

## KT-500-9

### BITZER Kältemaschinenöle für Hubkolbenverdichter

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**BSE32**

BSE55

BSE60K

**BSE85K**

BSG68K

SHC226E

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## 1 Introduction

BITZER compressors are charged with a high-quality refrigeration compressor oil, suitable for the refrigerant used. These BITZER oils are subject to the BITZER quality management and are optimized for the respective compressors. Their chemical compatibility also with modern construction materials and new refrigerants has been extensively tested and approved. The oils offer outstanding lubrication characteristics and a favourable viscosity performance (high viscosity index).

In addition to this document, please also observe the operating instructions for the respective compressor.

## 2 Safety references

### Authorized staff

All work done on the products and the systems in which they are or will be installed may only be performed by qualified and authorised staff who have been trained and instructed in all work. The qualification and expert knowledge of the qualified staff must correspond to the local regulations and guidelines.

### Residual risks

The products, electronic accessories and further system components may present unavoidable residual risks. Therefore, any person working on it must carefully read this document! The following are mandatory:

- relevant safety regulations and standards
- generally accepted safety rules
- EU directives
- national regulations and safety standards

Example of applicable standards: EN378, EN60204, EN60335, EN ISO14120, ISO5149, IEC60204, IEC60335, ASHRAE 15, NEC, UL standards.

### Personal protective equipment

When working on systems and their components: Wear protective work shoes, protective clothing and safety goggles. In addition, wear cold-protective gloves when working on the open refrigeration circuit and on components that may contain refrigerant.



Fig. 1: Wear personal protective equipment!

### Safety references

Safety references are instructions intended to prevent hazards. They must be stringently observed!



#### NOTICE

Safety reference to avoid situations which may result in damage to a device or its equipment.



#### CAUTION

Safety reference to avoid a potentially hazardous situation which may result in minor or moderate injury.

**WARNING**

Safety reference to avoid a potentially hazardous situation which could result in death or serious injury.

**DANGER**

Safety reference to avoid an imminently hazardous situation which may result in death or serious injury.

Concerning refrigeration compressor oils in general:

**CAUTION**

Oils may be harmful!

Observe the usual precautions for handling mineral oils and chemical products as well as good industrial hygiene practices.



- ▶ Provide adequate ventilation.
- ▶ Prevent formation of aerosols.
- ▶ Avoid skin contact.
- ▶ Wear required personal protective equipment (see respective material safety data sheet).
- ▶ Do not eat, drink or smoke when working with the product.
- ▶ Do not heat up the oil to temperatures close to its flash point.

**First aid measures:**

- ▶ Remove any clothing and shoes soiled by the product.
- ▶ In case of skin contact: wash carefully with soap and water.
- ▶ In case of eye contact: promptly wash eyes with plenty of water.
- ▶ In case of ingestion: rinse mouth thoroughly and get medical attention if necessary.
- ▶ In case of persistent symptoms: seek medical attention.

**CAUTION**

Oils may be environmentally hazardous and water-endangering!

Avoid release to the environment, do not allow to enter drainage system, surface or ground water.

Correctly dispose of the oil as pollutive waste, observe national and local regulations.

**Material safety data sheets**

Apart from this document, please observe the material safety data sheet (MSDS) for the respective oil. It contains information on toxicity, handling, personal protective equipment and disposal of the oil. Material safety data sheets for all BITZER oils are available *on request*.

When working on the refrigeration system:

**CAUTION**

Surface temperatures of more than 60°C or below 0°C.

Risk of burns or frostbite.



Close off accessible areas and mark them.

Before performing any work on the compressor: switch it off and let it cool down or warm up.

In addition to the safety references listed in this document, it is essential to observe the references and residual risks in the respective operating instructions!

### 3 General properties of refrigeration compressor oils

Refrigeration compressor oils not only have to lubricate the moving compressor parts, but (according to individual design and circuit) also seal the compression chamber and valves as well as dissipate heat. In order to ensure oil circulation and return from the system as well as to avoid lack of oil, the oil must be sufficiently soluble in the refrigerant (exception: R717 - ammonia, see Technical Information [AT-640](#)): Phase separation can lead to malfunctions e.g. in the evaporator, receiver and heat exchanger. Another important parameter is the viscosity over the whole temperature range: In the compressor, the oil must be adequately viscous, while still flowing sufficiently in the cold part of the system. In addition, the oil should be age-resistant, thermally and chemically stable.

#### NOTICE

Oil with high water content may damage compressor and refrigeration system!

Avoid air intake into the system and oil containers.

Use only originally sealed oil containers. Opened oil containers should be closed tightly and their content be used up as quickly as possible.

For used oils: Observe the warning values on water content.

