excellent performance in variety of compressors. Provide extended operating interval between overhauls. Meet the requirement of DIN 51506 VD-L.

ISO 32, ISO 46,
ISO 68, ISO 100

Advantages

- Extended oil drain interval
- Extends the life of system parts up to 400% (conditional to the physical status)
- Good protection against corrosion and wear
- Improve efficiency
- Reduce deposit and maintain system cleanliness
- Reduce downtime 200+%
- Reduce noise 3db~9db (conditional to compressor condition)
- Ultimate performance against oxidation and nitration

Applications

- SST ECI CAT-TV GC AF lubricates both cylinders and crankcases of reciprocating air compressors operating with high discharge temperatures. May also be used for drip-feed rotary sliding vane and screw type compressors. Can function as excellent ash-free hydraulic fluids.

Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	ISO 32	ISO 46	ISO 68	ISO 100
Kinematic Viscosity @ 40	ASTM D445	cSt	31.5	46.5	68	97.3
Kinematic Viscosity @ 100	ASTM D445	cSt	5.33	6.81	8.65	10.91
Viscosity Index	ASTM D2270		101	100	98	96.3
Flash Point (COC)	ASTM D92		220	224	230	242
Density @ 15		Kg / L	0.87	0.876	0.88	0.889

SST ECI CAT-TV GC
Gas Compressor Oil

SST ECI CAT-TV GC is a low-ash gas compressor oil where engine and compressor have a common lubrication system. It's formulated with highly refined mineral oils and additives to control wear, oxidation, nitration and bearing corrosion. The oil is enhanced with Steel Shield ABF technology for excellent performance. The oil demonstrates excellent performance in 4-strokes gas engines operating compressors on gas collection and transmission networks such as Caterpillar etc. The oil meets the requirement of API CF/SF.

SAE 40

Not Just Oil... IT'S TECHNOLOGY

THE ADDITIVE QUALITY

MADE IN SINGAPORE

Advantages

- Extended oil drain interval
- Extends the life of system parts up to 400% (conditional to the physical status)
- Good protection against corrosion and wear
- Improve efficiency
- Reduce deposit and maintain system cleanliness
- Reduce downtime 200+%
- Reduce noise 3db~9db (conditional to compressor condition)
- Ultimate performance against oxidation and nitration

Applications

- SST ECI CAT-TV GC is recommended for use in new generation gas compressors requiring low ash contents.

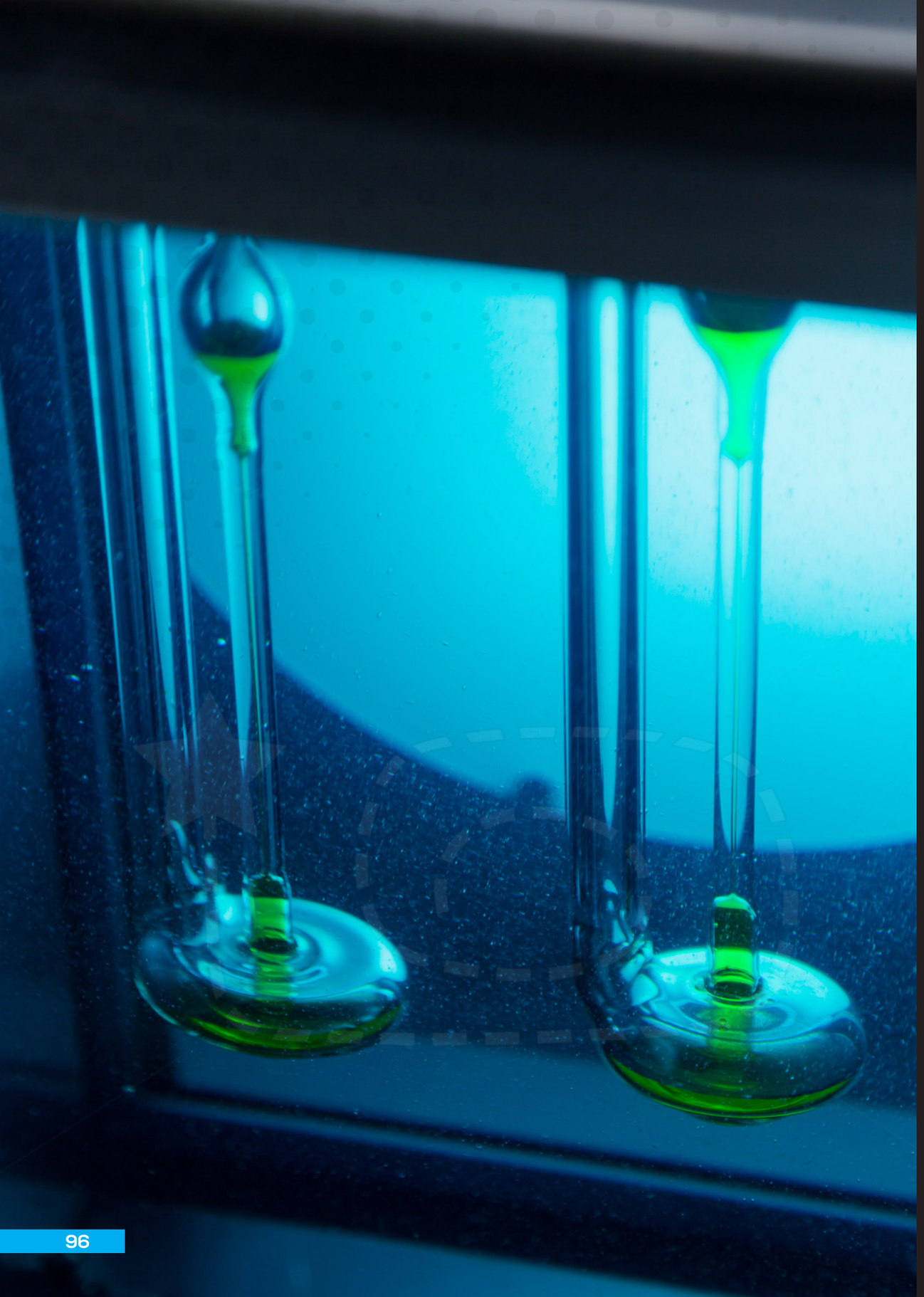
Directions of Usage

- Follow the maintenance manuals of the marine engine systems.

Properties	Standard	Unit	SAE 40
Density @ 15	ASTM D1298	Kg / L	0.886
Kinematic Viscosity @ 40°C	ASTM D445	cSt	125
Kinematic Viscosity @ 100°C	ASTM D445	cSt	13.28
Viscosity Index	ASTM D2270		97
Flash Point (COC)	ASTM D92	°C	>218
Pour Point	ASTM D97	°C	≤-15
Sulphated Ash	ASTM D874	%(M)	0.4
Boiling Point		°C	228

SINGAPORE COMPRESSOR OILS

"With Steel Shield, any marine compressor system can save huge amount of maintenance costs, and boost the efficiency to the highest level. This can only be achieved by ABF Technology"



21. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

“Steel Shield lubricants with ABF Technology is proven to be superior to any other top-class lubricants in the world.”

