Directive D-0503.1

Operating Fluids for Voith Turbo Couplings

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Contents

1 Field of Application

The list below contains the requirements to be fulfilled by operating fluids and a selection of types proposed for hydrodynamic couplings.

Turbo coupling with constant fill	(T…)
Fill-controlled turbo coupling	(TP…)
Variable speed turbo coupling	(S…)

Other fluids require the approval by Voith.
The producer's release is required for all materials which may get in contact with the lubricant.

In individual cases, special requirements can rule out a selection according to this list; in this case, the deviating specifications will be agreed upon order handling or they will be specified in the operating manual.

When designing the coupling, the possibly deviating density / filling and heat capacity of fluids compared to mineral oil need to be taken into account.

Application instructions specified by the producers that are normally stated in the product and safety data sheets are to be observed.

Notice

The values mentioned for the pour point, flash and fire point are approximate values and data originating from the oil suppliers. These may vary and Voith Turbo does not assume any warranty!

Country-specific production of the basic oil may result in different values.

- We recommend comparing the data with our specifications at any rate.
- In case of deviations, we urgently recommend consulting the respective oil producer.

2 Requirements to be fulfilled by the Operating Fluid

The characteristics as per Directive D-0502 are required as far as the product is concerned.

Special attention has to be paid to:

- Viscosity: ISO VG 32 as per DIN ISO 3448 *)
- Viscosity on start-up:
  less than 15000mm²/s **(T…)**
  less than 1000mm²/s **(S… - displacement pump)**
  less than 500mm²/s **(TP…)**
  less than 250mm²/s **(S… - centrifugal pump)**
- Pour point: 4° C below the minimum ambient temperature or lower
- Flash point: higher than 180° C and at least 40° C above the nominal response temperature of the fusible plugs
- Resistance to aging: aging-resistant refined product
- Cleanliness grade: 21/18/15 as per ISO 4406
  9 as per NAS 1638
  10 as per SAE AS 4059
- Sealing compatibility: NBR (Nitril-Butadien caoutchouc)
  FPM / FKM (fluor-caoutchouc)
- Fire point  at least 50° C above the max. surface temperature
- Air release property: ≤ 5 min. at 50° C as per DIN ISO 9120 **(TP… / S…)**

Beneficial additional characteristics:

- Test to FE8:D7.5/80-80: Wear of rolling elements <30mg
- Resistance to aging: increased resistance to aging

*) In special cases ISO VG 10 – 46 (T…), ISO VG 22 – 68 (TP…), ISO VG 100 (S…) can be applied.

3 Operating Fluids that can be used

3.1 Specifications / approvals

- Hydraulic oils HLP 32 to DIN 51524, Part 2 *)
- Lubricating oils CLP 32 to DIN 51517, Part 3
- Steam turbine oils LTD 32 to DIN 51515, Part 1 *)
- HD engine oils SAE 10 W (T… / TP…)
- ATF type A Suffix A (TASA) and type Dexron II, IID, IIE, III, MERCON (T… / TP…)
- M-891205 and M-921253 (T… / TP…)

*) In special cases ISO VG 10 – 46 (T…), ISO VG 22 – 68 (TP…), ISO VG 100 (S…) can be applied.

3.2 Operating temperature frequently above 100° C

FPM/FKM is recommended as sealing material; when selecting the mineral oil, ensure that it provides excellent oxidation resistance.

3.3 Proposed operating fluids VG 32 (T… / TP…)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Addinol Lube Oil GmbH	Hydraulic oil HLP 32	-21	195		
Avia	Avia Fluid RSL 32	-27	214	**X**	
	Gear RSX 32 S	-33	210	**X**	
Castrol	Alpha EP 32	-27	218	**X**	**X**
	Alpha VT 32	-42	234	**X**	**X**
	Hyspin ZZ 32	-30	216		**X**
	Hyspin AWS 32	-27	200		
Cepsa	HIDROSIC HLP 32	-24	204		
	EP 125	-30	206		
Chevron-Texaco	Texaco Rando HD 32	-30	196		
ENI	Agip Oso 32	-30	204		
	Agip Blasia 32	-29	215		
ExxonMobil	DTE 24	-27	220	**X**	
	Mobilfluid 125	-30	225		
	Mobil SHC 524	-54	234		
Fuchs Europe	Renolin MR10	-30	210		
	Renolin B10	-24	205		

