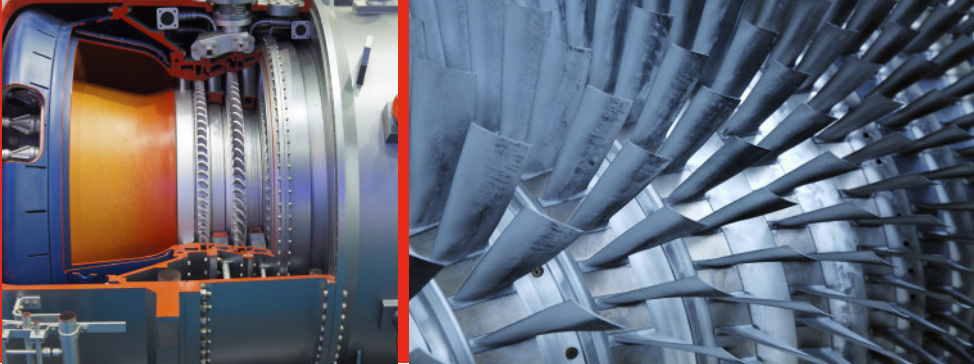


### ADDINOL Turbine Oils MT 32 and MT 46 for the use in gas, steam and water turbines under highest loads and for turbo compressors



ADDINOL Turbine Oils MT 32 and MT 46 are high-performance turbine oils specifically tailored to the demanding operating conditions in modern turbines. They are based on carefully selected, premium HC-base oils combined with optimally adjusted additives free of zinc.

- ✓ specifically developed in cooperation with leading OEM, targeted at current and future requirements
- ✓ preferred for gas, steam and water turbines (with or without gears) as well as turbo compressors under heightened thermal loads and extreme conditions
- ✓ perfectly fit for gear compressors with highest requirements

#### These are your practical benefits:

- ✓ outstanding ageing stability because of high-quality base components
- ✓ effective prevention of varnish based on highest thermal stability
- ✓ long operating lives of plants thanks to reliable wear protection of all components
- ✓ maximum plant efficiency and steady power transmission achieved by excellent air and water separation
- ✓ increased operational safety because of targeted prevention of rust and corrosion
- ✓ leaner inventories by universal suitability for various types and requirements
- ✓ stable lubricating film at all operating stages (both for starting and under full load)
- ✓ trouble-free run without power drop as there is practically no foam formation
- » longest oil change intervals

Characteristic values	Test conditions	Unit	MT 32	MT 46	Tested according to
ISO viscosity grade			32	46	DIN 51519
Viscosity	40 °C	mm <sup>2</sup> /s	32.7	47	DIN 51562/1 ASTM D 7042
	100 °C	mm <sup>2</sup> /s	6.0	7.7	
Flash point	COC	°C	230	255	DIN EN ISO 2592
Neutralisation number		mg KOH/g	< 0.20		DIN 51558/1
Corrosion category on steel	Method A and B		passed		DIN ISO 7120
Corrosion category on copper	at 150 °C, 3h	corrosion level	1		DIN ISO 2160
Ageing behaviour (Life TOST)	Time until NN is increased by 2.0 mg KOH/g	h	> 10,000		DIN EN ISO 4263/1

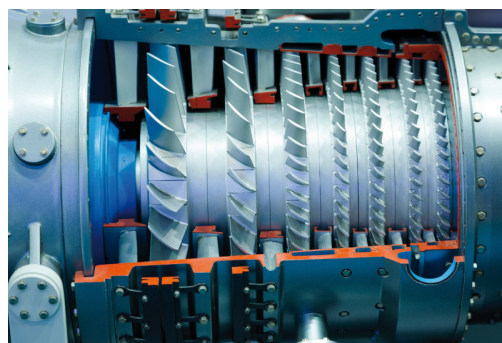
### ADDINOL Turbine Oils MT 32 and MT 46 master the extreme requirements in modern turbo units

Applications compressing gas, water or steam to transform rotational into mechanical energy are characterized by high loads, speeds and temperatures, and – for water and steam turbines – by the additional impact of humidity. Moreover, stop-&-go-operations depending on peak and cycle loads are quite common today.

The reliable operation of turbines installed in power plants is of particular importance. Interruptions, breakdowns and unscheduled downtimes endanger security of energy supplies and might quickly cause enormous costs. Moreover, each owner is interested in long operating lives for both plants and lubricants in order to minimize time and costs for maintenance and oil changes.

Turbines in turn require reliable lubrication for their stable operation and turbine oils must meet a whole range of various functions with specific requirements. Their main function is the lubrication of bearings, but depending on plant type and design they often serve as lubricating oils for gears and as hydraulic oils for control mechanisms as well.

Minimum requirements on turbine oils used in turbines and machines powered by them (i.e. compressors, generators, gears) under increased thermal loads are laid down in the German DIN 51515/2 (Turbine oils TG). These are tightened significantly in the current demands of the turbine manufacturers MAN Diesel & Turbo SE and Siemens Energy AG (see Table 1).

