Steel Shield Technologies

Not All Oil is Same !

"34~57% Savings in Maintenance & Repair!"

Serving the Industry since 1985

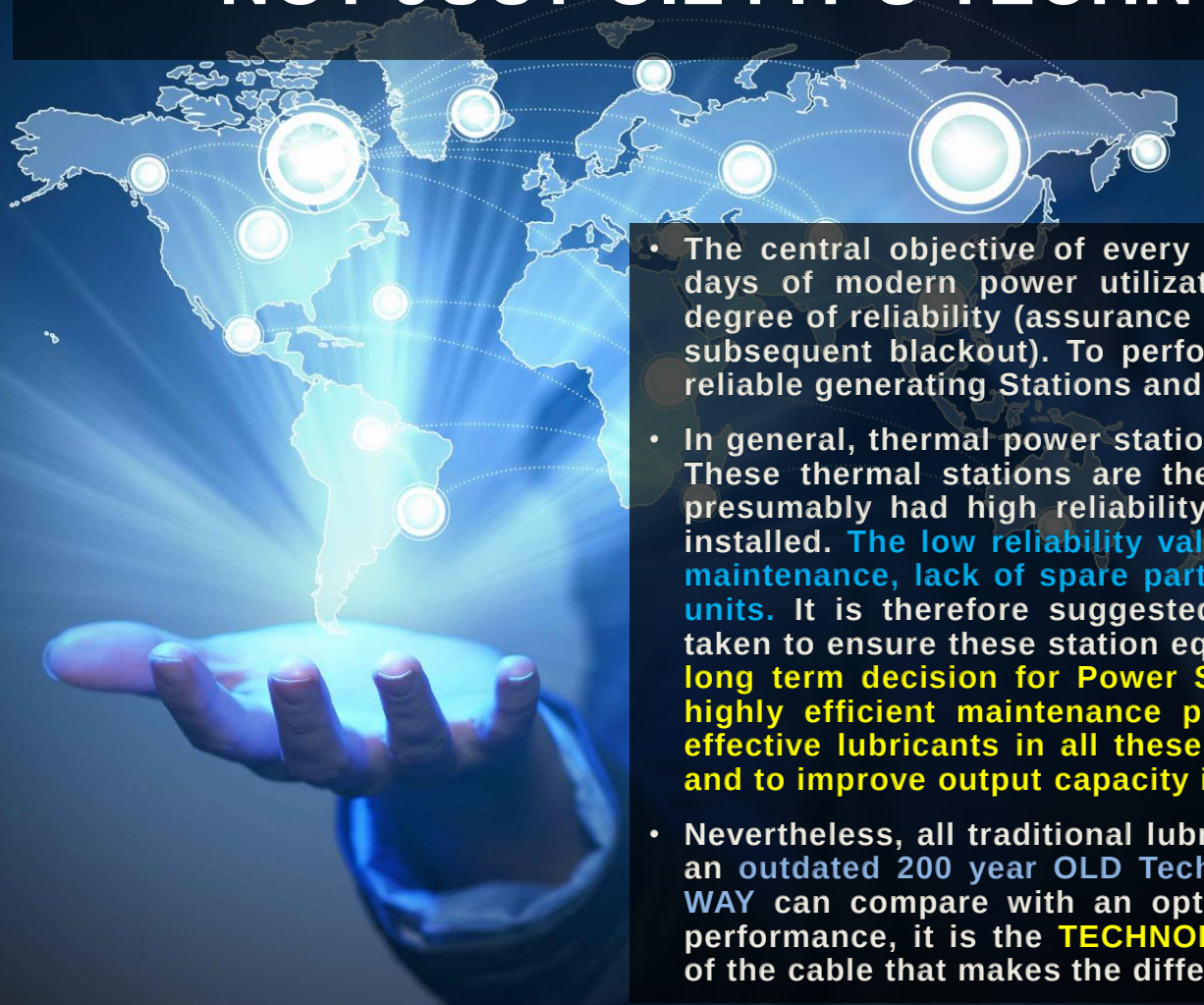
Power Plant Application

GAS Turbine

GAS Engine

ABF Technology Enlightens the World of Lubrication

NOT JUST OIL ! IT'S TECHNOLOGY !

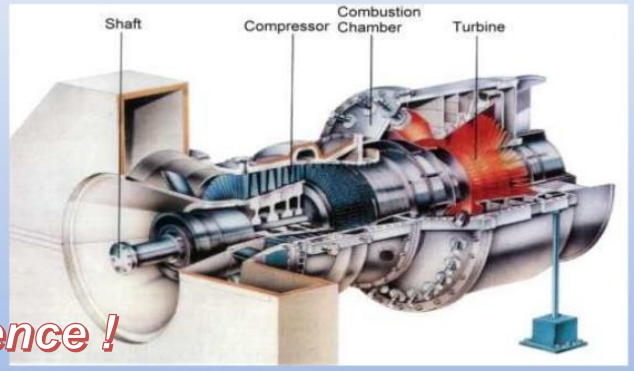


- The central objective of every power utility company in these days of modern power utilization is to achieve a very high degree of reliability (assurance against widespread outages and subsequent blackout). To perform reliably well, it should have reliable generating Stations and units.
- In general, thermal power stations have relatively low reliability. These thermal stations are the premier power stations. They presumably had high reliability figures when they were newly installed. The low reliability value is mainly as a result of poor maintenance, lack of spare parts for repair of the broken down units. It is therefore suggested that absolute care should be taken to ensure these station equipment are in its best status. A long term decision for Power Stations should be to enforce a highly efficient maintenance program whereas the use of an effective lubricants in all these equipment to reduce downtime and to improve output capacity is VITAL.
- Nevertheless, all traditional lubricants are made on the basis of an outdated 200 year OLD Technology ! A copper cable in NO WAY can compare with an optic cable in signal transmission performance, it is the TECHNOLOGY not the material structure of the cable that makes the difference !

STEEL SHIELD, Not Just Oil !
It's the ABF TECHNOLOGY that makes the difference !

GAS TURBINE POWER PLANT

- A.) Working Principle
- 1. Air is compressed to high pressure by a compressor.
- 2. Compressed air mix with fuel which can be oil, gas and coal in a combustion chamber and ignited.
- 3. Hot gases are emitted, which spin the turbine wheels.
- B.) Components
- Gas turbines in general are made up of three main parts;
- 1. Air Compressor
- 2. Combustion Chamber
- 3. Turbine



STEEL SHIELD, Not Just Oil !
It's the ABF TECHNOLOGY that makes the difference !

GAS TURBINE POWER PLANT

- Air Compressor
- The Air Compressor and Turbine are on a common shaft, with the Combustion Chamber between them.
- Gas Turbines require a starting motor to start.
- The Air Compressor sucks in air and compresses to increase air pressure.
- Combustion Chamber
- In the Combustion Chamber, the compressed air mix with fuel and is burnt.
- The greater the pressure of air, the better the fuel air mixture burns.
- Usually liquid fuel is used, but gaseous fuel, natural gas or gas produced by gasification of a solid fuel may also be used.
- Turbine
- Hot gases move through a multistage gas turbine.
- Same like steam turbine, there are also stationary and moving blades.
- The stationary blades guide the moving gases to the rotor blades and adjust velocity
- The shaft of the turbine is coupled to a generator (used for peak load and as stand-by unit).

STEEL SHIELD, Not Just Oil !
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GAS TURBINE POWER PLANT

- C.) Disadvantage
- 1. Low efficiency of 21~45%. About 55~79% of the power developed is used to drive the compressor.
- 2. Running speed in the range of 40,000~100,000 rpm and temperature 1100~1260 degree C, thus special alloys and metals have to be used for the various parts of the turbine.
- 3. High frequency noise from the compressor when in operation.

- STEEL SHIELD ENHANCES SYSTEM EFFICIENCY !
- STEEL SHIELD REDUCES SYSTEM WORKING TEMPERATURE !
- STEEL SHIELD HELPS REDUCING MACHINE NOISE !
- STEEL SHIELD ELIMINATES COLD START DAMAGE !
- STEEL SHIELD EXTENDS THE LIFE OF METAL PARTS !
- STEEL SHIELD MINIMIZES DEBRIS !
- STEEL SHIELD SAVES MAINTENANCE & REPAIR COSTS !

STEEL SHIELD, Not Just Oil !
It's the ABF TECHNOLOGY that makes the difference !

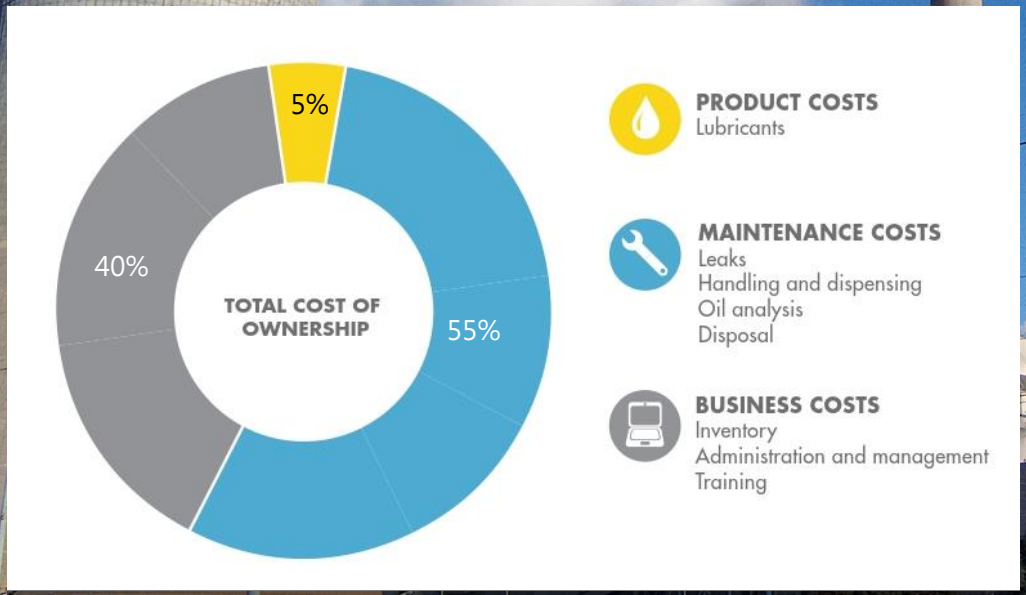
CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 1 – GENERAL COST REDUCTIONS CALCULATION BY STEEL SHIELD LUBRICANTS

Lubricants: SMALL Investment, HIGH Return !

Buying low-quality lubricants can be a false economy. Lubricant costs are typically less than 5% of a power generation business' total maintenance budget. We focus on providing performance products that can help to reduce maintenance requirements and increase reliability, and services that are designed to improve maintenance and business practices, and thus lower your overall costs.



Cost distributions of power plant operations

A typical biogas generator

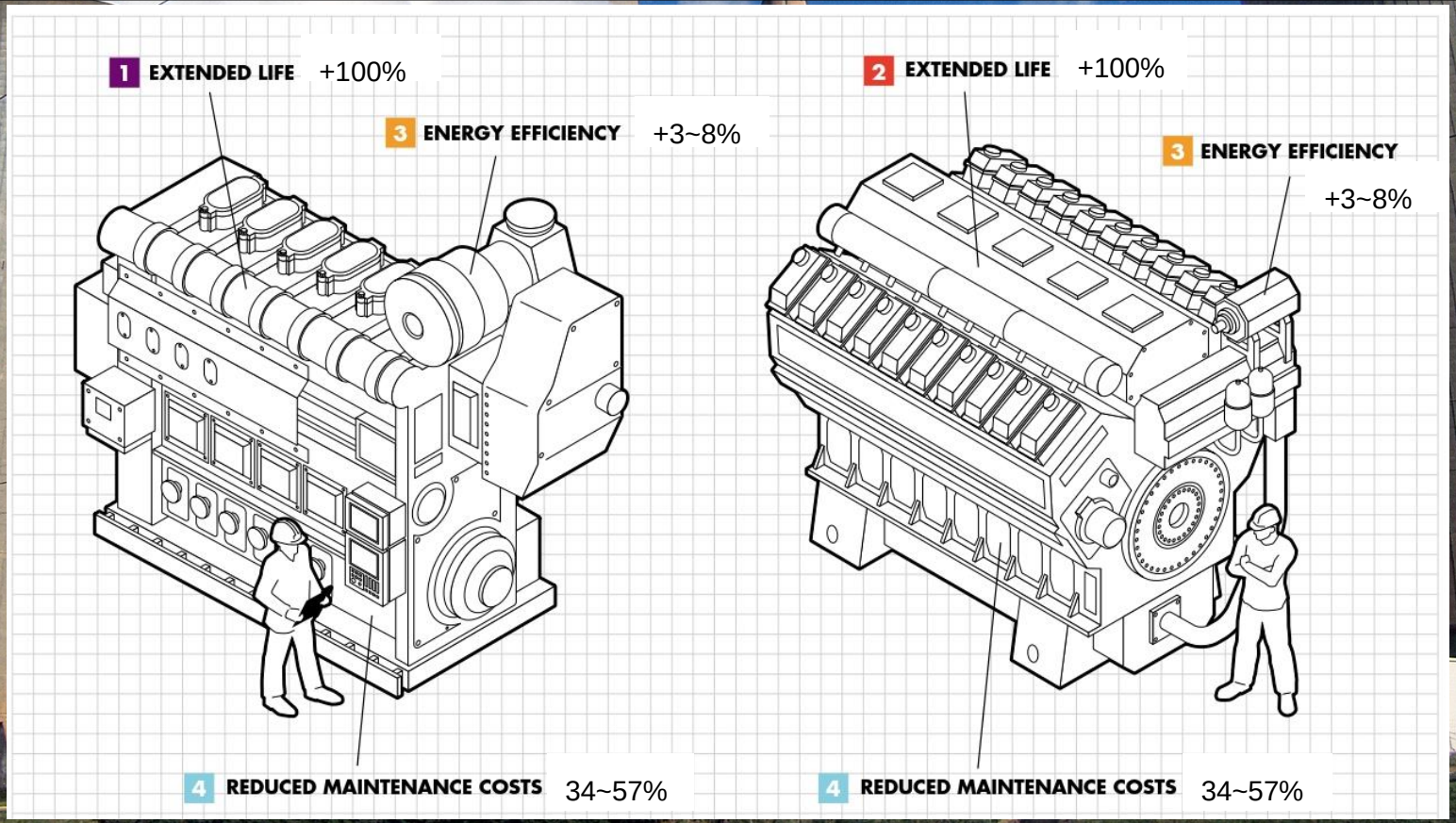
CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 1 – GENERAL COST REDUCTIONS CALCULATION BY STEEL SHIELD LUBRICANTS

Where Lubricants Can Add Value?

Some examples of ways that lubricants can help your operation to run more efficiently:



CASE STUDY – LANDFILL GAS POWER PLANT

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APPROACH 1 – GENERAL COST REDUCTIONS CALCULATION BY STEEL SHIELD LUBRICANTS

- According to the Total Cost of Ownership of Power Plant Generators (previous page), Lubricants Cost is about 5%, Maintenance Cost is about 55%.
- From the information provided by The Shenzhen Dongjiang Environmental Company Limited, it reveals that the total volume to purchase Caltex HDAX5500 LFG SAE40 lubricant is:
  30 drums x 200 liter x 12 times = 72,000 Litre
- The total cost to purchase Caltex HDAX5500 LFG SAE40 lubricant (tax included) is:
  25 RMB/Liter x 72,000 Liter = 1,800,000.00 RMB
- The Total Cost of Ownership can be calculated as (with 5% lubricant cost):
  1,800,000.00 RMB ÷ 5% = 36,000,000.00 RMB
- The total annual maintenance cost of Dongjiang is:
  36,000,000.00 RMB x 55% = 19,800,000.00 RMB
- With the applications of Steel Shield lubricants, the yearly Maintenance Cost of machines can be reduced by 34% to 57%, which means: 6,732,000 RMB to 11,286,000.00 RMB
- The percentage reduction in Total Cost of Ownership by Steel Shield lubricants (%)
  = (Total Maintenance Cost reduced + Lubricant Cost reduced) ÷ present Total Cost of Ownership x 100%
- *Minimum= { 6,732,000 RMB + 1,440,580 (Steel Shield No.3 Gas Engine Oil vs Caltex) } ÷ 36,000,000 X 100% = 22.70%
- *Maximum= { RMB 11,286,000 + 11,332,904 (Steel Shield No.2 Gas Engine Oil vs Caltex) } ÷ 36,000,000 X 100% = 62.83%

CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

Basic Data of Qing Shui He Xia Ping Biogas Power Plant

EXPLANATIONS

1. Qing Shui He Xia Ping Biogas Power Plant have 4 types of generators with No. M1, M2, M3 and M4.
2. The routine used lubricants analysis is about 200 hours for the first time (for new lubricants), and then 500 hours for the second time.
3. The downtime cost includes the revenue lost due to the suspension of electricity generations.
4. MAJOR Maintenance is the full functional examinations of generators. It is not included in the current cost analysis (for reference only).
5. The variable “A” is a real number, it is used to make assumptions for Maintenance & Part Cost because this cost is not provided by the Qing Shui He Xia Ping Biogas Power Plant.

Generator Data				
No.	Model	Quantity	Power (kW)	Total Power (kW)
M1	J320GSB 21 (GE Jenbacher)	1	1063	1063
M2	J320GSC 21 (GE Jenbacher)	8	1063	8504
M3	J320GSC 121 (GE Jenbacher)	3	1063	3189
M4	G3615 (Caterpillar)	2	800	1600
	Total	14		14356

The Present Operation Data			
Lubricant Consumption	6000	litre / month	
Lubricant Refill	1	times / month	12 times / year
Idle Time Before the Next MAJOR Maintenance	60000	hr	
Idle Time Before the Next Regular Maintenance	2000	*to*	4000 hr
Duration of Maintenance (Each Machine)	3	*to*	5 days
Downtime Cost (Each Machine)	18000	RMB / day	
Maintenance & Parts Cost (Entire Plant)	*A*	RMB / year	

CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

Improved Data by Steel Shield Lubricants

EXPLANATIONS

With Steel Shield lubricants, the following data can be improved:

1. The Idle Time Before the Next Regular Maintenance: after Steel Shield is refilled 2 to 5 times, it is expected that the idle time can be extended from 4000 to 6000 hours.
2. The Lubricant Refill times can be reduced from 8 to 6 times annually.
3. The Maintenance & Part Costs can be dramatically decreased to 0.5A (only 50% of the original cost) annually (where A is a real number) due to the extended components life by ABF Technology of Steel Shield lubricants.

Other possible cost reductions by the application of Steel Shield but not included in the current calculation:

1. Labor cost reduction: due to the reduction of unnecessary maintenance, reductions in overtime payments and reduction in employing temporary staffs

The Improved Maintenance Cost With the Application of Steel Shield			
Idle Time Before the Next Regular Maintenance (after refilled 2~5 times)	4000	*to*	6000 hr
Reduction in Lubricants Refills (%)	33	*to*	50 %
Lubricant Refill	8	*to*	6 times / year
Parts Life Extended 2 Times and More, Maintenance Reduction (%)	50 %		
Maintenance & Part Costs (Entire Power Plant)	0.5 *A*		RMB / year

CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

	EQUATIONS
1	$Total\ Lubricant\ Cost = Lubricant\ Cost\ (RMB\ /Litre) \times Lubricant\ Comsumption\ (Liter\ /Month) \times Lubricant\ Renew\ (Times\ /\ Year)$ Assume that the power plant refill Caltex once per month. With the application of Steel Shield, the refill time can be extended to 45 to 60 days, i.e. 8 to 6 times per year. The minimum and maximum cost of Caltex are both based on the fact that the lubricants are being refilled 12 time per year. The minimum and maximum cost of Steel Shield lubricant are based on the fact that the lubricants are being refilled 6 times and 8 times per year respectively.
2	$\text{Power Generator Maintenance Cost} = \frac{Duration\ Per\ Maintenance\ (day) \times Downtime\ Cost\ (RMB) \times 365\ days \times 24\ hr}{Idle\ Time\ for\ the\ Next\ Regular\ Maintenance\ (hr)}$ Example: To calculate the Minimum Maintenance Cost of Caltex, the maximum Idle Time for the Next Regular Maintenance (i.e. 4000 hr) and the minimum Duration Per Maintenance (i.e. 3 days) must be used. Alternatively, the Maximum Maintenance Cost of Caltex is calculated be the minimum Idle Time for the Next Regular Maintenance (i.e. 2000 hr) and the maximum Duration Per Maintenance (i.e. 35 days). The same method is applied when the Caltex is replaced by Steel Shield.
3	$TOTAL\ COST\ (Minimum) = Total\ Lubricant\ Cost\ (Minimum) + Total\ Maintenance\ Cost\ (Minimum) + Maintenance\ \&\ Parts\ Costs$ $TOTAL\ COST\ (Maximum) = Total\ Lubricant\ Cost\ (Maximum) + Total\ Maintenance\ Cost\ (Maximum) + Maintenance\ \&\ Parts\ Costs$
4	**Assumption of the present Maintenance & Part Costs:** Due to the absent of real data, the Maintenance & Part Costs is assumed to be 0 to 1,000,000 per year, and the analysis is performed by using these range of data discretely. **Assumption of the present Maintenance & Part Costs When Steel Shield is applied:** Normally, with the applications of Steel Shield, maintenance cost can be reduced by 30~65%. The minimum and maximum TOTAL COST are based on these assumptions, therefore, the change of TOTAL COST can be revealed when the Maintenance & Part Costs changes from 0 to 1,000,000 RMB.
5	$TOTAL\ COST\ Reduction\ (Minimum), \% = \frac{TOTAL\ COST\ After\ Steel\ Shield\ Applied\ (Maximum) - TOTAL\ COST\ When\ Caltex\ Applied\ (Minmum)}{TOTAL\ COST\ When\ Caltex\ Applied\ (Minmum)} \times 100\%$ $TOTAL\ COST\ Reduction\ (Maximum), \% = \frac{TOTAL\ COST\ After\ Steel\ Shield\ Applied\ (Minimum) - TOTAL\ COST\ When\ Caltex\ Applied\ (Maxmum)}{TOTAL\ COST\ When\ Caltex\ Applied\ (Maxmum)} \times 100\%$ From the above equations, the minimum and maximum reductions of TOTAL COST after Steel Shield is applied can be calculated respectively (in %).

CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

ANNUAL COST ANALYSIS (RMB/YEAR)

			The Present Situation		With the Application of Steel Shield with ABF Technologies							
			Caltex HDAX5500 LFG SAE40		SST ECI GECAT No.1 HD-AP Gas Engine Oil SAE 30/40 0.5% Ash		SST ECI GECAT No.2 LD-TV Gas Engine Oils SAE 30/40 0.5% Ash		SST ECI GECAT No.3 HD-AP / ST Gas Engine Oils SAE 40 0.7% Ash		SST ECI GECAT No.5 ND-AP MA-S3 Gas Engine Oils SAE 40 0.7% Ash	
		Lubricant Costs, Tax Not Included (RMB / litre)	21.75		27.47		21.01		30.48		21.57	
			Each Generator	All Generators	Each Generator	All Generators	Each Generator	All Generators	Each Generator	All Generators	Each Generator	All Generators
		Lubricant Cost (Minimum)	1,566,000	21,924,000	988,934	13,845,082	756,507	10,591,096	1,097,326	15,362,565	776,621	10,872,691
		Lubricant Cost (Maximum)	1,566,000	21,924,000	1,318,579	18,460,109	1,008,676	14,121,462	1,463,101	20,483,420	1,035,494	14,496,922
		Maintenance Cost (Minimum)	118,260	1,655,640	78,840	1,103,760	78,840	1,103,760	78,840	1,103,760	78,840	1,103,760
		Maintenance Cost (Maximum)	394,200	5,518,800	197,100	2,759,400	197,100	2,759,400	197,100	2,759,400	197,100	2,759,400
		Maintenance & Parts Costs	A / 14	A	0.5 A / 14	0.5 A	0.5 A / 14	0.5 A	0.5 A / 14	0.5 A	0.5 A / 14	0.5 A
		TOTAL COST (Minimum) Equation	1684260 + A / 14	23579640 + A	1067775 + 0.5 A / 14	14948842 + 0.5 A	835347 + 0.5 A / 14	11694857 + 0.5 A	1176167 + 0.5 A / 14	16466326 + 0.5 A	855461 + 0.5 A / 14	11976452 + 0.5 A
		TOTAL COST (Maximum) Equation	1960200 + A / 14	27442800 + A	1515680 + 0.5 A / 14	21219509 + 0.5 A	1205776 + 0.5 A / 14	16880862 + 0.5 A	1660202 + 0.5 A / 14	23242821 + 0.5 A	1232595 + 0.5 A / 14	17256322 + 0.5 A
	Assumption of the present Maintenance & Part Costs, A (RMB / yr)	Assumption of the present Maintenance & Part Costs When Steel Shield is applied, 0.5A (RMB / yr)										
TOTAL COST (Minimum)	0	0	1,684,260	23,579,640	1,067,774	14,948,842	835,347	11,694,856	1,176,166	16,466,325	855,461	11,976,451
	100,000	50,000	1,691,403	23,679,640	1,071,346	14,998,842	838,918	11,744,856	1,179,738	16,516,325	859,032	12,026,451
	200,000	100,000	1,698,546	23,779,640	1,074,917	15,048,842	842,490	11,794,856	1,183,309	16,566,325	862,604	12,076,451
	300,000	150,000	1,705,689	23,879,640	1,078,489	15,098,842	846,061	11,844,856	1,186,880	16,616,325	866,175	12,126,451
	400,000	200,000	1,712,831	23,979,640	1,082,060	15,148,842	849,633	11,894,856	1,190,452	16,666,325	869,747	12,176,451
	500,000	250,000	1,719,974	24,079,640	1,085,632	15,198,842	853,204	11,944,856	1,194,023	16,716,325	873,318	12,226,451
	600,000	300,000	1,727,117	24,179,640	1,089,203	15,248,842	856,775	11,994,856	1,197,595	16,766,325	876,889	12,276,451
	700,000	350,000	1,734,260	24,279,640	1,092,774	15,298,842	860,347	12,044,856	1,201,166	16,816,325	880,461	12,326,451
	800,000	400,000	1,741,403	24,379,640	1,096,346	15,348,842	863,918	12,094,856	1,204,738	16,866,325	884,032	12,376,451
	900,000	450,000	1,748,546	24,479,640	1,099,917	15,398,842	867,490	12,144,856	1,208,309	16,916,325	887,604	12,426,451
	1,000,000	500,000	1,755,689	24,579,640	1,103,489	15,448,842	871,061	12,194,856	1,211,880	16,966,325	891,175	12,476,451
TOTAL COST (Maximum)	0	0	1,960,200	27,442,800	1,515,679	21,219,509	1,205,776	16,880,862	1,660,201	23,242,820	1,232,594	17,256,322
	100,000	50,000	1,967,343	27,542,800	1,519,251	21,269,509	1,209,347	16,930,862	1,663,773	23,292,820	1,236,166	17,306,322
	200,000	100,000	1,974,486	27,642,800	1,522,822	21,319,509	1,212,919	16,980,862	1,667,344	23,342,820	1,239,737	17,356,322
	300,000	150,000	1,981,629	27,742,800	1,526,393	21,369,509	1,216,490	17,030,862	1,670,916	23,392,820	1,243,309	17,406,322
	400,000	200,000	1,988,771	27,842,800	1,529,965	21,419,509	1,220,062	17,080,862	1,674,487	23,442,820	1,246,880	17,456,322
	500,000	250,000	1,995,914	27,942,800	1,533,536	21,469,509	1,223,633	17,130,862	1,678,059	23,492,820	1,250,452	17,506,322
	600,000	300,000	2,003,057	28,042,800	1,537,108	21,519,509	1,227,204	17,180,862	1,681,630	23,542,820	1,254,023	17,556,322
	700,000	350,000	2,010,200	28,142,800	1,540,679	21,569,509	1,230,776	17,230,862	1,685,201	23,592,820	1,257,594	17,606,322
	800,000	400,000	2,017,343	28,242,800	1,544,251	21,619,509	1,234,347	17,280,862	1,688,773	23,642,820	1,261,166	17,656,322
	900,000	450,000	2,024,486	28,342,800	1,547,822	21,669,509	1,237,919	17,330,862	1,692,344	23,692,820	1,264,737	17,706,322
	1,000,000	500,000	2,031,629	28,442,800	1,551,393	21,719,509	1,241,490	17,380,862	1,695,916	23,742,820	1,268,309	17,756,322
TOTAL COST Reduction (Minimum), %	0	0			10		28		1		27	
	100,000	50,000			10		29		2		27	
	200,000	100,000			10		29		2		27	
	300,000	150,000			11		29		2		27	
	400,000	200,000			11		29		2		27	
	500,000	250,000			11		29		2		27	
	600,000	300,000			11		29		3		27	
	700,000	350,000			11		29		3		27	
	800,000	400,000			11		29		3		28	
	900,000	450,000			11		29		3		28	
	1,000,000	500,000			12		29		3		28	
TOTAL COST Reduction (Maximum), %	0	0			46		57		40		56	
	100,000	50,000			46		57		40		56	
	200,000	100,000			46		57		40		56	
	300,000	150,000			46		57		40		56	
	400,000	200,000			46		57		40		56	
	500,000	250,000			46		57		40		56	
	600,000	300,000			46		57		40		56	
	700,000	350,000			46		57		40		56	
	800,000	400,000			46		57		40		56	
	900,000	450,000			46		57		40		56	
	1,000,000	500,000			46		57		40		56	

CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

EXPLANATIONS OF THE PREVIOUS COST REDUCTION ANALYSIS

1. Under the column "Assumption of the present Maintenance & Part Costs, A (RMB / yr)", A is the assumed annual cost. For example, if the assumed annual cost is 200,000 RMB, then the annual TOTAL COST (minimum) of Caltex HDAX5500 LFG SAE40 is 23,779,640 RMB and the corresponding maximum TOTAL COST is 27,642,800 RMB.