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Klüber	Lamora HLP 32 (Next Generation)	-18	210		
	Klübersynth GEM 4-32 N [1)]	-50	200		**X**
Kuwait National Lubricant Oil Company (KNLOC)	Q8 Haydn 32	-30	208		
	Q8 Holst 32	-30	208		
Ravenol	Hydr. oil TS32	-24	220		
Shell	Tegula V32 [2)]	-33	211	**X**	**X**
	Tellus Oil S4 ME 32 [1)]	-54	240		
	Tellus Oil S3 M 32	-39	236		
SRS	Wiolan HS 32	-24	220	**X**	
	Wiolan HF 32 synth [1)]	-60	245		**X**
Total	Azolla ZS 32	-27	210		
	Azolla VTR 32	-36	230	**X**	**X**
	Preslia GT	-15	225		**X**

1) The operating fluid has got a lower density, its use has to be agreed with Voith.
2) Not admitted for use in TP… / DTP… .

Notice

The values mentioned above are approximate values and data originating from the oil producer. Voith Turbo does not assume any warranty! Country-specific production of the basic oil may result in different pour point, fire point and flash point values.

In case of critical applications, we recommend consulting the respective oil producer!

3.4 Proposed operating fluids VG 32 (S...)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Addinol Lube Oil GmbH	Hydraulic oil HLP 32	-33	235	**X**	
Addinol Lube Oil GmbH	Hydrodynamic transmission oil SGL 18	-39	225	**X**	
AP Oil International	AP Torque Oil 32	-25	210	**X**	
Autol	Hydraulic Oil HYS 32	-28	208	**X**	
Avia	Gear RSX 32-S	-33	211	**X**	**X**
Bharat Petroleum Corp. Ltd.	MAK Hydrol HLP 32	-9	190	**X**	
Caltex	Torque Fluid 32	-27	210	**X**	

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Castrol	Alpha EP 32	-27	218	X	X
Castrol	Alpha VT 32	-42	234	X	X
Castrol	Hyspin AWS 32	-27	200	X	
Castrol	Hyspin HL-XP 32	-36	230	X	
Castrol	Hyspin ZZ 32	-30	216		X
Cepsa	EP 125	-30	206	X	
Cepsa	Hidraulico HM 32	-24	204	X	
Cepsa	Mistral 32	-24	204	X	
Chevron-Texaco	Chevron Clarity Hydraulic Oil AW 32	-33	222		
Chevron-Texaco	Chevron Hydraulic Oil AW 32	-25	220		
Chevron-Texaco	Texaco Rando HD 32	-30	196	X	
Chevron-Texaco	Texaco Textran V 32	-39	220		
ENI	Agip Blasia 32	-29	215	X	
ENI	Agip OSO 32	-27	210	X	
ExxonMobil	Mobil DTE 10 Excel 32	-54	250	X	
ExxonMobil	Mobil DTE 24	-27	220	X	
ExxonMobil	Mobilfluid 125	-30	225	X	
Fabrika Maziva (FAM)	Hidofluid 125	-27	207	X	X
Fuchs Europe	Renofluid TF 1500	-24	224	X	
Fuchs Europe	Renolin Eterna 32	-15	220	X	
Fuchs Europe	Renolin ZAF 32 B	-30	215	X	
Fuchs Lubricants PTE Limited	Titan RR TF	-25	210	X	
Gazpromneft	Hydraulic HLP 32	-34	221		
Gulf Oil Corp. Ltd.	Crest EP 32	-24	212	X	
Gulf Oil Corp. Ltd.	Harmony AW 32	-24	202	X	
Hindustan Petroleum Corp.	Enklo HLP 32	-18	180	X	
Idemitsu Oil	Daphne Super Hydraulic Fluid 32	-35	216		
INA Maziva	INA Fluid V 32	-27	207		
Indian Oil Corp. Ltd.	Servo Torque 10	-34	213	X	
Indian Oil Corp. Ltd.	Servosystem HLP 32	-21	200	X	
Klüber	Lamora HLP 32 (New Generation)	-18	210	X	
Kuwait National Lubricant Oil Company (KNLOC)	Hydraulic Oil 32	-30	208	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Haydn 32	-30	208	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Holst 32	-18	208	X	X
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 van Gogh EP 32	-12	208	X	
Lotos Oil	Corvus 32	-30	225		
Lukoil LLK International	Geyser ST 32	-42	238	X	
Lukoil LLK International	Geyser ST 32	-42	238	X	
Maziva Zagreb d.o.o.	INA Fluid V 32	-36	230	X	