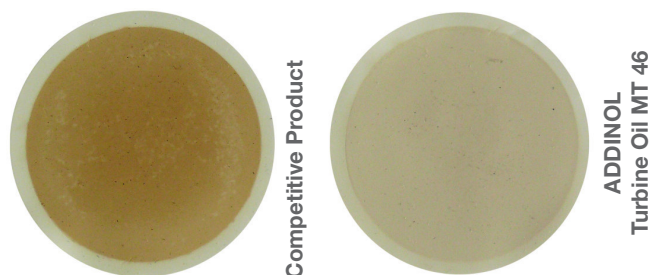


Requirements	DIN 51515/2	MAN Diesel & Turbo SE	Siemens Energy AG	ADDINOL Turbine Oil MT 32 and 46
Viscosity index	90	≥ 95	≥ 90	130
Purity level	20/17/14	≤ 17/15/12	≤ 20/17/14	17/15/12
Air separation ability at 50 °C (min)	< 5	≤ 5	≤ 4	< 3
Foaming characteristics				
at 24 °C	max. 450/0	≤ 50/0	≤ 450/0	0/0
at 93.5 °C	max. 50/0	≤ 50/0		0/0
at 24 °C after 93.5 °C	max. 450/0	≤ 50/0		0/0
Water content (mg/kg)	≤ 150	≤ 150	≤ 200	< 50
Water separation ability (s)	max. 300	≤ 300	≤ 300	< 100
Ageing behaviour RPVOT (min)	> 750	≥ 600	≥ 750	> 1,400
Load stage FZG (A/8.3/90)	8	≥ 8	≥ 8	11

Table 1: DIN and OEM requirements and results of ADDINOL Turbine Oils MT

#### Maximum ageing stability and targeted prevention of varnish

Superheated steam and combustion gases increase thermal loads on lubricants and components. In addition, the compression of entrained air bubbles (so-called micro-dieseling) and electrostatic spark discharge can result in localized hotspots. These factors accelerate oil ageing and cause decomposition of additives as well as cracking of base oil components. Insoluble decomposition products precipitate as sludge or plate out as varnish on surfaces.



Picture 1: Colorimetric assessment according to LTAT method

### ADDINOL Turbine Oils MT 32 and MT 46 master the extreme requirements in modern turbo units

These varnish deposits speed up bearing wear and have negative results on their load carrying capacity, they impair the control of the turbine by plugged servo valves and filters and impede heat dissipation.

The carefully selected base oils of ADDINOL Turbine Oils MT and their optimally adjusted additives display highest oxidative stability even at extreme thermal loads (see Chart 1).

The potential of turbine oils to form varnish under extreme thermal loads is determined by the help of the LTAT\*\* method. In this test ADDINOL Turbine Oil MT 46 practically does not form any decomposition products which might hinder the functionality of the circulating system (see Picture 1).

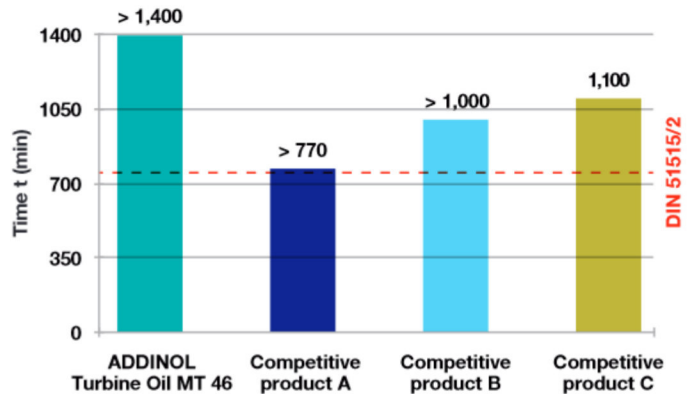


Chart 1: In the RPVOT\* ADDINOL Turbine Oil MT 32 and 46 exceed the value demanded according to DIN 51515/2 and reach superior time spans compared to competitive products.

\* RPVOT = Rotating Pressure Vessel Oxidation Stability Test

\*\* LTAT method = Lubrication Temperature Aging Test: In-house test of MAN Turbo exposing turbine oils to temperatures up to +180 °C. Oils are subjected to ageing processes at +120 °C, +150 °C and +180 °C over a period of 48 hours in the drying cabinet. Afterwards they are assessed visually and remainders in the filter (pore size 0.45 µm) are determined by gravimetric analysis.

### Excellent air separation, superior foaming characteristics

During operation the agitation and aeration of the lubricant is unavoidable. Entrained air disturbs steady power transmission and the efficient operation of the plants. Moreover, it holds the danger of cavitation on machine elements and promotes oil ageing. Because of increased oil circulation speeds there is no time for the turbine oil to “calm down”. Therefore entrained air bubbles must be separated and released from the oil quickly. ADDINOL Turbine oils of the MT range possess excellent air separation capacity. In the air separation test at 50 °C according to DIN ISO 9120 ADDINOL Turbine Oil MT 32 and MT 46 achieve the complete separation of air within 3 minutes and thus are clearly beyond the standard (see Table 1).