2. For Steel Shield lubricants, it is expected that the Assumption of the present Maintenance & Part Costs can be reduced by half. Therefore, the "Assumption of the present Maintenance & Part Costs When Steel Shield is applied, 0.5A (RMB / yr)" is A/2. For example, if the assumed annual cost is 200,000 RMB, then this cost is reduced by half which is only 100,000 RMB. The annual TOTAL COST (minimum) of SST ECI GECAT No.1 HD-AP Gas Engine Oil SAE 30/40 0.5% Ash is then 15,048,842 RMB and the corresponding maximum TOTAL COST is 21,319,509 RMB.

3. "The TOTAL COST Reduction (Minimum), %" and "The TOTAL COST Reduction (Maximum), %" columns are the expected percentage changes when Steel Shield is applied.
For example, in order to calculate "The TOTAL COST Reduction (Maximum), %" of SST ECI GECAT No.1 HD-AP Gas Engine Oil SAE 30/40 0.5% Ash if the "Assumption of the present Maintenance & Part Costs", A is 1,000,000, the "TOTAL COST (Minimum)" of SST ECI GECAT No.1 HD-AP Gas Engine Oil SAE 30/40 0.5% Ash and the "TOTAL COST (Maximum)" of Caltex HDAX5500 LFG SAE40 should be used in the calculation. The detail is as follow:

The TOTAL COST Reduction (Maximum),%

$$=\frac{(\text{Min.TOTAL COST of Steel Shield})-(\text{Max.TOTAL COST of Caltex})}{\text{Max. TOTAL COST of Caltex}}\times 100\%$$

$$=\frac{12{,}194{,}856-28{,}442{,}800}{28{,}442{,}800}\times 100\%$$

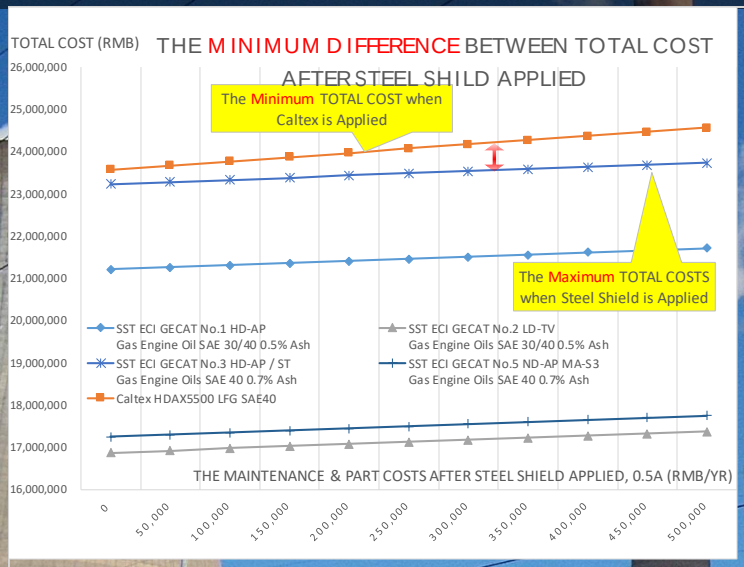
=57% Reduction

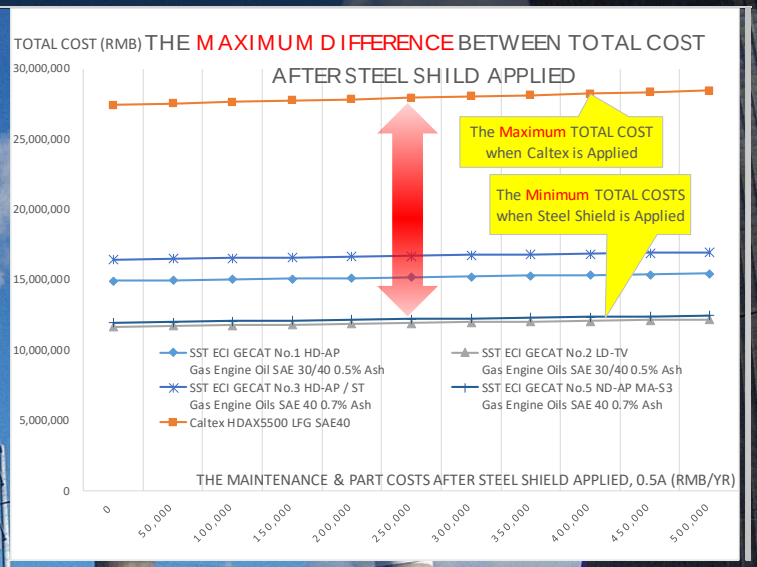
CASE STUDY – LANDFILL GAS POWER PLANT

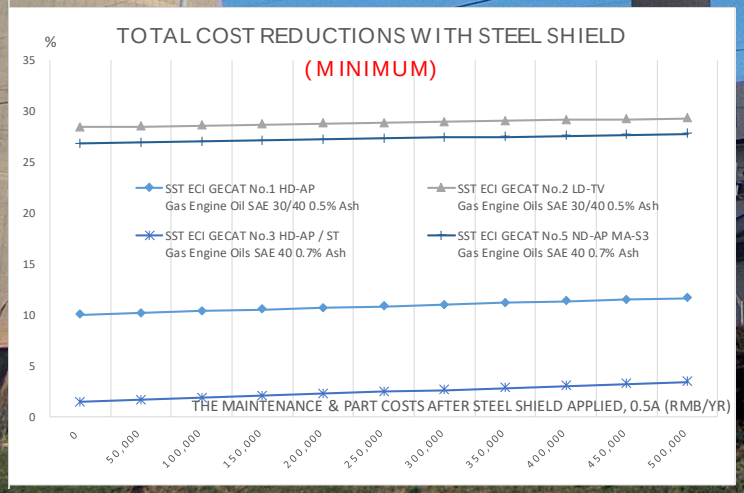
Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

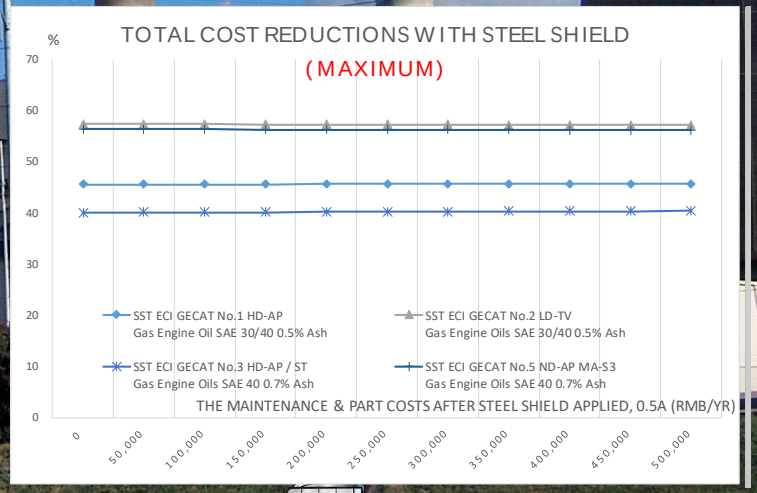
APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD

Improved Data by Steel Shield Lubricants





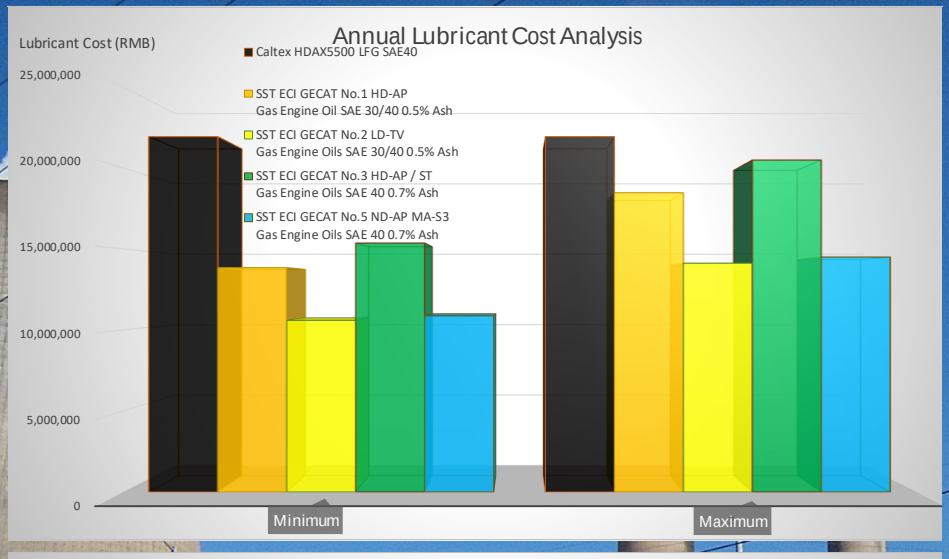


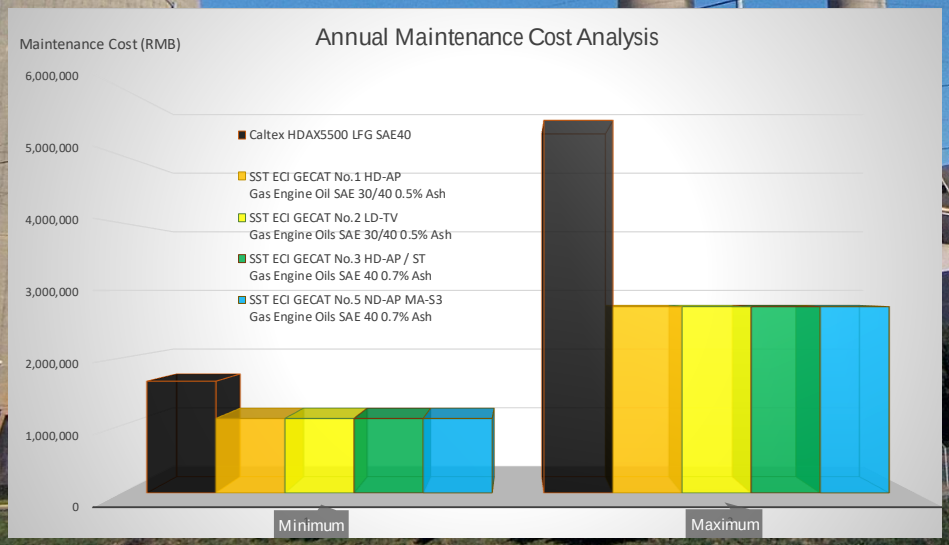


CASE STUDY – LANDFILL GAS POWER PLANT

Qing Shui He Xia Ping Biogas Power Plant – SHENZHEN, CHINA.

APPROACH 2 – COST ANALYSIS OF DONGJIANG POWER PLANT BY STEEL SHIELD





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Improved Data by Steel Shield Lubricants

Applying Steel Shield lubricants:

1. The annual Lubricant Cost with Steel Shield can be reduced by 10.6 million RMB, which is a substantial savings of 51.7%.
2. The annual Maintenance Cost can be as low as 1.2 million RMB, which is 80% of the original.
3. With the “Assumption of the present Maintenance & Part Costs”, the minimum TOTAL COST can be reduced to 11.7 million RMB, which is a COST SAVINGS of 59%.
4. STEEL SHIELD comparing to the other make of lubricants can help reducing projected maintenance costs dramatically.

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.

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1. THE CORPORATION & FACILITIES

Steel Shield Technologies Inc. (SST) with it's 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 for motor racing and industrial applications invented the unique ABF Formula – a New Technology in lubrications. Since then Dr. Fennell has been quickly earning his fame in the lubricants society and the product has become a must for the combat units of the US Armed Forces. SST is the only lubricant product in the World to guarantee firearms of any kind free from clogging barrels, feeds and magazines.

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 was incorporated in 1996 in Hong Kong to provide distribution and technical support for the entire Asia-Pacific Rim.

2. 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.

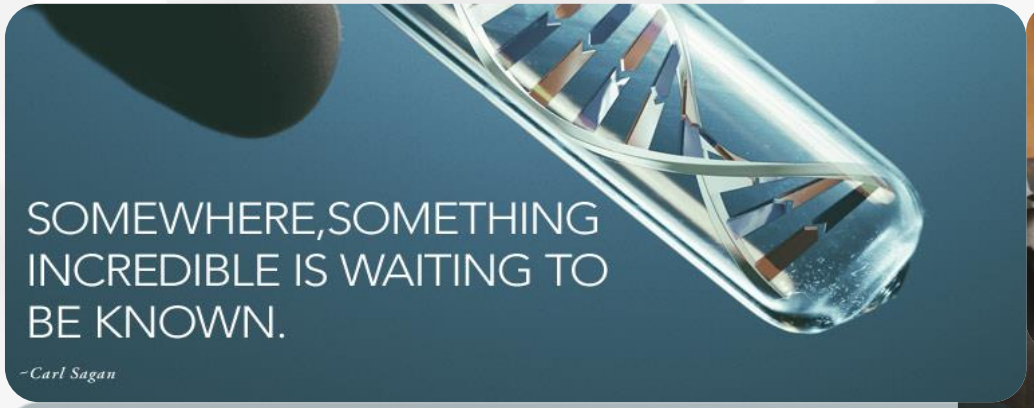
3. THE BIRTH OF STEEL SHIELD TECHNOLOGY

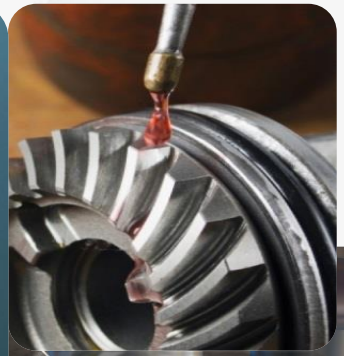
- During World War II, the German Science and Technology Research Institute was commissioned to develop a new lubricant technology in meeting the stringent demand for heavy duty military application such as artillery, armored vehicles, tanks, battleships and fighter-aircrafts to avail them in performing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

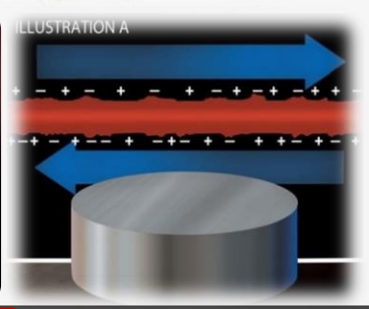
- The scientists proposed the concept of Zero friction, i.e. Farady's Law Like-Charge-Repel.

- 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.







Steel Shield –
Bio-Organo Lubrication Technology

4. 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.

Ethylene Oxide Reagent

$$\begin{array}{c} O \\ / \quad \backslash \\ n\ H2C - CH2\ n \end{array}$$

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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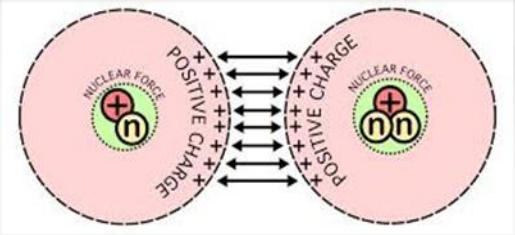
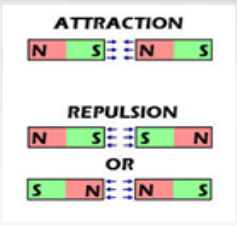
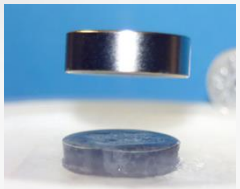
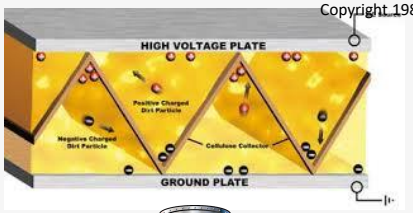
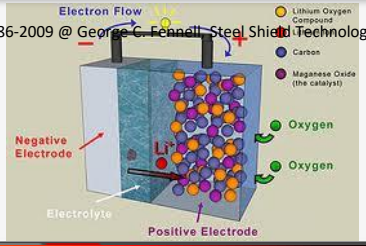










5. HOW ABF WORKS

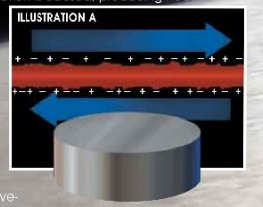
Steel Shield Technologies Has Redefined Lubrication.

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.

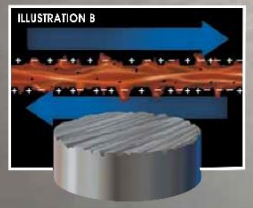
ILLUSTRATION A



Normal Lubricants Help

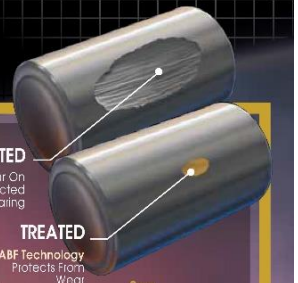
All lubricants help to slow this process to different degrees. **Illustration B** shows the results after a period of time of use of a typical oil lubricant. The constant friction and electro-magnetic interaction has caused the weakened metal to break off or chip away creating metallic debris in the 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.



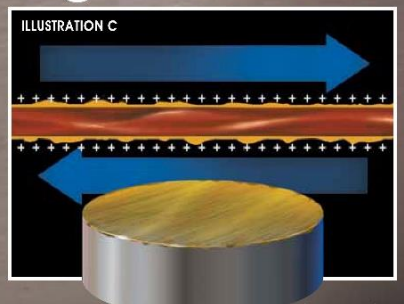
See Extreme Condition Lubrication Test At www.steelshieldtech.com

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 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.**

ILLUSTRATION C



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

6. MAJOR BREAKTHROUGHS IN LUBRICATION TECHNOLOGY

1. Virtual Zero Friction - RCB Ionic levitation

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

2. Dynamic Heat Transfer

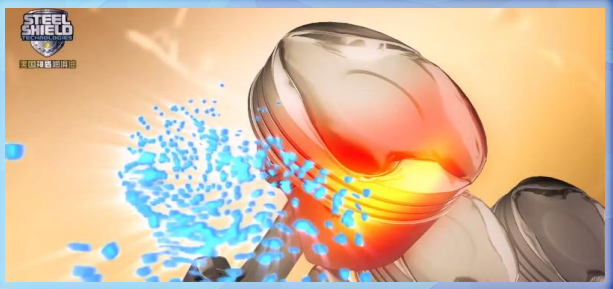
Lubricant accumulates at the hot spot automatically

3. Non Corrosive Cleansing

Metal sludge repelled via induction and removed

4. Metal Surface Re-hardening

From Shear Friction to Surface Lapping



5. Eliminate System Dysfunction

Not Just Oil, It's Technology

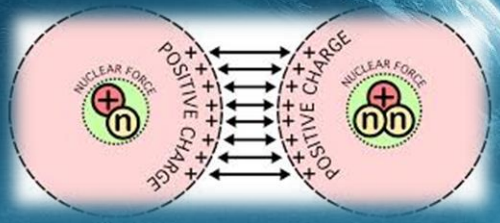
7. RCB Electrochemical Ionization

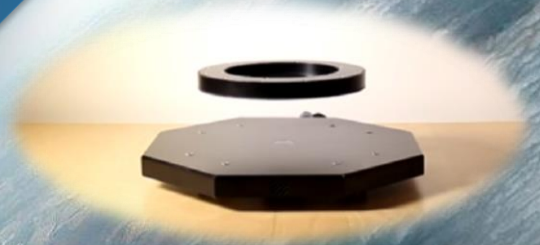
Metal Surface Positively Charged

Metals Repel Each Other

Magnetic Levitation

Near Zero Friction



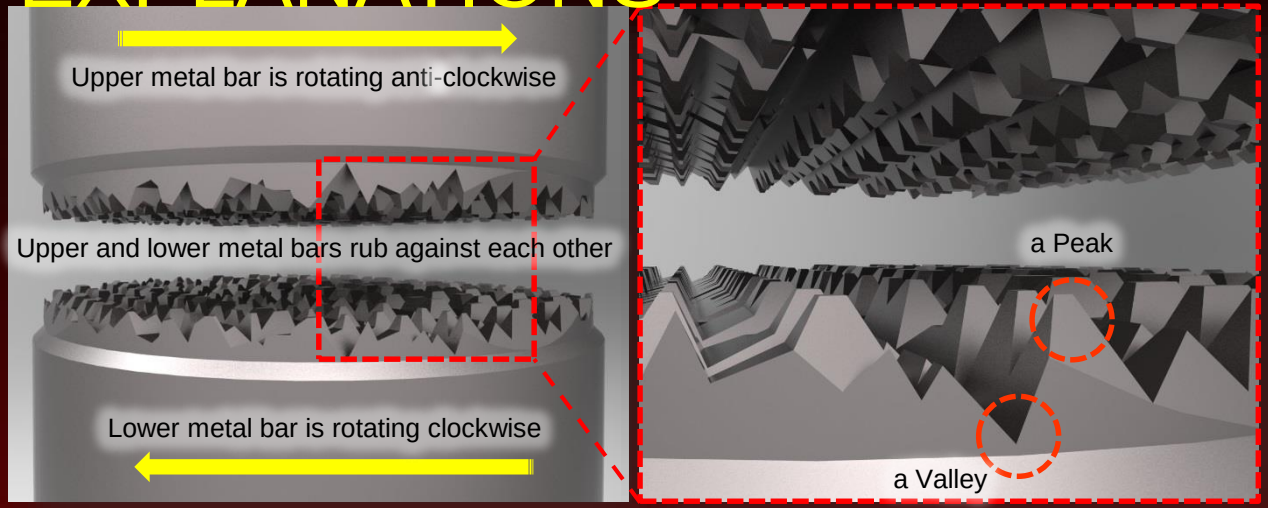


Positively Charged Metal Surface Repel Each Other

8. ABF TECHNOLOGY DETAILED EXPLANATIONS

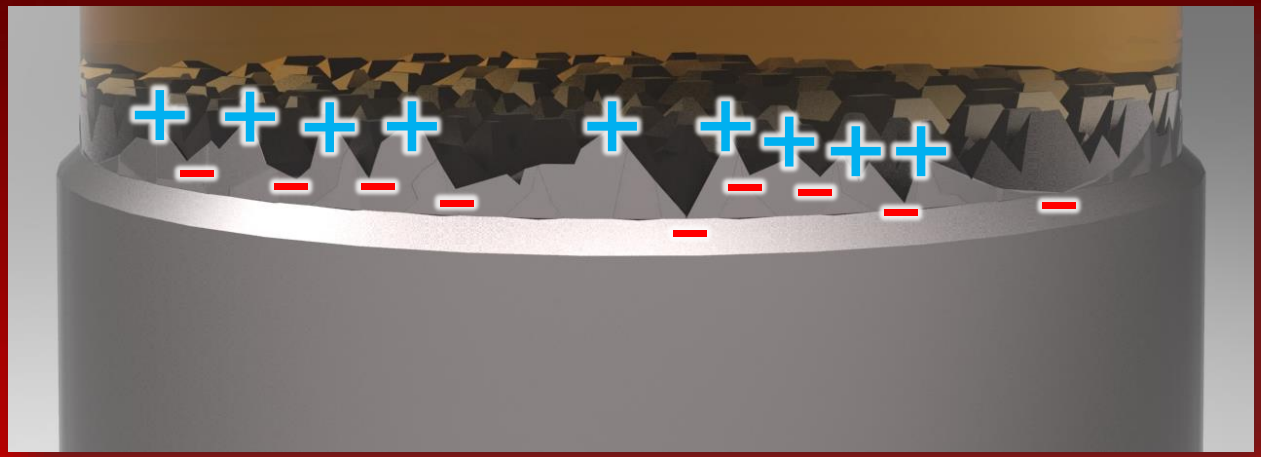
1. Metal Surface

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

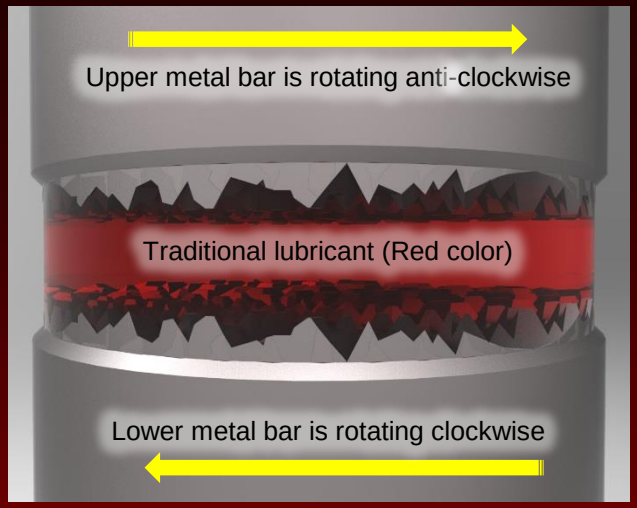
Peaks are positively charged and Valleys are negatively charged