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
MOL Hungarian Oil	Hydro HM 32 hydraulic oil	-18	190		
Morris Lubricants	Liquimatic No. 4	-35	220	X	
OEST	Hydraulic Oil H-LP 32	-27	210	X	
OEST	Turbo Hyd 32 S	-30	210	X	X
OMV	fluid VWG 32	-36	225	X	
OMV	hyd HLP 32	-30	220	X	
Orlen Oil	Hydrol L-HM / HLP 32	-34	215	X	
Orlen Oil	Transol V 32	-36	218	X	X
Paramo / Mogul	HM 32	-40	195	X	
Paramo / Mogul	OT-HP 3	-30	205	X	
Petrobras	Lubrax Hydra XP 32	-21	232		
Petrobras	Lubrax Industial EGF 32 PS	-12	222		
Petrobras	Lubrax Turbina EP 32	-21	234		
Petro-Canada	Environ AW 32	-42	233	X	
Petro-Canada	Hydrex AW 32	-39	217	X	
Petro-Canada	Turboflo EP 32	-33	220	X	
Petrol Ofisi	Hydro Oil HD 32	-27	238	X	
Petronas	Hidraulik EP 32	-9	222	X	
Petronas	Jenteram HC Extra 32	-12	218	X	
Phillips 66	Diamond Class AW Turbine Oil 32	-40	227	X	X
Phillips 66	Powerflow AW Hydraulic Oil 32	-37	216	X	X
Prista Oil	Prista MHP 32	-30	218	X	
PTT Oil and Retail Business Public Company Limited	Votera 32	-25	210	X	
Repsol	Telex E 32	-24	218	X	
Rosneft	Gidrotec HLP 32	-30	215		
Shell	Tellus Oil S2 MX 32	-30	220	X	
Shell	Tellus Oil S3 M 32	-33	215	X	
Shell	Turbo Oil S4 GX 32	-33	230	X	X
Sinopec	Greatwall L-HM 32	-21	222	X	
SK Lubricants	ZIC Supervis AW 32	-40	230		
SRS	Wiolan HF 32	-27	200	X	
SRS	Wiolan HF 32 DB	-27	200	X	
SRS	Wiolan HX 32	-27	210	X	
Statoil	HydraWay HMA 32	-27	218	X	
Tide Water Oil Co. (India) Limited	Veedol Avalon HLP 32	-21	212		
Total	Azolla ZS 32	-27	210	X	
Valvoline Cummins Ltd.	Valvoline HLP 32	-18	220		
Wisura	Kineta 32 V	-24	224	X	

3.5 Proposed operating fluids for low temperature application PAO VG 32 (S…)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
BASF SE	ProEco HE 801-32	-48	200	X	
Castrol	Aircol SR 32	-50	238	X	
Castrol	Alphasyn T 32	-54	210	X	
Castrol	Perfecto SN 32	-54	264	X	
ENI	Agip Dicrea SX 32	-60	248		
ExxonMobil	Mobil SHC 524	-54	234	X	
ExxonMobil	Mobil SHC 824	-54	248	X	
Fuchs Europe	Renolin Unisyn OL 32	-60	240	X	X
Klüber	Summit HySyn FG 32	-50	230	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Schumann 32	-54	224	X	
LUBRICANT CONSULT GmbH LUBCON	TURMOFLUID GV 32	-62	220		
Lubrication Engineers Inc	LE 9032 Monolec	-54	240		
Phillips 66	Syncon AW Hydraulic Fluid 32	-60	240		
Royal Purple	Synfilm GT 32	-62	249	X	
Shell	Tellus Oil S4 ME 32	-54	230	X	X
Statoil	Mereta 32	-60	235		X
Total	Dacnis SH 32	-57	250	X	
Wunsch	Syntholube compressor oil 32	-54	224	X	

