Technical Data Sheet

Shell Turbo *S4 GX 32*

- *Extra long oil life*
- *Enhanced wear protection*

Premium based industrial steam, gas and combined cycle turbine lubricant for geared turbines

Shell Turbo S4 GX 32 is based on Gas-to-Liquid (GTL) technology and has been developed to meet the demands of the latest high efficiency turbine systems. Designed to offer outstanding, long term performance under the most severe operating conditions Shell Turbo S4 GX 32 will minimise wear, deposit and sludge formation even under cyclic peak loading conditions.

DESIGNED TO MEET CHALLENGES

Performance, Features & Benefits

- **Extended oil life**

  Shell Turbo S4 GX 32 delivers exceptional resistance to degradation, even under conditions of high oxidative and thermal stress. Excellent results in both the ASTM dry TOST and the TOST life test (ASTM D943) demonstrate the potential for Shell Turbo S4 GX 32 to offer extended service life, reduced maintenance costs and less downtime when compared to conventional mineral oil technology.

- **Enhanced Equipment protection**

  The excellent prevention of deposit formation provided by Shell Turbo S4 GX 32 enables it to lubricate the hottest gas turbine bearings with minimal deposit build up or sludge formation. This reduces the potential for critical component failure and the risk of unplanned turbine shutdown.

  As the pressure increases on gearboxes in turbines it is critical for an oil to provide greater anti-wear protection. Shell Turbo S4 GX 32 offers enhanced anti-wear protection for heavily loaded gear boxes helping end users maintain optimum operating conditions under challenging situations without sacrificing resistance to deposits or oil life.

- **Enhanced System Efficiency**

  Demulsibility, air release, resistance to foaming, and filter blockage are critical factors for oil in the latest geared turbine designs (especially turbines which have shorter oil residence times). Shell Turbo S4 GX 32 offers excellent performance in all four areas, ensuring that optimum operating conditions are maintained.

Main Applications

- **Power and industrial steam, gas & combined cycle turbines**

  Shell Turbo S4 GX 32 is used as the lubricating oil of choice in modern steam, gas and combined cycle turbines, especially those needing enhanced anti-wear performance to protect highly loaded gearboxes.

- **Further industrial applications**

  Shell Turbo S4 GX 32 may also be used for other industrial applications requiring a high performance gas turbine oil, such as the lubrication of turbo compressors

Specifications, Approvals & Recommendations

Shell Turbo S4 GX 32 meets & exceeds international specification and requirements of the major turbine manufacturers including:

- ASTM 4304-13 Type I, II & III
- GB (China) 11120-2011, L-TSE, L-TGE and L-TGSE
- DIN 51515 Part 1 L-TDP & Part 2 L-TGP
- JIS K-2213 Type 2
- ISO 8068, L-TGF and L-TGSE
- Shell Turbo S4 GX is approved by Siemens Power Generation, spec TLV 9013 04 and TLV 9013 05
- General Electric GEK 32568j, 46506e, 28143b, 101941a, 107395a and 120498
- Alstom HTGD 90 117 V0001 Y
- Dresser Rand 003-406-001 Type I and III
- Westinghouse 21 TO591 and 55125Z3 and Eng Spec_DP21T-00000443
- Solar ES 9-224Y Class II
- MAN D&T SE TED 10000494596
- Shell Turbo S4 GX 32 meets the specification of Elliott Turbo-machinery X-18-0004

- Shell Turbo S4 GX meets Siemens Turbo-machinery specifications 1CW0047915, WN80003798, and report 65/0027
- Shell Turbo S4 GX meets Siemens Finspong MAT812109
- GE Oil and Gas – Appropriate Specification listed under document ITN52220.04
- ANSALDO TGO2-0171-E00000/B

For a full listing of equipment approvals and recommendations, please consult your local Shell Technical Helpdesk.