21A. GAS ENGINE OILS AND COMPRESSOR OILS TESTS

STEEL SHIELD REVEALED POWERFUL PERFORMANCE IN TESTS

Products of the same class

SwRI Lab No.	24564	23728	23252	23727	25250	25251
ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)	SST Gas Engine Oil SAE 40 Ashless Without EPA	Steel Shield Gas Engine Oil GECAT SAE40 Low Ash With EPA	Steel Shield EPA	Steel Shield Compressor Oil ISO #100 / 150	Mobil Pegasus 805SAE 40 Gas Engine Oil	Mobil Pegasus 801SAE 40 Gas Engine Oil
Volume (Gallon)	1	1	1	1	1	1
OK Load (lbs)	40	40	75	55	9	9
Score Load (lbs)	45	45	80	60	12	12
Temperature (°C)	38	38	38	38	38	38

FIGURE 1 - STEEL SHIELD WINS IN Timken TEST (ASTM D2782)

- The SwRI Timken Test report clearly testified Steel Shield products are FAR Superior than Mobil products of the same classes
- Steel Shield outperforms Mobil in OK LOAD parameter by 444 % and in SCORE LOAD by 375 %

Products of the same class

SwRI Lab No.	24564	23728	23252	23727	25250	25251
ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)	SST Gas Engine Oil SAE 40 Ashless Without EPA	Steel Shield Gas Engine Oil GECAT SAE40 Low Ash With EPA	Steel Shield EPA	Steel Shield Compressor Oil ISO #100 / 150	Mobil Pegasus 805SAE 40 Gas Engine Oil	Mobil Pegasus 801SAE 40 Gas Engine Oil
Volume (Gallon)	1	1	1	1	1	1
Corrected Load (kgf)	70	109	NA	1	136	74
Load Wear Index (kgf)	35	46	NA	48	34	35
Weld Point (kg)	200	250	>800	250	200	200
Last Non Seizure Load (kg)	80	100	80	100	63	80

FIGURE 2 - STEEL SHIELD WINS IN 4-BALLS TEST (ASTM D2783)

- The SwRI 4-Balls Test testified Steel Shield products are superior than Mobil products of the same classes
- Steel Shield outperforms Mobil in the Weld Point (oil strength in resistant to EP) parameter by 129 % and in the Last Non Seizure Load (wear performance in respect to load) by 159 %.
- *** Remarks: 4-ball test is normally for heavy weight oil and grease.

FIGURE 3 - ORIGINAL TEST REPORTS FROM SWRI (RIGHT PAGE)

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD 78238-5166 • P.O. DRAWER 28510 78228-0510 • SAN ANTONIO, TEXAS, USA • (210) 684-5111 • WWW.SWRI.ORG

November 20th, 2014

George Fennell
Steel Shield Technologies
3351 Industrial Blvd
Bethel Park, PA 15102-2543
Phone: 1-800-390-1535
Email:

Re: Fuel Analysis Results
SwRI WO# 71111
PO# 120

Dear Mr. Fennell:

Analyses have been completed on your samples in accordance with the tests requested. Twelve samples were received in good condition between July 21st, 2014 and October 7th 2014 in good condition. Eleven samples were received in one gallon plastic containers and one sample was received in a one quart plastic bottle. Sample Identification and testing requesting is shown in the table on the following page. Testing took place between October 13th and November 11th 2014. Test results and sample identifications are shown in the table attached.

Analyses were performed according to the listed ASTM test procedures with no modifications or deviations. Precision should be consistent with those stated in the ASTM test procedures. Sample aliquots were taken in accordance with the various ASTM test procedures. The analyses above pertain only to the sample received by Southwest Research Institute and represent only that sampling lot. This report shall not be reproduced except in full without the express written permission of Southwest Research Institute.

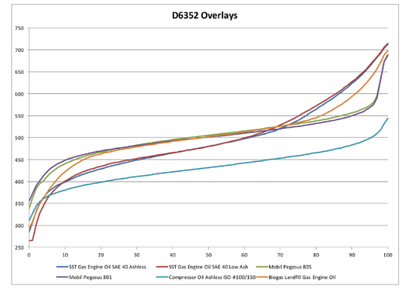
If there are any questions concerning these analyses, or if you need any additional testing on the samples, please contact me at (210) 522-2071. We appreciate the opportunity to be of service to your firm.

Sincerely,

Robert R. Legg
Fuels Laboratory Manager
Fuels & Lubricants Research Department
Office of Automotive Engineering

Benefiting government, industry and the public through innovative science and technology

Test Summary Report
November 20th, 2014
Steel Shield Technologies



In comparing the curves and D6352 chromatography, it is observed that samples SST Gas Engine oil SAE 40 Ashless and SST Gas Engine Oil SAE 40 Low Ash ar very similar with the exception that the Low Ash oil appears to have an added component that is somewhat lighter than the rest of the oil. The bulk of this oil is lighter than the others; however it does have a larger proportion of heavier compounds. In general it has broader array of hydrocarbons than the other oils. The Mobil Pegasus 801 and Mobil Pegasus 805 are essentially the same oil with the same boiling distribution. They both are a narrower cut reducing the amount of lighter and heavier hydrocarbon species. The Biogas Landfill Gas Engine Oil has a distribution in between the SST Gas Engine Oils and the Mobil Pegasus Oils. The Ashless Compressor oil is a significantly lighter oil than the rest of the samples.

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 24564

SST Gas Engine Oil
SAE 40 Ashless
1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	40
Score Load, lbs	45
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	70
Load Wear Index, kgf	35
Weld Point, kg	200
Last Non Seizure Load, kg	80

ASTM D6352 Boiling Range Distribution of Petroleum Distillates from 174 to 700 °C by GC

IBP	285.3	20%	428.8	40%	464.8	60%	497.5	80%	564.9
1%	306.2	21%	431.1	41%	466.4	61%	499.2	81%	570.0
2%	333.2	22%	433.3	42%	467.9	62%	501.1	82%	575.1
3%	351.6	23%	435.4	43%	469.4	63%	503.0	83%	580.6
4%	364.1	24%	437.2	44%	470.9	64%	505.0	84%	586.2
5%	373.5	25%	439.2	45%	472.4	65%	507.1	85%	591.8
6%	380.5	26%	441.2	46%	474.0	66%	509.3	86%	597.5
7%	386.7	27%	443.1	47%	475.6	67%	511.8	87%	603.5
8%	391.9	28%	444.9	48%	477.1	68%	514.5	88%	609.8
9%	396.0	29%	446.7	49%	478.6	69%	517.3	89%	616.3
10%	399.1	30%	448.6	50%	480.2	70%	520.4	90%	623.3
11%	403.0	31%	450.5	51%	481.8	71%	523.7	91%	630.3
12%	406.6	32%	452.1	52%	483.4	72%	527.3	92%	637.6
13%	410.2	33%	453.7	53%	485.1	73%	531.2	93%	645.6
14%	413.5	34%	455.2	54%	486.8	74%	535.3	94%	653.8
15%	416.5	35%	456.9	55%	488.5	75%	539.6	95%	662.7
16%	419.1	36%	458.5	56%	490.2	76%	544.2	96%	672.9
17%	421.8	37%	460.1	57%	492.0	77%	549.2	97%	682.4
18%	424.3	38%	461.7	58%	493.8	78%	554.5	98%	692.4
19%	426.5	39%	463.2	59%	495.7	79%	559.7	99%	704.3
								FBP	713.1

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 23728

Biogas Landfill Gas Engine Oil
SAE 40 (Gecat SAE 40 Low Ash)
1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	40
Score Load, lbs	45
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	109
Load Wear Index, kgf	46
Weld Point, kg	250
Last Non Seizure Load, kg	100

ASTM D6352 Boiling Range Distribution of Petroleum Distillates from 174 to 700 °C by GC

IBP	291.8	20%	462.9	40%	491.3	60%	512.8	80%	545.5
1%	308.9	21%	465.1	41%	492.4	61%	514.0	81%	548.7
2%	331.8	22%	467.0	42%	493.5	62%	515.2	82%	552.3
3%	349.1	23%	468.8	43%	494.7	63%	516.5	83%	556.3
4%	362.7	24%	470.4	44%	495.8	64%	517.8	84%	560.5
5%	374.7	25%	472.0	45%	496.9	65%	519.1	85%	565.1
6%	385.9	26%	473.6	46%	497.9	66%	520.4	86%	569.9
7%	396.5	27%	475.1	47%	498.9	67%	521.8	87%	575.0
8%	406.2	28%	476.5	48%	499.9	68%	523.1	88%	580.8
9%	415.0	29%	477.8	49%	500.9	69%	524.5	89%	586.8
10%	422.4	30%	479.1	50%	502.0	70%	526.0	90%	593.2
11%	429.0	31%	480.4	51%	503.0	71%	527.5	91%	599.9
12%	434.9	32%	481.6	52%	504.0	72%	529.0	92%	607.5
13%	440.2	33%	482.9	53%	505.1	73%	530.7	93%	615.4
14%	444.7	34%	484.2	54%	506.1	74%	532.4	94%	624.3
15%	449.2	35%	485.4	55%	507.2	75%	534.2	95%	633.7
16%	452.5	36%	486.6	56%	508.2	76%	536.1	96%	644.5
17%	455.4	37%	487.8	57%	509.3	77%	538.1	97%	656.4
18%	458.3	38%	489.0	58%	510.5	78%	540.4	98%	671.9
19%	460.7	39%	490.1	59%	511.7	79%	542.8	99%	688.2
								FBP	697.9