3.6 Proposed operating fluids VG 46 (S...)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Addinol Lube Oil GmbH	Hydraulic oil HLP 46 AF	-27	240	X	X
Addinol Lube Oil GmbH	Turbine Oil MT 46	-15	240	X	
Addinol Lube Oil GmbH	Turbine oil TP 46	-15	230	X	
ADNOC (Abu Dhabi National Oil Company)	GII Turbine Oil EP 46	-15	230		
Adnoc (Abu Dhabi National Oil Company)	Hydraulic Oil H 46	-34	228		
Bharat Petroleum Corp. Ltd.	MAK Hydrol CE 46	-24	230	X	
Caltex	Regal EP 46	-21	234		
Castrol	Hyspin XP 46	-27	215	X	X
Castrol	Hyspin ZZ 46	-30	225	X	X
Castrol	Perfecto XEP 46	-15	234	X	
Cepsa	HD Turbinas 46	-12	220	X	
Cepsa	Transmisiones EP 225	-30	232	X	
Chevron-Texaco	Texaco Rando HD 46	-30	204		
Chevron-Texaco	Texaco Regal Premium EP 46	-15	235	X	
ExxonMobil	Mobil DTE 10 Excel 46	-45	232	X	X
ExxonMobil	Mobil DTE 846	-30	244	X	
ExxonMobil	Mobil DTE Excel 46	-33	226	X	
Fuchs Europe	Renolin Eterna 46	-15	220	X	X
Gulf Oil Corp. Ltd.	Crest EP 46	-21	220	X	
Gulf Oil Corp. Ltd.	Harmony AW 46	-24	210	X	
Idemitsu Oil	Daphne Super Hydraulic Fluid 46	-32	230		
JOMO	Hydlux A 46	-35	224		
Kuwait National Lubricant Oil Company (KNLOC)	Hydraulic Oil 46	-30	222	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Haydn 46	-30	222	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Holst 46	-18	222	X	X
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 Hydraulic S-46	-30	222	X	
Kuwait Petroleum Int. Lubricants (Q8 Oils)	Q8 van Gogh EP 46	-12	222	X	
Lotos Oil	Corvus 46	-27	230		
Lotos Oil	Remiz TG 46	-18	228		
Lukoil LLK International	Geyser ST 46	-36	232	X	
Neste Oil	Neste Paine 46 ZFX	-27	220	X	
OMV	hyd HLP-AL 46	-27	232	X	
OMV	power turb 46	-15	254	X	
OMV	turb HTU 46	-15	216	X	
Paramo / Mogul	HM 46	-15	185	X	

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
PAZ Lubricants & Chemicals LTD	Pazelus CLH 46	-30	228	X	
Petrobras	Lubrax Turbina EP 46	-21	238	X	
Petro-Canada	Environ AW 46	-33	239	X	
Petro-Canada	Hydrex AW 46	-33	227	X	
Petro-Canada	Turboflo EP 46	-30	237	X	
Petronas	Jenteram HC 46	-9	218	X	
Petronas	Jenteram HC Extra 46	-9	218	X	
Phillips 66	Diamond Class AW Turbine Oil 46	-36	231	X	X
Phillips 66	Powerflow AW Hydraulic Oil 46	-34	221	X	
PTT Oil and Retail Business Public Company Limited	Terbin EP 46	-15	224	X	
Repsol	Hidróleo 46	-40	200	X	
Saudi Aramco	Turbo Compressor Oil 46 (acc. to 26-SAMSS-088)		230	X	
Shell	Tellus Oil S3 M 46	-33	220	X	X
Shell	Turbo Oil S4 GX 46	-21	245	X	X
Sinopec	Greatwall Ashless L-HM 46	-12	224	X	
Sinopec	Greatwall L-HM 46	-12	224	X	
Sinopec	Greatwall L-TSA 46	-13	221	X	
Sinopec	Greatwall L-TSE EP 46	-15	230	X	
TNK Oil	Turbo 46	-18	215		
Total	Preslia 46	-9	230	X	
Total	Preslia EVO 46	-15	254	X	X