Typical Physical Characteristics

Properties			Method	Shell Turbo S4 GX 32
ISO Viscosity Grade			ISO 3448	32
Kinematic Viscosity	@40°C	mm^2/s	ASTM D445	32.0
Kinematic Viscosity	@100°C	mm^2/s	ASTM D445	6.06
Viscosity Index			ASTM D2270	139
Density	@15°C	g/cm^3	IP 365	0.827
Flash Point (COC)		°C	ASTM D92	232
Pour Point		°C	ASTM D97	-42
Neutralisation Number		mg KOH/g	ASTM D974	0.15
Air Release	@50°C	minutes	ASTM D3427	1
Copper Corrosion	3hr/100°C		ASTM D130	1b
Rust Preventing Properties			ASTM D665 A & B	No Rust
Water Separability	minutes to 3 mL emulsion	minutes	ASTM D1401	15
Steam Demulsibility		seconds	IP 19	95
Foaming Characteristics	tendency, stability	mL/mL	ASTM D892	
Sequence I				0/0
Sequence II				0/0
Sequence III				0/0
Load Carrying - FZG - failure load stage			DIN 51354	10
Oxidation Stability				
RPVOT		minutes	ASTM D2272	1400
Modified RPVOT		% of RPVOT		95%
TOST lifetime		hour	ASTM D943	10 000+
TOST 1000hr sludge		mg/kg	ASTM D4310	25
Dry TOST	@120°C		ASTM D7873	
Sludge Content at 50% RPVOT		mg/kg		25
Time to 50% RPVOT		hours		1410

These characteristics are typical of current production. Whilst future production will conform to Shell's specification, variations in these characteristics may occur.

Health, Safety & Environment

- **Health and Safety**

Shell Turbo S4 GX 32 is unlikely to present any significant health or safety hazard when properly used in the recommended

application and good standards of personal hygiene are maintained.

Avoid contact with skin. Use impervious gloves with used oil. After skin contact, wash immediately with soap and water.

Guidance on Health and Safety is available on the appropriate Material Safety Data Sheet (MSDS), which can be obtained from shell

- **Protect the Environment**

Take used oil to an authorised collection point. Do not discharge into drains, soil or water.

Additional Information

- **Advice**

Advice on applications not covered here may be obtained from your Shell representative.

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روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

Technical Data Sheet

Shell Turbo *S4 GX 46*

- *Extra long oil life*
- *Enhanced wear protection*

Premium based industrial steam, gas and combined cycle turbine lubricant for geared turbines

Shell Turbo S4 GX 46 is based on Gas-to-Liquid (GTL) technology and has been developed to meet the demands of the latest high efficiency turbine systems. Designed to offer outstanding, long term performance under the most severe operating conditions Shell Turbo S4 GX 46 will minimise wear, deposit and sludge formation even under cyclic peak loading conditions.

DESIGNED TO MEET CHALLENGES

Performance, Features & Benefits

- **Extended oil life**

  Shell Turbo S4 GX 46 delivers exceptional resistance to degradation, even under conditions of high oxidative and thermal stress. Excellent results in both the ASTM dry TOST and the TOST life test (ASTM D943) demonstrate the potential for Shell Turbo S4 GX 46 to offer extended service life, reduced maintenance costs and less downtime when compared to conventional mineral oil technology.

- **Enhanced Equipment protection**

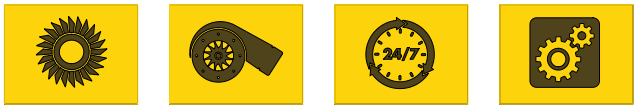
  The excellent prevention of deposit formation provided by Shell Turbo S4 GX 46 enables it to lubricate the hottest gas turbine bearings with minimal deposit build up or sludge formation. This reduces the potential for critical component failure and the risk of unplanned turbine shutdown.

- As the pressure increases on gearboxes in turbines it is critical for an oil to provide greater anti-wear protection. Shell Turbo S4 GX 46 offers enhanced anti-wear protection for heavily loaded gear boxes helping end users maintain optimum operating conditions under challenging situations without sacrificing resistance to deposits or oil life.

- **Enhanced System Efficiency**

  Demulsibility, air release, resistance to foaming, and filter blockage are critical factors for oil in the latest geared turbine designs (especially turbines which have shorter oil residence times). Shell Turbo S4 GX 46 offers excellent performance in all four areas, ensuring that optimum operating conditions are maintained.

Main Applications



- **Power and industrial steam, gas & combined cycle turbines**

  Shell Turbo S4 GX 46 is used as the lubricating oil of choice in modern steam, gas and combined cycle turbines, especially those needing enhanced anti-wear performance to protect highly loaded gearboxes.