The release of introduced air usually causes foam formation on the lubricant’s surface which is minimized successfully for ADDINOL Turbine Oils MT 32 and MT 46 because of silicone-free defoaming agents and carefully selected synthetic base components. That way a stable operation is ensured, power drop in the system is prevented. Moreover, foam might impair the formation of a hydrodynamic lubricating film and cause leakages if it finds its way through sealings and vent connections. ADDINOL Turbine Oils MT do not tend to form any foam. (see Chart 2).

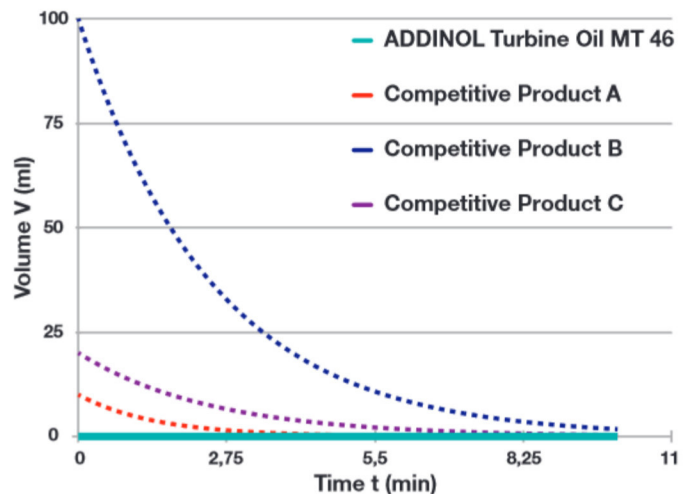


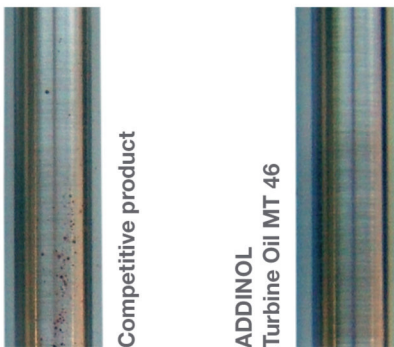
Chart 2: Foaming characteristics of ADDINOL Turbine Oil MT 46 compared with competitive products

### ADDINOL Turbine Oils MT 32 and MT 46 master the extreme requirements in modern turbo units

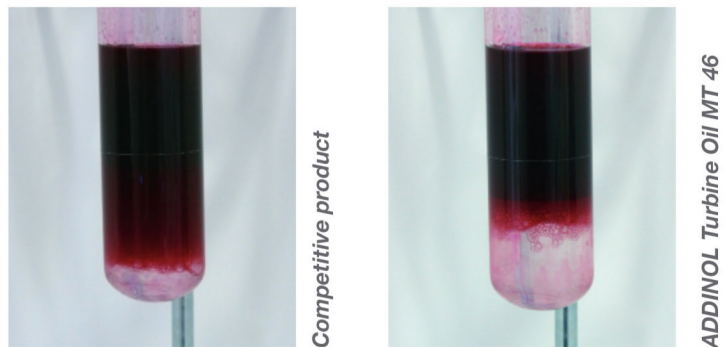
#### Reliable demulsibility, highest corrosion protection

For water and steam turbines the reliable separation of water and humidity is of utmost importance as these impair the stability of the lubricating film and entail the danger of rust and corrosion on metal elements. Therefore, turbine oils must not only possess an outstanding water separation ability but also display best corrosion protection. That way longest operating lives of the plants and highest operational safety can be ensured.

Thanks to perfectly tailored additives improving water separation ability and anti-corrosion behaviour ADDINOL Turbine Oils of the MT range achieve best results in relevant tests (see Characteristic values, Table 1, Picture 2 and 3).



Picture 2: Corrosion category on steel according to DIN ISO 7120



Picture 3: Water separation ability according to DIN 51589/1 (Turbine oils have been coloured for demonstration.)

#### Tips for practice

##### Just in case

In addition to the high-performance turbine oils of the MT range ADDINOL offers a wide variety of further turbine oils for specific applications. Moreover, our product portfolio also includes zinc-free gear and hydraulic oils perfectly suited for the application in high-performance turbines.

ADDINOL	ISO viscosity grade	Base oil	Water turbines	Steam turbines	Gas turbine	Turbo compressors	DIN
Turbine Oil TL	32, 46, 68	mineral	✓	✓ ✓ ✓	✓ ✓ ✓	✓	51515/1
				(normal thermal loads) without gears	(normal thermal loads) without gears		
Turbine Oil TP	32, 46	mineral	✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓	51515/1
				(normal thermal loads) with/without gears	(normal thermal loads) with/without gears		
Turbine Oil TW	68	mineral	✓ ✓ ✓				51515/1
Turbine Oil TL (especially for older turbines built in the former GDR)	24, 36	mineral	✓	✓ ✓ ✓	✓ ✓ ✓	✓	51515/1
				(normal thermal loads) without gears	(normal thermal loads) without gears		

✓ = suited · ✓ ✓ = good suitability · ✓ ✓ ✓ = excellent suitability