3.7 Proposed operating fluids for low temperature application PAO VG 46 (S…)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
BASF SE	ProEco HE 801-46	-45	280	**X**	
Castrol	Alphasyn T 46	-57	220	**X**	
Chevron-Texaco	Cetus PAO 46	-57	250	**X**	
Fuchs Europe	Renolin Unisyn OL 46	-60	260	**X**	**X**
Klüber	Summit HySyn FG 46	-45	240	**X**	
Kuwait Petroleum International Lubricants (Q8 Oils)	Q8 Schumann 46	-54	238	**X**	
Lubrication Engineers Inc	LE 9046 Monolec	-51	248	**X**	
Royal Purple	Synfilm GT 46	-60	262	**X**	
Shell	Tellus Oil S4 ME 46	-51	250	**X**	**X**
Statoil	Mereta 46	-60	252	**X**	**X**

3.8 Proposed operating fluids VG 100 (S...)

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Caltex	Regal EP 100	-18	255	**X**	
Castrol	Perfecto T 100	-12	215		
Chevron-Texaco	Texaco Ragal EP 100	-18	255	**X**	
ENI	Agip OTE 100	-8	250	**X**	
ExxonMobil	Mobil DTE Oil Heavy	-15	237		
	Teresstic T 100	27	242		
Kuwait National Lubricant Oil Company (KNLOC)	Q8 van Gogh 100	-12	254	**X**	
Petro-Canada	Hydrex AW 100	-30	250	**X**	
Shell	Turbo Oil T 100	-9	250	**X**	
Total	Azolla AF 100	-21	263	**X**	
	Preslia 100	-9	250	**X**	
Wunsch	Hydraulic oil HLP 100	-27	254	**X**	

4 Operating Fluids for use in the Food Industry (T… / TP…)

4.1 Proposed operating fluids

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
Klüber	Summit HySyn FG 32	-45	>230		

Notice
USDA H1-Registration, satisfies the FDS requirements.

5 High-Flash Point Fluids HFD-U (T...)

5.1 Precondition for the use

- Permissible material of radial shaft sealing ring: **FKM**

5.2 Proposed operating fluids

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	FE8 fulfilled
VOITH	HI-Fluid	-33	305	X	
Fuchs	Renosafe DU 46	-33	305	X	
	Renosafe FireProtect 46	-42	270	X	X

Notice

These high-flash point fluids of viscosity class ISO VG 46 contain neither chlorinated hydrocarbons nor phosphorus acid ester. The density of the fluids is lower than the density of water.

6 Quickly Biodegradable Fluids HEES (T…)

6.1 Precondition for the use

- Permissible material of radial shaft sealing ring: **FKM**

6.2 Proposed operating fluids

Producer	Designation	Pour point in ° C	Flash point in ° C	Ignition point => 250° C	EU-Eco label
Fuchs	Plantosyn 3268**	-36	290	450	DE/027/273
	Plantosyn 32 HVI*	-46	220	450	DE/027/273
Panolin	PANOLIN HLP SYNTH E 32*	-18	175	250	DE/027/289
Shell	Naturelle S4 Hydraulik Fluid 46**	-51	260		NL/027/019

* VG 32
** VG 46

Notice

All indicated operating fluids are environmentally friendly, high-temperature stable HVI multigrade hydraulic oils based on fully saturated synthetic ester (HEES), quickly biodegradable according to OECD 301 B > 60 %. The water risk class is 1 and the density of this fluid is lower than the density of water.