- **Further industrial applications**

  Shell Turbo S4 GX 46 may also be used for other industrial applications requiring a high performance gas turbine oil, such as the lubrication of turbo compressors

Specifications, Approvals & Recommendations

Shell Turbo S4 GX 46 meets & exceeds international specification and requirements of the major turbine manufacturers including:

- ASTM 4304-13 Type I, II & III
- GB (China) 11120-2011, L-TSE, L-TGE and L-TGSE
- DIN 51515 Part 1 L-TDP & Part 2 L-TGP
- JIS K-2213 Type 2
- ISO 8068, L-TGF and L-TGSE
- Shell Turbo S4 GX is approved by Siemens Power Generation, spec TLV 9013 04 and TLV 9013 05
- General Electric GEK 28143b
- Alstom, HTGD 90 117 V0001 Y
- Dresser Rand 003-406-001 Type I and III
- Solar ES 9-224Y Class II
- MAN D&T SE TED 10000494596
- Shell Turbo S4 GX meets Siemens Turbo-machinery specifications 1CW0047915 and WN80003798
- Shell Turbo S4 GX meets Siemens Finspong MAT812109 and Ruston report 65/0027

- GE Oil and Gas – Appropriate Specification listed under document ITN52220.04
- ANSALDO TGO2-0171-E00000/B

For a full listing of equipment approvals and recommendations, please consult your local Shell Technical Helpdesk.

Typical Physical Characteristics

Properties			Method	Shell Turbo S4 GX 46
ISO Viscosity Grade			ISO 3448	46
Kinematic Viscosity	@40°C	mm^2/s	ASTM D445	43.5
Kinematic Viscosity	@100°C	mm^2/s	ASTM D445	7.50
Viscosity Index			ASTM D2270	139
Density	@15°C	g/cm^3	IP 365	0.829
Flash Point (COC)		°C	ASTM D92	245
Pour Point		°C	ASTM D97	-27
Neutralisation Number		mg KOH/g	ASTM D974	0.15
Air Release	@50°C	minutes	ASTM D3427	1
Copper Corrosion	3hr/100°C		ASTM D130	1b
Rust Preventing Properties			ASTM D665 A & B	No Rust
Water Separability	minutes to 3 mL emulsion	minutes	ASTM D1401	15
Steam Demulsibility		seconds	IP 19	95
Foaming Characteristics	tendency, stability	mL/mL	ASTM D892	
Sequence I				0/0
Sequence II				0/0
Sequence III				0/0
Load Carrying - FZG - failure load stage			DIN 51354	11
Oxidation Stability				
RPVOT		minutes	ASTM D2272	1400
Modified RPVOT		% of RPVOT		95%
TOST lifetime		hour	ASTM D943	10 000+
TOST 1000hr sludge		mg/kg	ASTM D4310	25
Dry TOST	@120°C		ASTM D7873	
Sludge Content at 50% RPVOT		mg/kg		28
Time to 50% RPVOT		minutes		1433

These characteristics are typical of current production. Whilst future production will conform to Shell's specification, variations in these characteristics may occur.

Health, Safety & Environment

- **Health and Safety**

Shell Turbo S4 GX 46 is unlikely to present any significant health or safety hazard when properly used in the recommended application and good standards of personal hygiene are maintained.

Avoid contact with skin. Use impervious gloves with used oil. After skin contact, wash immediately with soap and water.

Guidance on Health and Safety is available on the appropriate Material Safety Data Sheet (MSDS), which can be obtained from shell

- **Protect the Environment**

  Take used oil to an authorised collection point. Do not discharge into drains, soil or water.

Additional Information

- **Advice**

  Advice on applications not covered here may be obtained from your Shell representative.

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روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

Technical Data Sheet

Shell Turbo *S4 X 32*

- *Extra Long Oil Life*
- *Extra efficiency*

Premium based industrial steam, gas and combined cycle turbine lubricant

Shell Turbo S4 X 32 is based on Gas-to-Liquid (GTL) technology and has been developed to meet the demands of the latest high efficiency turbine systems. Designed to offer outstanding, long term performance under the most severe operating conditions Shell Turbo S4 X 32 will minimise deposit and sludge formation even under cyclic peak loading conditions.

DESIGNED TO MEET CHALLENGES

Performance, Features & Benefits

- **Extended oil life**

  Shell Turbo S4 X 32 delivers exceptional resistance to oxidation even under conditions of high oxidative and thermal stress. Excellent results in both the ASTM dry TOST and the TOST life test (ASTM D943) demonstrate the potential for Shell Turbo S4 X 32 to offer extended service life and reduced maintenance costs when compared to conventional mineral oil technology.

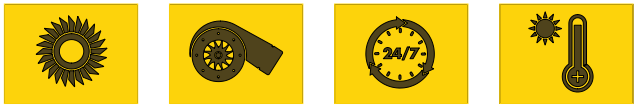
- **Enhanced Equipment protection**

  The greater resistance against varnish and sludge formation provided by Shell Turbo S4 X 32 allows turbine systems to operate reliably even during severe peak load operation. Minimising the formation of sludge and bearing deposits not only reduces the wear of critical system components, but can also reduce the risk of an unplanned turbine shutdown.