21B. STEEL SHIELD VS. YAMAMOTO AND ATLAS

STEEL SHIELD LARGELY OUTPERFORMS REPUTED GREASES MADE BY YAMAMOTO AND ATLAS

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 25252

SST-EPA

1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	75
Score Load, lbs	80
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	
Load Wear Index, kgf	
Weld Point, kg	>800
Last Non Seizure Load, kg	80

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 23727

Compressor Oil Ashless
ISO #100/150
1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	55
Score Load, lbs	60
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	133
Load Wear Index, kgf	48
Weld Point, kg	250
Last Non Seizure Load, kg	100

ASTM D6352 Boiling Range Distribution of Petroleum Distillates from 174 to 700 °C by GC

IBP	310.0	20%	398.6	40%	421.7	60%	442.0	80%	465.5
1%	326.9	21%	400.0	41%	422.7	61%	443.1	81%	466.9
2%	344.5	22%	401.4	42%	423.6	62%	444.1	82%	468.4
3%	354.0	23%	402.7	43%	424.6	63%	445.3	83%	469.9
4%	360.6	24%	404.0	44%	425.6	64%	446.4	84%	471.5
5%	365.4	25%	405.2	45%	426.6	65%	447.5	85%	473.2
6%	369.2	26%	406.4	46%	427.6	66%	448.7	86%	474.9
7%	372.5	27%	407.7	47%	428.6	67%	449.8	87%	476.7
8%	375.5	28%	408.9	48%	429.6	68%	450.9	88%	478.7
9%	378.2	29%	410.1	49%	430.6	69%	452.0	89%	480.7
10%	380.6	30%	411.2	50%	431.6	70%	453.1	90%	483.0
11%	382.8	31%	412.4	51%	432.6	71%	454.2	91%	485.6
12%	384.9	32%	413.4	52%	433.6	72%	455.4	92%	488.3
13%	386.9	33%	414.5	53%	434.6	73%	456.6	93%	491.4
14%	388.9	34%	415.5	54%	435.7	74%	457.8	94%	494.9
15%	390.7	35%	416.6	55%	436.7	75%	459.0	95%	498.8
16%	392.4	36%	417.7	56%	437.7	76%	460.2	96%	503.3
17%	394.0	37%	418.7	57%	438.8	77%	461.5	97%	509.1
18%	395.6	38%	419.7	58%	439.9	78%	462.8	98%	517.6
19%	397.1	39%	420.7	59%	440.9	79%	464.1	99%	531.3
								FBP	544.3

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 25250

Mobil Pegasus
805
1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	9
Score Load, lbs	12
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	136
Load Wear Index, kgf	34
Weld Point, kg	200
Last Non Seizure Load, kg	63

ASTM D6352 Boiling Range Distribution of Petroleum Distillates from 174 to 700 °C by GC

IBP	338.1	20%	467.0	40%	495.3	60%	515.0	80%	538.2
1%	363.1	21%	468.9	41%	496.4	61%	516.1	81%	539.6
2%	384.2	22%	470.6	42%	497.4	62%	517.1	82%	541.0
3%	396.2	23%	472.3	43%	498.3	63%	518.1	83%	542.6
4%	401.9	24%	474.0	44%	499.3	64%	519.2	84%	544.2
5%	410.8	25%	475.6	45%	500.3	65%	520.3	85%	545.9
6%	419.2	26%	477.1	46%	501.3	66%	521.4	86%	547.7
7%	426.0	27%	478.6	47%	502.2	67%	522.5	87%	549.7
8%	431.6	28%	480.0	48%	503.2	68%	523.6	88%	551.8
9%	436.1	29%	481.5	49%	504.1	69%	524.7	89%	554.1
10%	440.5	30%	482.9	50%	505.1	70%	525.8	90%	556.5
11%	444.1	31%	484.2	51%	506.0	71%	526.9	91%	558.9
12%	447.6	32%	485.6	52%	506.9	72%	528.1	92%	561.8
13%	450.8	33%	486.9	53%	507.9	73%	529.3	93%	565.0
14%	453.5	34%	488.2	54%	508.9	74%	530.5	94%	568.7
15%	456.1	35%	489.4	55%	509.9	75%	531.7	95%	573.2
16%	458.5	36%	490.6	56%	510.9	76%	533.0	96%	580.2
17%	460.8	37%	491.8	57%	511.9	77%	534.2	97%	594.4
18%	463.0	38%	493.0	58%	512.9	78%	535.5	98%	634.2
19%	465.1	39%	494.1	59%	514.0	79%	536.8	99%	674.3
								FBP	689.6

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 25251

Mobil Pegasus
801
1 Gallon Plastic Jug

ASTM D2782 Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

Okay Load, lbs	9
Score Load, lbs	12
Temperature, °C	38

ASTM D2783 Measurement of Extreme-Pressure Properties of Lubricating Fluids (4-Ball Method)

Corrected Load, kgf	74
Load Wear Index, kgf	35
Weld Point, kg	200
Last Non Seizure Load, kg	80

ASTM D6352 Boiling Range Distribution of Petroleum Distillates from 174 to 700 °C by GC

IBP	355.5	20%	469.5	40%	492.3	60%	510.0	80%	532.2
1%	372.7	21%	470.9	41%	493.3	61%	511.0	81%	533.6
2%	391.1	22%	472.3	42%	494.3	62%	511.9	82%	535.1
3%	401.9	23%	473.7	43%	495.2	63%	512.9	83%	536.5
4%	413.3	24%	475.0	44%	496.2	64%	513.9	84%	538.1
5%	422.1	25%	476.2	45%	497.0	65%	514.9	85%	539.7
6%	429.3	26%	477.4	46%	497.8	66%	516.0	86%	541.4
7%	435.4	27%	478.5	47%	498.7	67%	517.0	87%	543.2
8%	440.6	28%	479.7	48%	499.5	68%	518.0	88%	545.2
9%	444.6	29%	480.8	49%	500.4	69%	519.1	89%	547.4
10%	448.3	30%	481.9	50%	501.2	70%	520.2	90%	549.9
11%	451.6	31%	483.1	51%	502.1	71%	521.3	91%	552.7
12%	454.2	32%	484.2	52%	503.0	72%	522.4	92%	555.8
13%	456.7	33%	485.2	53%	503.8	73%	523.5	93%	559.1
14%	459.0	34%	486.3	54%	504.7	74%	524.7	94%	563.1
15%	461.0	35%	487.3	55%	505.5	75%	525.9	95%	568.2
16%	462.9	36%	488.4	56%	506.4	76%	527.1	96%	575.2
17%	464.7	37%	489.4	57%	507.2	77%	528.3	97%	590.1
18%	466.5	38%	490.3	58%	508.1	78%	529.6	98%	633.5
19%	468.1	39%	491.3	59%	509.0	79%	530.9	99%	673.0
								FBP	687.9

Petroleum Products Research Department
Test Summary Report
Steel Shield Technologies
Purchase Order # 114
October 25, 2013

SwRI Code:	Sample Identification:		20003 Litho Shield	20004 Yamamoto EP grease
D1264	Water Washout of Grease			
	Avg. Grease Washed Out	wt %	1.32	0.66
	Test Temp.	°C	79	79
	Dry Temp.	°C	77	77
D1742	Oil Separation from Lubricating Grease	mass %	2.04	* Note
D2265	Dropping Point	°C	258	307
	Oven Temp.	°C	288	316
D2266	Wear Characteristics (Four-Ball Method)			
	Scar Diameter	kgf	0.75	0.47
D2596	Four-Ball Extreme Pressure Properties			
	Corrected Load	kgf	851.1	501.68
	Load-Wear Index	kgf	92.27	66.73
	Weld Point	kgf	800	315
	LNSL	kgf	80	63

* No oil separation occurred for grease sample "Yamatomo EP grease", therefore, sample is considered "outside the scope of the method".

