TECHNICAL INFORMATION

Translation from the original language

Sizes C...XH; CompaX 350, 400

Oils for screw compressors

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1 Oils for screw compressors

1.1 Oils for refrigeration technology and gas compression

General Information

The oils specified in the tables are approved for use with screw compressors from GEA Refrigeration Germany GmbH. The selection of the oils depends on the chemical properties of the oil, the refrigerants, the operating conditions of the plant and the required oil viscosity during start up and run. After inquiring with the compressor manufacturer, oils other than those listed in the table may also be used. There is more information on listed oils in the data sheets and diagrams of the oil manufacturer. For refrigeration compressors, special refrigeration oils have to be used. The selection depends on the refrigerant, viscosity (at least 7 cSt for oil temperature before entering the compressor), evaporating temperature (pour point) and requirement made of the oil separation behaviour (flash point, viscosity).

Basis of the lubricating oils and used abbreviations:

M	Mineral oil
M*	Mineral oil with special treatment (hydrocracked oil)
AB	Alkylbenzene
PAO	Polyalphaolefin
E	Polyolester
PAG	Polyalkylene glycol
"X"-"Y"	Mixed oil from previous base oils

Application instruction for oil selection:

- Compressors are equipped with suitable elastomers at the sealing point, which are selected dependent on the refrigerant and lubricant. (*Table 7: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*)
- When selecting the type of oil, the compatibility of the sealant material used in the compressor for o-rings (elastomer quality) must be taken into consideration in addition to the refrigerant. (*Table 7: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*)
- Oil grades are not always compatible with each other (cannot be mixed).
- Not all the listed oil types can be used for an existing compressor. It is absolutely necessary to assign the oil grade depending on the elastomer used, even if the refrigerant is the same.
- Changing from one oil type to another can lead to disruptions in the operation of the compressor and to leakages at the sealing points. The compressor manufacturer should always be contacted before changing the oil type.
- The pour point describes the cold fluidity of an oil and represents a non-guaranteed guide value for the minimum evaporating temperature.

Application instruction for trouble-free operation:

- The lubricant viscosity range downstream of the compressor given in data sheet must always be observed. At the same time, it must be noted that refrigerant/oil combinations are possible in which, dependent on the pressure and temperature in the oil separator of the package, the refrigerant dissolves in the oil. This leads to a reduction of the viscosity of the pure oil and to the formation of foam when the solution equilibrium is altered due to pressure reduction or temperature increase. In this case, the oil must be cooled by a minimum temperature difference, which is calculated in the compressor selection programme for the given operating conditions.

The compressor may only be operated if the oil entry temperature is complied with in accordance with the compressor selection programme!

- The oil separation behaviour of the types of oil given in the Table can vary greatly (e.g. influence of oil vapour pressure, oil viscosity, solubility, discharge temperature).

1.1.1 Oil selection for refrigeration technology applications

Table 1: Oils for R717 (Ammonia), recommended especially if minimum oil carry over from the oil separator is important

Manufac-turer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
GEA	PR-OLEO C-MH68A	M*	64	245	-42	Hydrotreated	H2
	PR-OLEO C-MH68A-FG	M*	62	240	-42		H1
	PR-OLEO C-MH100A-FG	M*	102	270	-30		H1
	PR-OLEO C-PAO68-FG	PAO	64	264	-54		H1
	PR-OLEO C-PAO100-FG	PAO	98	264	-45		H1
CPI	CPI 1009-68	M*	68	226	-40	Hydrotreated	H2
	CPI 1008-68	M*	64.9	240	-39		H2
Klüber Lubrication	Klüber Summit RHT 68	M*	68	240	-39		H2
	Klüber Summit RHT FG-68	M*	68	243	-36		H1
	Klüber Summit R 100	PAO	32	> 230	-60		H1
	Klüber Summit R 150		46	> 240	-51		
	Klüber Summit R 200		68	> 230	-51		

Manufac-turer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Petro Canada	Reflo 68A	M*	58	236	-42	Hydrotreated	H2
TEXACO	Capella Premium	M*-PAO	67	262	-42		
Paramo	Mogul Komprimo ONC 68	M*	68	230	-33		
TOTAL	Lunaria NH 68	M*	68	230	-36		
Fuchs	Reniso Ultracool 68	PAO	62	250	-48		H2
NXT Next Lubri-cants	NXT-717	M*	61	249	-42	Hydrotreated	
Mobil	Gargoyle Arctic 68 NH	M*	69	248	-36		