7 Anti-freezing Agent / Glysantine (TW…)

7.1 Preconditions for the use

- Permissible material of radial shaft sealing ring:
  NBR (preferable from the technical point of view)
  FKM
- Mixing ratio: **50:50**

7.2 Proposals for concentrates

Producer	Designation
AVIA AG	AVIA ANTIFREEZE APN-S
	AVIA ANTIFREEZE NG
BASF	GLYSANTIN G30
	GLYSANTIN G40
BELGİN MADENİ YAĞLAR TİC. ve SAN. A.Ş.	LUBEX ANTIFREEZE MG-40
BP Lubricants Technology Centre	Aral Antifreeze - silicate-free
	Castrol Radicool Si-OAT
CEPSA	XTAR SUPER COOLANT Si-OAT
CLASSIC Schmierstoff GmbH & Co. KG	CLASSIC KOLDA UE G30®
	CLASSIC KOLDA UE G40®
Cummins Filtration	Fleetcool® OAT Plus
ENI	Eni Antifreeze Spezial 12++
FUCHS SCHMIERSTOFFE GMBH	MAINTAIN FRICOFIN DP
KUWAIT Petroleum	Q8 Antifreeze Lobrid
Moove Lubricants Limited	Mobil Antifreeze Advanced Concentrate
	Mobil Antifreeze Ultra Concentrate
Nalco Australia	Nalcool NF40
NESTE Corporation	Neste Pro+ Coolant N
	Neste Pro+ Coolant M
ORGANIKA - CAR S.A	Glixol G12+ Long Life Koncentrat
	Glixol Premium G12++ Koncentrat
Pakelo Motor Oil	Pakelo Coolant G30® Red Long Life
	Pakelo Coolant G40® Hybrid
PANOLIN Production AG	PANOLIN ANTI-FROST MT-650
Total	TOTAL GLACELF SI-OAT

Notice
The water risk class is 1 and the density of this fluid is **higher** than the density of water.

7.3 Proposals for mixed anti-freezing agents

Producer	Designation
BASF	GLYSANTIN G30 Ready Mix
	GLYSANTIN G40 Ready Mix
BP Lubricants Technology Centre	CASTROL Radicool Si-OAT Premix
CEPSA	XTAR SUPER COOLANT Si-OAT 50%
CLASSIC Schmierstoff GmbH & Co. KG	CLASSIC KOLDA UE G40® FG (1:1)
FUCHS SCHMIERSTOFFE GMBH	MAINTAIN FRICOFIN DP 50
Moove Lubricants Limited	Mobil Coolant Advanced Ready Mix
	Mobil Coolant Ultra Ready Mix
ORGANIKA - CAR S.A	Glixol G12+ Long Life -37
	Glixol Premium G12++ -37
Pakelo Motor Oil	Pakelo Coolant G40® Ready Mix
PUMA Energy International SA	Puma HD Hybrid Coolant 5050
RUBiS Energy Kenya PLC	Rubis Antifreeze Coolant
Total	TOTAL COOLELF SI-OAT
Valvoline Europe - Ellis Enterprises B.V.	Valvoline™ ZEREX™ G30® Ready To Use

Notice

The water risk class is 1 and the density of this fluid is **higher** than the density of water.

8 Requirements to be fulfilled by the Operating Fluid 'Water'

Water can only be used in couplings which are suitable for this operating medium due to corresponding sealing and corrosion protection measures (e.g. TW... / TPW... / SVTW...).

8.1 Requirements

p_H-value (ϑ = 10° C)	5 - 8	(for $\vartheta_{operation} \leq$ 40° C)
	5 - 7.5	(for $\vartheta_{operation} <$ 70° C)

The water used should
– to the greatest possible extent, be free from solid matters,
– only contain a low amount of salt,
– contain only a low concentration of other additives.

8.2 Operating fluids that can be used

Normally, drinking water satisfies these requirements.