Benefiting government, industry and the public through innovative science and technology

Petroleum Products Research Department
Test Summary Report
Steel Shield Technologies
Purchase Order # 114
October 25, 2013

SwRI Code:	Sample Identification:		20005 Atlas Chisel lube
D1264	Water Washout of Grease		
	Avg. Grease Washed Out	wt %	1.11
	Test Temp.	°C	79
	Dry Temp.	°C	77
D1742	Oil Separation from Lubricating Grease	mass %	** Note
D2265	Dropping Point	°C	302
	Oven Temp.	°C	316
D2266	Wear Characteristics (Four-Ball Method)		
	Scar Diameter	kgf	0.71
D2596	Four-Ball Extreme Pressure Properties		
	Corrected Load	kgf	302.79
	Load-Wear Index	kgf	41.23
	Weld Point	kgf	315
	LNSL	kgf	50

** No oil separation occurred for grease sample "Atlas Chisel Lube", therefore, sample is considered "outside the scope of the method".

Benefiting government, industry and the public through innovative science and technology

Test Items	Four-Ball Extreme Pressure Properties	Steel Shield Lithi Shield	Yamamoto EP Grease	Atlas Chisel Lube
Loading Ability	Corrected Load	851.1	501.68	302.79
Anti-Wear Ability	Load Wear Index	92.27	66.73	41.23
High Temperature Loading	Weld Point	800	315	315
High Pressure Loading	LNSL	80	63	50

Figure 1
- Grease test report summary
- Steel Shield Lithi Shield is superior to Yamamoto EP Grease and Atlas Chisel Lube in Loading ability, Anti-Wear Ability, High Temperature Loading and High Pressure Loading.

Figure 2
- Steel Shield (right) and Atlas (left)

22. INSURANCE CERTIFICATE & CONFIRMATION OF NO INSURANCE CLAIM

“The most powerful and reliable evidence showing that Steel Shield is the only lubricant you can trust.”

22A. CERTIFICATE OF LIABILITY INSURANCE

OVER USD 2,000,000 INSURANCE

ACORD

INSURANCE BINDER

DATE (MM/DD/YYYY): 11/24/2015

THIS BINDER IS A TEMPORARY INSURANCE CONTRACT, SUBJECT TO THE CONDITIONS SHOWN ON THE REVERSE SIDE OF THIS FORM.

AGENCY
Best Insurance Agency Inc.
340 South Main Street
P.O. Box 670
Butler PA 16003-0670
PHONE (A/C, No, Ext): (724) 283-5670 FAX (A/C, No): (724) 283-1160
CODE: 37-149 SUB CODE:
AGENCY CUSTOMER ID: 00008675

COMPANY
Cincinnati Indemnity Co.

BINDER #
B15112401745

EFFECTIVE DATE: 4/24/2015 TIME: 12:01 X AM PM
EXPIRATION DATE: 4/24/2016 TIME: X 12:01 AM NOON
THIS BINDER IS ISSUED TO EXTEND COVERAGE IN THE ABOVE NAMED COMPANY
PER EXPIRING POLICY #: ENP04242014

INSURED
Steel Shield Technologies Inc
3351 Industrial Blvd

Bethel Park PA 15102

DESCRIPTION OF OPERATIONS/VEHICLES/PROPERTY (Including Location)
3351 Industrial Blvd., Bethel Park, Pa.
lubricants

COVERAGES

TYPE OF INSURANCE	COVERAGE/FORMS	DEDUCTIBLE	COINS %	LIMITS AMOUNT
PROPERTY — CAUSES OF LOSS: BASIC / BROAD / X SPEC	Business Personal Property	1,000		140,000
GENERAL LIABILITY				
X COMMERCIAL GENERAL LIABILITY			EACH OCCURRENCE	$ 2,000,000
CLAIMS MADE / X OCCUR			DAMAGE TO RENTED PREMISES	$ 50,000
			MED EXP (Any one person)	$
			PERSONAL & ADV INJURY	$ 2,000,000
RETRO DATE FOR CLAIMS MADE			GENERAL AGGREGATE	$ 2,000,000
			PRODUCTS - COMP/OP AGG	$ 2,000,000
VEHICLE LIABILITY			COMBINED SINGLE LIMIT	$ 1,000,000
ANY AUTO			BODILY INJURY (Per person)	$
ALL OWNED AUTOS			BODILY INJURY (Per accident)	$
SCHEDULED AUTOS			PROPERTY DAMAGE	$
X HIRED AUTOS			MEDICAL PAYMENTS	$
X NON-OWNED AUTOS			PERSONAL INJURY PROT	$
			UNINSURED MOTOR IST	$
				$
VEHICLE PHYSICAL DAMAGE — DED	ALL VEHICLES	SCHEDULED VEHICLES	ACTUAL CASH VALUE	
COLLISION			STATED AMOUNT	$
OTHER THAN COL				
GARAGE LIABILITY			AUTO ONLY - EA ACCIDENT	$
ANY AUTO			OTHER THAN AUTO ONLY: EACH ACCIDENT	$
			AGGREGATE	$
EXCESS LIABILITY			EACH OCCURRENCE	$
UMBRELLA FORM			AGGREGATE	$
OTHER THAN UMBRELLA FORM	RETRO DATE FOR CLAIMS MADE:		SELF-INSURED RETENTION	$
			WC STATUTORY LIMITS	
WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY			E.L. EACH ACCIDENT	$
			E.L. DISEASE - EA EMPLOYEE	$
			E.L. DISEASE - POLICY LIMIT	$
SPECIAL CONDITIONS / OTHER COVERAGES			FEES	$
			TAXES	$
			ESTIMATED TOTAL PREMIUM	$

NAME & ADDRESS

MORTGAGEE / ADDITIONAL INSURED
LOSS PAYEE
LOAN #

AUTHORIZED REPRESENTATIVE

ACORD 75 (2010/04) Page 1 of 2
INS075 (20100401) 02

FIGURE 1 - ORIGINAL CERTIFICATE OF LIABILITY INSURANCE

Best Insurance Agency
340 S. Main St., P.O. Box 670
Butler, PA 16003-0670
(724)283-5670 (724)283-1160Fax
Email: Ray@Bestinsurancebutler.com

September 18, 2013

Steel Shield Technologies (Asia Pacific) Limited
22nd Floor, W. Business Centre
4 Kam Hong Street
North Point, Hong Kong

To Whom It May Concern:

Please be advised that Steel Sheild Technologies Inc, manufacturer of specialty lubricants and greases, located in Bethel Park,Pennsylvania, USA, has had no claims, claim related incidents or notices of loss under any General Liability policy issued by our office. We have provided them with General Liability coverage continously since April 24, 2008

If you have any questions or need further information please feel free to contact me. I will be happy to be of further assistance.

Sincerely,

Raymond A. Rosenbauer
Vice President

FIGURE 2 - CONFIRMATION LETTER OF NO INSURANCE CLAIM

- Steel Shield had NEVER been claimed

23. AUTHORITATIVE COMPLIMENTS LETTERS

“Formalized respectful action paid to STEEL SHIELD by the most renowned cooperations in the world. IN STEEL SHIELD, WE TRUST!”

23A. COMPLIMENTS FROM THE US ARMED FORCES

WEAPON SHIELD WAS TRUELY A LIFE SAVER

Mark W. Pushnick
President & CEO
Steel Shield Technologies, Inc
3351 Industrial Blvd
Bethel Park, PA 15102-2543

07 May 2008

Mark,

I wanted to take time to express my sincere thanks to you and Steel Shield Technologies, Inc. for your support while I was deployed overseas in support of the Global War on Terrorism.

Your product, Weapon Shield, was truly a "life saver".

In my first combat tour to Afghanistan in late 2003, not knowing much about your product, I began to use it for my personal weapon and my crew-served vehicle weapon as a just another oil that I received in my care packages from home. I soon became educated on how this product was head and shoulders above the rest.

In the grueling conditions of southwestern Afghanistan, our weapons were subject to severe heat, dust, and even potential rust due to the humidity in the area. Compared to the other oils that we received, Weapon Shield was the only product that stood up to the battlefield environment and did not cause the bolt of the weapons to become "gummy" or "sticky". Weapon Shield actually acted as a "shield" and as a dust repellent.