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

Table 2: Oils for use with dry evaporation (DX) with R717 (ammonia)

Manufac-turer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Mobil	Zerice S32	AB	32	154	-33	Please contact manufac-turer	

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

Table 3: Oils for R717 (ammonia) and R22

Manufac-turer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Castrol	Aircol 299	M	56	180	-34	for R22 on-ly	
	Aircol AMS 68	M	68	230	-36	for R717 only	
	Aircol 2294	PAO	69	233	-60	for R717 only	
CPI	CPI-4700-68	AB	56	179	-35	for R22 on-ly	
MOBIL	Zerice S32	AB	32	154	-33		
	Zerice S68	AB	68	174	-27	for R22 on-ly	
	Gargoyle Arctic SHC 226E	PAO	68	266	-45	for R717 only	H1
	Gargoyle Arctic SHC NH 68	PAO-AB	64	211	-54		
	Gargoyle Arctic 300	M	68	200	-36		
	Gargoyle Arctic C Heavy	M	46	195	-42		
Fuchs	Reniso S68	AB	68	190	-33		
	Reniso Synth 68	PAO	68	260	-57	for R717 only	H1
	Reniso KS 46	M	46	195	-42		
	Reniso KC 68	M	68	200	-39		H2
Shell	Shell Re-frigeration Oil S4 FR-V 46	AB	46	180	-42		
	Shell Re-frigeration Oil S4 FR-V 68	AB	68	190	-39		

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
TOTAL	Lunaria NH 46	M	46	226	-36	for R717 only	
	Lunaria SH 46	PAO	44	252	-51	for R717 only	H1
	Lunaria FR 68	M	68	175	-34	for R22 only	
Petro-Canada	Reflo Synthetic 68A	PAO-AB	62	245	-54	for R717 only	

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

Table 4: Oils for R134a; R404A; R407C; R410A; R507

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Castrol	Aircol SW 68	E	68	245	-39		
	Aircol SW 220		220	250	-27		
CPI	Solest 68	E	64	266	-43		
	Solest 120		125	262	-33		
	Solest 220		216	271	-27		
Fuchs	Reniso Triton SE 55	E	55	286	-48		H2
	Reniso Triton SEZ 68		68	258	-39		
	Reniso Triton SEZ 80		82	251	-39		
	Reniso Triton SEZ 100		100	266	-30		

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
	Reniso Triton SE 170		173	260	-27		
	Reniso PAG 220	PAG	220	240	-38	for R134a only	
Shell	Shell Refrigeration Oil S4 FR-F 68	E	66	230	-42		
	Shell Refrigeration Oil S4 FR-F 100		94	230	-42		
MOBIL	EAL Arctic 68	E	68	230	-36		
	EAL Arctic 100		105	250	-30		
TOTAL	Planetelf ACD 100FY	E	100	270	-30		
	Planetelf ACD 150FY		150	272	-36		

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

INFO When using high-viscosity oils with high refrigerant solubility after initial fill of the plant a sufficient mixture from refrigerant and oil has to be provided before start-up the screw compressor.

Table 5: Oils for R744 (CO2) applications

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
CPI	CPI 4624-46F	PAO	46	246	-60		H1
	CPI 4624-68F		68	268	-51		H1

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Fuchs	Reniso C 85 E	E*	80	246	-42	complete miscible	H2
	Reniso C 170 E	E*	170		-30	attend to the miscibility gap	
Klüber Lubrication	Klüber Summit R 100	PAO	32	> 230	-60		H1
	Klüber Summit R 200		68	> 230	-51		
Mobil	SHC Gargoyle 80 POE	E*	78	285	-45		

* During application of Polyolester: $t_{\text{oil inlet}} \leq t_{\text{discharge}} - 4K$

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

INFO When using high-viscosity oils with high refrigerant solubility after initial fill of the plant a sufficient mixture from refrigerant and oil has to be provided before start-up the screw compressor.