- **Enhanced System Efficiency**

  Demulsibility, air release and resistance to foaming are critical performance factors for oil in the latest turbine designs (especially turbines which have shorter oil residence times). Shell Turbo S4 X 32 offers excellent performance in all three areas, ensuring that optimum operating conditions are maintained.

Main Applications



- **Power and industrial steam, gas & combined cycle turbines**

  Shell Turbo S4 X 32 is used as the lubricating oil of choice in modern steam, gas and combined cycle turbines.

- Note that some applications with highly loaded gearboxes require a lubricant with enhanced anti-wear performance - for these applications use Shell Turbo S4 GX.

- **Further industrial applications**

  Shell Turbo S4 X 32 may also be used for other industrial applications requiring a high performance gas turbine oil, such as the lubrication of turbo compressors.

Specifications, Approvals & Recommendations

Shell Turbo S4 X 32 meets & exceeds international specification and requirements of the major turbine manufacturers including:

- ASTM 4304-13 Type I & III
- GB (China) 11120-2011, L-TGA, L-TSA, L-TGSB
- DIN 51515 Part 1 L-TD & Part 2 L-TG
- ISO 8068, L-TGB and L-TGSB
- Shell Turbo S4 X 32 is approved by Siemens Power Generation, spec TLV 9013 04 and TLV 9013 05
- General Electric GEK 32568j, 46506e, 28143b, 107395a and 120498
- Alstom HTGD 90 117 V0001 Y
- Dresser Rand 003-406-001 type I & III
- Westinghouse 21 TO591 and 55125Z3 and Eng Spec_DP21T-00000443
- Solar ES 9-224Y Class II
- MAN D&T SE TED 10000494596
- Shell Turbo S4 X 32 meets the specification of Elliott Turbo-machinery X-18-0004
- GE Oil and Gas – Appropriate Specification listed under document ITN52220.04

- Shell Turbo S4X 32 meets the requirements of MS04-MA-CL001 (Rev.4), MS04-MA-CL002 (Rev.4) and MS04-MA-CL005 (Rev.2)

  For a full listing of equipment approvals and recommendations, please consult your local Shell Technical Helpdesk.

Typical Physical Characteristics

Properties			Method	Shell Turbo S4 X 32
ISO Viscosity Grade			ISO 3448	32
Kinematic Viscosity	@40°C	mm^2/s	ASTM D445	32.0
Kiematic Viscosity	@100°C	mm^2/s	ASTM D445	6.10
Viscosity Index			ASTM D2270	141
Density	@15°C	g/cm^3	IP 365	0.827
Flash Point (COC)		°C	ASTM D92	230
Pour Point		°C	ASTM D97	-42
Neutralisation Number		mg KOH/g	ASTM D974	0.10
Air Release	@50°C	minutes	ASTM D3427	1
Copper Corrosion	3hr/100°C		ASTM D130	1b
Rust Preventing Properties			ASTM D665 A & B	No Rust
Water Separability	minutes to 3 mL emulsion	minutes	ASTM D1401	15
Steam Demulsibility		seconds	IP 19	80
Foaming Characteristics	tendency, stability	mL/mL	ASTM D892	
Sequence I				0/0
Sequence II				0/0
Sequence III				0/0
Load Carrying - FZG - failure load stage			DIN 51354	7
Oxidation Stability				
RPVOT		minutes	ASTM D2272	1400
Modified RPVOT		% of RPVOT		95%
TOST lifetime		hr	ASTM D943	10 000+
TOST 1000hr sludge		mg/kg	ASTM D4310	20
Dry TOST	@120°C		ASTM D7873	
Sludge Content at 25% RPVOT		mg/kg		51
Time to 25% RPVOT		minutes		1320

These characteristics are typical of current production. Whilst future production will conform to Shell's specification, variations in these characteristics may occur.

Health, Safety & Environment

- **Health and Safety**

  Shell Turbo S4 X 32 is unlikely to present any significant health or safety hazard when properly used in the recommended application and good standards of personal hygiene are maintained.

  Avoid contact with skin. Use impervious gloves with used oil. After skin contact, wash immediately with soap and water.

  Guidance on Health and Safety is available on the appropriate Material Safety Data Sheet (MSDS), which can be obtained from shell

- **Protect the Environment**

  Take used oil to an authorised collection point. Do not discharge into drains, soil or water.

Additional Information

- **Advice**

  Advice on applications not covered here may be obtained from your Shell representative.