8. ABF TECHNOLOGY DETAILED EXPLANATIONS

3. Traditional Lubricants

- Traditional lubricants help slow the process of heat and friction to some degree.
- When 2 metal surface contact each other and move in opposite directions, friction is caused, producing heat & metal deterioration.
- Constant friction & electromagnetic interaction causes the weakened metal to break off creating metallic debris & particles in the lubricants



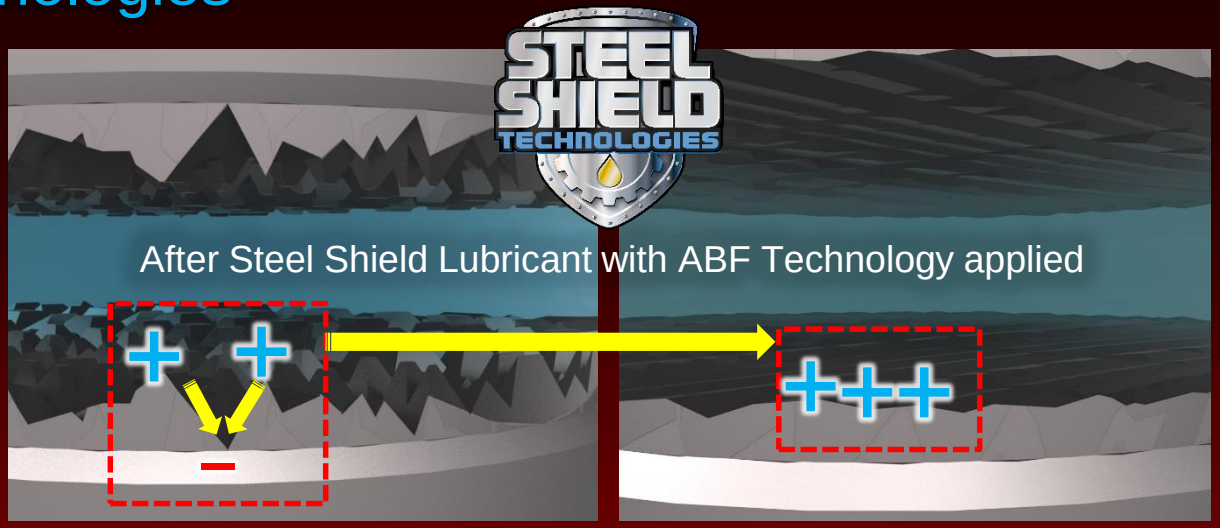
Lubricant additives damage metal surface

Metal Wear

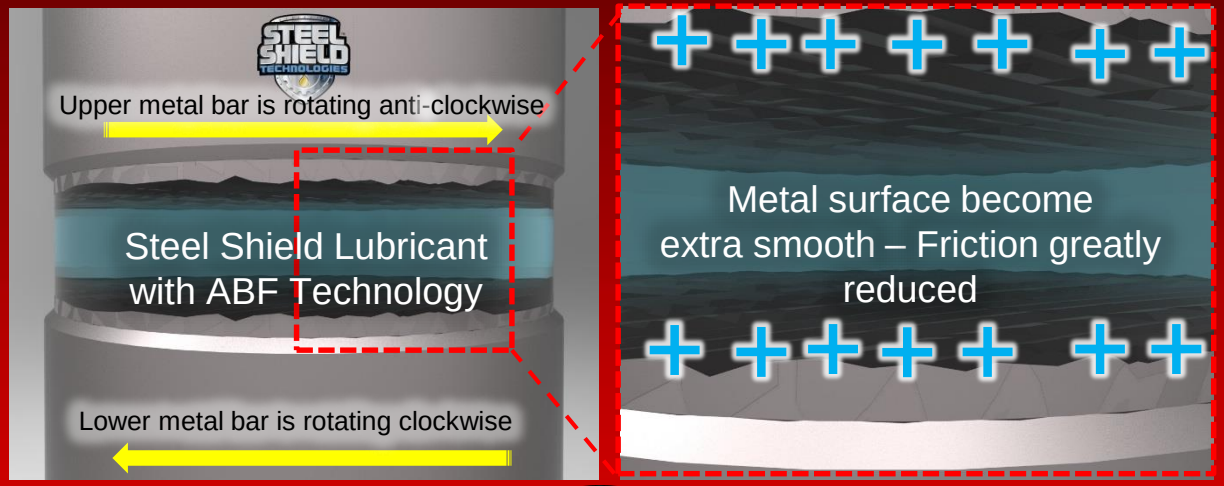
8. ABF TECHNOLOGY DETAILED EXPLANATIONS

4. Steel Shield Technologies

- Forms electro-negative surface attaching compounds to seek out & affix themselves to lower surface areas filling the micro-pores & fissures
- Asperities roll out or flatten creating greatly improved metal surfaces



- Created in this process is a total positive state of polarity
- When metal surface become uniform in charge, there is a reduction in friction due to Faraday reaction of like-charges



8. ABF TECHNOLOGY DETAILED EXPLANATIONS

5. Advanced boundary Film of Steel Shield

- Advanced methods of tribology that improve lubricity and load carrying capacity
- Reacts chemically under thermal conditions with the contacting metal surfaces to form a complex surface-attaching film of protection
- Surface smoothing is accomplished resulting in improved spread characteristics of the surfaces themselves
- Increases fluid film strength resulting in greatly reduced wear while imparting extreme pressure properties (EP)

Roller bearing

9. ADVANTAGES & TARGETED INDUSTRIES

CONCEPT

- Van der Waals Forces
- Dipole-Dipole Surface Reactions

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

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

10. SPECIALTY PRODUCT LINES

www.steelshieldtech.com.hk
www.facebook.com/steelshieldtech

11. POWER PLANT GAS TURBINE SYSTEM

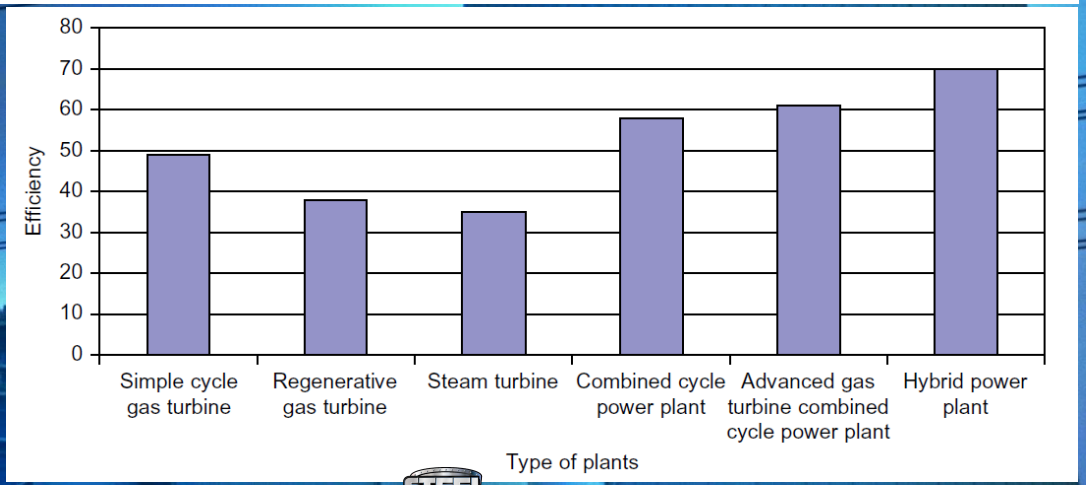
Economic Comparison of Various Generation Technologies

Economic and Operation Characteristics of Plant

Technology Comparison	Diesel Engine	Gas Engine	Simple Cycle Gas Turbine	Micro Turbine	Fuel Cell	Solar Energy Photovoltic Cell	Wind	Biomass	River Hydro
Product rollout	Available	Available	Available	Available	Available	Available	Available	Available	Available
Size range (kW)	20–100,000+	50–7,000+	500–450,000+	30–200	50–1,000+	1+	Up to 5,000	Up to 5,000	20–3,000+
Efficiency (%)	36–43%	28–42%	21–45%	25–30%	35–54%	NA	45–55%	25–35%	60–70%
Gen. set cost ($/kW)	125–400	250–600	300–600	800–1,200	1,500–3,000	NA	—	NA	NA
Turnkey cost No-heat recovery ($/kW)	200–500	600–1,000	400–850	1,200–2,400	2,500–5,000	5,000–10,000	700–1,300	800–1,500	750–1,200
Heat recovery added cost ($/kW)	75–100	75–100	150–300	100–250	1,900–3,500	NA	NA	150–300	NA
O&M cost ($/kW h)	0.007–0.015	0.005–0.012	0.003–0.008	0.006–0.010	0.005–0.010	0.001–0.004	0.007–0.012	0.006–0.011	0.005–0.010

*The above information is based on data obtained from several sources such as manufacturers and technical magazines.

According to statistical information, the efficiency ratings of Gas Engines and Gas Turbines power plants are between 21% to 45%. Reducing mechanical frictions and increasing efficiencies are critical for sustainable operations.



11. POWER PLANT GAS TURBINE SYSTEM

Economic Comparison of Various Generation Technologies

Economic and Operation Characteristics of Plant

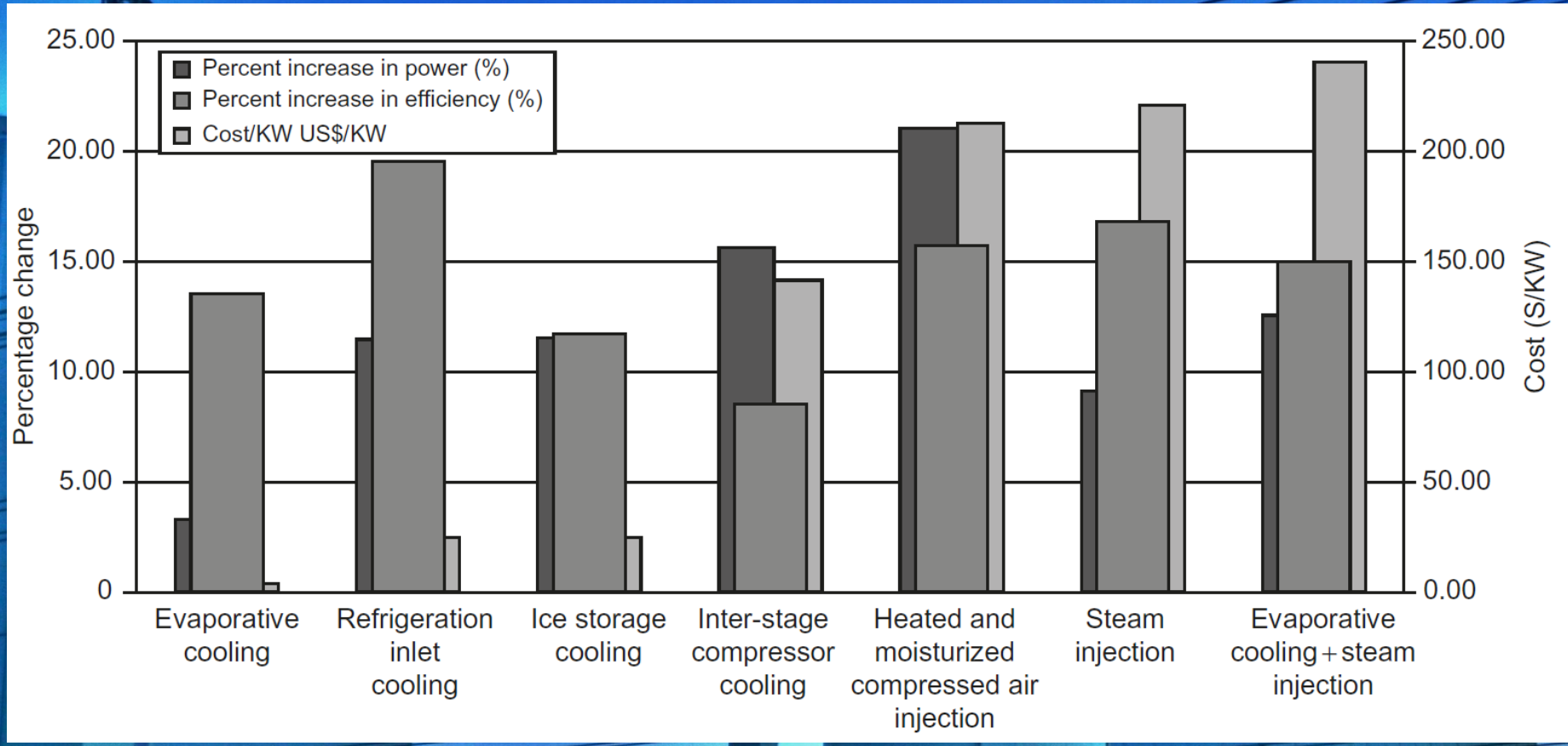
Type of Plant	Capital Cost ($/kW)	Heat Rate BTU/kWh (kJ/kWh)	Net Efficiency	Variable Operation and Maintenance ($/MWh)	Fixed Operation and Maintenance ($/MWh)	Availability (%)	Reliability (%)	Time from Planning to Completion (Months)
SCGT (2500 °F/1371 °C) Natural gas fired	300–350	7582–8000	45	5.8	0.23	88–95	97–99	10–12
SCGT oil fired	400–500	8322–8229	41	6.2	0.25	90–96	95–98	12–16
SCGT crude fired	500–600	10,662–11,250	32	13.5	0.25	75–80	90–95	12–16
Regenerative gas turbine natural gas fired	375–575	6824–7200	50	6	0.25	86–93	96–98	12–16
Combined-cycle gas turbine	600–900	6203–6545	55	4	0.35	86–93	95–98	22–24
Advanced gas turbine CCPP	800–1,000	5249–5538	65	4.5	0.4	84–90	94–96	28–30
Combined-cycle coal gasification	1,200–1,400	6950–7332	49	7	1.45	75–85	90–95	30–36
Combined-cycle fluidized bed	1,200–1,400	7300–7701	47	7	1.45	75–85	90–95	30–36
Nuclear power	1,800–200	10,000–10,550	34	8	2.28	80–89	92–98	48–60
Steam plant coal fired	800–1,000	9749–10285	35	3	1.43	82–89	94–97	36–42
Diesel generator-diesel fired	400–500	7582–8000	45	6.2	4.7	90–95	96–98	12–16
Diesel generator-power plant oil fired	600–700	8124–8570	42	7.2	4.7	85–90	92–95	16–18
Gas engine generator power plant	650–750	7300–7701	47	5.2	4.7	92–96	96–98	12–16

Reducing mechanical frictions by using STEEL SHIELD lubricants not only reduce the maintenance costs, but also increasing the availability, reliability, and extends the operation intervals which leads to much higher overall equipment efficiencies.

11. POWER PLANT GAS TURBINE SYSTEM

Economic Comparison of Various Generation Technologies

Comparison of various cycles based on percent change in power and efficiency and cost $/KW



Cooling is one the critical issues in power plants. Reducing heat generated by frictions can improve equipment reliability and increase efficiency dramatically.

11. POWER PLANT GAS TURBINE SYSTEM

STEEL SHIELD LUBRICANTS APPLICATIONS

LIST OF GAS TURBINE TYPES

STEEL SHIELD Lubricants are suitable for all types simple-cycle gas Turbine in the following six broad groups:

1. Frame type heavy-duty gas turbines. The frame units are the large power generation units ranging from 3 to 480MW in a simple-cycle configuration, with efficiencies ranging from 30% to 48%.

2. Aircraft-derivative gas turbines. Aeroderivatives, as the name indicates, are power generation units that have origin in the aerospace industry as the prime mover of aircraft. These units have been adapted to the electrical generation industry by removing the bypass fans and adding a power turbine at their exhaust. The power of these units ranges from about 2.5 to 50MW. The efficiencies of these units can range from 35% to 45%.

3. Industrial-type gas turbines. These turbines vary in range from about 2.5 to 15MW. These are used extensively in many petrochemical plants for compressor drive trains. The efficiencies of these units are in the low 30s.

4. Small gas turbines. These gas turbines are in the range from about 0.5 to 2.5MW. They often have centrifugal compressors and radial-inflow turbines. The efficiencies of the simple-cycle applications vary from 15% to 25%.

5. Microturbines. These turbines are in the range from 20 to 350kW. The growth of these turbines has been dramatic from the late 1990s, as there is an upsurge in the distributed generation market.

6. Vehicular gas turbines. These turbines have ranged from 300 to 1,500 HP. The first vehicular turbine was built in 1954 by Chrysler Corporation and followed by the Ford Motor Company's truck engine. The only vehicular turbine that has been very successful is the gas turbine being used in US Army Abrams Tank.

11. POWER PLANT GAS TURBINE SYSTEM

AVAILABILITY AND RELIABILITY

Increase Gas Turbine Economic

The Availability of a gas turbine is the percent of time the gas turbine is available to generate power in any given period at its acceptance load. The Acceptance Load or the Net Established Capacity would be the net electric power generating capacity of the gas turbine at design or reference conditions established as a result of the Performance Tests conducted for acceptance of the plant. The actual power produced by the gas turbine would be corrected to the design or reference conditions and is the actual net available capacity of the gas turbine. Thus it is necessary to calculate the effective forced outage hours, which are based on the maximum load the plant can produce in a given time interval when the plant is unable to produce the power required of it. The effective forced outage hours are based on the following relationship:

$$EFH = HO_x \frac{(MW_d - MW_a)}{MW_d}$$

Where:
MW_d = Desired output corrected to the design or reference conditions. This must be equal to or less than the gas turbine load measured and corrected to the design or reference conditions at the acceptance test.
MW_a = Actual maximum acceptance test produced and corrected to the design or reference conditions.
HO = Hours of operation at reduced load.

The Availability of a gas turbine can now be calculated by the following relationship, which takes into account the stoppage due to both forced and planned outages, as well as the forced effective outage hours.

$$A = \frac{PT - PM - FO - EFH}{PT}$$

Where:
PT = Time period (8760 hrs/year)
PM = Planned maintenance hours
FO = Forced outage hours
EFH = Equivalent forced outage hours

11. POWER PLANT GAS TURBINE SYSTEM

AVAILABILITY AND RELIABILITY

Increase Gas Turbine Economic

The Reliability of the gas turbine is the percentage of time between planned overhauls and is defined as:

$$R = \frac{PT - FO - EFH}{PT}$$

Availability and Reliability have a very major impact on the plant economy. Reliability is essential in that when the power is needed it must be there. When the power is not available it must be generated or purchased and can be very costly in the operation of a plant. Planned outages are scheduled for nonpeak periods. Peak periods are when the majority of the income is generated, as usually there are various tiers of pricing depending on the demand. Many power purchase agreements have clauses, which contain capacity payments, thus making plant availability critical in the economics of the plant. A 1% reduction in plant availability could cost $500,000 in loss of income on a 100MW plant.

Reliability of a plant depends on many parameters, such as the type of fuel, the preventive maintenance programs, the operating mode, the control systems, and the firing temperatures. Another very important factor in a gas turbine is the Starting Reliability (SR). This reliability is a clear understanding of the successful starts that have taken place and is given by the following relationship:

$$SR = \frac{number\ of\ starting\ successes}{number\ of\ starting\ successes + number\ of\ starting\ failures}$$

The insurance industry concerns itself with the risks of equipment failure. For advanced gas turbines, the frequencies of failures and the severity of failures are major concerns. In engineering terms, however, risk is better defined as:

Risk = Probability of Failure X Consequences of Failure

Where
the consequences of failure include the repair/replacement costs and the lost revenue from the down time to correct the failure.

11. POWER PLANT GAS TURBINE SYSTEM

AVAILABILITY AND RELIABILITY

Increase Gas Turbine Economic

Actions taken, which reduce the probability and/or consequences of failure, tend to reduce risk and generally enhance insurability. Because of the high risks associated with insuring advanced gas turbines, demonstrated successful operation is important to the underwriting process.

Gas turbines with the new technology, higher pressure ratio, and higher firing temperature, have led to the building of large gas turbines producing nearly 300MW and reaching gas turbine efficiencies in the mid-forties. The availability factor for units
with mature technology, below 100MW, are between 94–97%, while the bigger units above 100 MW have availability factors of 85–89%. The bigger units produce twice the output, but the availability factor has decreased from 95% to 85%. A decrease of 7–10 points for all manufacturers. Part of this decrease may be related to larger machinery taking more time to repair. It is also due to the high temperature and pressure.

The increase in unit size and complexity together with the higher turbine inlet temperature and higher pressure ratio has led to an increase in overall gas turbine efficiency. The increase in efficiency of 7–10% has in many cases led to an availability
decrease of the same amount or even more as seen in next page.

A 1% reduction in plant availability could cost USD 876,000 a year in income on a 100MW plant, thus in many cases offsetting gains in efficiency.

100MW Power Plant generate electricity for 365days
= 100 MW x 24 hr x 365 days = 87,600 MWh

Total income per year (assume power price is USD 0.1/kWh)
= 87,600 MWh x USD 0.1/ kWh = USD 87,600,000

1% loss in availability corresponds to:
= USD 87,600,000 x 1% = USD 876,000

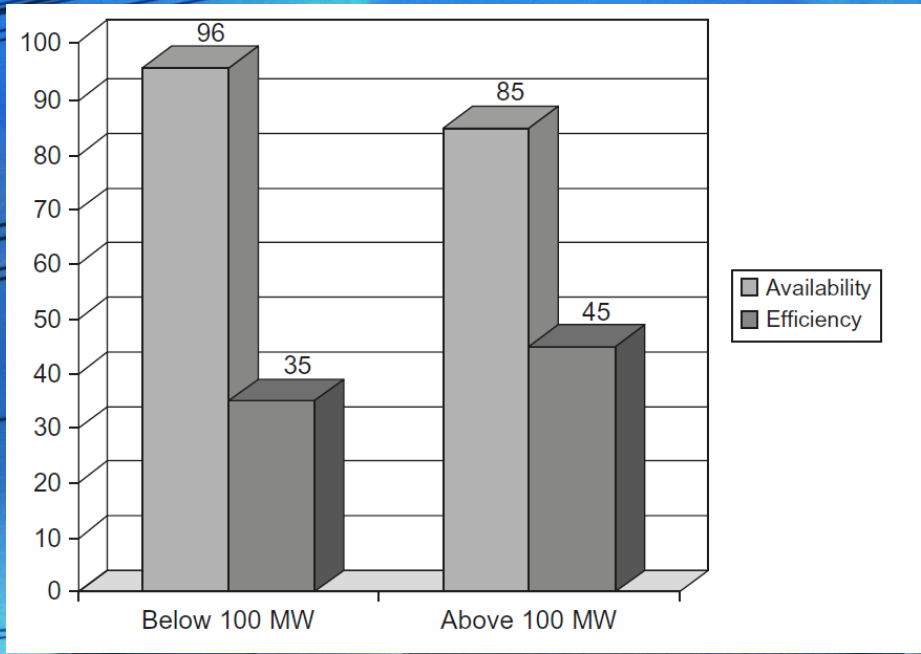
11. POWER PLANT GAS TURBINE SYSTEM

AVAILABILITY AND RELIABILITY

Redesign for Higher Machinery Reliability with STEEL SHIELD

Low reliability of units gives rise to high maintenance costs. Low reliability is usually a greater economic factor than the high maintenance costs. In many large power plants, refineries, and petrochemical complexes, about one-third of the failures are due to machinery failure; it is therefore necessary to redesign parts of a machine to improve reliability.

With STEEL SHIELD Lubricants, availability of Gas Turbines and Engines can increase dramatically which leads to increase in overall efficiency and profitability.



Comparison of availability and efficiency for large frame–type gas turbines.

11. POWER PLANT GAS TURBINE SYSTEM

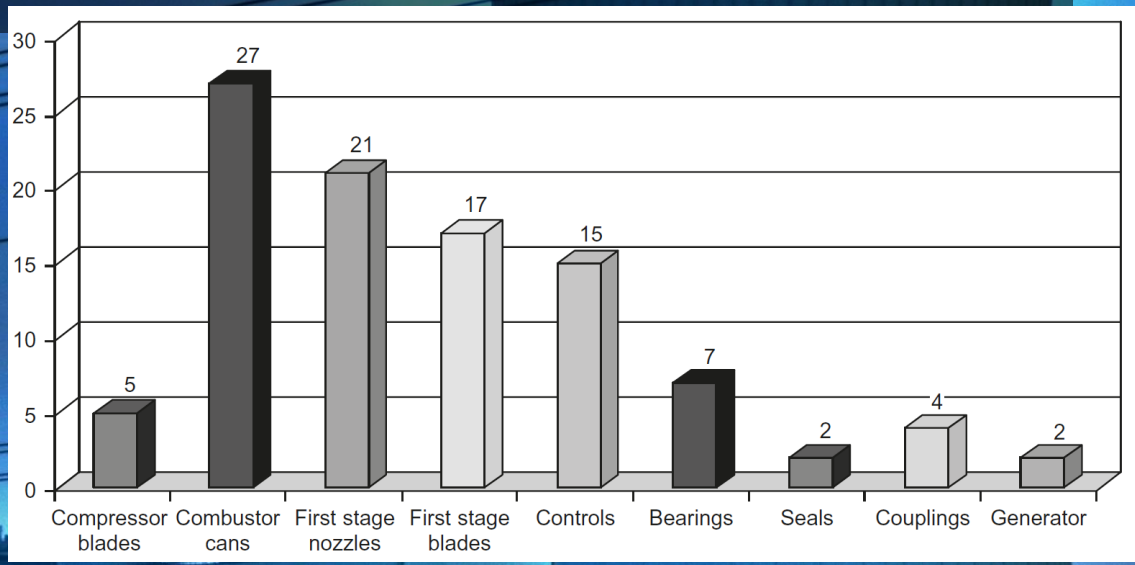
COMPONENTS FAILURE DISTRIBUTIONS

Major Focus of Downtimes

Bearing failures are one of the major causes of failures in turbomachinery. The changing of various types of radial bearings from cylindrical and/or pressure dam babbitted sleeve bearings to tilting pad journal bearings is becoming common in the industry. In most cases, this gives better stability, eliminates oil whirl, and under misalignment condition, is more forgiving.