Water in the refrigerating circuit can lead to corrosion and to freezing of the expansion valve. It adversely affects lubricity and stability of the oils. With some refrigerants (e.g. CO<sub>2</sub>) or oils (e.g. ester oils), water also reacts by forming acids – the acid in turn corrodes metal surfaces, and the water cannot be removed anymore by evacuation. Special care is necessary with polyalkylene glycol oils (PAG), polyvinyl ether oils (PVE) and polyolester oils (POE): They are strongly hygroscopic, i.e. they withdraw water from ambient air. This dissolves in the oil and can therefore not be recognised visually.

### 4 Oils for HFC and HFO refrigerants

BITZER compressors which are intended for use with chlorine-free HFC and HFO refrigerants (R134a, R404A, R407A/C/F, R507A, R1234yf, R513A, R450A etc.) are charged with a high-quality polyolester oil. In these cases, a "Y" is added to the type designation of the compressor. BITZER polyolester oils significantly exceed the requirements of DIN 51503, Part 1, for refrigeration compressor oils with respect to water content and total acid number (TAN). They mix well with HFC and HFO refrigerants and are therefore especially suitable for operation with these substances.

#### Characterising the oils

Oil	Oil type	Applications	Designation on compressor
<b>BSE32</b>	polyolester oil (POE)	standard oil charge	"Y" (e.g. 2CES-4Y)
<b>BSE55</b>	polyolester oil (POE)	alternative oil charge for condensing temperature $t_c > 70^\circ\text{C}$ (available for many compressors)	"Y" (e.g. 2CES-4Y)
<b>BSE85K</b>	polyolester oil (POE)	oil charge for special applications	"Y" (e.g. 2CES-4Y)

Tab. 1: BITZER oils for HFC and HFO refrigerants in reciprocating compressors

#### Initial charge only with original oils

#### NOTICE

Risk of compressor damage!

BITZER polyolester oils are mandatory for the running-in period of the compressor. Use only these oils for the initial charge!

BITZER polyolester oils are characterised by specific tribological characteristics and have special wear protection additives which increase the service life of the compressor. The use of alternative oils whose characteristics correspond largely to the original charge is only possible at the system owner's own responsibility. It is possible to mix them with the original oil, within the respective viscosity group, as long as appropriate own or comparable experience is available for the application concerned. Generally, mixing different oil types may have a negative effect on

the properties of the oils. Precondition for the use of alternative oils is that the manufacturer or supplier guarantees product quality and moisture content < 50 ppm.

BITZER will only use BITZER polyolester oils for the complex tests of compatibility with new materials and refrigerants. In case of material changes on products, only BITZER polyolester oils will be included in the tests.

### Low GWP refrigerants: stricter requirements for refrigeration systems

Many refrigerant blends with low global warming potential (GWP) such as R448A, R449A, R450A, R452A and R513A contain the unsaturated compounds R1234yf and R1234ze(E). Part of them are highly soluble in oil and lead to a strong reduction of viscosity. Therefore, sufficient superheat has to be ensured! The low chemical stability (which is desirable for a low GWP) requires particular care regarding cleanliness, dryness and evacuation of the refrigerant circuit.

### Material safety data sheets

Apart from this document, please observe the material safety data sheet (MSDS) for the respective oil. It contains information on toxicity, handling, personal protective equipment and disposal of the oil. Material safety data sheets for all BITZER oils are available *on request*.

### Application range

Oil	suitable e.g. for refrigerants	Application range			
		cooling with $t_o \leq 25^\circ\text{C}$	air conditioning	medium temperature application	low temperature application
<b>BSE32</b> $t_c \leq 70^\circ\text{C}$	R134a	✓	✓	✓	(✓)
	R513A	✓	✓	✓	(✓)
	R1234yf	✓	✓	✓	(✓)
	R450A	✓	✓	✓	--
	R404A				
	R448A				
	R449A	--	(✓)	✓	✓
R452A					
R407A / F					
R407C	--	✓	✓	--	
R507A	--	(✓)	✓	✓	
<b>BSE55</b> $t_c \leq 70^\circ\text{C}$	R1234ze(E)	--	✓	✓	--
<b>BSE55</b> $t_c$ even $> 70^\circ\text{C}$	R134a	✓	✓	✓	(✓)
	R513A	✓	✓	✓	(✓)
	R1234yf	✓	✓	✓	(✓)
	R450A	✓	✓	✓	--
R407C	--	✓	✓	--	
R410A	--	✓	✓	(✓)	
<b>BSE85K</b>	R1234ze(E) at $t_o > 15^\circ\text{C}$ or $t_c > 70^\circ\text{C}$ . Other refrigerants: special application after consultation with BITZER Application Engineering.				

Tab. 2: Application range of polyolester oils (POE) for HFC and HFO refrigerants in BITZER reciprocating compressors. For application limits see also BITZER SOFTWARE.