1.1.2 Oil selection for refrigeration technology applications with CompaX compressor

Oils for compressor CompaX with R717 (Ammonia)

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
GEA	PR-OLEO C-MH68A	M*	64	245	-42		H2
	PR-OLEO AC-MH68A-FG		62	240	-42		H1
Klüber	Summit R100	PAO	32	>230	-60		H1
	Summit R150		46	>240	-51		

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
	Summit R200		68	>230	-51		
Shrieve	Zerol PAG R717 52	PAG	52	220	-60		
	Zerol PAG R717 68		68	230	-51		

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

1.1.3 Oil selection for gas compression

Table 6: Oils for natural gas and hydrocarbon compounds

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
Castrol	PD 68	M	68	234	-21	for natural gas compression	
CPI	CPI 1515-68	PAG	67	224	-43	For heavy hydrocarbons, where strong dilution or condensation will occur	
	CPI 1519-100		102	249	-51		
	CPI 1516-68		68	218	-48	For propane refrigerant plants or volatile hydrocarbons, where the danger of stronger dilution or condensation does not exist	

Manufac-turer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
	CPI 1516-100		100	260	-40		
	CPI 1516-150		150	260	-34		
CPI	CPI 4600-68	PAO	68	248	-51	For high-temperature applications with pure hydrocarbons (R290, R1270)	
	CPI 4600-100		97	238	-51		
	CPI 4601-68		64	268	-54	For high temperature application and for feed gas control compressors for gas turbines	H2
	CPI 4601-100		97	271	-48		
CPI	CPI 1507-68	PAG	68	231	-48	For heavy hydrocarbons, for hydrocarbon cooling applications in range of high pressure/ low temperature	
	CPI 1507-100		90	260	-37		
MOBIL	Glygoyle 11	PAG	85	226	-45	For natural gas and propane	
	Glygoyle 22		177	229	-41		
	Glygoyle 100		100	265	-30		
Shell	Corena S3 R68	M	68	240		For natural gas	

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality 1)
	Shell Gas Compressor Oil S4 PV 190	PAG	190	262	-30	For natural gas and propane	
TOTAL	DACNIS LPG 150 2)	PAG	142	280	-48	For natural gas, propane and volatile hydrocarbons	
Klüber Lubrication	Summit NGSH-68	PAO-E	68	250	-36	For natural gas, for feed gas control compressors for gas turbines and hydrocarbons	
	Summit NGSH-100		100	250	-39		

1) Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

2) Product rebranded from "TOTAL Primera LPG 150" into "TOTAL DACNIS LPG 150".

Selection of elastomers for natural gas and hydrocarbon compounds

INFO If natural gas and hydrocarbon compounds are used as compression medium (*Table 7: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*), O-ring elastomers should be requested from the manufacturer depending on the operation condition.

1.1.4 O-ring elastomers for refrigeration technology and gas compression

Table 7: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:

Refrigerant	M	M*	M*-PAO	AB	E	PAO	AB-PAO	PAG
R717 (ammonia)	CR*)/ HNBR	CR*)/ HNBR	CR*)/ HNBR	CR	-	CR	CR	CR/ HNBR
R22	CR	-	-	CR	CR	-	CR	-

Refriger-ant	M	M*	M*-PAO	AB	E	PAO	AB-PAO	PAG
R134a, R404A, R407C, R410A, R507, R23	-	-	-	-	HNBR	-	-	-
R290 (propane), R1270 (propy-lene)	-	-	-	-	-	HNBR	-	HNBR
R744 (Carbon dioxide CO_2)	-	-	-	-	CR	HNBR	-	CR

*) recommended

Abbreviations used for the elastomers:
- CR: Chloroprene (Neoprene caoutchouc)
- HNBR: Hydrogenated nitrile butadiene caoutchouc

Selection of elastomers for natural gas and hydrocarbon compounds

INFO If natural gas and hydrocarbon compounds are used as compression medium (*Table 7: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*), O-ring elastomers should be requested from the manufacturer depending on the operation condition.

1.2 Oils for heat pumps

General Information

The oils specified in the tables are approved for use with screw compressors from GEA Refrigeration Germany GmbH. The selection of the oils depends on the chemical properties of the oil, the refrigerants, the operating conditions of the plant and the required oil viscosity during start up and run. After inquiring with the compressor manufacturer, oils other than those listed in the table may also be used. Further information on listed oils, are given in the data sheets and diagrams of the oil manufacturer.

Basis of the lubricating oils and used abbreviations:

M	Mineral oil
M*	Mineral oil with special treatment (hydrocracked oil)
PAO	Polyalphaolefin

GEA Refrigeration Germany GmbH recommends the use of PAO oil for screw compressors.