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

SHELL TURBO® OILS T

Premium quality turbine and general purpose R&O inhibited circulating oils

Product Description

Shell Turbo® Oils T are premium quality lubricating oils designed to provide excellent lubrication of steam turbines and many other industrial applications. These oils are made from severely hydroprocessed (API Group II) base oils, which have been carefully selected to provide satisfactory viscosity/temperature characteristics, low foaming tendencies and good water separation properties. In addition, they contain proven additives to protect equipment against rusting and to resist oxidation for long service life. **Shell Turbo Oils T** are available in four ISO viscosity grades from 32 to 100. Grade nomenclature conforms to the ASTM/ISO viscosity system.

Turbine Applications

Shell Turbo® Oils T **have a long and successful record of providing dependable turbine lubrication with excellent performance.** Shell Turbo® Oils T **meet the requirements of major turbine builders including GE, Siemens, Westinghouse, ABB Alstom, Elliot and Demag Delaval Steam Turbines. The appropriate grade of** Shell Turbo® Oil T **used in a given application should be in accordance with the viscosity recommendation of the equipment manufacturer. General recommendations for the various kinds of turbines are:**

	Viscosity cSt at 40°C	Lubricant
Steam Turbines:		
• Direct Drive – ring oiled w/water cooling	54-75	**Turbo Oil T 68**
• Direct Drive – forced feed	30-38	**Turbo Oil T 32**
• Gear Drive – forced feed	54-75	**Turbo Oil T 68**
Hydroelectric Turbines:		
• Large Vertical Machines	54-75	**Turbo Oil T 68**
• Small Vertical Machines	30-38	**Turbo Oil T 32**
• Horizontal Machines	30-38	**Turbo Oil T 32**

General Applications

- a wide range of lubrication applications
- general purpose plant lubrication
- non-anti-wear hydraulic and circulating oil systems
- non-EP gear oils

August, 2005

Shell Turbo® Oils T meet the American Standards Institute (ANSI)/American Gear Manufactures Association (AGMA) 9005-D94 requirements for R&O oils. Standards for machine tool lubrication established by the STLE include a classification for Hydraulic Fluid and General Purpose Lubricants.

Shell Turbo® Oils T for Hydraulic Fluid and General Purpose Lubricants

STLE Standard No.	STLE Identifying No.	Recommended Shell Lubricant
ASLE 64-1	H-150	Turbo Oil T 32
ASLE 64-2	H-215	Turbo Oil T 46
ASLE 64-3	H-315	Turbo Oil T 68

Features/Benefits

- excellent oxidation stability
- non-corrosive to metals
- fast separation of water and good de-aeration properties

Approvals

- Alstom Power HTGD 90 117 and NBA P50001
- Siemens TLV 9013 04
- Cincinnati Lamb; P-38, P-55 and P-54

Meets or Exceeds Requirements

- General Electric GEK 28143A
- General Electric GEK 46506
- General Electric GEK 32568F
- Siemens/Mannesmann Demag 800 037 98
- Man Turbo SP 079984 D0000 E99
- Westinghouse 21 T0591
- Solar Turbines ES 9-224U
- ISO 8068
- ASTM D 4304, Type I (non-EP)
- DIN 51515 Part 1
- JIS K-2213 Type 2
- BS 489-1999

Typical Properties of Shell Turbo® Oils T

	Test Method	ISO Viscosity Grade			
		32	46	68	100
Product Code		65602	65603	65605	65558
Gravity, °API	D 1298	32.2	31.8	31.4	30.7
Color	D 1500	1.0	1.0	1.0	1.5
Flash Point, COC, °F	D 92	420	430	440	450
Pour Point, °F	D 97	-20	-10	-10	+10
Viscosity: @ 40°C, cSt @ 100°C, cSt	 D 445 D 445	 32 5.45	 46 6.90	 68 8.95	 100 11.5
Viscosity Index	D 2270	105	105	105	102
Acid Number, mg KOH/g	D 974	0.05	0.05	0.05	0.05
Cu Corrosion, 3 hrs @ 212°F	D 130	1b	1b	1b	1b
Rust Test	D 665B	Pass	Pass	Pass	Pass
Demulsibility, separation time, minutes	D 1401	15	15	20	20
Modified Turbine Oil Stability Test*, hrs	Mod D 943	11,000	11,000+	11,000+	------
RBOT, minutes	D 2272	1100+	1100+	1100+	1100+

Test allowed to run past usual end point of 10,000 hours until acid number of 2.0 mg KOH/g reached.

Handling & Safety Information

For information on the safe handling and use of this product, refer to its Material Safety Data Sheet. If you are a Shell Distributor, please call **1+800-468-6457** for all of your service needs. All other customers, please **call 1+800-840-5737** for all of your service needs. Information is also available on the World Wide Web

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روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

August, 2005