$t_o$ : evaporation temperature

$t_c$ : condensing temperature

(✓): after consultation with BITZER Application Engineering

## Technical data

	BSE32	BSE55	BSE85 K	Unit
Density at 15°C	1.006	1.010	0.993	g/ml
Flashpoint	247	280	246	°C
Pour point	-57	-51	-42	°C
Kinematic viscosity				
at 20°C	74	147	200	cSt
at 40°C	32	55	80	cSt
at 100°C	6	9	11	cSt
Specific heat capacity				
at 40°C	1.94	1.92	1.89	kJ/kg*K
at 100°C	2.12	2.09	2.05	kJ/kg*K
Thermal conductivity				
at 40°C	0.15	0.15	0.14	W/m*K
at 100°C	0.14	0.14	0.13	W/m*K

Tab. 3: Technical data of oils for HFC and HFO refrigerants in BITZER reciprocating compressors

## Miscibility gaps BSE32

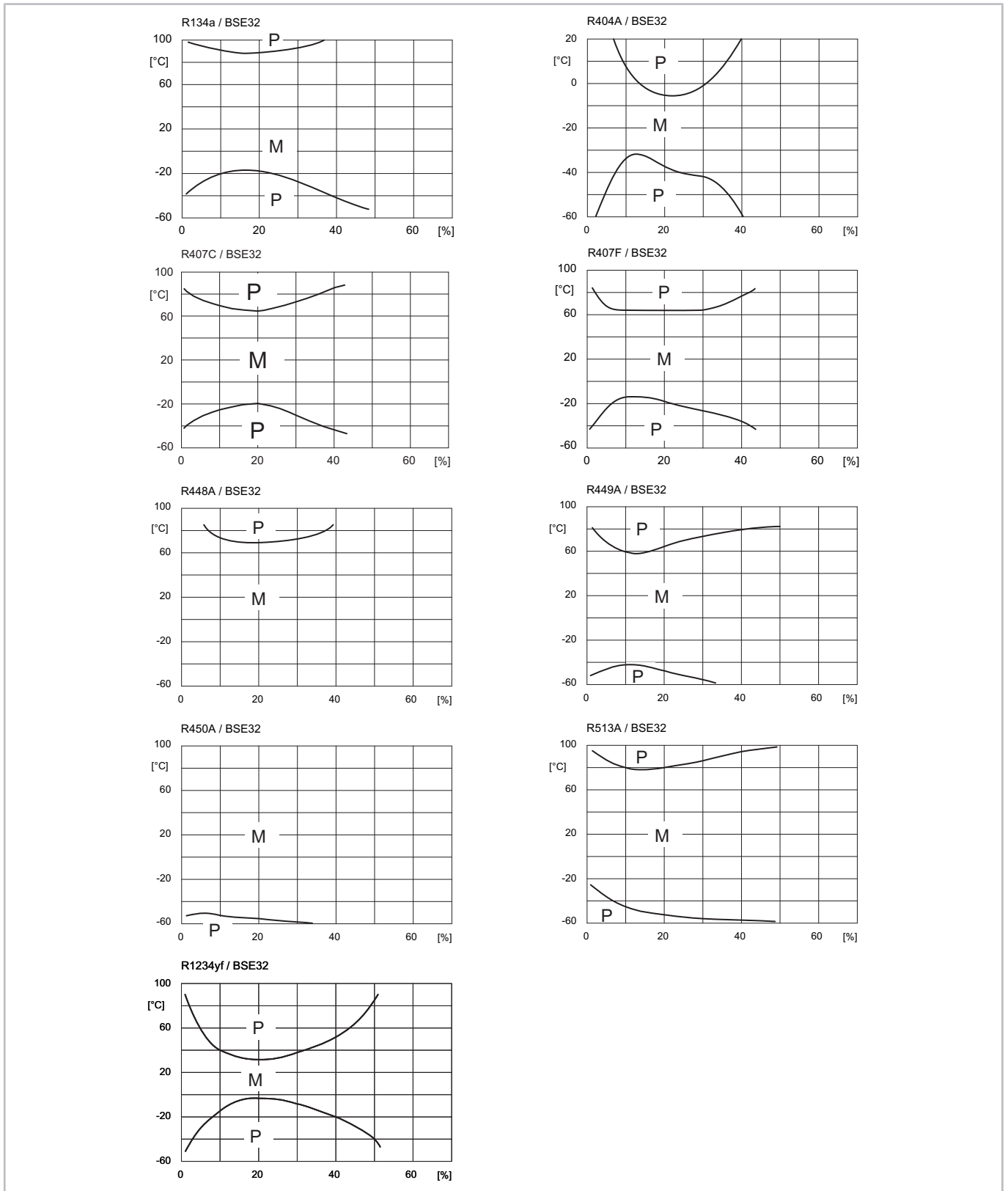


Fig. 2: Miscibility gaps for oil BSE32: Limit temperature depending on oil content (mass % of oil in oil refrigerant blend).