Application instruction for oil selection:

- Compressors are equipped with suitable elastomers at the sealing point, which are selected dependent on the refrigerant and lubricant. (*Table 2: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*)
- When selecting the type of oil, the compatibility of the sealant material used in the compressor for o-rings (elastomer quality) must be taken into consideration in addition to the refrigerant. (*Table 2: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:*)
- Oil grades are not always compatible with each other (cannot be mixed).
- Not all the listed oil types can be used for an existing compressor. It is absolutely necessary to assign the oil grade depending on the elastomer used, even if the refrigerant is the same.
- Changing from one oil type to another can lead to disruptions in the operation of the compressor and to leakages at the sealing points. The compressor manufacturer should always be contacted before changing the oil type.
- The pour point describes the cold fluidity of an oil and represents a non-guaranteed guide value for the minimum evaporating temperature.

Application instruction for trouble-free operation:

- The lubricant viscosity range downstream of the compressor given in data sheet must always be observed. At the same time, it must be noted that refrigerant/oil combinations are possible in which, dependent on the pressure and temperature in the oil separator of the package, the refrigerant dissolves in the oil. This leads to a reduction of the viscosity of the pure oil and to the formation of foam when the solution equilibrium is altered due to pressure reduction or temperature increase. In this case, the oil must be cooled by a minimum temperature difference, which is calculated in the compressor selection programme for the given operating conditions. The compressor may only be operated if the oil entry temperature is complied with in accordance with the compressor selection programme!
- The oil separation behaviour of the types of oil given in the Table can vary greatly (e.g. influence of oil vapour pressure, oil viscosity, solubility, discharge temperature).

1.2.1 Oil selection for heat pumps

Table 1: Oils for heat pumps R717 (ammonia)

Manufacturer	Type of oil	Basis	Viscosity at 40°C in cSt	Flash point in °C	Pourpoint in °C	Remark	NSF Quality[1)]
GEA	PR-OLEO C-PAO100-FG	PAO	98	264	-45		H1
Klüber	Summit R 300	PAO	100	>240	-39		H1
Fuchs	Reniso Ultracool 100	PAO	108	239	-45		H2
CPI	CPI-4600-100	PAO	97	238	-51		

[1)] Application area in food-processing industry according to NSF (National Sanitation Foundation, www.nsf.org)

- H1: Applicable in all food-processing environments where there is the possibility of incidental food contact.
- H2: Applicable in all food-processing environments where there is no possibility of incidental food contact.

Recommended oil test intervals when using mineral oil

Prerequisites

1. End temperature 95°C and oil temperature approx. 70°C:
   - 1.1 first oil test after 500 operating hours
   - 1.2 second oil test after 1000 operating hours
   - 1.3 first oil test after each 1000 operating hours
   - 1.4 After 5000 operating hours or with previously occurring abnormalities, the oil test interval is set to 500 operating hours
2. End temperature 105°C and oil temperature approx. 75°C:
   - 2.1 first oil test after 500 operating hours
   - 2.2 second oil test after 1000 operating hours
   - 2.3 first oil test after each 1000 operating hours
   - 2.4 After 3000 operating hours or with previously occurring abnormalities, the oil test interval is set to 500 operating hours

1.2.2 O-ring elastomers for heat pumps

Table 2: Use of O-ring elastomer in screw compressors depends on refrigerant and lubricant:

Refrigerant	M	M*	PAO
R717 (ammonia)	CR/ FEPM	CR/ FEPM	CR/ FEPM

Abbreviations used for the elastomers:

- CR: Chloroprene (Neoprene caoutchouc)
- FEPM: fluororubber

1.3 Notes for oil selection for screw compressors

General Information

The characteristics of refrigerating machine oil influence the functionality of a refrigerator with oil flooded screw compressors, since this cannot be precluded despite the high-capacity oil separator and remnants of refrigerating machine oil can enter the refrigerant line. So when selecting oil,

- a sufficient lubricity of the oil at the bearing points of the screw compressor (minimum oil viscosity with consideration of the solubility of refrigerants in oil depending on both the pressure and temperature),
- the vapour pressure of the oil for a proper separation behaviour in the oil separator,
- a sufficient fluidity of the oil at both the evaporating and suction temperature,
- the requirements upon the miscibility of the liquid phases of the refrigerant and the oil (miscibility gap).

need to be taken into account.

The refrigerant used, the operation conditions and the specific plant design all determine the required characteristics of the refrigerator and heat pump oil.