When I found out that I was deploying back to Iraq in 2007, one of my first calls was to my father to get my hands on Weapon Shield. While conducting pre-deployment training at Fort Bragg, I introduced my soldiers to this product. When it comes to selling to a tough audience, young enlisted men are some of the toughest to buy into a new idea. Within days, all of the men were carrying this product and were even hoarding bottles within their packs.

When we got to Iraq, Weapon Shield bottles became a part of the combat packing list as assigned by my Detachment Sergeant. Weapon Shield was now the Standing Operating Procedure, a small bottle on each man and tube of grease in each truck.

Weapons Shield brought us through over 25 fire fights with great success when other soldier's from different unit's weapons failed. On one occasion on patrol with another unit, their .50 cal machine gun jammed. One of my gunners tossed a bottle of Weapon Shield to them. They broke down their weapon, applied the shield and quickly got back into the firefight. In our mission after action review, my soldiers quickly commented on how their weapons would only be treated with this product.

The bottom line is this... In two combat tours to both Afghanistan and Iraq, weapons treated with Weapon Shield, NEVER jammed. That saved lives. As a unit commander, my most important job was to complete this mission while bringing all of my soldiers home. Weapon Shield was a great contributor to my unit accomplishing that mission. In combat, the only option is perfect. If you are not, you can die. Weapon Shield was PERFECT every time.
Victory!

Craig A. Hickerson
MAJOR, Infantry
USAR

FIGURE 1 (ABOVE) - US SOLIDERS HOLDING STEEL SHIELD BANNER

FIGURE 2 (RIGHT) - EMBLEM OF THE UNITED STATES DEPARTMENT OF THE ARMY

FIGURE 3 (LEFT) - LETTERS OF THANKS AND COMPLIMENTS FROM THE US ARMY

23B. COMPLIMENTS FROM THE SIEMENS

STEEL SHIELD PRODUCTS ARE GREAT CONTRIBUTORS TO SIEMEN'S SUCCESS

SIEMENS
VAI

December 10, 2008

Mark W. Pushnick
President & CEO
Steel Shield Technologies, Inc.
3351 Industrial Blvd.

Mark,

I would like to take this opportunity to thank you for introducing us to Steel Shield Technologies line of lubricants and Metal Treatment products. The performance of your products has been overwhelmingly superior to any other lubricants or metal treatments we have used in the past.

We are currently using the Lithi-Shield grease in our shop and it has proven to work very well in our high temperature applications. We have experienced absolutely no down time due to bearing failure on our high temp furnace since we began using the Lithi-Shield grease. In the past all bearings were replaced on a quarterly basis causing a significant amount of downtime and material cost. We also use the grease in our automated welding equipment and anywhere else frequent greasing is needed. It has out performed our previously used grease in every application and we use it as often as possible.

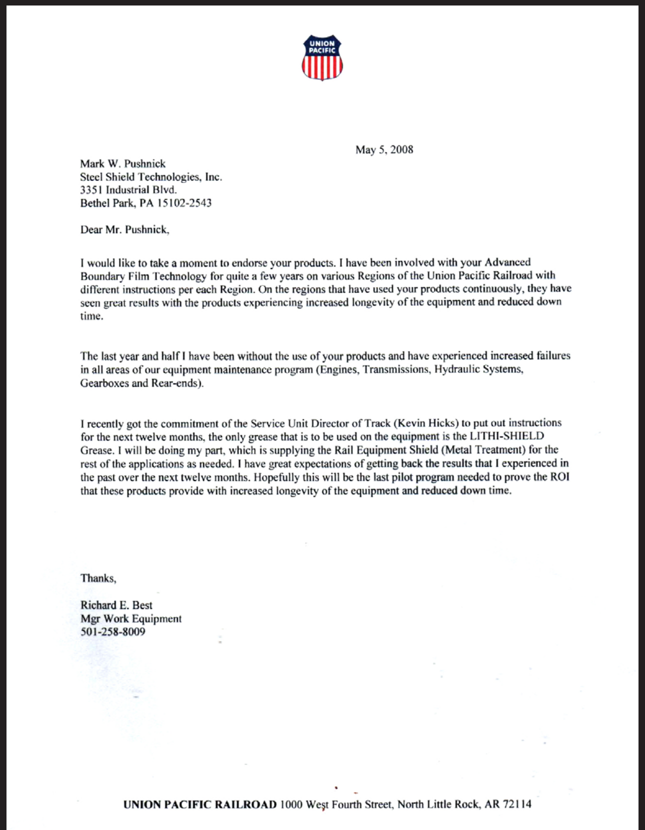
Because of the performance of the Lithi-Shield grease we started using Steel Shield EPA in all of our metalworking equipment. Since its introduction to our machines we have not experienced a significant breakdown of any kind and it has left them running smoother and quieter than ever. The Steel Shield Drill and Tap fluid is also used our shop and has significantly decreased our tooling costs and become a favorite of most of our machinists. The Spray Shield product is used by our maintenance department and it is proving to be superior to anything used here in the past. We are very happy with the cost and performance of Steel Shield Technologies products and I highly recommend them. I am continually looking for ways to reduce costs and downtime Steel Shield products have been a great contributor to our success.

Bob Cavill
Maintenance Department Supervisor
Siemens VAI Services, LLC
2901 Industrial Blvd.
Bethel Park, PA 15102
412-851-6700

FIGURE 1 - THE ORIGINAL LETTER OF COMPLIMENT FROM SIEMENS

23C. LETTERS FROM UNION PACIFIC RAILROAD

UNION PACIFIC RAILROAD USES STEEL SHIELD PRODUCT EXTENSIVELY. STEEL SHIELD HAS BEEN PROVED TO BE FUNCTIONAL AND COST-EFFECTIVE, AND ARE HIGHLY RECOMMENDED



UNION PACIFIC

May 5, 2008

Mark W. Pushnick
Steel Shield Technologies, Inc.
3351 Industrial Blvd.
Bethel Park, PA 15102-2543

Dear Mr. Pushnick,

I would like to take a moment to endorse your products. I have been involved with your Advanced Boundary Film Technology for quite a few years on various Regions of the Union Pacific Railroad with different instructions per each Region. On the regions that have used your products continuously, they have seen great results with the products experiencing increased longevity of the equipment and reduced down time.

The last year and half I have been without the use of your products and have experienced increased failures in all areas of our equipment maintenance program (Engines, Transmissions, Hydraulic Systems, Gearboxes and Rear-ends).

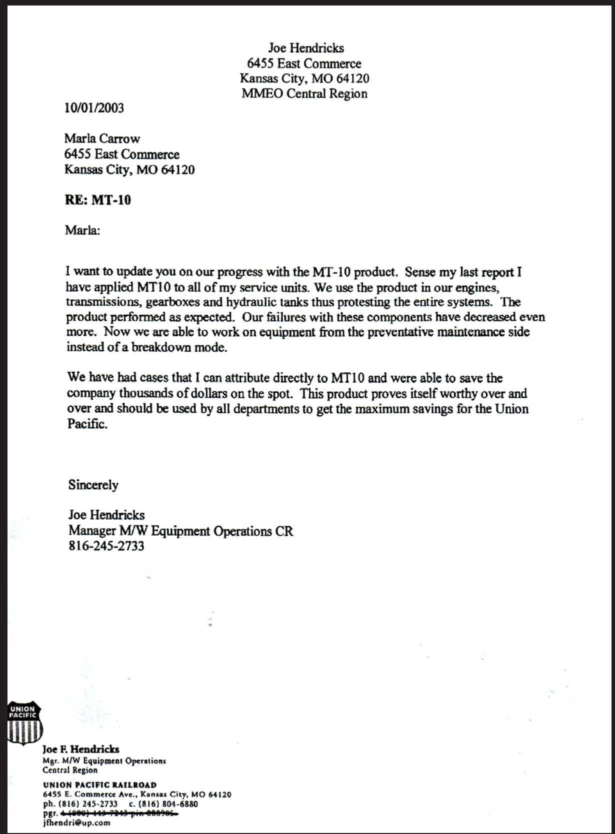
I recently got the commitment of the Service Unit Director of Track (Kevin Hicks) to put out instructions for the next twelve months, the only grease that is to be used on the equipment is the LITHI-SHIELD Grease. I will be doing my part, which is supplying the Rail Equipment Shield (Metal Treatment) for the rest of the applications as needed. I have great expectations of getting back the results that I experienced in the past over the next twelve months. Hopefully this will be the last pilot program needed to prove the ROI that these products provide with increased longevity of the equipment and reduced down time.