M: Range of complete miscibility.

P: Phase separation range (miscibility gap).



### Miscibility gaps BSE55

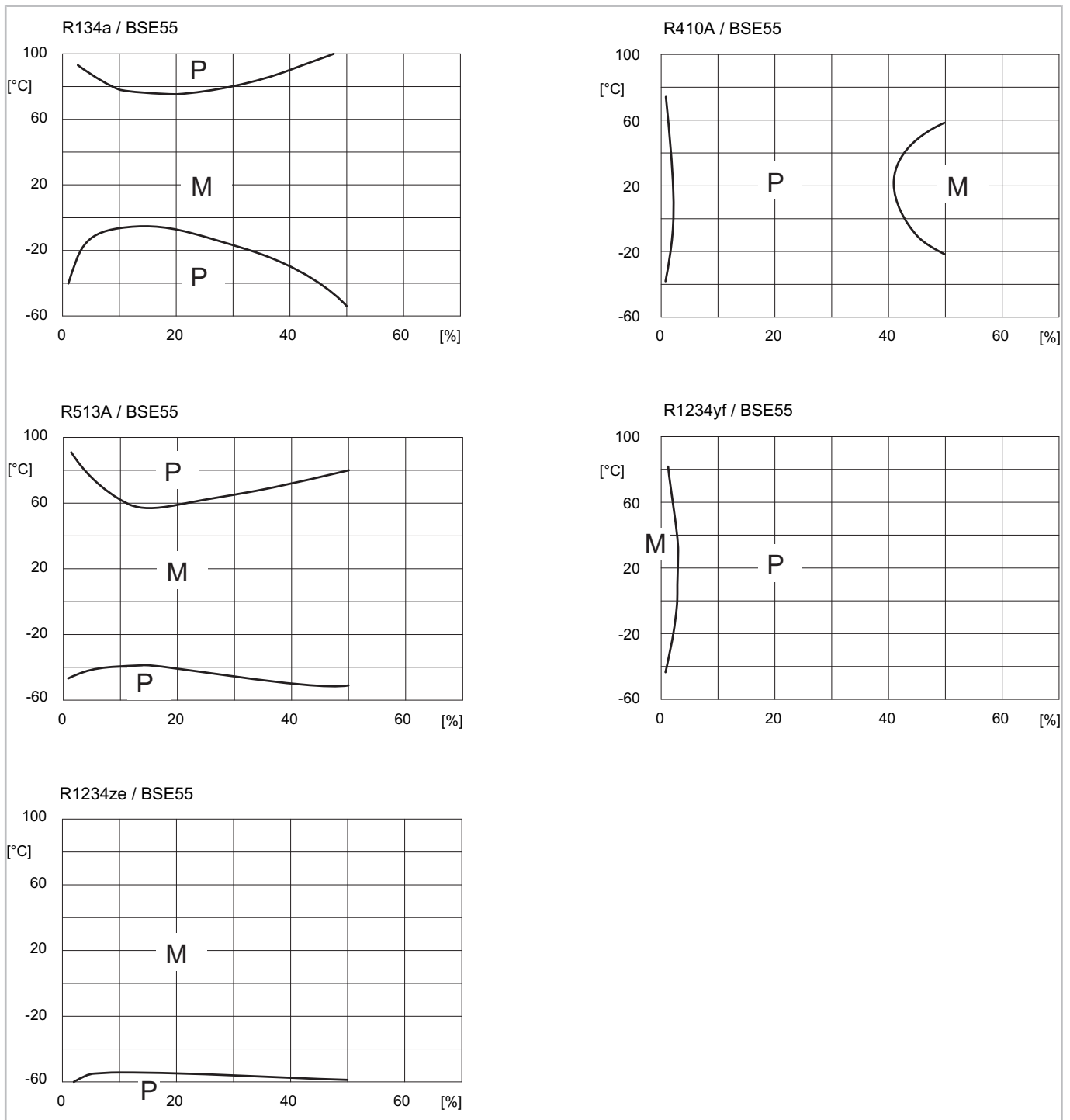


Fig. 3: Miscibility gaps for oil BSE55: Limit temperature depending on oil content (mass % of oil in oil refrigerant blend).

M: Range of complete miscibility.

P: Phase separation range (miscibility gap).

## Refrigerant solubility in BSE32

The following diagrams can be used to read off the refrigerant content in the lubricant depending on refrigerant pressure and oil temperature.