At present, five different base oil brands are used:

- M, M*: Mineral oils for ammonia and R22
- PAO: Polyalphaolefins for ammonia and CO_2 (R744), R290, R1270.
- AB: Alkyl benzene for ammonia and R22
- PAG: Polyalkylene glycol (PAG oil) for ammonia, as well as for natural gas and hydrocarbon compounds, R290, R1270.
- E: Ester oil for R22, R404A, R134a, R 507 and CO_2 as well as other refrigerant blends such as R410A and R407C

In addition to pure base oil components, mixtures of mineral oil or alkylbenzenes with polyalphaolefin are also used.

The characteristics of the refrigerants regarding the oils mentioned are very different.

Thereby 2 fundamental requirements are needed from the refrigerant and refrigeration oil:

- A minimum oil viscosity of 7 cSt and a maximum of 70 cSt at the compressor inlet must be maintained, taking into account the solubility of the refrigerant in the oil
  - For sizes XG and XH, a minimum oil viscosity of 15 cSt at the compressor inlet is required, considering the solubility of the refrigerant in the oil.

and

- Miscibility of both liquid phases of a certain portion of the oil (approx. 1 to 2 %) and the refrigerant.

In addition to the lubrication oil viscosity requirements the discharge temperatures in the compressor need to be high enough so that oil containing refrigerants can be cooled by at least 5 K, so that no foam forms in the compressor in the event of lower temperatures and/or temperature increases before the oil reaches the storage locations.

The second basic requirement is not fulfilled by mineral oil, alkyl benzine polyalphaolefin in association with ammonia, since the no 100% mixture gap is created and neither the solubility of the refrigerant vapour in the oil nor miscibility in the liquid phases. Nevertheless these oils are used NH_3 plants. Fine oil separation phases prevent larger oil volumes from entering the refrigeration circuit.

The base oil versions mentioned will bring about differing oil carry-over rates as the flash points of the oils cited differ greatly from each other (lowest flash point of alkyl

benzene at approx. 160 °C, highest flash point of polyalphaolefin considerably above 200 °C).

Although the fluidity of the oil is characterized by the pour point indicated by the oil manufacturers, the base oil brands mentioned above feature different VT-characteristics so that at the same initial viscosity of say 68 cSt, there may arise differences in viscosity at low temperatures in the evaporator in the range of approx. 1500 and 20000 cSt at –20°C.

With relation to oils, the refrigerants feature the following properties:

- Ammonia:
  - Ammonia is only slightly soluble in lubricants. The mechanical mixture is very intense so that oil is always carried with the ammonia. Due to the low share of ammonia, the lubrication of the oil will not change and the miscibility of oil and refrigerant during the liquid phases is not possible. Efficient oil separation is thus necessary.
- HFC (e.g. R134a, R404A, R507):
  - HFC contains no chlorine and is not limited in its applications. Ester oil is used for this refrigerant. The greater solubility of this refrigerant in ester oil needs to be taken into account when selecting an oil, since the initial viscosity of the oil through the dissolving of refrigerant in the oil can change significantly. However, the fluidity of the oil in the evaporator is given due to proper miscibility over a wide range.

The most important properties of the main oil groups are described in the following:

- Mineral oil
  - Naphten-based mineral oils are best suited for refrigerating plants, but paraffin-based oils are also used. Special treatment (paraffin removal) means that paraffin-based oils have more or less the same characteristics as naphten-based oils. Mineral oils are characterised by relatively low miscibility with HCFCs (e.g. R22) at lower temperatures. Mineral oils have a relatively high viscosity index and low steam pressure (high flammability) that positively influences the oil impact.
- Alkyl benzene (also known as alkyl benzole)
  - Alkyl benzenes are synthetic oils created from natural gas. They are characterized by high miscibility with HCFCs (e.g. R22) even at lower evaporating temperatures. Alkyl benzenes have greater thermal stability than mineral oils (ammonia use in piston compressors). However they have a higher tendency towards foam formation than mineral oils in the oil separator and thus to greater discharge despite the lower flame point. When switching from mineral oil to alkyl benzenes, it should be noted that alkyl benzenes have higher cleaning efficiency and thus the filter will dirty faster after the oil change.
- Polyalphaolefin
  - Polyalphaolefins are synthetic oils with high levels of chemical and thermal stability. Therefore, they are preferably used in compressors operating at high discharge temperatures e.g. in heat pumps. Polyalphaolefins are also used in ammonia plants. The very low pour point creates a very low evaporating temperature. The high flame point leads to low oil discharge.
- Ester oils
  - As opposed to mineral oils, alkyl benzines and polyalphaolefins, ester oils are soluble in the new non-chlorinated HFCs (R134a, R404A, R507 etc.). So ester oils are thus the only lubricant that may be used with HFCs. Ester oils have a high flash point, whereby the oil vapour share in the oil separator and thus the oil discharge are positively influenced. Ester oils are hygroscopic. They absorb water when they come into contact with the atmosphere. Ester oils thus need to be stored in sealed containers. The compressors needs to be thoroughly evacuated before the oil filling.
- Polyglycol oil
  - Polygylcol oils are soluble in ammonia and very hygroscopic. They are thus subject to the same handling conditions as ester oils. When selecting oils the drop in viscosity resulting from dissolving refrigerants in the oil needs to be taken into consideration. The flowablility of the oil in the evaporator needs to be tested