Thanks,

Richard E. Best
Mgr Work Equipment
501-258-8009

UNION PACIFIC RAILROAD 1000 West Fourth Street, North Little Rock, AR 72114

FIGURE 1 - THE ORIGINAL LETTER FROM MR. RICHARD E. BEST, THE MANAGER OF THE WORK EQUIPMENT



Joe Hendricks
6455 East Commerce
Kansas City, MO 64120
MMEO Central Region

10/01/2003

Marla Carrow
6455 East Commerce
Kansas City, MO 64120

RE: MT-10

Marla:

I want to update you on our progress with the MT-10 product. Sense my last report I have applied MT10 to all of my service units. We use the product in our engines, transmissions, gearboxes and hydraulic tanks thus protesting the entire systems. The product performed as expected. Our failures with these components have decreased even more. Now we are able to work on equipment from the preventative maintenance side instead of a breakdown mode.

We have had cases that I can attribute directly to MT10 and were able to save the company thousands of dollars on the spot. This product proves itself worthy over and over and should be used by all departments to get the maximum savings for the Union Pacific.

Sincerely

Joe Hendricks
Manager M/W Equipment Operations CR
816-245-2733

UNION PACIFIC
Joe F. Hendricks
Mgr. M/W Equipment Operations
Central Region
UNION PACIFIC RAILROAD
6455 E. Commerce Ave., Kansas City, MO 64120
ph. (816) 245-2733 c. (816) 804-6880
pgr. ~~1-(800) 443-7243 pin 888906~~
jfhendri@up.com

FIGURE 2 - THE ORIGINAL LETTER FROM MR. JOE HENDRICKS, THE MANAGER M/W EQUIPMENT OPERATIONS CR

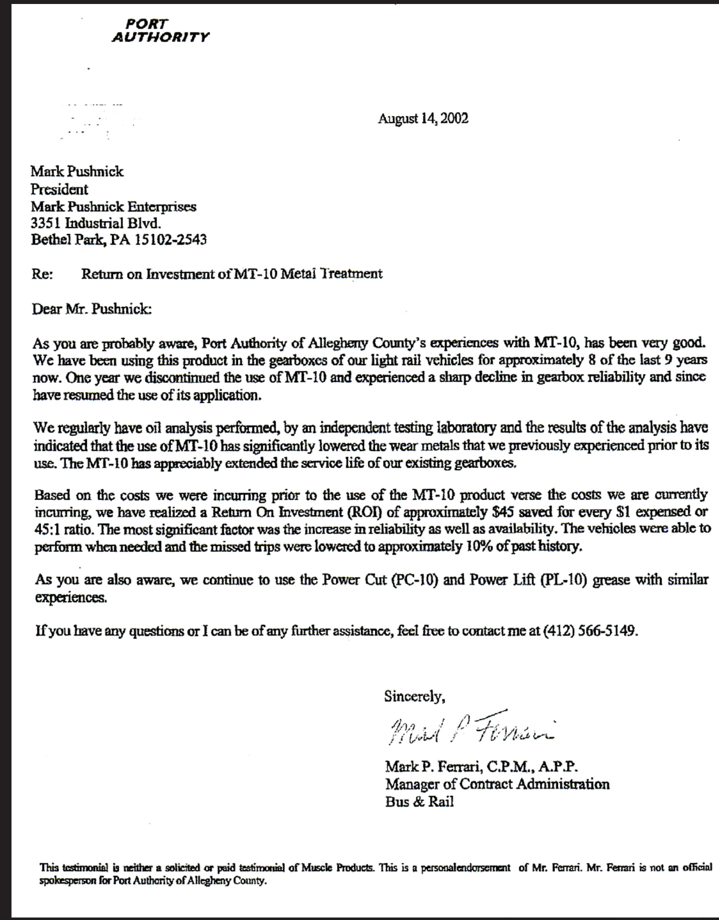
23D. LETTERS FROM THE PA PORT AUTHORITY

SAVED AROUND USD 45 IN MAINTENANCE COST FOR EVERY USD ONE DOLLAR INVESTMENT IN STEEL SHIELD PRODUCTS. ALSO, THE VEHICLES MALFUNCTIONS DROP TO AROUND 10%

FIGURE 1 (TOP RIGHT) - THE ORIGINAL LETTER FROM MR. MARK P. FERRARI, C.P.M., A.P.P., MANAGER OF CONTRACT ADMINISTRATION OF BUS & RAIL

FIGURE 2 (BOTTOM LEFT) - THE GEARBOX SYSTEM OF LIGHT RAILS

FIGURE 3 (BOTTOM RIGHT) - THE LIGHT RAIL VEHICLES OF PORT AUTHORITY



PORT AUTHORITY

August 14, 2002

Mark Pushnick
President
Mark Pushnick Enterprises
3351 Industrial Blvd.
Bethel Park, PA 15102-2543

Re: Return on Investment of MT-10 Metal Treatment

Dear Mr. Pushnick:

As you are probably aware, Port Authority of Allegheny County's experiences with MT-10, has been very good. We have been using this product in the gearboxes of our light rail vehicles for approximately 8 of the last 9 years now. One year we discontinued the use of MT-10 and experienced a sharp decline in gearbox reliability and since have resumed the use of its application.

We regularly have oil analysis performed, by an independent testing laboratory and the results of the analysis have indicated that the use of MT-10 has significantly lowered the wear metals that we previously experienced prior to its use. The MT-10 has appreciably extended the service life of our existing gearboxes.

Based on the costs we were incurring prior to the use of the MT-10 product verse the costs we are currently incurring, we have realized a Return On Investment (ROI) of approximately $45 saved for every $1 expensed or 45:1 ratio. The most significant factor was the increase in reliability as well as availability. The vehicles were able to perform when needed and the missed trips were lowered to approximately 10% of past history.

As you are also aware, we continue to use the Power Cut (PC-10) and Power Lift (PL-10) grease with similar experiences.

If you have any questions or I can be of any further assistance, feel free to contact me at (412) 566-5149.

Sincerely,

Mark P. Ferrari, C.P.M., A.P.P.
Manager of Contract Administration
Bus & Rail

This testimonial is neither a solicited or paid testimonial of Muscle Products. This is a personalendorsement of Mr. Ferrari. Mr. Ferrari is not an official spokesperson for Port Authority of Allegheny County.

23E. LETTER FROM VOLVO CHINA

THE HORSEPOWER OF VOLVO VEHICLES INCREASED BY 8% TO 12% AFTER USING STEEL SHIELD PRODUCTS

中沃汽车有限公司

致：美国离子能源有限公司
香港荃湾德士古道 188-202 号
立泰工业中心二期 11 楼 K 室

感谢 贵司提供神盾润滑油予我司作汽车马力输出测试。于是次测试当中，我司将神盾润滑油使用于 4 辆沃尔沃 Volvo 汽车[型号：沃尔沃 S80]，并将 4 辆汽车分别放上汽车马力输出测试机(Dyno-Shaft On-Vehicle Dynamometer) 进行测试。测试结果显示，4 辆进行测试的沃尔沃 Volvo 汽车在使用神盾润滑油之后，所输出的马力比起未有使用之前增加了 8%－12%。我司非常乐意向客户推荐神盾润滑油。

顺祝

商祺

中沃汽车有限公司
2013 年 11 月 8 日

地址：杭州市滨江区江南大道 3688 号通策广场 2 幢 1613 室 电话:0571-86852031
Http://www.sinoworldcar.com

FIGURE 1 - THE ORIGINAL LETTER FROM VOLVO

Volvo Car Corporation

8th November, 2013

To: Steel Shield Technologies (Asia Pacific) Limited
Unit K, 11/F, Leader Industrial Centre, Phase 2,
188-202 Texaco Road, Tsuen Wan, H.K.

Dear Ms. Eva Lam,

We would like to express our gratitude to Steel Shield Technologies (Asia Pacific) Limited for providing Steel Shield lubricants for our vehicle horse power tests. In this test, our company applied Steel Shield lubricants to 4 Volvo cars (model: Volvo S80). We mounted the 4 cars on the horse power testing machines (Dyno-Shaft On-Vehicle Dynamometer) and conducted the tests individually.