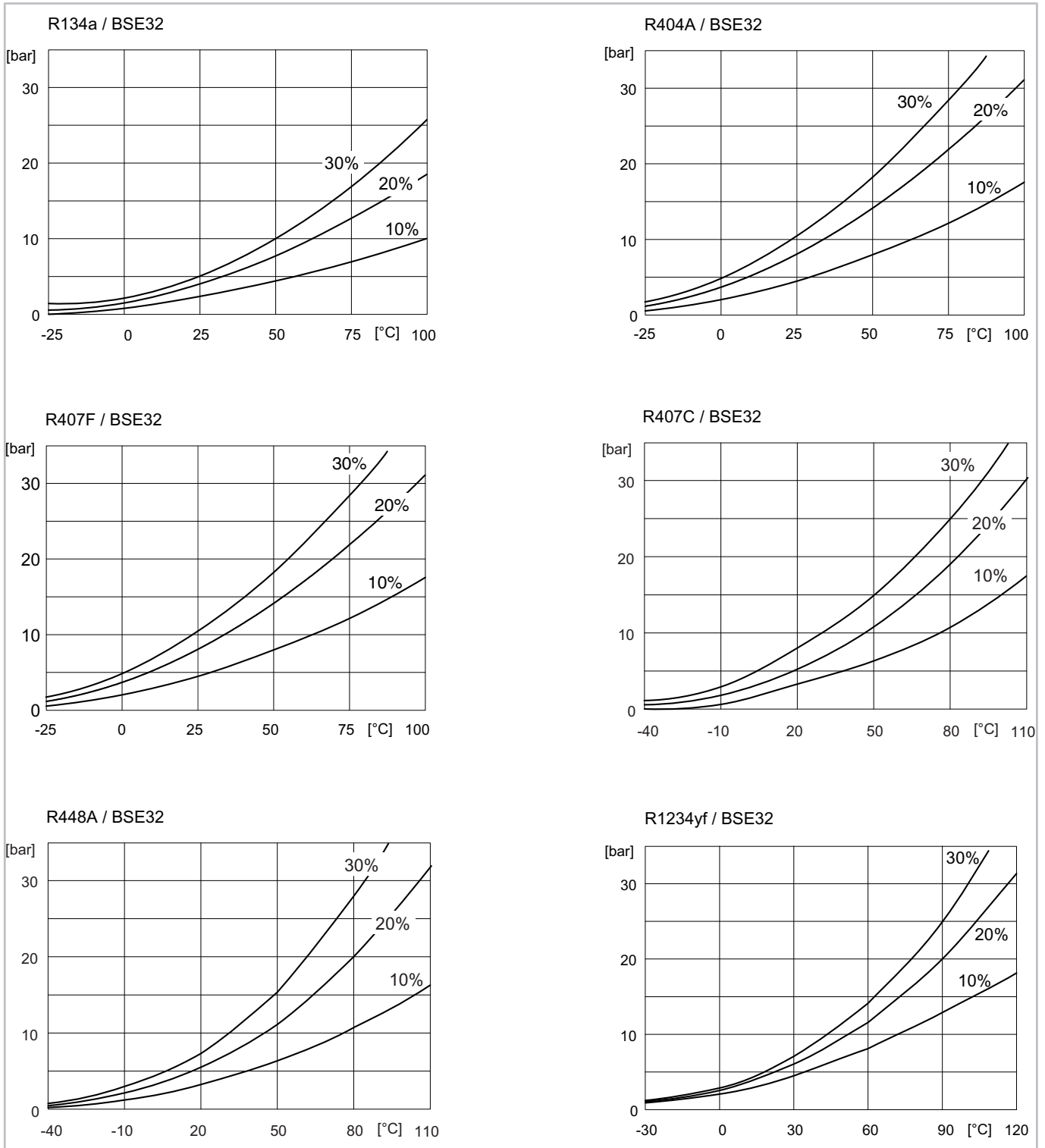


Fig. 4: Oil BSE32: Refrigerant pressure depending on oil temperature and refrigerant content (mass % of refrigerant in oil-refrigerant blend).