Thrust bearing changes, from the simple, tapered land thrust bearings to tilting pad thrust bearings with leveling links (Kingsbury type) are another area of common change. These types of bearings absorb sudden load surges and liquid slugs. Many users have changed out the inactive thrust bearing to carry the same load as the active thrust bearings. This has been the case in older gas turbines where traditionally the load carrying capacity of the inactive thrust bearing was 1/3 of the active thrust bearing. As gas turbines got older the leakages increased and the thrust forces were altered greatly leading to failures in the inactive thrust bearings.

STEEL SHIELD Lubricants rehardens the metal surfaces and dramatically reduces the failure of bearings which does not ONLY reduce downtimes and boost up machine availability but LONGER life of the bearings.



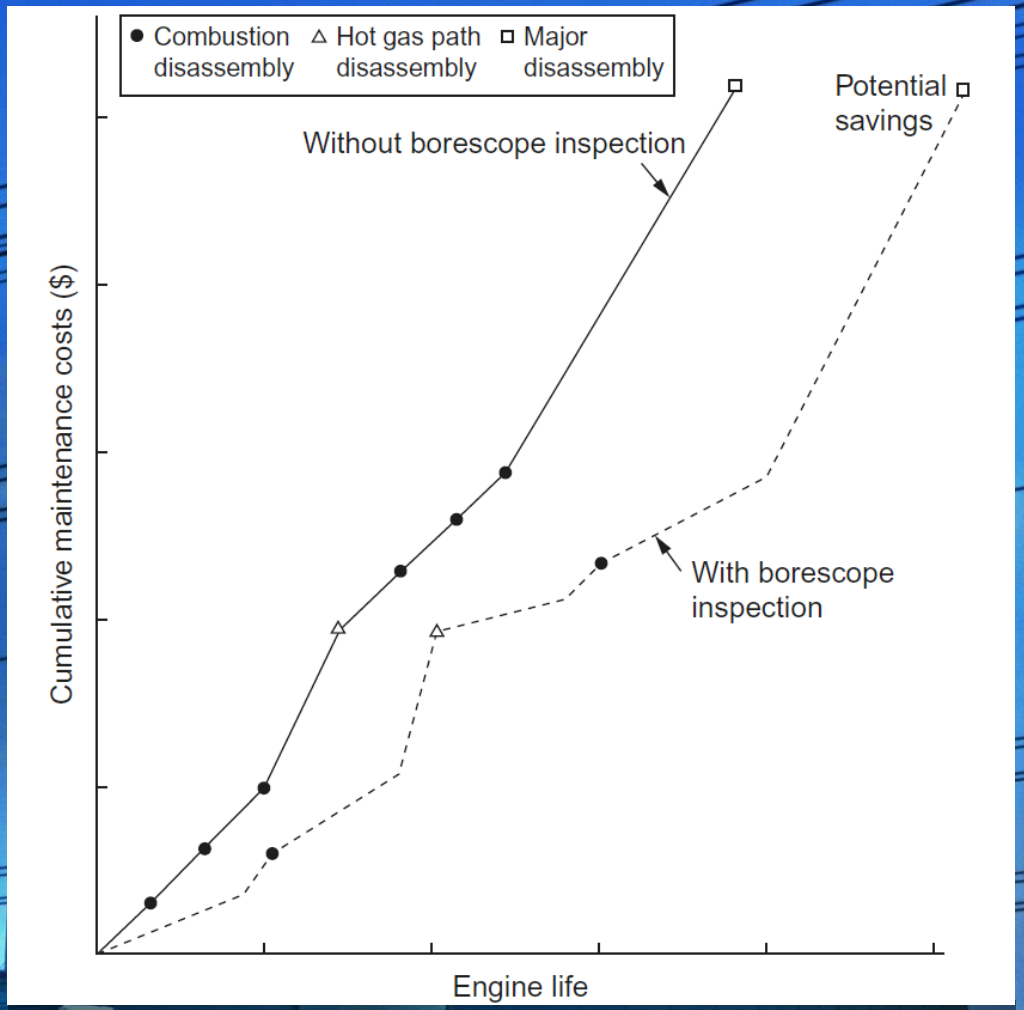
Contributions of various major components to gas turbine down time

11. POWER PLANT GAS TURBINE SYSTEM

COMPONENTS FAILURE DISTRIBUTIONS

Potential Saving with Borescope

A borescope is a device used to examine components inside a cavity that cannot be visually examined directly. A flexible fiberscope lets you see inside spaces and can offer the additional benefit of articulation, which is the ability to remotely control the tip of the scope so that it bends in two or four directions to look around a cavity. The figure shows the time savings we may obtain by the proper use of borescopic inspection for planned maintenance. Borescope inspection program and STEEL SHIELD products together can lead to sustainable long-term cost reductions!



Estimated Effect of planned maintenance with usage of borescope

11. POWER PLANT GAS TURBINE SYSTEM

COMPONENTS FAILURE DISTRIBUTIONS

Potential Saving with Borescope

Potential benefits gains by Borescope inspection in the maintenance program:

1. Perform internal on-site visual checks without disassembly.
2. Detect abnormal conditions early to avoid failures.
3. Determine degradation rates.
4. Extend periods between scheduled inspections.
5. Allow accurate planning and scheduling of maintenance actions.
6. Monitor condition of internal components.
7. Provide increased ability to predict required parts, special tools, and skilled manpower.

→ Reduce maintenance cost

Potential benefits gains with Steel Shield in normal maintenance program:

1. Prolonged components life (see our test reports in later sections)
2. Reduced components cost
3. Reduced inventory cost
4. Reduced maintenance frequency, duration and cost (proved by the cost analysis report of the Union Pacific Railroad)

→ Reduce maintenance cost

+

↓

Further reduction in maintenance cost

11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield

The Overview of Non-Recoverable Performance Degradation

Performance degradation in a gas turbine can be categorize:

1. Recoverable performance: the deterioration in a gas turbine performance that can be recovered by engine cleaning, otherwise known as an on-line and off-line water wash.
2. Non-recoverable degradation: the performance deterioration of a gas turbine caused by internal engine component wear. The only way to recover the non-recoverable degradation is by performing a shop inspection and engine overhaul.

The rate at which a gas turbine deteriorates is primarily affected by the amount of contaminants that enter the turbine through the inlet air filters, ducts, water from evaporative coolers, fuel, and the frequency as well as the thoroughness of
engine water washing. At times unusual site conditions exist that accelerate gas turbine degradation. Unusual airborne contaminants from process mists, smoke, oil, and chemical releases, dust storms, sugar cane burning smoke, and other sources have been documented to accelerate engine degradation.

Deterioration in turbine performance is indicated by one or more of the following conditions:

- Slower engine acceleration
- Engine compressor surge or stall
- Lower power output
- Loss of engine compressor discharge pressure
- Increase in compressor discharge temperature

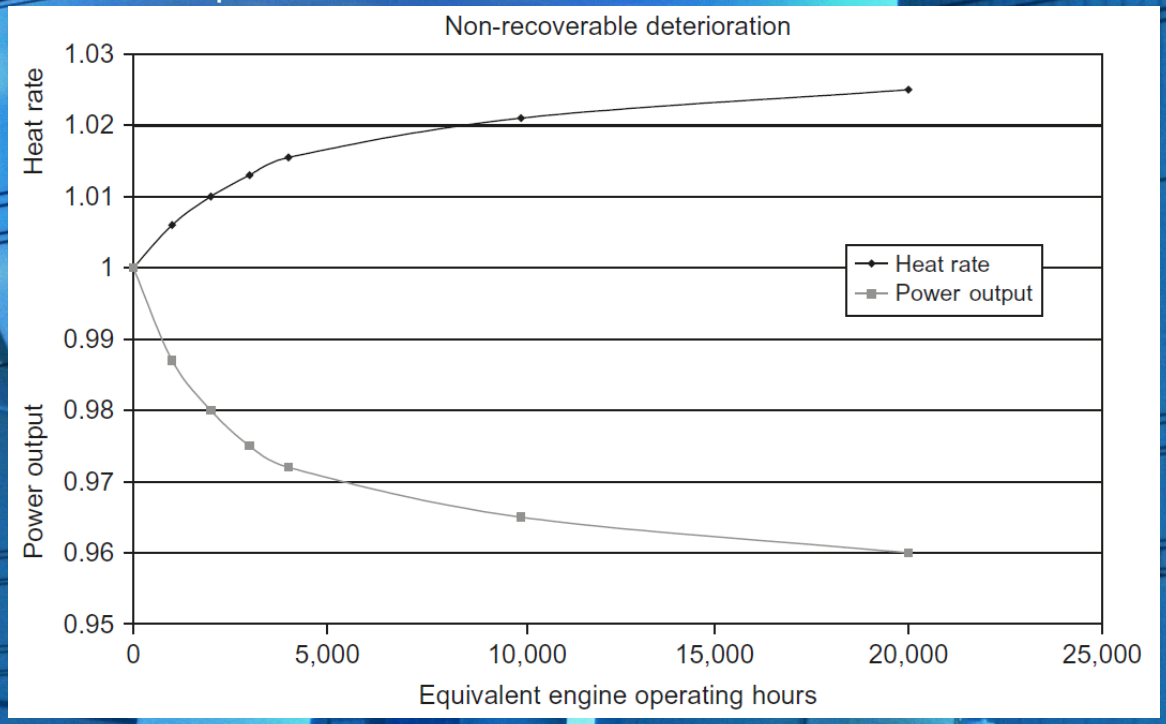
11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield

The Overview of Non-Recoverable Performance Degradation

Figure below is a typical non-recoverable power and heat rate degradation curve as a function of equivalent engine operating hours (EOH).With an increase in equivalent engine operating hours there is a sharp drop in delivered power and an increase in the turbine heat rate during the first 5,000 equivalent operating hours. These losses are non-recoverable in most cases, and would require the turbine to be returned to the shop, and outfitted with most new components.



A typical non-recoverable losses of a gas turbine engine

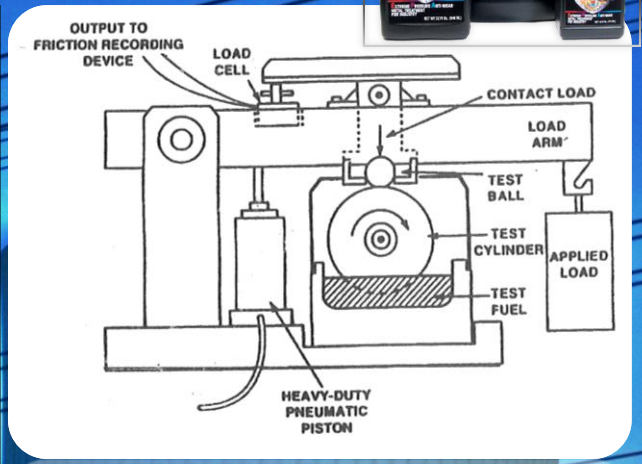
11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield

As mentioned previously, the majority of non-recoverable performance degradation is caused by internal engine component wears. The lower the wear rate of the engine, the smaller the degradation effects would be resulted. The following test revealed that Steed Shield EPA have superior performance in anti-wear in high loading conditions which is a reliable solution to overcome performance degradation problems.

The test apparatus design is defined in ASTM D5001 and ASTM D6078 as shown in the right figure. The test ball specimens with diameter 6.35mm were sliding on a 49.1mm diameter cylinder. The results of loads applied and wears of the balls are recorded in the following table:



Additive	Concentration, Vol.%	Friction Coefficient	Wear Scar Diameter (D), mm	Wear Volume (V), mm^3x10^{-3}	Scuff Load (L) Run A, grams	Scuff Load (L) Run B, grams	Predicted FZG Result (PF_{LS})	Predicted Ryder Result (PR_R), lb/in	Friction at Scuffing
None	0	0.164	0.800	6.3665	4,500	4,500	7.00	2,139	0.126
Steel Shield EPA	3	0.170	0.720	4.1728	4,750	4,750	8.00	2,208	0.135
	7	0.148	0.700	3.7272	9,000	9,250	10.00	3,413	0.120
	10	0.152	0.690	3.5184	12,000	12,000	11.50	4,206	0.128
Additive B	3	0.140	0.790	6.0533	4,750	4,750	7.10	2,208	0.114
	7	0.142	0.790	6.0533	5,000	5,250	7.50	2,311	0.122
	10	0.138	0.800	6.3665	5,750	5,000	7.60	2,380	0.123
Additive C	3	0.167	0.750	4.9148	4,500	4,500	7.00	2,139	0.112
	7	0.165	0.750	4.9148	4,250	4,750	7.00	2,139	0.119
	10	0.168	0.750	4.9148	4,500	4,500	7.00	2,139	0.123
Additive D	3	0.170	0.715	4.0578	5,000	4,750	7.30	2,243	0.143
	7	0.171	0.710	3.9453	6,500	6,750	8.50	2,725	0.140
	10	0.166	0.690	3.5184	7,250	7,500	9.00	2,931	0.130

Oil analysis results: STEEL SHIELD EPA vs other premium additives

11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield

The Gear Oil Scuff Test (GOST) procedure was developed to accurately predict the result obtained using both the Ryder and FZG Gest Tests. A detailed description of the GOST methodology may be obtained in Aircraft Information Report 4978. Like the full-scale gear tests, the GOST procedure consists of a sequence of 60 second ball-on-cylinder tests performed as a function of applied load. The minimum applied load (L) required to produce a friction coefficient greater than 0.175 is used to define lubricity, with the result reported to the nearest 250 grams. Prior to each load stage, the cylinder is moved at least 0.5mm and a new ball is placed in the loader. The cylinder wear test specimen used in the GOST procedure is identical to that defined in ASTM D6078. The fluid sample is not changed between individual load increments.
Noticed that the wear volume of the ball specimens was calculated by the following equation:

$$V = (\frac{\pi}{3})(2r^3 - \left(\left(\frac{D}{2}\right)^2 + 2r^2\right)\left(r^2 - \left(\frac{D}{2}\right)^2\right)^{\frac{1}{2}})$$

Where:
D = the average diameter of the elliptical wear scar formed on the ball specimen
V = actual wear volume
r = radius of the ball specimen

Also, the Predicted FZG Result (PF_{LS}) can be calculated by the following equation:

$$PF_{LS} = 0.1044(L + 1590(\ln(v))^{\frac{4}{3}} - 3000)^{\frac{1}{2}}$$

Where:
L = the minimum applied load
v = kinematic viscosity of the lubricant

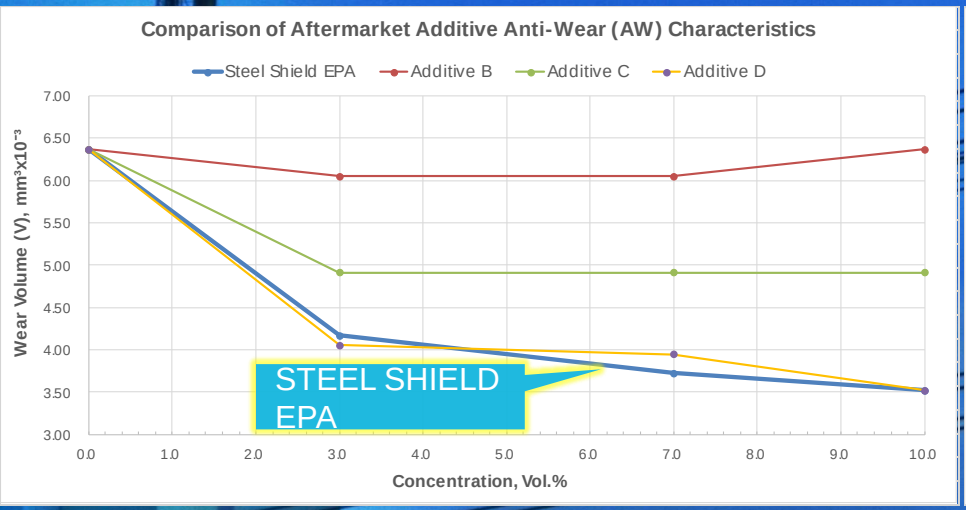
Similarly, the Predicted Ryder Gear Result can be calculated as follow:

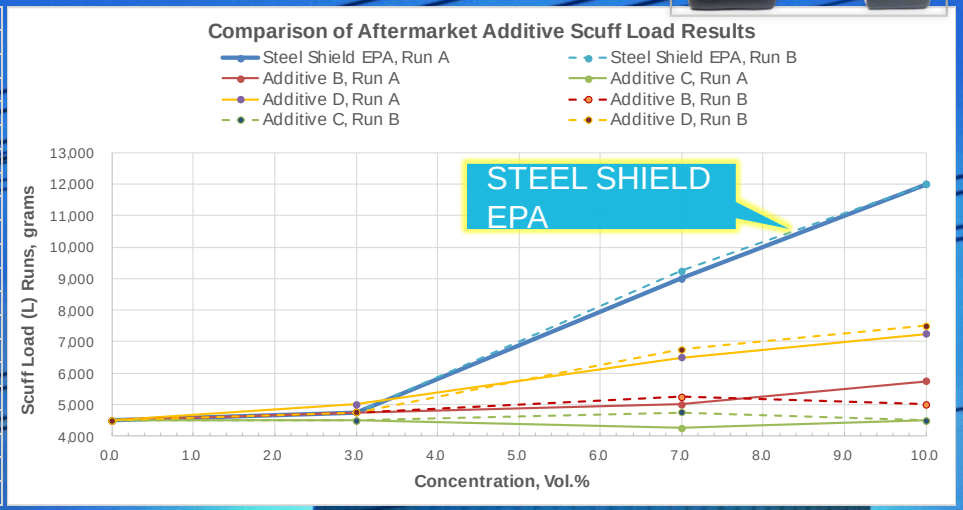
$$PR_R = 0.2755L + 657(\ln(v))^{\frac{4}{3}} - 339$$

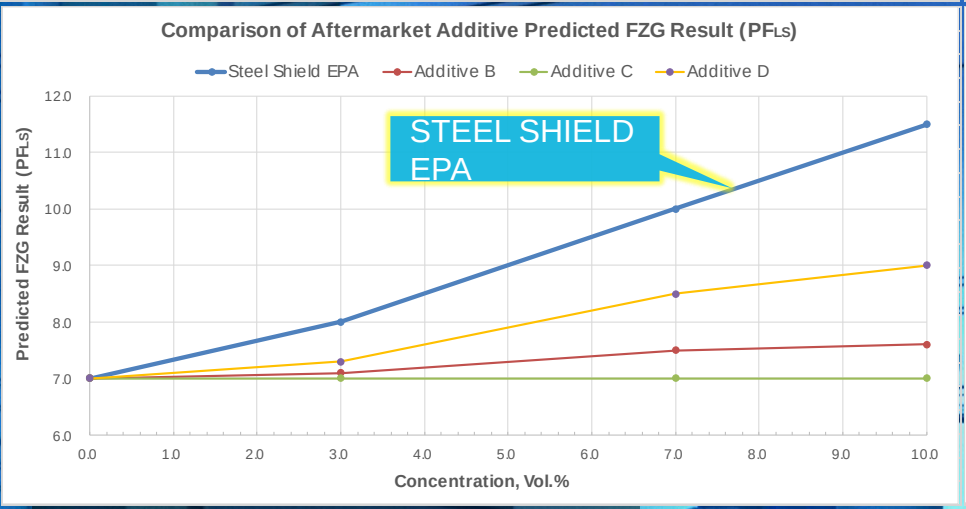
11. POWER PLANT GAS TURBINE SYSTEM

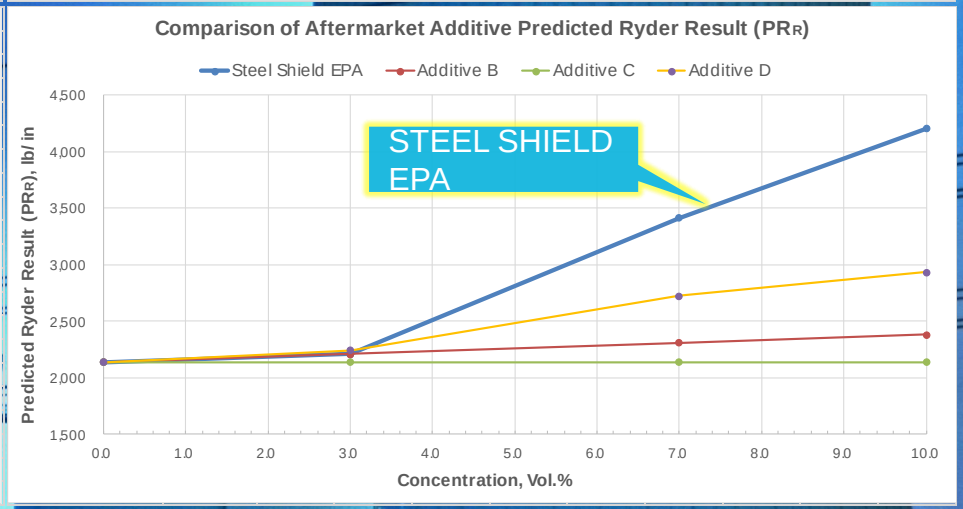
MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield









The brilliant results of Steel Shield EPA

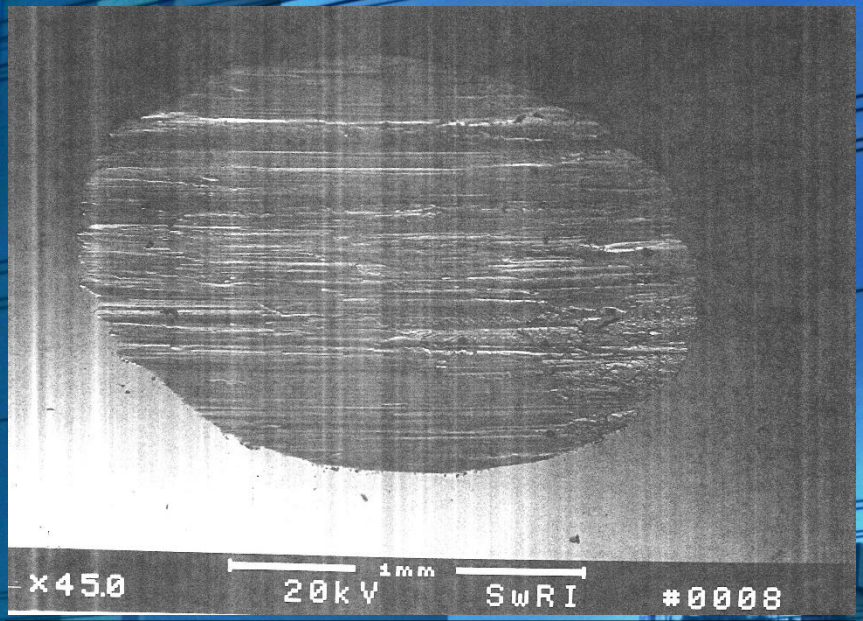
11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

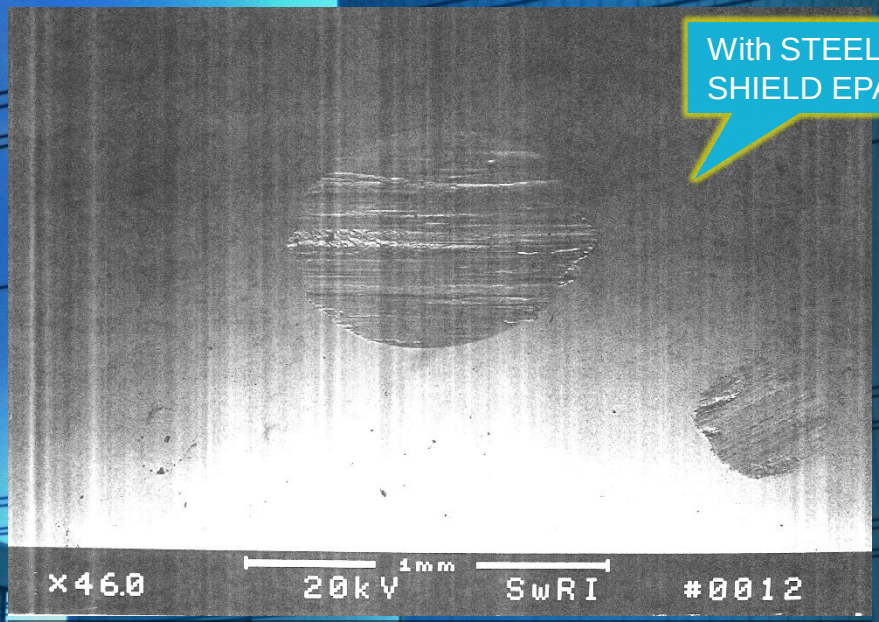
Overcoming Performance degradation with Steel Shield

Results and Comments

- Steel Shield EPA demonstrated the BEST result. The addition of 10 vol.% Steel Shield EPA improved the predicted FZG load stage result to 11.6 and the predicted Ryder result to 4206 lb/in.
- The result obtained for Steel Shield EPA represent the highest level possible in this test with a base oil of this viscosity.
- By comparison, the wear scar produced by the Steel Shield EPA treated oil is appreciably smaller. The Steel Shield EPA treated scar has a smooth topography and is largely free of ploughing and plastic deformation. As shown below:



Photomicrograph of the wear scar produced by neat polyolester during a GOST test with an applied load of 7 kg



Photomicrograph of the wear scar produced by polyolester plus 10 Vol% Steel Shield EPA during a GOST test with an applied load of 7 kg

11. POWER PLANT GAS TURBINE SYSTEM

MAINTENANCE OF GAS TURBINE

Overcoming Performance degradation with Steel Shield

Results and Comments

- A 10 vol% concentration of Steel Shield EPA additive improved the load carrying characteristics of a turbine engine oil beyond the measurement capabilities of the test apparatus
- The improvement in load carrying capacity provided by the halogenated hydrocarbon used in the information of Steel Shield EPA could not be achieved by addition of even unusually high concentrations of either Zinc Dialkyl Dithiophosphate (ZDDP) or tricresyl Phosphate (TCP)
- The additive formulation used in Steel Shield EPA appears to produce a synergistic result which is more effective than any of the components individually
- The careful formulation of the additive package used in Steel Shield EPA results in both excellent anti-wear and extreme pressure characteristics.
- Evaluation of Steel Shield EPA in extended field trials indicated no propensity to cause corrosion of lead Babbitt bearings
- Use of Steel Shield EPA in extended field trials virtually eliminated failure of lead Babbitt bearings in railroad cars

The Ultimate Result of applying Steel Shield Lubricants in Gas Turbine System

Apply Steel Shield → Dramatically reduce metal wears and improve extreme pressure properties → Overcome non-recoverable performance degradation in gas turbine generator systems, increase generation efficiency and reduce maintenance costs

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Uniqueness of Natural Gas Engines

The primary difference between natural gas and other internal combustion engine oils is the necessity to withstand the various levels of oil degradation caused by the gas fuel combustion process, which results in the accumulation of oxides of nitrogen. This condition, commonly called nitration, must be monitored regularly if both lubricant and engine life are to be maintained.