The results indicate that, the 4 Volvo cars which had Steel Shield lubricants applied got horse power boosted by 8% - 12% compared with the same 4 cars without Steel Shield lubricants. Our company will be pleased to recommend Steel Shield to our customers.

Sincerely,
Volvo Car Corporation
R/M 1613, 2th Phase, Tongce Square,3688 Jiangnan Road,
Binjiang, Hangzhou, China
Tel.: 0571-86852031 www.sinoworldcars.com

FIGURE 2 - THE ENGLISH TRANSLATION FROM THE ORIGINAL LETTER OF VOLVO

FIGURE 3 - VOLVO V70

24. STEEL SHIELD HVAC CASE STUDIES

"Concrete feedbacks and appreciations from customers are important for the success of STEEL SHIELD."

1987 - AETOS CONSTRUCTION COMPANY

In 18th May, 1987, 4 oz. Steel Shield EPA was added to the crankcase of a Dunham / Bush 30 HP 4-cylinder refrigeration compressor based on an estimated system oil capacity of 5 gallons (Table 1). In 29th June, 1987, on the recommendation of George Fennel (the inventor and owner of Steel Shield), the compressor crankcase was drained, and refilled with new 4-GS oil and 16 oz. of Steel Shield EPA (Table 2).

Compared with the initial readings before adding Steel Shield EPA, the compressor showed a consistent 5% reduction in current draw with Steel Shield EPA. This reduction in current draw alone would result in an energy savings of USD 285 per year per compressor.

FIGURE 1 - DUNHAM / BUSH 30 HP 4-CYLINDER REFRIGERATION COMPRESSOR SYSTEM

Date	Ambient Temperature	Suction Pressure	Discharge Pressure	L1 Amps	L2 Amps	L3 Amps
5/18	80°F	23	120	44	45	48
5/19	74°F	23	110	44	44	48
5/20	72°F	23	110	43	43	47
5/21	74°F	24	115	44.5	46	48.3

Table 1- COMPRESSOR READINGS ON 5/18/87 - 5/21/87

- Added 40 oz. of Steel Shield EPA to the crankcase of the compressor based on an estimated system oil capacity of 5 gallons

Date	Ambient Temperature	Suction Pressure	Discharge Pressure	L1 Amps	L2 Amps	L3 Amps
6/29	76°F	23	115	44	46	46
6/30	76°F	23	115	42	44	44
7/01	78°F	23	118	42	43	44

Table 2- COMPRESSOR READINGS ON 6/29/87-7/1/87

- On the recommendation of George Fennel, the compressor crankcase was drained, and refilled with new 4-GS oil and 16 oz. of Steel Shield EPA

1989 - GEORGIA-PACIFIC CORPORATION

In the morning of 30th June, 1986, Steel Shield EPA was added to a A Fuller 1000 Vane Compressor. After one hour, the operating current dropped from 7.4 amps (normal condition) to 6.4 amps which reduced energy consumption by 14%.

FIGURE 2 - FULLER 1000 VANE COMPRESSOR

TABLE 3 (BELOW) - TEST LOGS ON 6/30/89

Equipment:	Fuller 1000 Vane Compressor	
Details:	No previous heat problems	
Before:	7.4 amps average consumption	
Activity:	6/30/89 7:00 a.m.	Added Steel Shield EPA
	6/30/89 8:00 a.m.	Average consumption 6.4 amps, 14% reduction

1989 - JOHN BEATTY REFRIGERATION & HEATING

CASE 1

System Configurations: a 10 ft x 20 ft walk-in freezer; R-502 refrigerant; using a Copeland MRA-0500 compressor, 3-phase, approx. 14 years old; Box temperature approx. -10°F.

Problem & Solution: "One of two condenser fans had quit. Compressor, in high ambient conditions, locked up. By reversing directions several times, we were able to break compressor loose, but unit was drawing almost full locked-rotor current. Oil level OK. As a what-do-we-have-to-lose, Steel Shield EPA was added directly to the crankcase. Power was applied, and the motor speed picked up as amperage steadily dropped. This was in the summer of 1986 and unite is still functinoing."

FIGURE 3 - COPELAND MRA-0500 COMPRESSOR

CASE 2

System Configurations: Hill 8 ft Frozen Meat case, upright; Copeland LAM-0310, 3-phase, semi-hermetic compressor; R-502 refrigerant; normal case temp. -5°F to -15°F; June 1989.

Problem & Solution: "Service call on case-high case temp. Case iced up. Case de-iced by over-night shut-down. Restarted next day; refrigerant and oil levels checked and adjusted if necessary. Compressor noisy. After 2 days, case still would not pull below +20. On third day, Steel Shield EPA was added to crankcase; nothing else was donw (or could be, short of changing out compressor). Customer reported next day that case was below zero. System continues to operate satisfactorily."

FIGURE 4 - COPELAND LAM-0310 COMPRESSOR

CASE 3

System Configurations: 8 ft Produce case; Copeland KAJ-0100, 1-phase; R-12 refrigerant; Case temp. +35°F to +38°F; March 1989.

Problem & Solution: "Compressor would run for only a few seconds before going out on overload, due to being mechanically "tight". Oil level low, but within specs. Steel Shield EPA added. Again, system operating normally."

FIGURE 5 - COPELAND KAJ-0100 COMPRESSOR

CASE 4

System Configurations: 8 ft x 8 ft walk-in Cooler; R-12 refrigerant; Tecumseh ¾ hp. hermetic, 1-phase; Temperature approx. +35°F; July 1987.

Problem & Solution: "Similar to case 3 above in symptoms, and again, same excellent results: Steel Shield EPA added and system operating normally."

FIGURE 6 - TECUMSEH 3/4 HP COMPRESSOR

CASE 5

System Configurations: 42" Belt-drive exhaust fan, propeller type; 1" pillow block bearings.

Problem & Solution: "Because of constant start-stop cycling, and also because of just marginal design, fanshaft bearings were a constant replacement item, requiring replacement about every 12-15 months. A new set of the same type were installed, then lubricated with Steel Shield - Lithi Shield. Same set are still in use after over 2 years, with no visible sign of wear."

FIGURE 7 - PILLOW BLOCK BEARING

CASE 6

Problem & Solution: "Countless sleeve-bearing fan motors, many locked or very near locked; Steel Shield EPA mixed with 150 vis. refrigeration oil in about a 50/50 ratio, added directly to bearings. At least 75% of all motors treated responded. The customer used this mix in the routine maintenance of motors, as well in new replacements."

FIGURE 8 - SLEEVE BEARINGS

"We could go on (and on!), but this should give you a little ideo of how successful Steel Shield has been for the customers in the HVAC service. We have several customers who insist that we add Steel Shield EPA to any equipment they have or add. Almost without exception, they will add and said that they didn't care what Steel Shield costs, just make sure we add it to their unit!"

1993 - MURPHY HEATING & AIR CONDITIONING

On February, 1990, A TRANE 7½ ton rooftop unit, Model No. YCH090A3L0AA, Serial No. D29145142D was installed in Pawn-Pub Cocktail Lounge, 1000 Village Green, Universal City, TX. The air-conditioning equipment was running 16 hours per day.

Steel Shield EPA was added to the system on 5/31/93 and 8/5/93. On 8/23/93, the energy consumption of the system was only 18.8 amps which was much smaller than the previous situation of 22.5 amps. Energy consumption saved over 16%.

Date	Amperage Compressor	Suction Pressure	Liquid Pressure	Ambient Temperature	Indoor Temperature
5/31/93	22.5	68	285	91.1	77
5/31/93	Added 6 oz. Steel Shield EPA				
6/30/93	21.5	61	260	90	69.3
8/05/93	21.8	70	275	92	
8/05/93	Added 6.5 oz. Steel Shield EPA				
8/23/93	18.8	63	280	96	75

Table 4- OPERATING CONDITIONS OF TRANE EQUIPMENT

- On 8/23/93, after Steel Shield EPA was added, current dropped dramatically to only 18.8 amps

2003 - KOWLOON CITY PLAZA

The Kowloon City Plaza have 8 units of Carrier reciprocate chillers, 4 of them are using Steel Shield lubricants. All of the compressors have individual ampere meter to record energy consumption activities. From August, 2003 to January, 2004, the systems operated 12 hours per day.