## Refrigerant solubility in BSE55

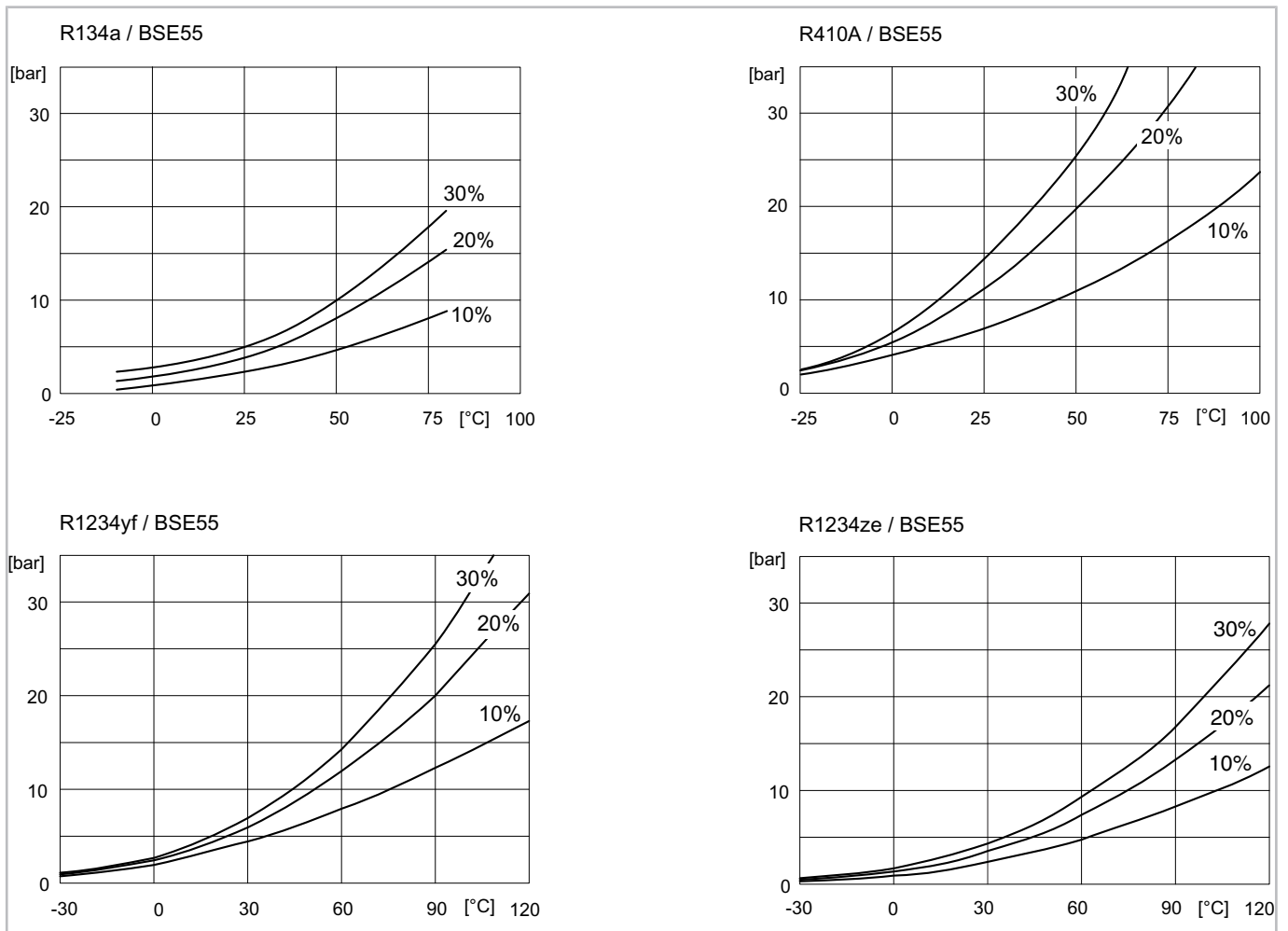


Fig. 5: Oil BSE55: Refrigerant pressure depending on oil temperature and refrigerant content (mass % of refrigerant in oil-refrigerant blend).

## Warning values for used oils

The listed polyolester oils are categorized as group KD according to DIN51503, Part 1. To determine the used condition of the oil, e.g. with respect to water content or total acid number (TAN), the reference values of DIN 51503, Part 2, apply.

Oil	Kinematic viscosity at 40°C (DIN EN ISO3104)	Max. water content (DIN51777-2)	Total acid number (DIN51558-1)
<b>BSE32</b>	outside of 27 .. 37 cSt (*)	200 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g
<b>BSE55</b>	outside of 47 .. 63 cSt (*)	200 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g
<b>BSE85K</b>	outside of 68 .. 92 cSt (*)	200 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g

Tab. 4: Warning values for used BITZER oils for HFC and HFO refrigerants.

(\*): that is ± 15% of the value for new oil

When using A2L refrigerants



### WARNING

Risk of refrigerant evaporation from the used oil.

Increased risk with A2L refrigerants due to flammability!



Used oil may still contain relatively high percentages of dissolved refrigerant even at atmospheric pressure.

Transport and storage: Fill used oil into a pressure-resistant vessel. Store under a nitrogen atmosphere (holding charge).