Sulfated ash content is another consideration unique to natural gas engine oils and the significance of sulfated ash will be described in detail during our discussion of the testing techniques.

To properly select the most cost-effective condition-monitoring techniques to achieve maximum efficiency and long life from the engines, engine design, operating conditions and the lubricants must be considered.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Condition-Monitoring Techniques

Several common condition-monitoring techniques are applied to natural gas engines. The analysis of the compression pressure/crank angle or pressure-time (P-T) curve is one common technique. Natural gas engines have some cycle-to-cycle combustion variations and by measuring the P-T curves, the analyst can determine such conditions as high fuel consumption, uneven internal pressures, high temperatures and unbalance causing detonation, all of which can affect the life of upper cylinder components and the effectiveness of the lubrication and emission control systems.

An analysis of the pressure-volume (P-V) curve can be used to balance cylinders, detect valve train problems and determine frictional losses, by comparing engine horsepower to compressor horsepower. In addition, analyzing reciprocating vibration patterns can provide the analyst with an understanding of certain mechanical conditions, such as burned valves or gas leaks.

Perhaps the most effective and least expensive natural gas engine condition-monitoring technique available today is the analysis of the engine's lubricants. Unfortunately, many natural gas engine operators take the lubricant for granted and do not consider the engine oil as another component of the machine, which should be as closely monitored as any other system within the engine. The oil analysis tests which should be considered part of a regularly scheduled predictive maintenance and condition-monitoring program for natural gas engines include the following:

- Viscosity
- Base number
- Acid number
- Glycol contamination
- Water contamination
- Insolubles
- Spectrochemical analysis
- Nitration/oxidation

Each of these testing recommendations and its significance is described in detail in the next pages.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Viscosity

Viscosity should be measured using the standard method ASTM D445 to measure the viscosity at both 40°C and 100°C. The results, reported in centistokes, can then be compared with the viscosity specifications of the new oil. The significance of these results can indicate conditions such as oil thickening (an indicator of oxidation or nitration), increased contamination levels and/or an increase in insolubles.

A reduction in the viscosity can indicate dilution of the oil and in the case of multigrade lubricants may indicate shearing of the viscosity index improvers.

STEEL SHIELD ABF Technology does not rely on high viscosity to provide protections. It is possible to apply lower viscosity STEEL SHIELD lubricant to achieve superior metal protections whilst improve energy efficiency.

Base Number (BN)

Base number (BN) is an indication of the reserve alkalinity contained in an engine oil. It is an indicator of the level of the detergent/dispersant additive package's ability to counteract acids. The standard test ASTM D2896 provides an accurate indicator of the BN, the results of which can be compared to the unused oil's BN. This test is an indicator of additive depletion and the rule-of-thumb is that an oil has reached the end of its useful life when the BN is reduced to one-half that of the new oil specification. Low BNs are usually accompanied by increases in viscosity.

BN is not often used as a test for natural gas engine oils unless the application operates under dual fuel conditions (where the engine uses either diesel or natural gas as fuel under various operating conditions). If the operation requires that diesel fuel is used for up to 50 percent of running time, BN testing should be included as an oil analysis requirement. Because most natural gas engine oils are formulated as low to medium ash oils, the BNs will generally be in a range of three to seven. These levels may not be sufficient to protect engines using dual fuels.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Base Number (BN) (*continued*)

BN is also an important oil analysis test when the fuel in use contains high levels of sulfur and/or organic halogens, such as chlorine or fluorine. When high sulfur sour gas or landfill gas is in use, the typical natural gas oils available may not sufficiently protect the engine from acid compounds. In these cases, the engine operator may need to shorten oil drains, or select an oil with a higher BN, which will provide a higher level of alkalinity.

Potential lubrication problems caused by the use of the kinds of fuel described should be discussed with both the engine manufacturer and the lubricant supplier.

STEEL SHIELD lubricants are formulated with selected additives which will provide extra protection from acid with highly stable base number.

Acid Number

Acid number (AN) is an indication of increased acid levels in natural gas engine oils, frequently accompanied by viscosity increases. AN tests are often used to establish optimum oil drain intervals for many types of industrial oils, particularly those used in natural gas engines. High AN is an indicator of nitration, oxidation and contamination.

The standard ASTM D664 is the primary test used and the rule-of-thumb for this test application is that when the AN doubles that of the new oil value, the oil is nearing its condemning limit.

STEEL SHIELD lubricants are NOT acidic in nature. It performs highly stable and remains neutral over a long operating period.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Glycol Contamination

Testing for glycol leaks in accordance with ASTM D2982 must be part of any oil analysis program. Any amount of glycol in the analysis can indicate a coolant leak into the engine and will cause catastrophic failure by promoting corrosive acids, sludge and varnish to form quite rapidly, as well as to cause a reduction in oil film, which can suddenly increase wear. (It is important to remember that some oils may test “glycol positive,” so caution must be applied when interpreting these results).

STEEL SHIELD ABF Technology treats metal surface and the lubricant neutralize acids which enable metal surface to endure under any accidentals.

Water Contamination

Water contamination, which can be a problem in natural gas engine oils, particularly in those engines which exhibit high flow rates and turbulence, should be determined using ASTM D1744 or D93. Systems can experience foaming problems with as little as 100 ppm to 300 ppm of water. This is of particular importance in engines where the oil temperatures are too low. Evaporation may not occur and low oil operating temperatures create the conditions necessary for nitration to develop. This is the reason “most” natural gas engine manufacturers recommend that engines run with oil temperatures in a range of 180°F to 185°F (82°C to 85°C).

When the engine’s oil operating temperature is unknown, 120°F (49°C) should be added to the ambient temperature to obtain the estimated oil sump temperature. The resulting oil temperature should then be confirmed with the engine manufacturer to determine if it’s acceptable.

STEEL SHIELD lubricants have excellent water separation ability that help the system to drive water out of the engine.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Insolubles

Insolubles are the solid contaminants which remain in the lubricating oil, such as dust, dirt and carbon particles, in addition to wear metals that have not been removed through filtration. When insolubles are present, particularly in large quantities, they can promote foaming and will generally increase the oil's viscosity.

In addition, some natural gas engines that operate in an unbalanced condition will generate soot due to incomplete combustion.

It is important that these insoluble contaminants be monitored and controlled and that they be measured using techniques such as precipitation, centrifugation, gravimetric or particle counting methods.

One such technique, which is performed in accordance with ASTM D4055, measures insolubles by filtering a measured quantity of oil diluted with pentane through a 0.8 micron filter and then weighing the remaining deposit after the filter is dry. The deposit can also be viewed under a microscope and an experienced analyst or engine operator can evaluate the particulate for further action.

One result of such testing is the determination that the lubrication system itself (reservoirs, filter housings, piping and settling tanks) may require cleaning and flushing.

STEEL SHIELD ABF Technology treats metal surface which enhance surface hardness and smoothness. Metal wear reduces and debris drops to minimum. It also protects metals from insolubles and prevent metal damages.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Spectrochemical Analysis

Spectrochemical analysis measures the levels of wear metals and the concentration of additive elements. The results, usually reported in parts per million (ppm), provide an indication of the rates of wear of engine components and the depletion of additives.

Three things must be kept in mind when interpreting spectrochemical analysis. First, the wear particles analyzed are generally limited to those in the 5 micron to 6 micron range. (those particles which are the result of wear, but not the cause of it). Secondly, wear rate trends are best established after the interpretation of at least three oil samples taken at the same sample interval; in other words, at three similar oil change intervals, or if the oil has not been changed, at the same operating interval, such as 500 hours. Finally, it is a mistake to assume that every engine of identical make and model will exhibit the same wear rate level or pattern. Each engine will exhibit its own wear rate “finger print” and accurate record keeping is essential if the data collected is to be useful in evaluating engine condition.

It is PROVED that STEEL SHIELD lubricants perform much better than other premium competitors. The metal wear is dropped dramatically, thanks to ABF Technology !

Sulfated Ash

Any discussion of the elemental analysis of natural gas engine oils is not complete without a comment concerning the issue of sulfated ash content. Natural gas engine operation tends to form various deposits such as varnish, sludge and an ash residue which remains after the oil is burned during operation. The varnish and sludge are controlled by the detergent/dispersant additives, however these detergent/dispersant additives tend to leave a grey, fluffy ash residue after the oil has been burned. This ash residue is made up of metal sulfates from such additives as barium, calcium, phosphorus, zinc, magnesium and boron (Table 1 on next page).

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Sulfated Ash *(continued)*

Therefore, lubricant formulators must ensure that these additive concentrations are high enough to help prevent valve recession, but not so high as to cause unwanted and harmful deposits, or cause catalysts to become ineffective.

Valve recession is the premature wearing of the valve seat into the cylinder head. The sulfated ash residue helps to prevent premature valve recession by “cushioning” the valve seat area (Figure 1).

Table 1

Oil Category	Ash Content
Ashless	Less than 0.1 percent
Low Ash	0.1 - 0.5 percent
Medium Ash	0.5 - 1.5 percent
High Ash	Greater than 1.5 percent

Note: These are general guidelines only. Most oil formulators now list the sulfated ash percentages, as well as the concentration of the additive levels in PPM in their specification data.

Excessively high concentrations of certain additives, such as zinc or phosphorus, can also be harmful to catalyst equipped natural gas engines, because these additives may deactivate the exhaust catalyst by forming glassy-amorphous deposits which prevent the exhaust gas from reaching the active surfaces of the catalyst, which in turn makes control of harmful emissions impossible.

In addition, natural gas engine manufacturers also list the levels of sulfated ash and the additive concentrations that are acceptable for use in their particular engines. For specific recommendations concerning ash content and additive levels, the engine operator should contact both the engine manufacturer and the lubricant supplier.

Figure 1: Typical Valve Recession in a Natural Gas Engine

STEEL SHIELD lubricants have a wide product range with different ash contents which can sufficiently protect your valuable engines.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Nitration and Oxidation

Nitration and oxidation are naturally occurring processes within natural gas engine oils that can be quite severe, depending upon conditions such as air-to-fuel ratios and oil operating temperatures.

Oxidation is caused by the reaction of oil with oxygen in combination with such catalysts as copper wear particles, particularly as oil temperatures increase above 200°F (95°C). Oxidation occurs to some degree in all lubricated systems and results in an increase in the oil's viscosity.

Nitration on the other hand, occurs most frequently in natural gas engines and if left uncontrolled, can cause serious problems, including the complete solidification of the oil.

Nitration is a chemical reaction within the oil, which causes the carbon chains to react with nitrogen dioxide (NO2) formed during natural gas combustion, causing serious and premature thickening of the oil. This results in the formation of severe varnish and carbon deposits. Once begun, the condition worsens exponentially.

There are two major factors that must be carefully controlled if excessive nitration is to be prevented. The first is the oil's operating temperature. Nitration becomes significant at oil reservoir temperatures of about 135°F (57°C) and becomes even more dramatic at lower temperatures. (Natural gas engines must be operated with oil temperatures in a range of 180°F to 185°F (82°C to 85°C) in order to control both nitration and oxidation.)

The second major consideration in the prevention of nitration is the air-to-fuel ratio, which has the greatest effect on nitration rates. Nitration peaks at air-to-fuel ratios of 18-to-1 or 19-to-1, depending upon engine type and fuel condition. As Figure 2 (on next page) illustrates, a rich ratio of 15.5-to-1 is used for best horsepower in a Waukesha gas engine, while a more lean mixture of 17-to-1 is used for greatest economy. At a ratio of 17-to-1, nitration will occur. In the newer, lean-burn designed engines with ratios of 20-to-1 or leaner, nitrogen oxides are not released, which effectively and dramatically reduces or eliminates nitration.

12. NATURAL GAS ENGINE LUBRICANTS CRITERIA

IMPORTANT KNOWLEDGE

Nitration and Oxidation

It is for this reason that the use of either direct infrared spectroscopy, or Fourier Transform infrared (FTIR) oil analysis techniques are highly recommended for natural gas engine oils. The techniques compare samples of the used oil with a reference sample of new oil. The testing instruments chart a curve which represents the difference between the used and new reference samples. The chart's curve will immediately point out any contamination, nitration or oxidation conditions. A high concentration of nitration can be used as a indication that a tune up is necessary, because nitration is primarily caused by air-to-fuel ratio, or engine temperature problems (Figure 3).

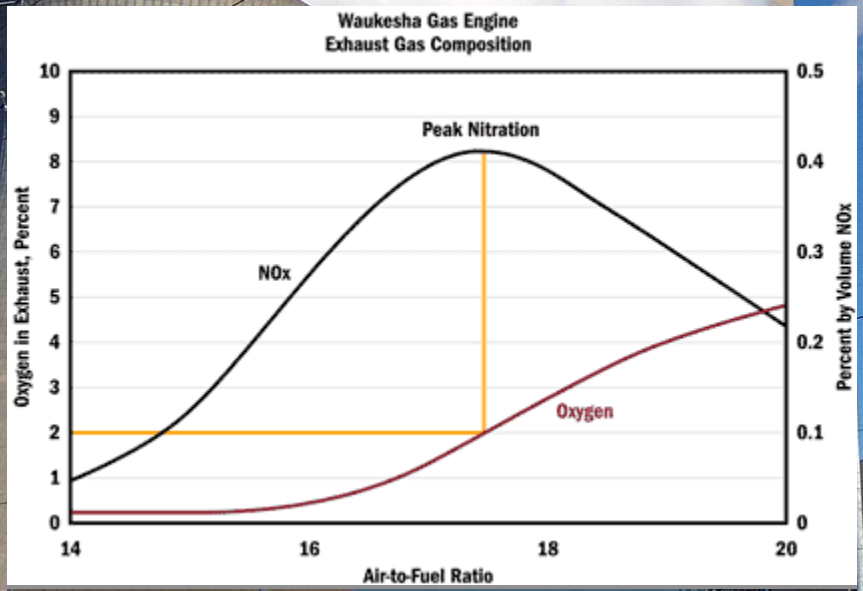


Figure 2. Operators Select the Air-to-Fuel Ratio for the Application or Conditions Required.

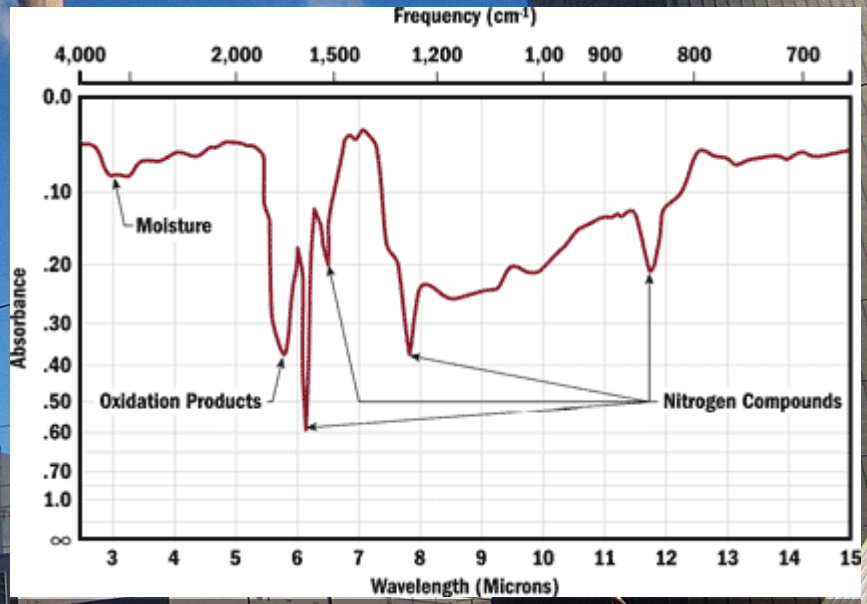


Figure 3. Infrared Analysis Can Immediately Determine Nitration and Oxidation Levels.

STEEL SHIELD lubricants are highly stable under high temperature and other severe conditions. It resists to react and deteriorate, and prevent oxidation and nitration.

13. STEEL SHIELD BENEFITS GAS TURBINE SYSTEM

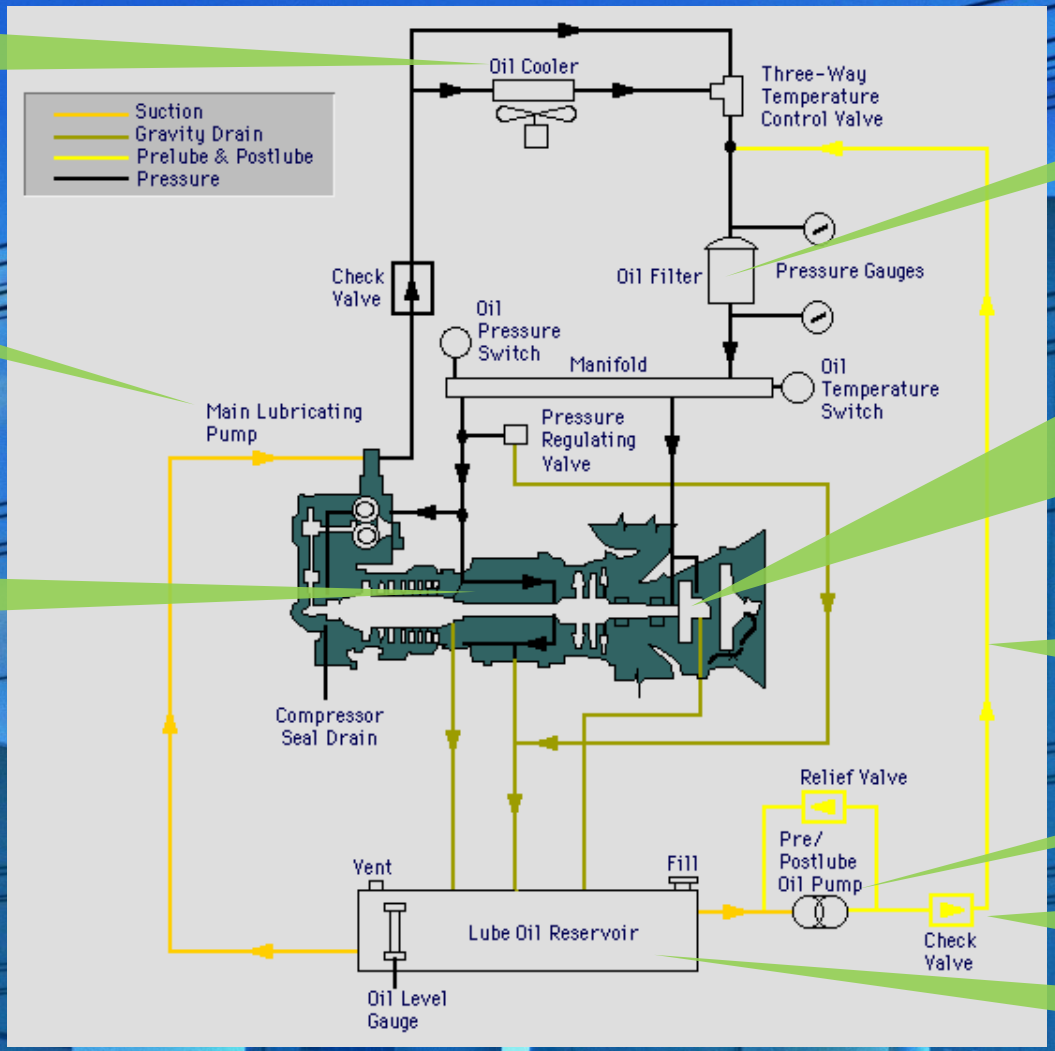
LUBRICATION SYSTEM

HOW STEEL SHIELD ENHANCE TURBINE SYSTEM?

- Remove debris
- Maintain oil flow
- Enhance cooling efficiency

- Ready for cold start
- Maintain oil flow

- Cool down the engine
- Extend engine life
- Reduce energy loss



- Filter remains clean
- Increase filter life

- Protect bearings
- Extend bearings life
- Harden metal surface
- Reduce downtime
- Reduce energy consumptions
- Reduce heat generation
- Enhanced cooling

- Remove debris
- Maintain oil flow

- Ready for cold start

- Remove debris
- Maintain oil flow

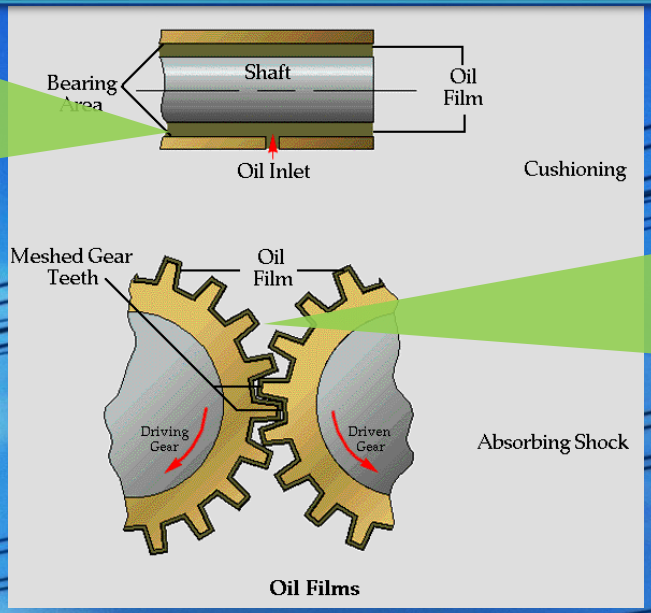
- Remain oil stable
- Ready for cold start

13. STEEL SHIELD BENEFITS GAS TURBINE SYSTEM

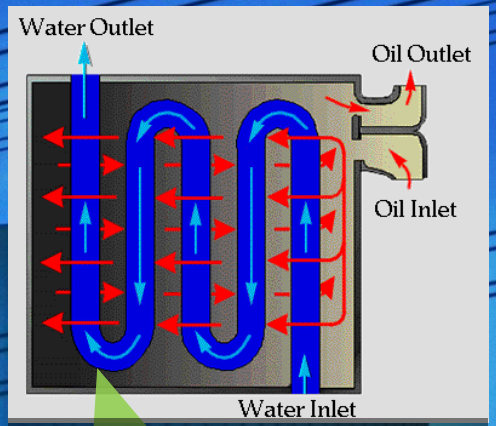
LUBRICATION SYSTEM

HOW STEEL SHIELD ENHANCE TURBINE SYSTEM?