The engineers of Kowloon City Plaza concluded that Steel Shield dramatically reduced energy consumptions from 5% to 18% which was much more economic than Carrier lubricants. Also, the noise generated during operations reduced significantly.

FIGURE 9 - CARRIER RECIPROCATE CHILLER SYSTEM

FIGURE 10 - KOWLOON CITY PLAZA

25. MAJOR CORPORATE CLIENTS

“Your trust is our motivation.”

25A. THE MOST REPUTED CUSTOMERS

UNITED STATES DEPARTMENT OF DEFENSE

- The most advanced army in the world

SIEMENS

- The largest engineering company in Europe

UNION PACIFIC RAILROAD

- The largest railway company in the US
- New York Stock Exchange No.: UNP

DONG JIANG ENVIRONMENT

- A leading provider for wastes management and environmental services in the PRC
- Hong Kong Stock Exchange No.: 895

26. STEEL SHIELD EVENTS

“Practical experience with STEEL SHIELD lubricants.”

26A. RACING EVENTS SPONSORED BY STEEL SHIELD

61ST MACAU GRAND PRIX 2014

ZHUHAI 3 HOURS MOTORCYCLE COMPETITION 2014

60TH MACAU GRAND PRIX 2013

USA RACING EVENTS

26B. STEEL SHIELD REMARKABLE EXHIBITIONS

HONG KONG MOTORCYCLE SHOW 2014

HONG KONG MOTORCYCLE SHOW 2013

GUANGZHOU LUBRICSHOW 2013

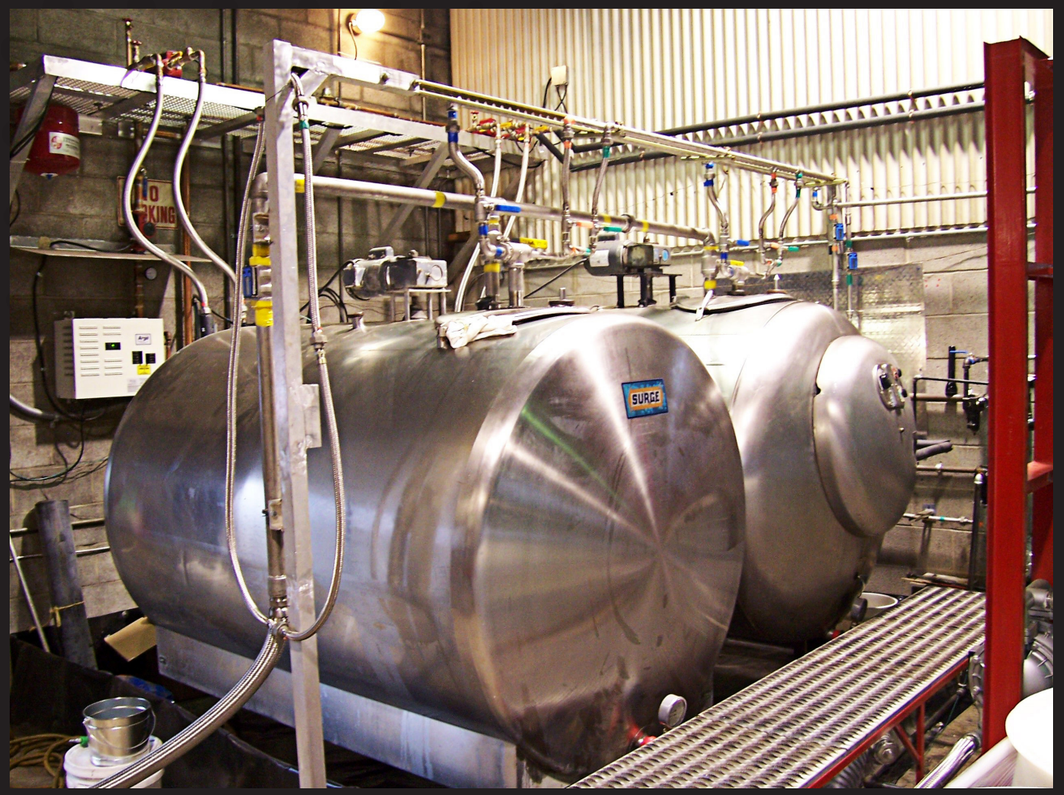
QINGDAO LUBRICANT SHOW 2013

27. STEEL SHIELD OFFICES & FACILITIES

“Consolidated manufacturing plant of ABF Technology and management offices enabled STEEL SHIELD to expand the service networks to differenct sectors all over the world.”

27A. STEEL SHIELD TECHNOLOGIES US HEADQUARTER

THE BASE OF ABF TECHNOLOGIES

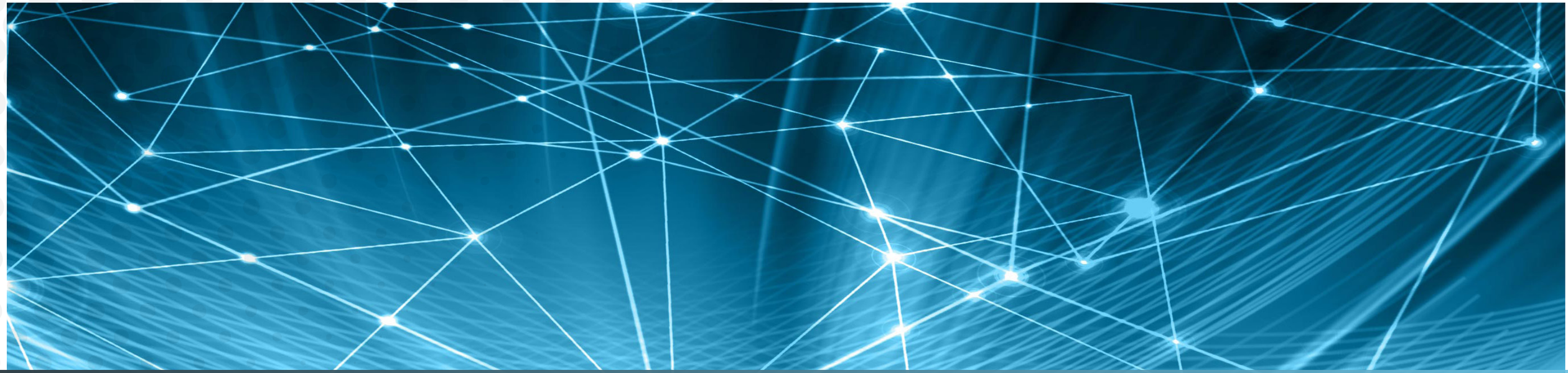


27B. STEEL SHIELD TECHNOLOGIES H.K. OFFICE

HEADQUARTER OF ASIA PACIFIC NETWORK

28. STEEL SHIELD WEBSITE & VIDEOS

“Up-to-Date information and demonstrations are available through mouse clicks.”



STEEL SHIELD VIDEOS PAGE

www.steelshieldtech.com.hk/Media_steel_shield_videos.html

STEEL SHIELD VIDEOS DESCRIPTIONS

STEEL SHIELD TECHNOLOGY INTRODUCTION

- How ABF Technology works?
- What benefits can you gain from Steel Shield?

STEEL SHIELD TECHNOLOGY INTRODUCTION (CHINESE)

- How ABF Technology works?
- What benefits can you gain from Steel Shield?
- Chinese dialogue and subtitles

TIMKEN TEST DEMONSTRATION

- How Steel Shield lubricants defeat other preminum lubricants in the market?
- How ABF Technology dramatically reduce metal wear, maintenance costs and energy?

GUANGDONG SPORT TV INTERVIEW

- Steel Shield being recongized by the Chinese customers and market

STEEL SHIELD MOTORHEAD GARAGE COMMERCIAL

- The original US promotion show introducing Steel Shield products

STEEL SHIELD TECH FULL FEATURE ON MOTORHEAD GARAGE

- The original US video showing how Steel Shield lubricants with ABF Technology enhance engine performance

STEEL SHIELD TECHNOLOGIES

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Not Just Oil... IT'S TECHNOLOGY

HIGH PERFORMANCE IONIC CHARGE