## Elastomer compatibility

Relevant literature recommends the following seal materials for polyolester oils (POE) with HFC and HFO refrigerants:

- acrylonitrile butadiene rubber, nitrile content >36%
- hydrogenated acrylonitrile butadiene rubber, nitrile content >36%
- ethylene propylene diene rubber

## 5 Oils for refrigerant R744 (CO<sub>2</sub>)

### Characterising the oils

Oil	Oil type	Applications	Designation on compressor
<b>BSE60K</b>	polyolester oil (POE)	standard oil charge for subcritical (e.g. cascade) applications	"K" (e.g. 4DSL-10K)
<b>BSE85K</b>	polyolester oil (POE)	standard oil charge for transcritical applications, alternative oil charge for subcritical (e.g. booster) applications	"K" (e.g. 4FTE-30K)
<b>BSG68K</b>	polyalkylene glycol oil (PAG)	standard oil charge and precondition for applications with low pressure > 40 bar / high pressure > 120 bar, alternative oil charge for sub- and transcritical compressors in booster applications e.g. with ejectors	"Z" (e.g. 4MTEU-10LZ)

Tab. 5: BITZER oils for R744

### Material safety data sheets

Apart from this document, please observe the material safety data sheet (MSDS) for the respective oil. It contains information on toxicity, handling, personal protective equipment and disposal of the oil. Material safety data sheets for all BITZER oils are available *on request*.

### Application range

Oil	Air conditioning	Medium temperature application	Low temperature application
<b>BSE60K</b>	--	--	✓
<b>BSE85K</b>	(✓)	✓	✓
<b>BSG68K</b>	✓*	✓	✓

Tab. 6: Application range of oils for R744 in BITZER reciprocating compressors. For application limits see also BITZER SOFTWARE.

(✓): after consultation with BITZER Application Engineering

✓\*: BSG68K is precondition for applications with low pressure > 40 bar / high pressure > 120 bar

### Technical data

	<b>BSE60K</b>	<b>BSE85K</b>	<b>BSG68K</b>	Unit
Density at 15°C	1.009	0.993	1.003	g/ml
Flashpoint	286	246	> 200	°C
Pour point	-48	-42	-46	°C
Kinematic viscosity				
at 40°C	55	80	68	cSt
at 100°C	9	11	16	cSt

Tab. 7: Technical data of oils for R744 in BITZER reciprocating compressors

## Miscibility gaps

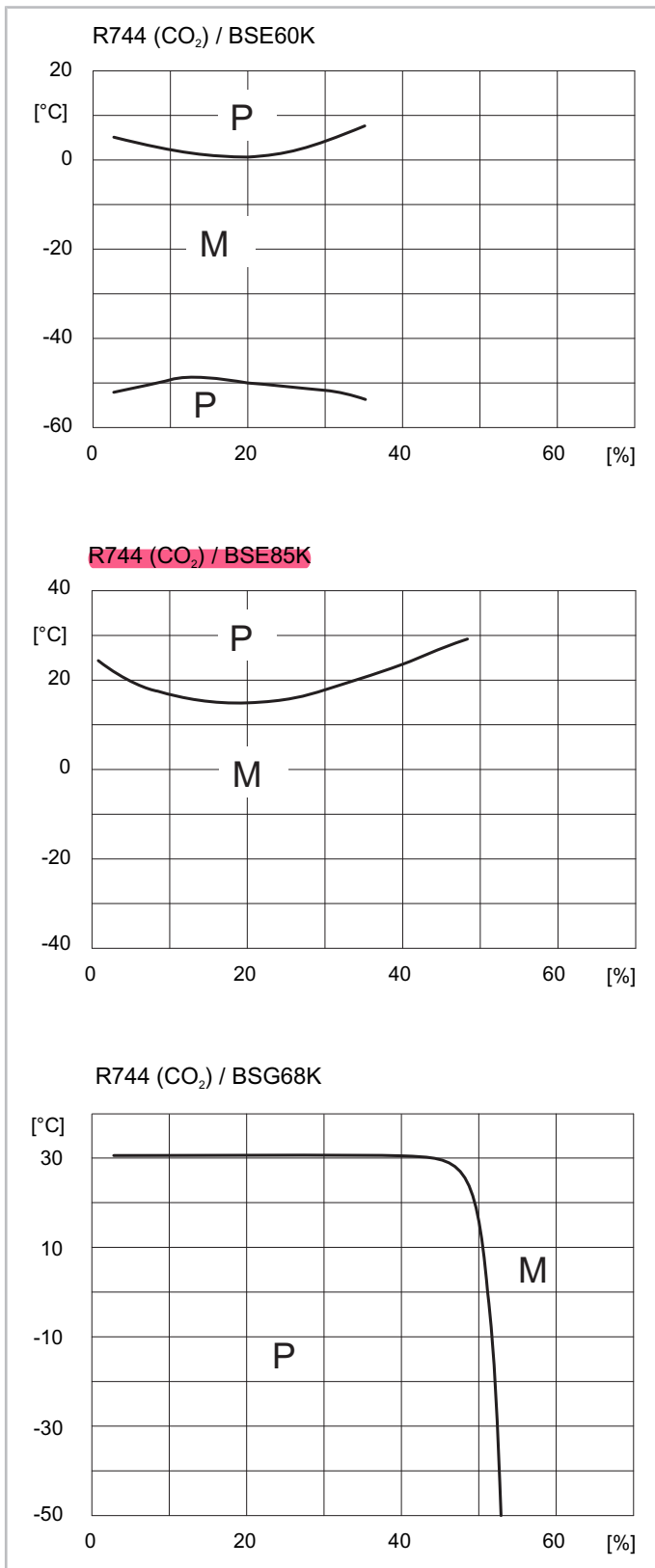


Fig. 6: Miscibility gaps for R744: Limit temperature depending on oil content (mass % of oil in oil refrigerant blend).