- Increase metal surface hardness and smoothness
- Reduce friction loss
- Reduce energy consumption
- Extend metal life
- Keep metal cool
- Reduce wear & debris



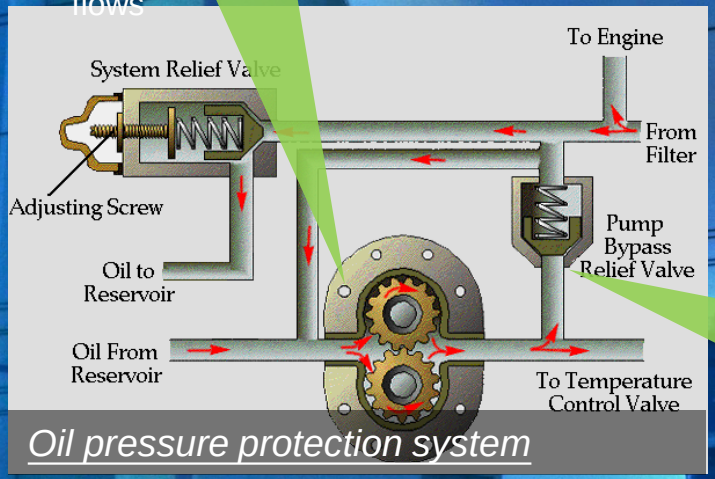
- Increase metal surface hardness and smoothness
- Reduce friction loss
- Reduce energy consumption
- Extend metal life
- Keep metal cool
- Reduce wear & debris
- Absorb shock



Oil cooler system

- Remove metal debris & prevent debris formations
- Increase cooling efficiency

- Increase surface smoothness
- Reduce debris
- Reduce friction loss
- Improve oil flows
- Ensure stable flows

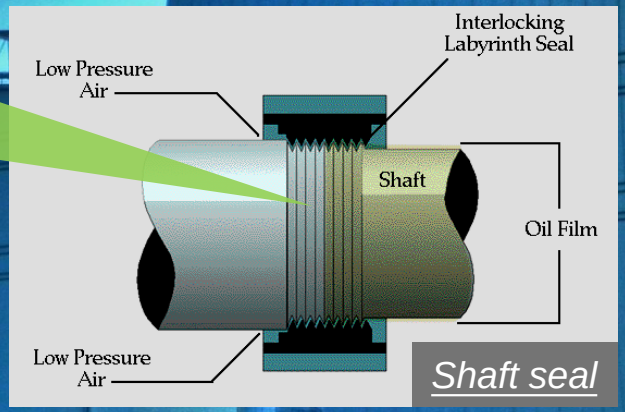


Oil pressure protection system

- Increase metal surface hardness and smoothness
- Extend metal life
- Seal components
- Prevent lubricant lost

For ALL valves:

- Remove debris
- Improve & smooth mechanism
- Enhance safety

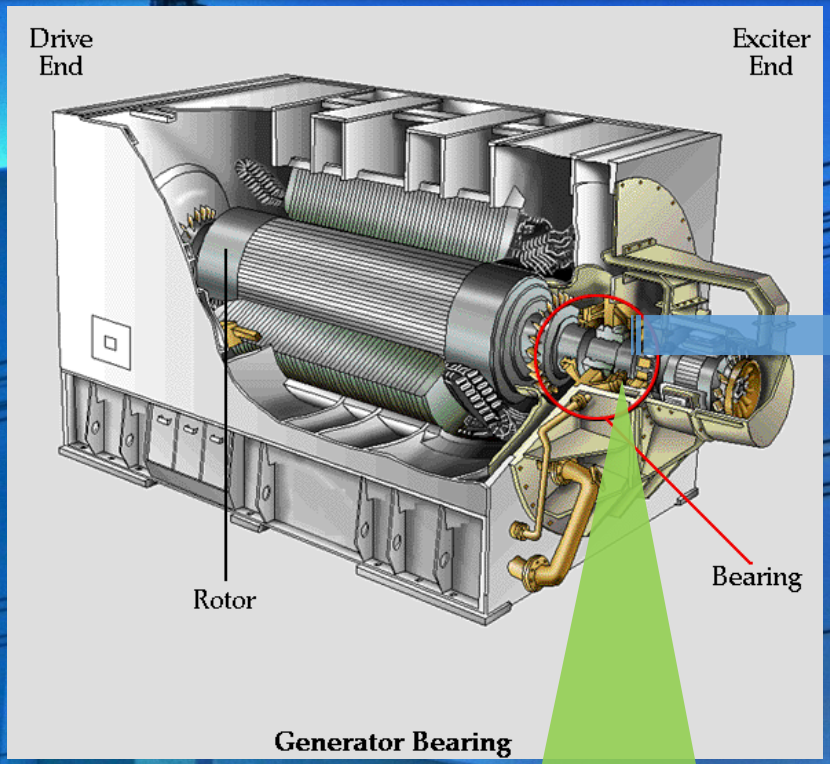


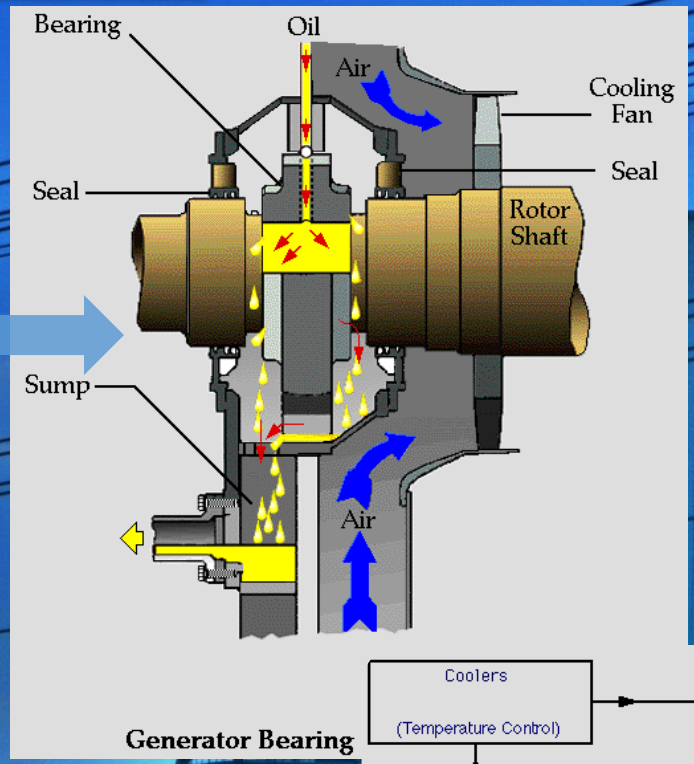
Shaft seal

13. STEEL SHIELD BENEFITS GAS TURBINE SYSTEM

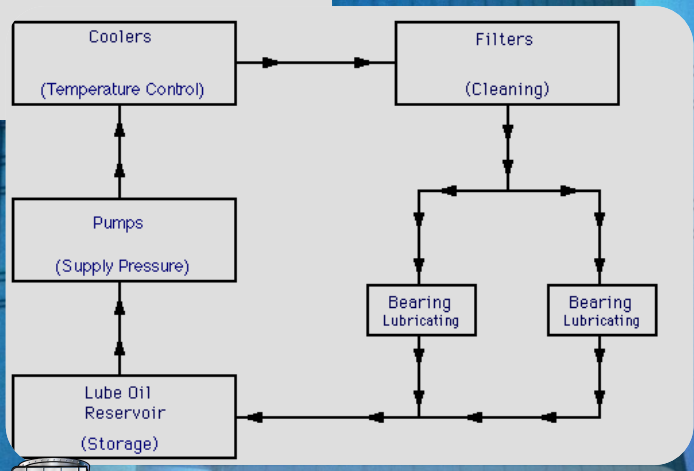
LUBRICATION SYSTEM

HOW STEEL SHIELD ENHANCE TURBINE SYSTEM?





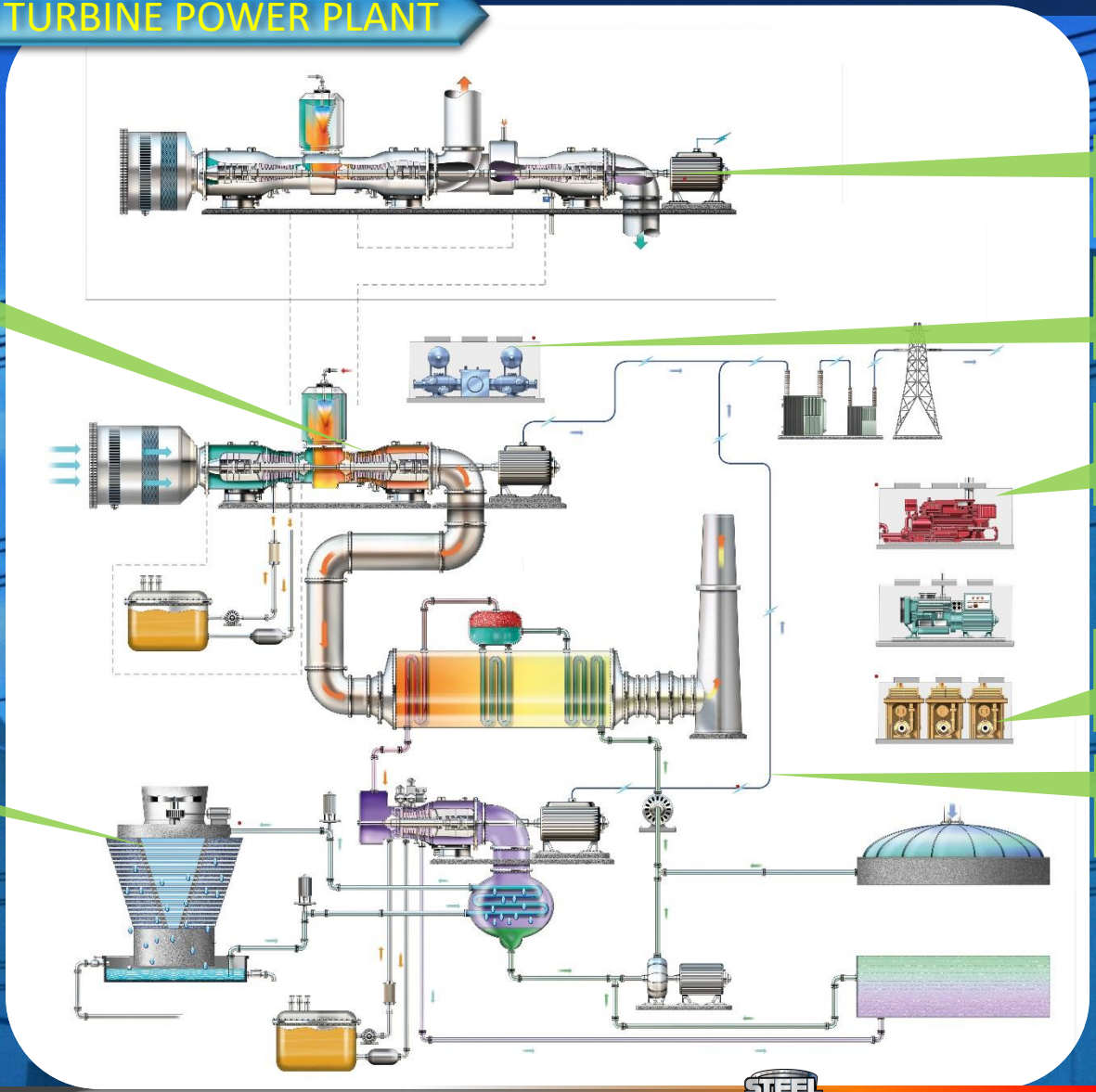
- ABF Technology enhance the metal surface by increase the hardness and smoothness
- Extended bearing life
- Reduce downtime, frequency and costs
- Increase efficiency of bearing and power plant economy
- Reduce heat generated, enhance cooling



14. STEEL SHIELD APPLICATIONS GUIDE

GENERAL LOCATIONS FOR LUBRICATIONS

GAS AND STEAM TURBINE POWER PLANT

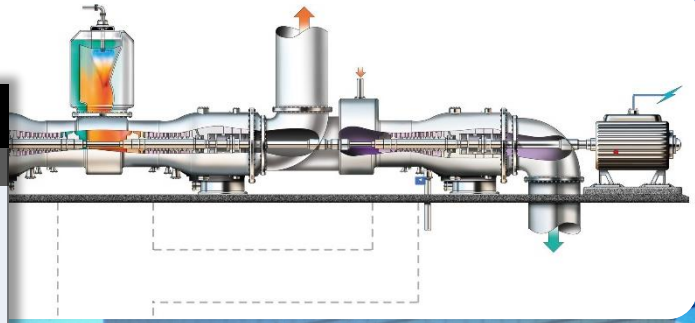


- Gas Turbine Generator Unit
- Cooling Towers
- Single Shaft Turbine Generator Unit
- Gas Compressors
- Back-up Generators / Fire Water Pumps
- Air Compressors
- Steam Loop / Feed Water Pumps

14. STEEL SHIELD APPLICATIONS GUIDE

GENERAL LOCATIONS FOR LUBRICATIONS

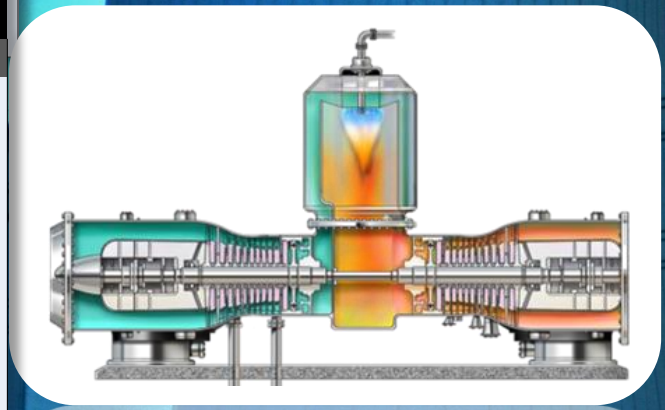
Single Shaft Turbine Generator Unit



STEEL SHIELD Lubricants Recommended

	UNITS	STEEL SHIELD LUBRICANT
1	Turbine reservoir, Generator bearings, EHC system	• SST ECI TURBINO Turbine Oils • SST ECI GECAT No.1 HD-AP Gas Engine Oils • SST ECI GECAT No.2 LD-TV Gas Engine Oils • SST ECI GECAT No.3 HD-AP / ST Gas Engine Oils • SST ECI GECAT No.4 HD-AP Gas Engine Oils • SST ECI GECAT No.5 ND-AP MA-S3 Gas Engine Oils

Gas Turbine Generator Unit



STEEL SHIELD Lubricants Recommended

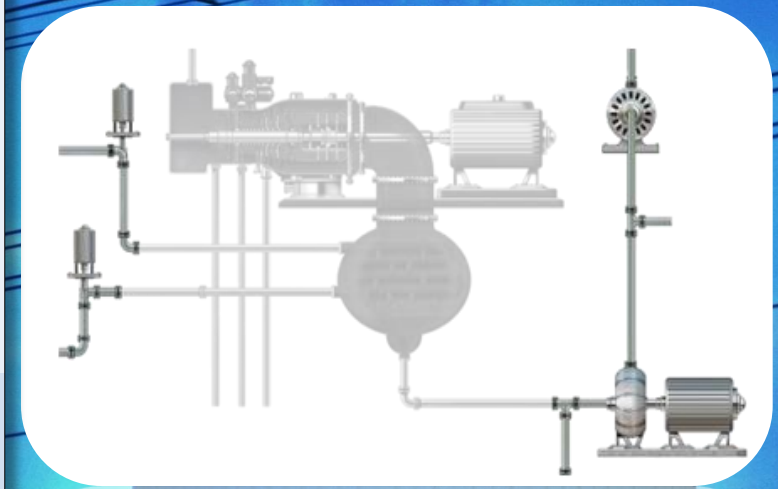
	UNITS	STEEL SHIELD LUBRICANT
1	Turbine reservoir, Generator bearings, EHC system	• SST ECI TURBINO Turbine Oils • SST ECI GECAT No.1 HD-AP Gas Engine Oils • SST ECI GECAT No.2 LD-TV Gas Engine Oils • SST ECI GECAT No.3 HD-AP / ST Gas Engine Oils • SST ECI GECAT No.4 HD-AP Gas Engine Oils • SST ECI GECAT No.5 ND-AP MA-S3 Gas Engine Oils • STEEL SHIELD EPA • LITHI-SHIELD GREASE

14. STEEL SHIELD APPLICATIONS GUIDE

GENERAL LOCATIONS FOR LUBRICATIONS

Steam Loop / Feed Water Pumps

STEEL SHIELD Lubricants Recommended		
	UNITS	STEEL SHIELD LUBRICANT
1	Pumps	• SST ECI POWER-AP PAG Gear Oils • SST ECI T-GEAR AP EP Gear Oils • SST ECI T-SHC AP EP Gear Oils • SST ECI HD-AP ATF DIII Gear Oils • SST ECI HD-AP EP-GL-5 Gear Oils • SST ECI HD-AP PTF Gear Oils • STEEL SHIELD EPA • SPRAY-SHIELD • STRIKE-SHIELD • LITHI-SHIELD GREASE
2	Electric motors	• STEEL SHIELD EPA • SPRAY-SHIELD • STRIKE-SHIELD • LITHI SHIELD GREASE
3	Plain and roller bearings	• STEEL SHIELD EPA • SPRAY-SHIELD • STRIKE-SHIELD • LITHI-SHIELD GREASE
4	Electric motor bearings	• STEEL SHIELD EPA • SPRAY SHIELD • STRIKE SHIELD • LITHI SHIELD GREASE



14. STEEL SHIELD APPLICATIONS GUIDE

GENERAL LOCATIONS FOR LUBRICATIONS

Cooling Towers

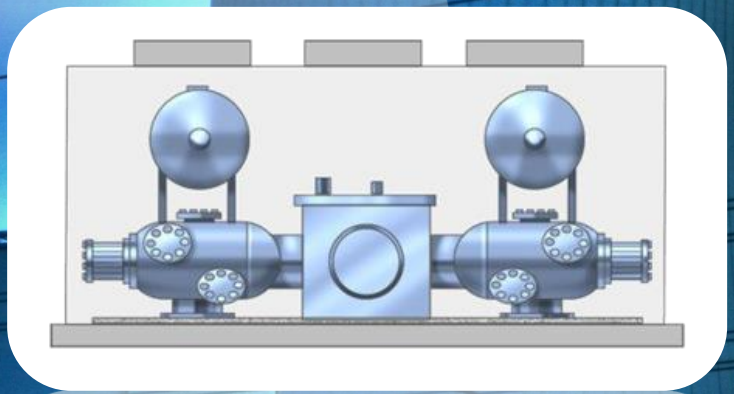
STEEL SHIELD Lubricants Recommended

	UNITS	STEEL SHIELD LUBRICANT
1	Gear drives	• SST ECI POWER-AP PAG Gear Oils • SST ECI T-GEAR AP EP Gear Oils • SST ECI T-SHC AP EP Gear Oils • SST ECI HD-AP ATF DIII Gear Oils • SST ECI HD-AP EP-GL-5 Gear Oils • SST ECI HD-AP PTF Gear Oils • STEEL SHIELD EPA
2	Electric motors	• STEEL SHIELD EPA • SPRAY-SHIELD • STRIKE-SHIELD • LITHI SHIELD GREASE

Gas Compressors

STEEL SHIELD Lubricants Recommended

	UNITS	STEEL SHIELD LUBRICANT
1	Compressors	• SST ECI CAT-TV GC AF Gas Compressor Oils • SST ECI CAT-TV GC Gas Compressor Oils • STEEL SHIELD EPA

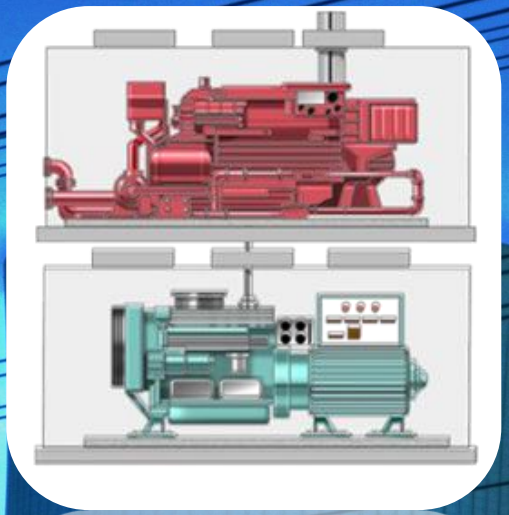


14. STEEL SHIELD APPLICATIONS GUIDE

GENERAL LOCATIONS FOR LUBRICATIONS

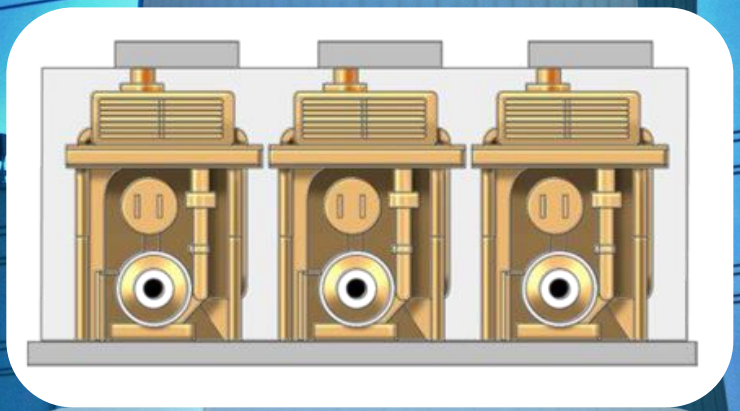
Back-up Generators / Fire Water Pumps

STEEL SHIELD Lubricants Recommended		
	UNITS	STEEL SHIELD LUBRICANT
1	Diesel Engines	• SST ECI HD-AP DIESELUBE CF Diesel Engine Oils • STEEL SHIELD EPA • SPRAY-SHIELD • STRIKE-SHIELD • LITHI-SHIELD GREASE



Air Compressors

STEEL SHIELD Lubricants Recommended		
	UNITS	STEEL SHIELD LUBRICANT
1	Compressors	• SST ECI AP COMPRESSO LOW ASH 0.5 Air Compressor Oils • STEEL SHIELD EPA



15. USA STEEL SHIELD PRODUCTS DESCRIPTIONS

Lithi Shield

Steel Shield EPA

Strike Shield

Not Just Oil…
IT'S TECHNOLOGY

100% Made in USA
100% Import from USA

Spray Shield

Tool Shield

Drill & Tap Shield

5.1. LITHI SHIELD (NLGI #2)

PRODUCT SPECIFICATIONS

- NLGI Grade: No. 2
- Anti-wear metal treatment: Steel Shield

ASTM TESTS

• D-217	Penetration, Worked, 60s	265 - 295
• D-217	Penetration, Unworked	265 - 295
	Thickener Type	Lithium Complex
• D128	Thickener, %	8 - 11
	Color	Light Amber
	Texture	Smooth
• D-2265	Dropping point	500˚F
• D-445	Viscosity @ 40˚F, cst	220
• D-445	Viscosity @ 100˚F, cst	19
• D-2270	Viscosity Index	95
• D-92	Flash Point,˚F	464
• D-92	Fire Point,˚F	550
• D-2509	Timken OK load (lbs.)	60
• D-1743	Rust	Pass
• D-4048	Copper Corrosion	1B
• D-2266	4-Ball Wear Test, mm	0.68
• D-2596	4-Ball EP Weld Test, Kg Min.	800 / Pass
• D-5483	Oxidation Induction time @210˚C, min	11.47
• D-1264	Water washout @ 79˚C	2.7 %
• US Steel Mobility Test	Mobility at 77˚F, g/min	576
	Mobility at 60˚F, g/min	275.4
	Mobility at 40˚F, g/min	86.6
	Mobility at 20˚F, g/min	15.3
	Mobility at 0˚F, g/min	1.6

RECOMMENDED USED

- All extreme pressure applications
- Universal joints
- Rotating machinery
- Heavy equipment
- Railroad equipment
- Boat trailers and marine applications
- Conveyors
- Bearings
- Chassis fittings
- Pumps
- CV joints
- Axies

GEAR SYSTEM REBUILDING & MAINTENANCE:

LITHI-SHIELD™ in Roller Bearings:

In newer style roller bearing type, LITHI-SHIELD surpasses any aftermarket greases in reliability, heat endurance and wear prevention.

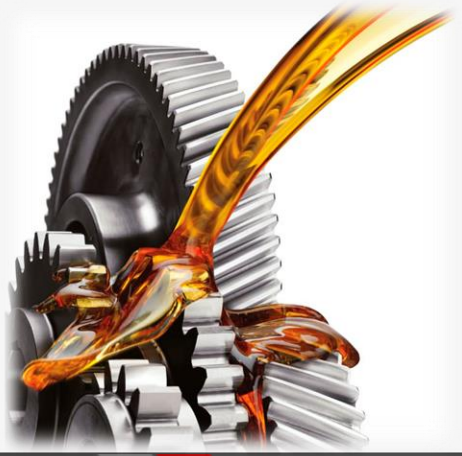
LITHI-SHIELD™ in Armature Bearings:

The use of LITHI-SHIELD in the armature bearings of any industrial systems has reduced failures and wear significantly.

ITEM NO.	ITEM UPC#	ITEM DESCRIPTIONS	CASE PACK	CASE DIMENSIONS	CASE CUBE	CASE WEIGHT	TI / HI
LS-T	8-94630-00181-6	Lithi-Shield Lithium Complex Grease – 59.14 mL/Case	24	9.25”X 6.5”X 4.75”	0.16 inch³	1.9 lb	40 / 8
LS-C	8-94630-00182-3	Lithi-Shield Lithium Complex Grease – 414 mL/Case	40	12”X 10.75”X 19.5”	1.45 inch³	42 lb	6 / 5
LS-LB	8-94630-00183-0	Lithi-Shield Lithium Complex Grease – 473 mL/Case	12	13.5”X 6.25”X 3.5”	0.17 inch³	15.2 lb	36 / 8
LS-5LB	8-94630-00184-7	Lithi-Shield Lithium Complex Grease – 2.365 L/Case	4	14.125”X 6.75”X 9.5”	0.53 inch³	23.4 lb	12 / 8
LS-P	8-94630-00185-4	Lithi-Shield Lithium Complex Grease – 16.5 L/Case	1			38 lb	
LS-K	8-94630-00186-1	Lithi-Shield Lithium Complex Grease – 56.8 L/Case	1			132 lb	
LS-D	8-94630-00187-8	Lithi-Shield Lithium Complex Grease – 189 L/Case	1			437 lb	

15.1.1. Lithi Shield & Reel Shield Grease Compatibility Chart

	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
Barium 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
Calcium 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	-

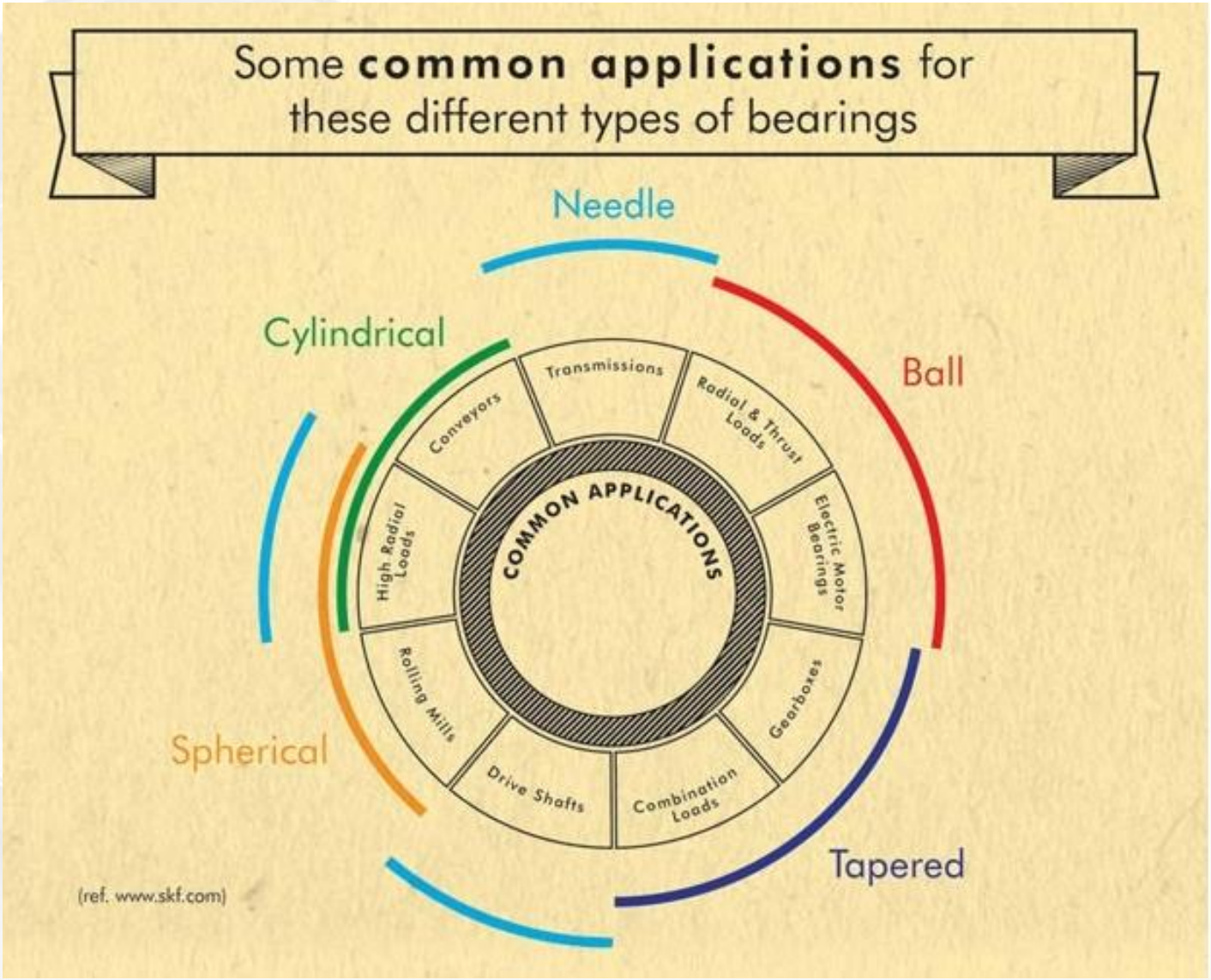


Relative Compatibility Rating

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.