9 Criteria and Information for Evaluation of used Oils

9.1 General

Mineral oils change with advanced operating time under the influence of atmospheric oxygen, temperature and impurities with catalytic effect. Additives applied are used up. This finally results in the fact that the mineral oil does no longer meet the requirements. Information enabling such an evaluation is based, above all, on the comparison of results of used oil analysis with the relevant data of the fresh oil. Considering the variety of the oils it is not advisable to define fixed limit values for individual characteristics. Only the interpretation of all combined characteristic values can provide a verifying statement as to the fitness for continued use of the operating fluid.

Notice
The decision regarding the suitability of the operating oil for continued use thus remains reserved to the respective oil producer / oil supplier.

9.2 Sampling

Used oils should be checked for continued usability (trend analysis) at regular intervals (see installation and operating manual). Correct and careful sampling is of utmost importance for the informative value of analysis results. Samples should preferably be taken from an area with oil in motion during operation or immediately upon standstill of the unit. It is important here to ensure that a certain flow quantity is drained before filling the sample container.

Notice
The sample quantity depends on the scope of inspection.
For a standard scope as per Chapter 8.3 a sample quantity of 0.5 liters is required.

9.3 Scope of analysis

The scope of the analysis depends on the condition of the unit and possible problems.
The following scope may be selected for a standard analysis to evaluate the condition of the oil and the unit:

- Additives:
  Calcium, magnesium, zinc, phosphorus, barium, boron
- Contaminants:
  Silicone, potassium, sodium, water as per Karl Fischer in ppm (or %)
- Condition of oil:
  Viscosity at 40° C and 100° C, viscosity index, oxidation,
  appearance, neutralization number
- Wear metals:
  Iron, chromium, tin, aluminum, nickel, copper, lead, molypdenum, PO index
- Particle counting as per ISO 4406 / SAE 4059
- Air release property (LAV) as per DIN ISO 9120 I ASTM D 3427

9.4 Criteria / information for the evaluation of used oils

The following list contains aspects to be considered and rough standard limits for evaluating the suitability of operating oils for continued use from Voith Turbo's point of view. These data can only be considered as reference values as they depend on the different operating conditions as well as also on the composition and type of oil.

9.4.1 Additives

Increasing aging of the oil may reduce the value of the failure load stage.
In addition to visual inspections of the components (see operating manual), the oil producer/supplier should issue a statement about the residual content of additives via the infrared spectrum. A residual content of EP additives of more than 30% normally guarantees that the reduction of the FZG load stage is not more than one stage. A lower residual content of EP additives indicates that the oil needs to be changed.

9.4.2 Oil condition

A visual / sensory test (severe blackening, settling of residues (formation of sludge) and precipitation and / or sharp or burning smell) and the results of the oil analysis indicate that the oil needs to be changed.

A change in viscosity of > ± 10 % compared to the fresh oil is also an indication for a necessary oil change.

Notice
It is necessary to find the cause for the change in viscosity!

9.4.3 Neutralization number NZ (DIN 51558)

The increase in neutralization number is not a general criterion for the aging of oil.

However, it is recommended changing the oil at the following increase of the neutralization number compared to the one of fresh oil:

- for turbine oils: 0.5 - 1.0 mg KOH / g
- for HLP oils: 1.0 - 1.5 mg KOH / g
- for CLP oils: 1.5 - 2.0 mg KOH / g

9.4.4 Water content (DIN ISO 3733)

If the water content exceeds 0.05 weight-percent (500 ppm), measures to remove the water have to be taken. Procedure: Centrifuging, filtering using a coalescer (multi-phase separator), vacuum treatment, settling (by letting the oil rest for 1 to 2 days) and draining through a drain cock or by heating up.

At a water content of ≥ 0.2 weight-% (already visible as clouding of the oil), the oil needs to be changed.

Oils with verified water release property are capable of emulsifying up to approx. 0.2 % water without any negative effect on the function.

Notice
Find the cause for water content!

9.4.5 Air release property LAV (DIN ISO 9120)

Air release property of new oil ≤ 5 minutes (0.2 % at 50° C).
It is necessary to change the oil in case of pressure and speed variations, if other causes, as e.g. too low oil level, can be excluded.
We recommend determining the air release property value.