taking into account the miscibility between the refrigerating machine oil and the refrigerant at each relevant evaporating temperature.

Parameters for oils

Specific density

The density difference between the coolant and oil may be important for the oil return. Care should be taken that alkyl benzine has a lower density than mineral oils and polyglycol and greater density than mineral oil. The methods for measuring density is described in DIN 51757.

Viscosity

In accordance with the ISO 3448 standard lubricants are classified according to viscosity classes listed as ISO VG No. The ISO No. is only a nominal value in such classes, i.e. the actual viscosity may deviate in certain areas (DIN 51562). The viscosity entries are based on the temperatures of 40°C and 100°C.

Viscosity index

The viscosity index supplies the connection between the change in viscosity depending on the temperature (ISO 2909). Greater viscosity index readings mean lower viscosity changes when temperatures change compared to lower viscosity index values.

Flash point

The flash point indicates at which temperature the vapours escaping from a heated cup may be ignited over a flame. The measuring method is described in ISO 2592. Oils with higher flash points have lower oil vapour pressures. This will enhance the possibilities of oil separation from a compressed gas in the oil separator and reduce the oil carry-over rate from the compressor into the plant.

Pourpoint

The pour point is the temperature, where the flowability of oil declines so that under certain conditions no oil will flow from a container within five seconds. In accordance with the standards, the pourpoint temperature is 3% lower than the measured temperature (measuring method in accordance with ISO 3016) The pour point is interesting for material pairs that are not soluble with one another. Oils with a low pourpoint are easier to lead back to the suction side than oils with higher pour points. Practice teaches that it is possible to use oils at evaporating temperatures lower than the pourpoint without having any operational problems.

Floc point

The floc point is the temperature where R12 liquids with a 10% oil admixture will become darkened due to wax particles separating from the oil when the liquid is cooled (measuring method in accordance with DIN 51351). The floc point is interesting when oils and refrigerants are mixed together. The floc point displays that an oil has fewer wax components and plants with HCFC (e.g. R22) can be operated at lower evaporating temperatures. Wax from oil can lead to problems on the expansion valves or on regulating valves. A critical solution temperature shall be supplied for ester oils using a mixture of 10% oil and 90% R134a. The critical solution temperature is that which the oil is completely removed from the refrigerant (no standardized amount).

Aniline point

The aniline point indicates the temperature at which a homogeneous solution will clear when warmed with a constant volume share of a lubricant or lubrication material or oil and aniline when cooling and clouding occurs through separation upon cooling. The aniline point is the measurement of unsaturated carbon which can be found in the oil. It is also the measurement of various sealing materials the oil comes into contact with (measuring method in accordance with ISO 3977). Most refrigerating machine oils have a low aniline point. Neoprene or chloroprene o-rings swell and therefore need to be replaced after disassembly.

Neutralization number

The neutralization number displays the acidic value of an oil and is generated using titration with caustic soda (KOH). The value is provided in mg KOH per g oil (measurement method in accordance with DIN 51558). Fresh oil should have low neutralization number.

ATTENTION

Hints for oil change

- When changing the oil type or the manufacturer of an oil, consult the seal manufacturer beforehand to prevent any problems in operating the plant.
- If the oils are not compatible excretions from the oil are possible which may lead to problems with the plant (oil filter, lubricating capacity of the bearings, oil return not assured).
- If it is necessary to use a different type of oil, it is essential to completely remove all oil from the system and thoroughly clean the compressor and oil separator (preferably with an additional flushing cycle).

ATTENTION

Validity of the oil selection tables

- All approved oils for Grasso screw compressors are listed in the oil selection tables. Depending on the specifications of the plant the technical characteristics listed above need to be taken into consideration when making the oil selection.

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