15.1.2. GREASE APPLICATIONS OF BEARINGS



15.1.2. GREASE APPLICATIONS OF BEARINGS

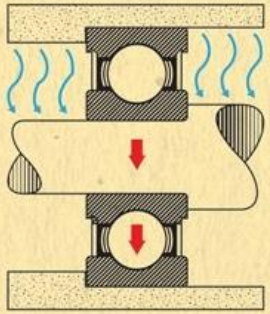
Remember, bearing type affects **grease life**.

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

BEARING TYPE	RELATIVE TYPE OF GREASE
Deep-groove, single-row ball bearing	1
Angular contact, single-row ball bearing	0.625
Self-aligning ball bearing	0.77 - 0.625
Thrust ball bearing	0.2 - 0.17
Cylindrical, single-row roller bearing	0.625 - 0.43
Needle roller bearing	0.3
Tapered roller bearing	0.25
Spherical roller bearing	0.14 - 0.08

(ref. Booser, Bloch, ML)

Bearings also work under different kinds of **loads**.



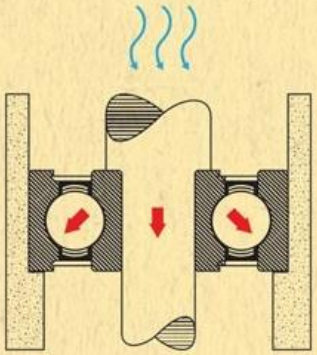
RADIAL LOAD

When the load is perpendicular to the shaft due to

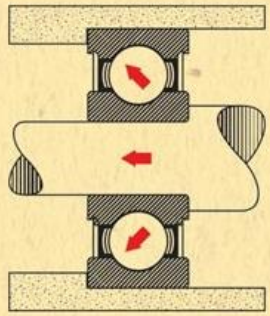
GRAVITY

AXIAL OR THRUST LOAD

(When the load is parallel to the shaft)



Axial load in a vertical pump or electric motor due to gravity



Axial load in a horizontal pump

(ref. www.skf.com)

15.1.2. GREASE APPLICATIONS OF BEARINGS

HOW TO CHOOSE THE RIGHT GREASE?

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.

Base Oil Viscosity

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.

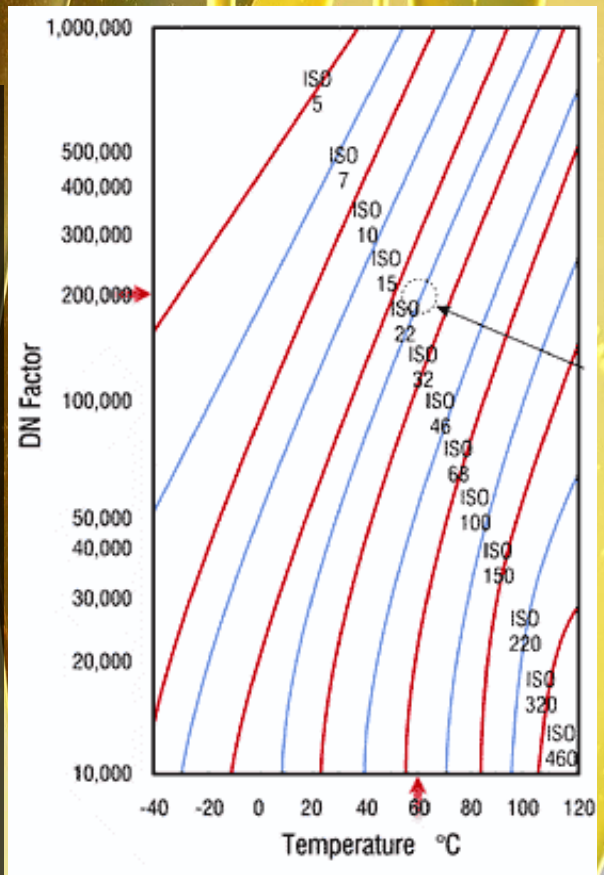


Figure 1

15.1.2. GREASE APPLICATIONS OF BEARINGS

HOW TO CHOOSE THE RIGHT GREASE?

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.

Additives and Base Oil Type

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

15.1.2. GREASE APPLICATIONS OF BEARINGS

HOW TO CHOOSE THE RIGHT GREASE?

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)	NLGI No.*
-30 to 100°F	0 - 75,000 75,00 - 150,000 150,000 - 300,000	1 2 2
0 to 150°F	0 - 75,000 75,00 - 150,000 150,000 - 300,000	2 2 3
100 to 275°F	0 - 75,000 75,00 - 150,000 150,000 - 300,000	2 3 3

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

15.1.2. GREASE APPLICATIONS OF BEARINGS

HOW TO CHOOSE THE RIGHT GREASE?

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.

15.1.3. LITHI SHIELD OUTPERFORMS MOBIL & YAMAMOTO?

01. Performance Advantages of Steel Shield

WHY SHOULD WE SWITCH TO STEEL SHIELD?

Properties	Standard	Unit	Mobilgrease XHP 222	Lithi Shield
NLGI Grade			2	2
Thickener Type			Li-Complex	Li-Complex
4-Ball Weld Load	ASTM D2596	kg	315	800
Timken OK Load	ASTM D2509	lb	40	60

Results:

The 4-Ball Weld Load and Timken OK Load of Lithi Shield are 2.5 Times and 1.5 Times Higher Than Mobilgrease XHP222 Respectively.

When Lithi Shield is Used, The Following Results Can Be Expected:

- Greatly Extended Machine Life
- Dramatically Reductions in Maintenance Costs & Machine Downtimes
- Reliability and Safety of Mechanical System Increase

Mobilgrease XHP 222 Reference: http://www.exxonmobil.com/marinelubes-en/products_auxiliary-machinery_greases_mobilgrease-xhp-222.aspx#

15.2. STEEL SHIELD - EPA

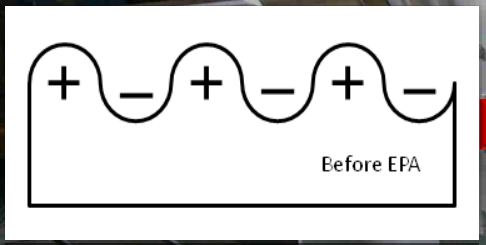
Ionize metal surface

Re-harden metal surfaces & charged with positive ions

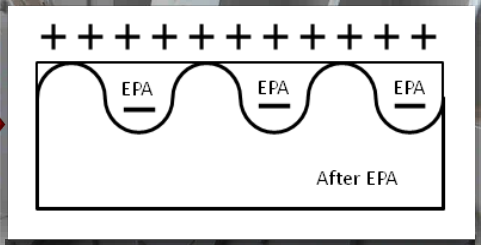
Farady's Law Like-Charge repel causing ionic levitation

Eject dirt, metallic debris, etc.

Greatly reduce friction; improve productivity

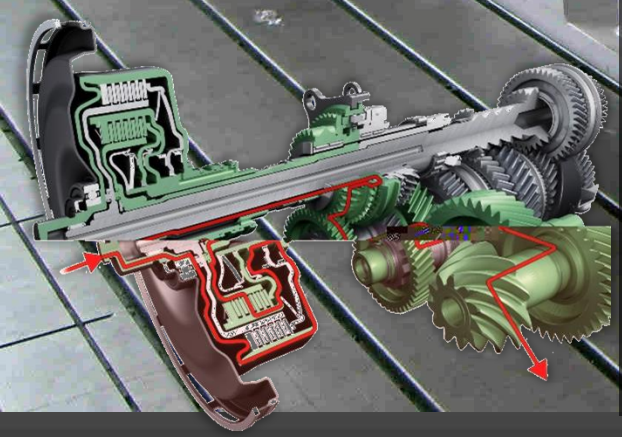


A series of sharp peaks and valleys of metal surface: Peaks are positively charged while the valleys are negatively charged



Applying EPA will effect a change of cation when the metal surface will be positively polarized:

- Surface lapping instead of chip-away endowing new hardness to the metal surface
- Ring opening, oxirane acid scavenging and corrosion inhibition
- Improved surface smoothness and rolling out of asperities



STEEL SHIELD Extreme Pressure Anti-Wear (EPA)™ is made by the latest and the most innovative technology which does not contain any solid additives. 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.

Enhanced performance will greatly reduce maintenance and downtime, and effect significant energy savings through ABF Technology by lowering the operating temperatures, extending the life of component parts and increasing reliability and efficiency.

15.2.1 **STEEL SHIELD EPA COMPATIBILITY**

Item	Base Oil	Compatible with SST-EPA ?	SST Product to Use
1	Petroleum, Mineral Oil	• Yes	• SST-EPA
2	SHC (Synthetic Hydrocarbon) A. Alkylated Aromatics B. Olefin Oligomers e.g. Amsoil, Mobil 1, Castrol Syntec	• Yes	• SST-EPA
3	Halogenated Hydrocarbons A. Chlorotrifluoroethylene, Polytetrafluoroethylene, (PTFE). e.g. Insoluble cutting oil, radiation resistant oil, some heavy duty gear oil, load carrying oils.	• Yes	• SST-EPA
4	Glycol Synthetic Esters A. Alkanolamines B. Polyol Glycols e.g. Fire proof hydraulic fluids, cutting fluids, R-134A Refrigerant Oils, etc.	• No	• On Request
5	Organic Ester Synthetics A. VME - Vegetable Methyl Ester e.g. Some food grade oils, specialty biodegradable oils	• No	• On Request
6	Phosphate Esters A. Triphenol Butylated Phosphate B. Trisecyl Phosphate C. Tricresyl Phosphate e.g.Turbine Oils	• No	• On Request
7	Silicone Oils A. Methyl Silicone B. Phenyl Methyl Silicone C. Silicate Ester/Disiloxane	• No	• None
8	Synthetic Ether A. Polyphenyl Ether B. Chlorinated Diphenyl Ether C. Perfluorinated polyether	• No	• On Request

Keywords to look for on MSDS or Product Description/Technical Sheets

"Glycol" "Alkanolamine" "Ether" "Ester" "Phosphate" "VME" "Phenyl/Phenol" "Silicate" "Boron Oxide *"

- **Boron Oxide is a common additive to Alkanolamine cutting fluids**

15.2.1 STEEL SHIELD PRODUCT COMPATIBILITY

▶In order to help you further understand and determine compatibility issues, we are publishing this three-part test to assist you in determining if oils or fluids are compatible with Steel Shield EPA (SST EPA) and other Steel Shield (SST) products while in the field. Doing these three steps can identify a compatibility issue within 95% accuracy.

▶First: Examine the material safety data sheet for the oil to which the SST EPA is to be added. Look for key words in Section 2, Hazardous Ingredients/Identity Information, which may indicate either product compatibility or incompatibility. Standard petroleum oils are usually referred to as “severely hydrotreated naphthenes” or “paraffinic base stocks”. Other key words are “contains mineral oil” or “synthetic hydrocarbons”. All of these oils have the characteristics of petroleum oil and are compatible with SST products.

▶Key words such as “alky-(compound), alkynol, glycol, alkanolamine, esters, mono esters, polyol or amines” are direct indications of additives and base fluids that are NOT compatible with SST products. For these chemicals, we will provide special SST products that is compatible but only upon request.

▶Second: A good test for compatibility is to mix equal amounts of the base oil in question and SST products. After both are thoroughly blended, allow the mixture to stand for 10 to 15 minutes. If no separation occurs, the likelihood of compatibility is very good. An occurrence of a radical separation indicates the oils are incompatible, and do not mix properly because of chemical differences.

▶Third: After the test above is completed to your satisfaction, the final phase is to perform a lubricity test. Run the base oil in question first to determine its lubricity and load carrying characteristics. Then, mix a proper ratio of SST product with the base oil and run the mixture on the Falex machine. Note the result. If a full-scale reading can be achieved without grinding or damaging the bearing, then you can safely assume the oil and SST product are compatible. However, if only a slight to moderate increase in lubricity can be achieved over the base oil by itself, it must be assumed that there is something present that is inhibiting the formation of the boundary film, which would indicate the base oil and SST product are NOT compatible.

▶When these steps are followed, compatibility issues can be solved in nearly every situation. However, if you have followed through with these steps and still are not able to make a definite decision on compatibility, please do not hesitate to contact our Technical Department to research and verify compatibility issues.

15.3. TOOL SHIELD

MSDS DATA

- Flash Point: 226℃
- Non-flammable
- Non-hazardous
- Synthetic Hydrocarbons

PHYSICAL DATA

- Boiling point: 238℃
- Evaporation rate: < 0.01
- Specific gravity: 1.07
- Insoluble in water
- Vapor pressure: < 1@25℃
- Medium to dark amber

RECOMMENDED USES

- Rotary-type air tools
- Piston-types air tools
- Impact wrenches
- Air ratchets
- Air sanders
- Air drills
- Air cutting tools
- Air grinders
- Air nailers
- Air staplers
- Automatic oilers
- Hand tools

APPLICATION DIRECTIONS

- Use in accordance with tool manufacturers' 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.

Greatly increase the metal surface hardness

Reduce friction, lower temperature, prevent oxidation of metal

Increase efficiencies of tools; Reduced maintenance cost

Achieve highly smooth, durable and silence operations

TOOL SHIELD™ is the ultimate protection for the moving metal parts for automotive and industrial tools. It protects moving metal parts from heat, friction & wear due to boundary conditions of frictional abrasion, extreme pressure torque, air line moisture and internal dirt. It works in all piston and rotary type 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.

ITEM NO.	ITEM UPC#	ITEM DESCRIPTIONS	CASE PACK	CASE DIMENSIONS (W x H x D)	CASE CUBE	CASE WEIGHT	TI / HI
TS-1	8-94630-00141-0	Tool Shield – 1 oz. (29.5 mL)	24	6.875”X 3.875”X 4.625”	0.07 inch³	2.5 lb	48 / 12
TS-4	8-94630-00143-4	Tool Shield – 4 oz. (118 mL)	12	5.5”X 6.5”X 7.125”	0.16 inch³	3.8 lb	40 / 8
TS-16	8-94630-00144-1	Tool Shield – 16 oz. (473 mL)	12	10.75 X 10.75 X 8	0.54 inch³	15 lb	20 / 5
TS-128	8-94630-00145-8	Tool Shield – 1 Gallon (3.785 L)	4	9.25 X 12.5 X 14.5	0.97 inch³	34 lb	12 / 4
TS-5G	8-94630-00126-7	Tool Shield – 5 Gallon (18.93 L)	1			42 lb	
TS-15G	8-94630-00127-4	Tool Shield – 1 Gallon (56.78 L)	1			125 lb	
TS-55G	8-94630-00128-1	Tool Shield – 1 Gallon (208 L)	1				

15.4. STRIKE SHIELD

MSDS DATA

- Flash point: 61℃ PMCC (Pensky –Martens closed-cup test)
- Non-hazardous
- Combustible
- Synthetic hydrocarbons
- Do not store or expose above 61℃
- Do not spray near sparks or open flames
- If swallowed, do not induce vomiting and call a physician immediately
- In case of contact with eyes, flush thoroughly with water for 15 minutes
- Avoid breathing of vapor and prolonged contact with skin
- Contains petroleum aliphatic hydrocarbons

PHYSICAL DATA

- Boiling point: 186 - 201℃
- Evaporation rate: < 0.01
- Specific gravity: 1.02
- Insoluble in water
- Vapor pressure: < 1@25℃
- Light to dark amber

RECOMMENDED USED

- Frozen or scaled nuts and bolts
- Sticky locks
- Squeaky hinges
- Sliding doors
- Linkages
- Shafts
- Bushings
- Sliding parts and mechanisms

APPLICATION DIRECTIONS

- Apply Strike Shield on surfaces that require penetrating and lubricating oil. Reapplication may be necessary on extremely rusted and corroded conditions.

STRIKE SHIELD™ is the ultimate penetrant to rapidly pierce rusted and corroded metal surfaces using a distinctive spreading action to break loose 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.

It leaves a unique layer of film on surfaces that prevents 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

ITEM NO.	ITEM UPC#	ITEM DESCRIPTIONS	CASE PACK	CASE DIMENSIONS (W x H x D)	CASE CUBE	CASE WEIGHT	TI/HI
STKS-4WS	8-94630-00104-5	Strike Shield – 4 oz. (118 mL)	12	6.625”X 7”X 5”	4 inch³	0.13 lb	56 / 7
STKS-16WS	8-94630-00105-2	Strike Shield – 16 oz. (473 mL)	12	10.125”X 10”X 7.625”	14 inch³	0.44 lb	20 / 5
STKS-128	8-94630-00109-0	Strike Shield – 1 Gallon (3.785 mL)	4	15.625”X 11.875”X 8.125”	33.5 inch³	0.17 lb	12 / 4
STKS-5G		Strike Shield – 5 Gallon (18.93 L)	1		42.5 inch³		
STKS-15G		Strike Shield – 15 Gallon (56.78 L)	1				
STKS-55G		Strike Shield – 55 Gallon (208 L)	1				

15.5. SPRAY SHIELD

MSDS DATA

- Flash Point: 226℃
- Non-flammable
- Non-hazardous
- Synthetic Hydrocarbons

PHYSICAL DATA

- Boiling point: 238℃
- Evaporation rate: < 0.01
- Specific gravity: 1.07
- Insoluble in water
- Vapor pressure: < 1@25℃
- Medium to dark amber

RECOMMENDED USES

- Metal mechanisms
- Metal-to-metal surfaces
- Chain drives
- Drag lines
- Bushings
- Pulleys
- Hinges
- Tools
- Sleeve bearings
- 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

APPLICATION DIRECTIONS

- Apply Spray Shield to surfaces requiring lubrication. Reapplication may be necessary for extremely rusted or corroded situations.
- Contains NO volatiles or solvents.
- Contains synthetic hydrocarbons and advanced chemical additive technology.

MACHINERY REBUILDING & MAINTENANCE:

SPRAY SHIELD™ is the ultimate multi-purpose lubricant that also penetrates metal surfaces while maintaining highest qualities in corrosive and extreme humidity environments. It 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.

ITEM NO.	ITEM UPC#	ITEM DESCRIPTIONS	CASE PACK	CASE DIMENSIONS (W x H x D)	CASE CUBE	CASE WEIGHT	TI/HI
SS-1	8-94630-00146-5	Spray Shield – 1 oz. (29.5 mL)	24	6.875” X 3.875” X 4.625”	0.07 inch³	2.5 lb	48 / 12
SS-4	8-94630-00148-9	Spray Shield – 4 oz. (118 mL)	12	5.5” X 7” X 7.125”	0.16 inch³	3.8 lb	40 / 8
SS-16	8-94630-00149-6	Spray Shield – 16 oz. (473 mL)	12	10.75” X 10.75” X 8”	0.54 inch³	15 lb	20 / 5
SS-128	8-94630-00150-2	Spray Shield – 1 Gallon (3.785 L)	4	9.25” X 12.5” X 14.5”	0.97 inch³	34 lb	12 / 4
SS-5G	8-94630-00129-8	Spray Shield – 5 Gallon (18.93 L)	1			42 lb	
SS-15G	8-94630-00130-4	Spray Shield – 15 Gallon (56.78 L)	1			125 lb	
SS-55G	8-94630-00150-2	Spray Shield – 55 Gallon (208 L)	1				

15.6. DRILL & TAP SHIELD

MSDS DATA

- Flash Point: 226℃
- Non-flammable
- Non-hazardous
- Synthetic Hydrocarbons

PHYSICAL DATA

- Boiling point: 238℃
- Evaporation rate: < 0.01
- Specific gravity: 1.07
- Insoluble in water
- Vapor pressure: < 1@25℃
- Medium to dark amber

RECOMMENDED USES

- Direct cutting lube / coolant
- Additive to improve performance of insoluble oils
- Drilling
- Taping
- Machining
- Milling
- CNC
- Broaching
- Sharpening
- Wet grinding

APPLICATION DIRECTIONS

- Drill & Tap Shield™ can be used as a direct replacement for currently used cutting fluids and lubrication / coolants in a 100% undiluted application.
  NOTE: Drill & Tap Shield™ is not compatible with water glycol compounds or triphenol butylated phosphate oils.
- Contains NO volatiles or solvents.
- Contains synthetic hydrocarbons and advanced chemical additive

MACHINERY REBUILDING & MAINTENANCE:

DRILL & TAP SHIELD™ in Axle Grinder / Finisher – Axle-End Thread Tapping:

When used as the lubricant / coolant for axle grinding and finishing machines, DRILL & TAP SHIELD will provide improved final finishes of the axles to well within specified tolerances, which in some cases, were unachievable otherwise.

ITEM NO.	ITEM UPC#	ITEM DESCRIPTIONS	CASE PACK	CASE DIMENSIONS (W x H x D)	CASE CUBE	CASE WEIGHT	TI/HI
DTS-1	8-94630-00171-7	Drill & Tap Shield – 1 oz. (29.5 mL)	24	6.875”X 3.875”X 4.625”	0.07 inch³	2.5 lb	48 / 12
DTS-4	8-94630-00172-4	Drill & Tap Shield – 4 oz. (118 mL)	12	5.5”X 7”X 7.125”	0.16 inch³	3.8 lb	40 / 8
DTS-16	8-94630-00173-1	Drill & Tap Shield – 16 oz. (473 mL)	12	10.75”X 10.75”X 8”	0.54 inch³	15 lb	20 / 5
DTS-128	8-94630-00174-8	Drill & Tap Shield – 1 Gallon (3.785 L)	4	9.25”X 12.5”X 14.5”	0.97 inch³	34 lb	12 / 4
DTS-5G	8-94630-00175-5	Drill & Tap Shield – 5 Gallon (18.93 L)	1			42 lb	
DTS-15G	8-94630-00176-2	Drill & Tap Shield – 15 Gallon (56.78 L)	1			125 lb	
DTS-55G	8-94630-00177-9	Drill & Tap Shield – 55 Gallon (208 L)	1				

16. SINGAPORE STEEL SHIELD PRODUCTS DESCRIPTIONS

GEAR, HYDRAULIC & AIR-COMPRESSOR LUBRICANTS

SST ECI HD-AP ATF DIII Auto-Transmission Fluid

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

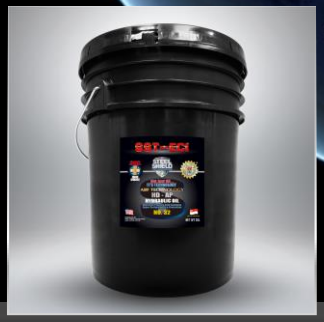
SST ECI HD-AP PTF Transmission Fluid

SST ECI POWER-AP PAG Gear Oil

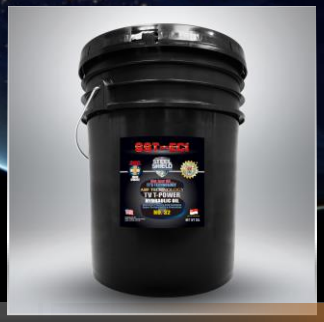
SST ECI T-GEAR AP EP Gear Oil

SST ECI T-SHC AP EP Gear Oil

SST ECI HD-AP Hydraulic Oil



SST ECI TV T-Power Hydraulic Oil



SST ECI AP COMPRESSO Air-Compressor Oil

Not Just Oil... IT'S TECHNOLOGY

Made in Singapore

100% USA Additives

16.1. SST ECI HD-AP ATF DIII Auto-Transmission Fluid

Ultra Quality Lubricants For Heavy Gearing Systems

Physical Data

Properties	Standard	Unit	Data
SAE Grade			DIII
Kinematic Viscosity @ 40℃	ASTM D445	cSt	34
Kinematic Viscosity @ 100℃	ASTM D445	cSt	7.6
Viscosity Index	ASTM D2270		176
Flash Point (COC)	ASTM D92	℃	170
Pour Point	ASTM D97	℃	-35

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

SST-ECI HD-AP ATF DIII is a state-of-the-art automatic transmission fluid made with the unique ABF technology especially for modern automatic gearboxes. The oil is blended with highly refined base oils and select additives to enhance oxidation stability, anti-friction, anti-wear and low temperature properties and low temperature fluidity. The oil meets and complies with the requirements of GM DEXRON IID, IIIG, IIIH, Ford MERCON, Caterpillar TO-2, Allison C-4.

SST-ECI HD-AP ATF DIII, 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.

16.2. SST ECI HD-AP EP-GL-5 Auto-Gear Oil

Ultra Quality Lubricants For Heavy Gearing Systems

Physical Data

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

Benefits

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

Available Container Volumes

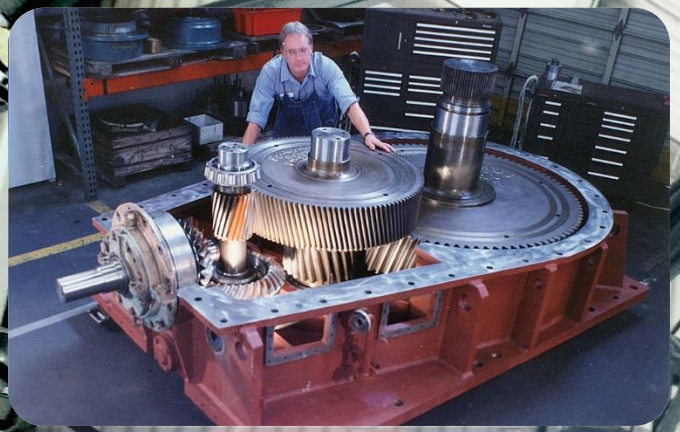
- 20L, 200L, 1000L

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, anti-oxidation, de-mulsification 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.

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.

16.3. SST ECI HD-AP PTF Transmission Fluid

Ultra Quality Lubricants For Heavy Gearing Systems



Physical Data

Properties	Standard	Unit	Data				
SAE Grade			10W	30	40	50	60
Kinematic Viscosity @ 40℃	ASTM D445	cSt	42	97	141	228	318
Kinematic Viscosity @ 100℃	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	℃	205	210	215	225	230
Pour Point	ASTM D97	℃	-30	-25	-25	-9	-9

Benefits

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

Available Container Volumes

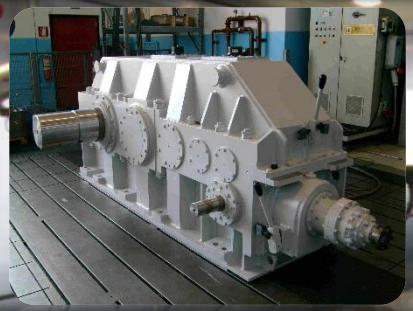
- 20L, 200L, 1000L

SST-ECI HD-AP PTF, 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.

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.

16.4. SST ECI POWER-AP PAG Gear Oil

Ultra Quality Lubricants For Heavy Gearing Systems



Physical Data

Properties	Standard	Unit	Data			
ISO Grade			150	220	320	460
Kinematic Viscosity @ 40℃	ASTM D445	cSt	150	220	320	460
Kinematic Viscosity @ 100℃	ASTM D445	cSt	23	34	51	72
Viscosity Index	ASTM D2270		185	202	220	230
Flash Point (COC)	ASTM D92	℃	225	225	225	230
Pour Point	ASTM D97	℃	-30	-30	-30	-27
FZG Fail Loading Stage	DIN 51354-2		12+	12+	12+	12+

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

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.

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.

16.5. SST ECI T-GEAR AP EP Gear Oil

Ultra Quality Lubricants For Heavy Gearing Systems

Physical Data

Properties	Standard	Unit	Data						
SAE Grade			150	220	320	460	680	1000	1500
Kinematic Viscosity @ 40℃	ASTM D445	cSt	150	220	320	460	680	1000	1500
Kinematic Viscosity @ 100℃	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	℃	240	245	247	250	250	252	255
Pour Point	ASTM D97	℃	-10	-9	-9	-9	-6	-3	-3
Copper Corrosion	ASTM D130		1B	1B	1B	1B	1B	1B	1B

Benefits

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

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.

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.

16.6. SST ECI T-SHC AP EP Gear Oil

Ultra Quality Lubricants For Heavy Gearing Systems

SST ECI T-SHC AP EP Gear Oils are all season high performance synthetic extreme pressure industrial gear oils fortified with sulphur-phosphorous and ash-less dispersant additives and with ABF Technology to enhance anti-oxidation, anti-corrosion, de-mulsification, 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.

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.

Physical Data

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

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

16.7. SST ECI HD-AP Hydraulic Oil

Excellent Anti-Wear Abilities & Reduce Maintenance Costs

Physical Data

Properties	Standard	Unit	Data				
ISO Grade			32	46	68	100	150
Kinematic Viscosity @ 40℃	ASTM D445	cSt	30	45	67	98	145
Kinematic Viscosity @ 100℃	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	℃	212	220	228	245	250
Pour Point	ASTM D97	℃	-12	-12	-10	-10	-10

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

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.

SST ECI HD AP 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.

16.8. SST ECI TV T-Power Hydraulic Oil

Excellent Anti-Wear Abilities & Reduce Maintenance Costs

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.

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

Physical Data

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

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

16.9. SST ECI AP COMPRESSO Air-Compressor

Excellent Anti-Wear Abilities & Reduce Maintenance Costs

Physical Data

Properties	Standard	Unit	Data				
ISO Grade			32	46	68	100	150
Kinematic Viscosity @ 40℃	ASTM D445	cSt	29	46	68	97	150
Kinematic Viscosity @ 100℃	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	℃	215	220	230	245	248
Pour Point	ASTM D97	℃	-15	-12	-10	-10	-9

Benefits

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

Available Container Volumes

- 20L, 200L, 1000L

SST ECI AP COMPRESSO Air-Compressor Oils 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 demulsification properties, meet the requirements of DIN 51506 VD-L

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

17. SINGAPORE STEEL SHIELD PRODUCTS DESCRIPTIONS

GAS ENGINE, TURBINE & GAS COMPRESSOR LUBRICANTS

SST ECI TURBINE Turbine Oils

SST ECI GECAT No.1 HD-AP Gas Engine Oils

SST ECI GECAT No.2 LD-TV Gas Engine Oils

SST ECI GECAT No.3 HD-AP / ST Gas Engine Oils

SST ECI GECAT No.4 HD-AP Gas Engine Oils

SST ECI GECAT No.5 ND-AP MA-S3 Gas Engine Oils

SST ECI CAT-TV GC AF Gas Compressor Oils

SST ECI CAT-TV GC Gas Compressor Oils

Not Just Oil... IT'S TECHNOLOGY

Made in Singapore

100% USA Additives

17.1. SST ECI TURBINO Turbine Oils

Ultimate Turbine Performaner & Protector With High Stabilities

Physical Data

Properties	Standard	Unit	Data			
ISO Grade			32	46	68	100
Kinematic Viscosity @ 40℃	ASTM D445	cSt	32	46	68	100
Kinematic Viscosity @ 100℃	ASTM D445	cSt	5.3	6.9	8.7	11.2
Viscosity Index	ASTM D2270		110	106	100	99
Flash Point (COC)	ASTM D92	℃	210	215	225	240
Pour Point	ASTM D97	℃	-12	-12	-12	-12

Benefits

- Excellent chemical stability
- Excellent demulsifibility
- Excellent thermal stability
- Extended oil drain interval
- Extends the life of engine parts up to 300% (conditional to the physical status)
- Good anti-oxidation and anti-rust properties
- Good filterability
- Improves efficiency in terms of usable output energy
- Reduce downtime 200% and more
- Reduce noise 3db~9db (conditional to system condition)
- Resistance to foaming
- Resistance to sludge deposit

Available Container Volumes

- 20L, 200L, 1000L

SST ECI TURBINO are premium highly refined turbine oils with ashless additives to enhance demulsification, anti-rust and anti-oxidation properties. The oils being enhanced with ABF Technology meet requirements of DIN51515, DIN51524 Part 1, GEK 32568, GEK107395, GEK46506, Siemens TLV90134, Alstom HTGD90117, Denison HF-1M, Solar Turbines Esq-224, AIST125, ISO8068, etc. These oils have a long service life due to high level of chemical and thermal stability, good load carrying capability and resistance to sludge formation.

SST ECI TURBINO are suitable for lubrication the steam, gas and water turbines and other precision machinery, hydraulic fluid, heat transfer fluid, etc.

17.2. SST ECI GECAT No.1 HD-AP Gas Engine

High Performance Low Ash Gas Engine Lubricants Built For Severe Environment

Physical Data

Properties	Standard	Unit	Data	
SAE Grade			30	40
Kinematic Viscosity @ 40℃	ASTM D445	cSt	100	138
Kinematic Viscosity @ 100℃	ASTM D445	cSt	11.1	14.2
Viscosity Index	ASTM D2270		98	99
Flash Point (COC)	ASTM D92	℃	220	235
Pour Point	ASTM D97	℃	-20	-20
TBN	ASTM D2896	mgKOH/g	5	5
Sulphated Ash	ASTM D874	%wt	0.45	0.45

Benefits

- Extended oil drain interval
- Extends the life of engine parts up to 400% (conditional to the physical status)
- Good protection against corrosion and wear
- Improves efficiency in terms of usable output energy
- Reduce deposit and maintain engine cleanliness
- Reduce downtime 300% and more
- Reduce noise 3db~9db (conditional to engine condition)
- Strong TBN retention
- Ultimate performance against oxidation and nitration

Available Container Volumes

- 20L, 200L, 1000L

SST ECI GECAT No.1 HD-AP is a Heavy Duty low-ash natural gas / bio-gas engine oils formulated with highly refined mineral oils and select additives to control wear, oxidation, nitration and bearing corrosion. Enhanced with Steel Shield ABF Technologies the oil demonstrates excellent performance in variety of engines such as Caterpillar, Deutz- MWM, Jenbacher, Guascor, etc. These oils exceed the performance requirements of API CF and Caterpillar Series 3.

SST ECI GECAT No.1 HD-AP is recommended for use in new generation spark-ignition, highly rated, both 2-cycle and 4-cycle gas engines requiring low-ash contents.

17.3. SST ECI GECAT No.2 LD-TV Gas Engine

A Low Ash Gas Engine Super Enhancer Tailor Made For Light Duty Gas Engines

Physical Data

Properties	Standard	Unit	Data
SAE Grade			40
Kinematic Viscosity @ 30℃	ASTM D1298	Kg / L	0.886
Kinematic Viscosity @ 40℃	ASTM D445	cSt	146.8
Kinematic Viscosity @ 100℃	ASTM D445	cSt	14.52
Viscosity Index	ASTM D2270		91
Flash Point (COC)	ASTM D92	℃	>218
Pour Point	ASTM D97	℃	≤-15
TBN	ASTM D2896	mgKOH/g	4.8
Sulphated Ash	ASTM D874	%wt	0.4
Boiling Point		℃	228

Benefits

- Extended oil drain interval
- Extends the life of engine parts up to 400% (conditional to the physical status)
- Good protection against corrosion and wear
- Improves efficiency in terms of usable output energy
- Reduce deposit and maintain engine cleanliness
- Reduce downtime 300% and more
- Reduce noise 3db~9db (conditional to engine condition)
- Strong TBN retention
- Ultimate performance against oxidation and nitration

Available Container Volumes

- 20L, 200L, 1000L

SST ECI GECAT No.2 LD-TV is a low-ash, light duty natural gas/bio-gas engine oils 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. Built for Landfill / biogas Engine: The oil demonstrates excellent performance in variety of engines such as Caterpillar, Guascor, Jenbacher, Deutz- MWM etc. The oil qualifies for API CF/SF.

SST ECI GECAT No.2 LD-TV is recommended for use in new generation spark-ignition, highly rated, both 2-cycle and 4-cycle gas engines & gas compressors requiring low-ash contents.

17.4. SST ECI GECAT No.3 HD-AP/ST Gas Engine

High Performance Mid Ash Gas Engine Lubricants Built For Severe Environment

Physical Data

Properties	Standard	Unit	Data
SAE Grade			40
Kinematic Viscosity @ 40℃	ASTM D445	cSt	123
Kinematic Viscosity @ 100℃	ASTM D445	cSt	13.7
Viscosity Index	ASTM D2270		105
Flash Point (COC)	ASTM D92	℃	235
Pour Point	ASTM D97	℃	-12
TBN	ASTM D2896	mgKOH/g	6.3
Sulphated Ash	ASTM D874	%wt	0.51-0.71

Benefits

- Exceptionally resistant to viscosity increase
- Extended oil drain interval
- Extends the life of engine parts up to 400% (conditional to the physical status)
- Good protection against corrosion and wear
- Improves efficiency in terms of usable output energy
- Reduce deposit and maintain engine cleanliness
- Reduce downtime 300% and more
- Reduce noise 3db~9db (conditional to engine condition)
- Strong resistance to TAN increase
- Strong TBN retention
- Ultimate performance against oxidation and nitration

Available Container Volumes

- 20L, 200L, 1000L

SST ECI GECAT No.3 HD-AP / ST is a Heavy Duty Mid Ash Gas Engine Oil formulated with highly refined mineral oils and selected additives to control wear, oxidation, nitration and bearing corrosion. Enhanced with Steel Shield ABF Technologies the oil demonstrates excellent performance in a variety of engines including but not limited to Caterpillar, Deutz-MWM, Jenbacher, Guascor and Waukesha. The oil exceeds the performance requirements of API CF and caterpillar series 3.

SST ECI GECAT No.3 HD-AP / ST is recommended for use in spark-ignition 4-stroke, highly rated stationary gas engines requiring medium-ash contents.

17.5. SST ECI GECAT No.4 HD-AP Gas Engine

High Performance Ashless Gas Engine Lubricants Built For Severe Environment

Physical Data

Properties	Standard	Unit	Data	
SAE Grade			30	40
Kinematic Viscosity @ 40℃	ASTM D445	cSt	102	138
Kinematic Viscosity @ 100℃	ASTM D445	cSt	11.5	13.8
Viscosity Index	ASTM D2270		99	98
Flash Point (COC)	ASTM D92	℃	225	238
Pour Point	ASTM D97	℃	-20	-20
TBN	ASTM D2896	mgKOH/g	2.2	2.2
Sulphated Ash	ASTM D874	%wt	<0.1	<0.1

Benefits

- Exceptional control of deposit, wear and bearing corrosion
- Extended oil drain interval
- Extends the life of engine parts up to 400% (conditional to the physical status)
- Improves efficiency in terms of usable output energy
- Minimizing spark plug fouling and pre-ignition
- Reduce deposit and maintain engine cleanliness
- Reduce downtime 300% and more
- Reduce noise 3db~9db (conditional to engine condition)
- Strong TBN retention
- Superior oxidation and nitration stability

Available Container Volumes

- 20L, 200L, 1000L

SST ECI GECAT No.4 HD-AP is a Heavy Duty ashless natural gas engine oils formulated with highly refined paraffinic base oils and special select ashless additives. Enhanced with Steel Shield ABF Technologies these oils demonstrate excellent control of deposits, wear, bearing corrosion, oxidation and nitration. They can meet the requirements of Ajax, Clark, Cooper-Bessemer and Fairbanks-Morse 2-cycle naturally aspirated and turbo-charged engines fuelled by natural gas.

SST ECI GECAT No.4 HD-AP is recommended for use in 2-cycle, spark-ignition industrial gas engines where ashless oil is required.

17.6. SST ECI GECAT No.5 ND-AP MA-S3 Gas

High Performance Medium Ash Gas Engine Lubricants Built For Powerful Engines

Physical Data

Properties	Standard	Unit	Data	
SAE Grade			30	40
Kinematic Viscosity @ 40℃	ASTM D445	cSt	101	128
Kinematic Viscosity @ 100℃	ASTM D445	cSt	11.2	13.3
Viscosity Index	ASTM D2270		98	98
Flash Point (COC)	ASTM D92	℃	222	235
Pour Point	ASTM D97	℃	-15	-12
TBN	ASTM D2896	mgKOH/g	9.8	9.8
Sulphated Ash	ASTM D874	%wt	0.94	0.94

Benefits

- Exceptionally resistant to viscosity increase
- Extended oil drain interval
- Good protection against corrosion and wear
- Improves efficiency
- Reduce deposit and maintain engine cleanliness
- Reduce downtime 200+%
- Reduce noise 3db~9db (conditional to engine condition)
- Strong resistance to TAN increase
- Ultimate performance against oxidation and nitration

Available Container Volumes

- 20L, 200L, 1000L

SST ECI GECAT No.5 ND-AP MA-S3 are medium ash natural gas engine oils formulated with highly refined mineral oils and select additives to control wear, oxidation, nitration and bearing corrosion. The oil is enhanced with Steel Shield ABF Technologies for excellent performance in a variety of engines such as Caterpillar, Deutz-MWM, Jenbacher, Guascor as well as Waukesha. These oils meet the performance requirements of API CF and caterpillar series 3.

SST ECI GECAT No.5 ND-AP MA-S3 is recommended for use in spark-ignition four-stroke, highly rated stationary gas engines requiring medium-ash content.

17.7. SST ECI CAT-TV GC AF Gas Compressor

Premium Ash Free Lubricants With Proven Protection For Extended Engine Life

Physical Data

Properties	Standard	Unit	Data			
ISO Grade			32	46	68	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

Benefits

- 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

Available Container Volumes

- 20L, 200L, 1000L

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.

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.

17.8. SST ECI CAT-TV GC Gas Compressor Oils

Premium Low Ash Lubricants For New Generation Gas Compressors

Physical Data

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

Benefits

- 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

Available Container Volumes

- 20L, 200L, 1000L

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.

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

18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD LARGELY OUTPERFORMS REPUTED GREASES MADE BY YAMAMOTO AND ATLAS

Report 1

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

STEEL SHIELD LITHI SHIELD

SwRI Code:	Sample ID: 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 grea… tomo EP grease" therefore, sample is co…dered "outside the scope of the method".

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

SwRI Code:	Sample ID: 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
		kgf	50

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

WIN

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

18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2782 TIMKEN TESTS

THE TEST REPORT FROM SOUTHWEST RESEARCH INSTITUTE – Timken ASTM D2782

Report 2

Test Report
2014 / 11 / 20
Steel Shield Technologies

SwRI Lab No.	24564	23728	25252	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 805 SAE 40 Gas Engine Oil	Mobil Pegasus 801 SAE 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 (℃)	38	38	38	38	38	38

Products of the same class

Results

Steel Shield Wins：
Steel Shield outperforms Mobil in OK LOAD parameter by 444 % and in SCORE LOAD by 375 %.

The SwRI Timken Test report clearly testified Steel Shield products are FAR Superior than Mobil products of the same classes

SOUTHWEST RESEARCH INSTITUTE website:
www.swri.org

18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

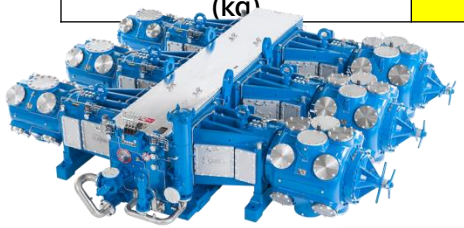
STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2783 FOUR BALLS TESTS

THE TEST REPORT FROM SOUTHWEST RESEARCH INSTITUTE – 4-Ball ASTM D2783

Report 2

Test Report
2014 / 11 / 20
Steel Shield Technologies

SwRI Lab No.	24564	23728	25252	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 SAE 40 Low Ash With EPA	Steel Shield EPA	Steel Shield Compressor Oil ISO #100 / 150	Mobil Pegasus 805 SAE 40 Gas Engine Oil	Mobil Pegasus 801 SAE 40 Gas Engine Oil
Volume (Gallon)	1	1	1	1	1	1
Corrected Load (kgf)	70	109	NA	133	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



Products of the same class

Results

Steel Shield Wins :

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.

The SwRI 4-Balls Test testified Steel Shield products are superior than Mobil products of the same classes

SOUTHWEST RESEARCH INSTITUTE website: www.swri.org

18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2782 Timken, D2783 4-Ball & D6352 GC – Original Documents

Report 2

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.

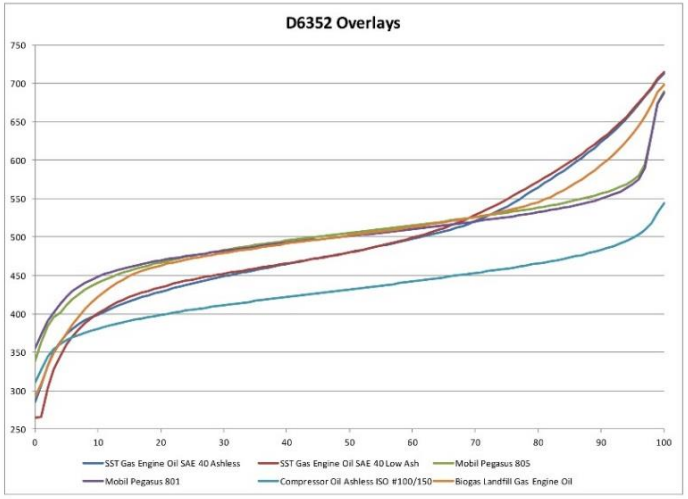
If there are any questions concerning these analyses, or if you need any additional testing on the samples, please contact me at (210) 522-2071. We appreciate the opportunity to be of service to your firm.

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.

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18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2782 Timken, D2783 4-Ball & D6352 GC – Original Documents

Report 2

Test Summary Report
November 20th, 2014
Steel Shield Technologies

SwRI Lab# 24564

SST Gas Engine Oil
5AE 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

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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

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18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2782 Timken, D2783 4-Ball & D6352 GC – Original Documents

Report 2

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

18. SOUTHWEST RESEARCH INSTITUTE TEST REPORTS

STEEL SHIELD GAS ENGINE OILS AND COMPRESSOR OILS ASTM D2782 Timken, D2783 4-Ball & D6352 GC – Original Documents

Report 2

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
		39%	491.3	59%	509.0	79%	530.9	99%	673.0
								FBP	687.9

19. INSURANCE CERTIFICATE & CONFIRMATION OF NO INSURANCE CLAIM

ACORD

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 5/14/2014

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Best Insurance Agency
340 S. Main St., P.O. Box 670
Butler PA 16003-0670

CONTACT NAME: Jamie McDonald
PHONE (A/C, No, Ext): (724) 283-5670 FAX (A/C, No): (724) 283-1160
E-MAIL ADDRESS: jamie@bestinsurancebutler.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A: Cincinnati Insurance Companies	
INSURER B:	
INSURER C:	
INSURER D:	
INSURER E:	
INSURER F:	

INSURED
Steel Shield Technologies Inc
3351 Industrial Blvd /
Bethel Park PA 15102

COVERAGES CERTIFICATE NUMBER: coi 2014 - 15 REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: X POLICY PRO-JECT LOC			ENP04242014	4/24/2014	4/24/2015	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 100,000 $ 5,000 $ 1,000,000 $ 2,000,000 $ 2,000,000
	AUTOMOBILE LIABILITY ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS						COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ $ $ $
A	X UMBRELLA LIAB OCCUR EXCESS LIAB CLAIMS-MADE DED RETENTION $			ENP04242014	4/24/2014	4/24/2015	EACH OCCURRENCE AGGREGATE	$ 1,000,000 $
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N N/A					WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ $ $

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD

Over USD 2,000,000 Insurance

CERTIFICATE HOLDER

Steel Shield Technologies Inc.
3351 Industrial Blvd.
Bethel Park, PA 15102

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

ACORD 25 (2010/05)
INS025 (201005).01

Confidence Guarantee

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

20. MAJOR CORPORATE CLIENTS

US ARMY

SIEMENS

UNION PACIFIC RAILROAD
(NEW YORK STOCK EXCHANGE NO.: UNP)

DJE 东江环保 Dongjiang Environment

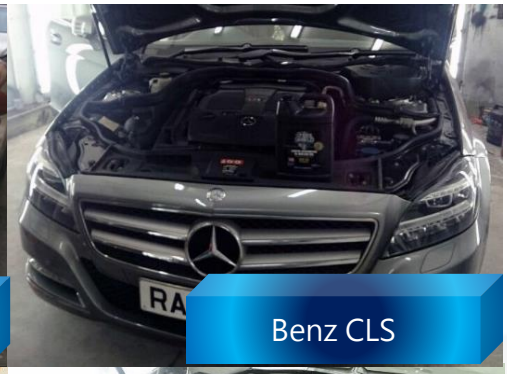
DONGJIANG ENVIRONMENT
(HONG KONG STOCK EXCHANGE NO.: 895)

21. SUPER CAR USERS

Super performance cars using Steel Shield help reducing engine noise, more power at the wheels, swift response, extends battery life and cleaner engine. These car owners were surprised to see the cars behaved just like NEW ! Cruising on the highways they gained an average 12-15% less fuel.

Maserati Quattroporte

Porsche Panamera 4S



Benz CLS

STEEL SHIELD TECHNOLOGIES

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

22. MSNS FOR THE STEEL SHIELD PRODUCTS ADDED TO eesoh-mis

products for weapons, weapon systems and military equipment running under harsh conditions and environments

US Air-Force Purchasing Items

NSN/LPN: 9150PHM00065498

MSN: 9150PHM00065498

CAGE: 4TXQ2

Trade Name: STEEL SHIELD WEAPON SHIELD METAL TREATMENT

NSN/LPN: 9150PHM00065496

MSN: 9150PHM00065496

CAGE: 4TXQ2

Trade Name: WSG-EP1, WEAPON-SHIELD EP #1 GREASE

NSN/LPN: 9150PHM00065584

MSN: 9150PHM00065584

CAGE: 4TXQ2

Trade Name: STEEL SHIELD ANTI-WEAR EP METAL TREATMENT

NSN/LPN: 9150PHM00065578

MSN: 9150PHM00065578

CAGE: 4TXQ2

Trade Name: LITHI-SHIELD EP #2 GREASE

NSN/LPN: 9150PHM00065587N

MSN: 9150PHM00065587

CAGE: 4TXQ2

Trade Name: STEEL SHIELD STRIKE SHIELD

SN/LPN: 9150PHM00065590

MSN: 9150PHM00065590

CAGE: 4TXQ2

Trade Name: STEEL SHIELD TOOL SHIELD

NSN/LPN: 9150PHM00065581

MSN: 9150PHM00065581

CAGE: 4TXQ2

Trade Name: STEEL SHIELD SPRAY SHIELD

23. Compliments from the US ARMED FORCES

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

Original

Letters of Thanks and Compliments from the US Army
"Weapon Shield was truly a life saver"

24. Letter from Siemens USA

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

SIEMENS Letter of Gratitude

Original

25. Letters from Union Pacific Railroad & PA Port Authority

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

The letter states that the Union Pacific Railroad uses Steel Shield product extensively. Steel Shield has been proved to be functional and cost-effective, and are highly recommended.

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 letter states that they save around USD 45 in maintenance cost for every USD 1 investment in Steel Shield products. Also, the vehicles malfunctions drop to around 10%

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 888985~~
jfhendri@up.com

26. Letter from VOLVO China

Original

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

电话:0571-86852031

English

Volvo Car Corporation

8th November, 2013

To: STEEL SHIELD TECHNOLOGIES
Unit K, 11/F, Leader Industrial Centre, Phase 2,
188-202 Texaco Road, Tsuen Wan, N.T., H.K.

Dear Ms. Eva Lam,

We would like to express our gratitude to STEEL SHIELD TECHNOLOGIES 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

This letter states that the horsepower of Volvo vehicles increased by 8% to 12% after using Steel Shield products.

27. MACAU GRAND PRIX AND EVENTS

61st Macau Grand Prix 〈2014〉

Exhibition & Events

28. STEEL SHIELD TECHNOLOGIES (USA HEADQUARTER)

Reception Area

Steel Shield Lubricant Storage Facility

Steel Shield Unique Additive Production Machine

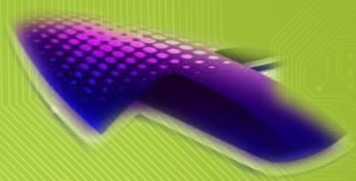
Steel Shield Unique Additive Production Machine

29. STEEL SHIELD TECHNOLOGIES

The Steel Shield Certificate

30. STEEL SHIELD VIDEO DEMONSTRATIONS

- Steel Shield ABF Technology – How it works?
- Steel Shield ABF Technology – Timken Demonstration.
- Steel Shield Technology Demo 1
- Steel Shield Technology Demo 2
- Steel Shield Tech Full Feature on Motorhead Garage
- Steel Shield Motorhead Garage Commercial
- Steel Shield Interviewed by the Guangdong Sport TV in the China International Lubricants and Technology Exhibition



Please click the links

31. Contact US

STEEL SHIELD TECHNOLOGIES

Company Address：
Workshop 9, 8th/Floor,
Goodview Industrial Building,
No.11 Kin Fat Street, Tuen Mun, HK
Tel：+852 2545 8029
Fax：+852 2545 8030

Not Just Oil...
IT'S TECHNOLOGY

Confidence Guarantee

Not All Oil is Same !

Made In USA

Email： steelshieldtech@yahoo.com
Website：www.steelshieldtech.com.hk
Facebook: www.facebook.com/steelshieldtech
Weibo：www.weibo.com/steelshield