M: Range of complete miscibility.

P: Phase separation range (miscibility gap).

## Refrigerant solubility in oil

The following diagrams can be used to read off the refrigerant content in the lubricant depending on refrigerant pressure and oil temperature.

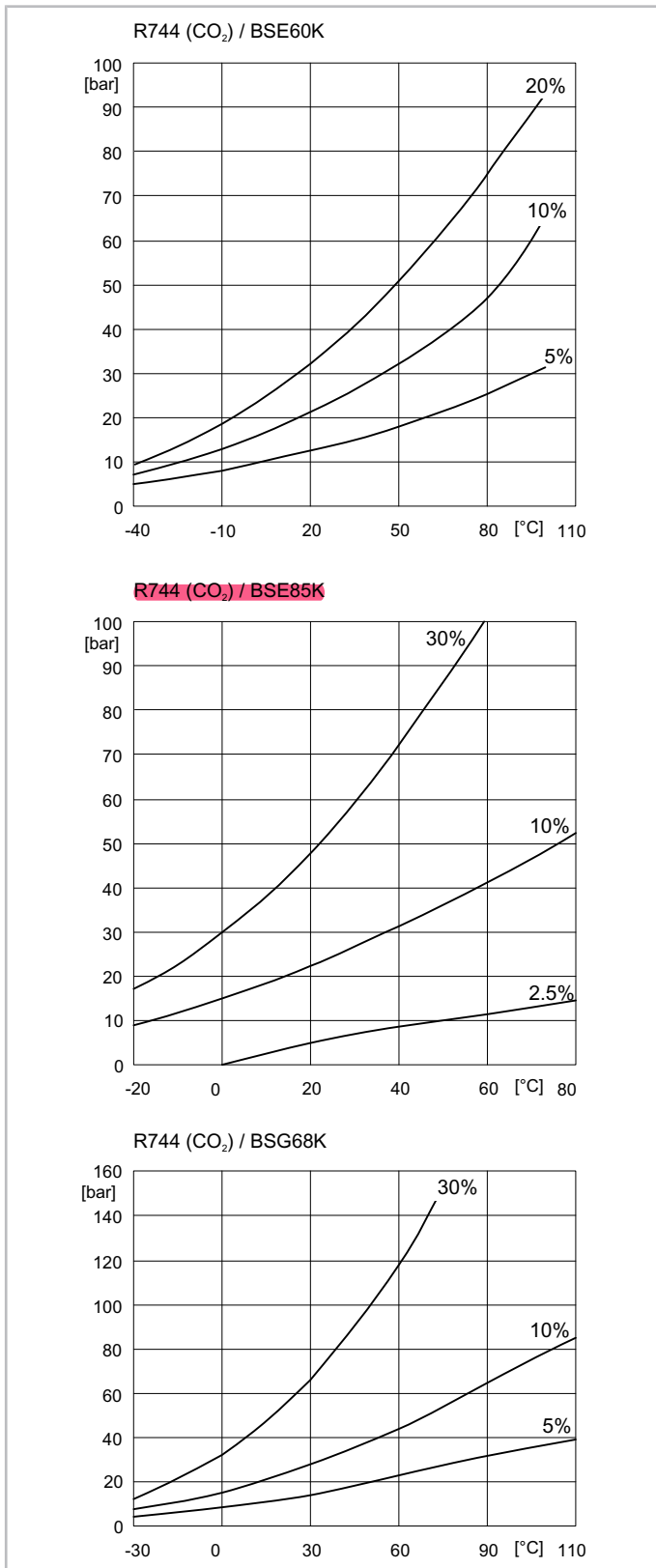


Fig. 7: Oils for R744: Refrigerant pressure depending on the oil temperature and the refrigerant content (mass % of refrigerant in oil-refrigerant blend).

## Warning values for used oils

The listed polyolester oils and the polyalkylene glycol oil are categorized as group KB according to DIN51503, Part 1. To determine the used condition of the oil, e.g. with respect to water content or total acid number (TAN), the reference values of DIN 51503, Part 2, apply.

Oil	Kinematic viscosity at 40°C (DIN EN ISO3104)	Max. water content (DIN51777-2)	Total acid number (DIN51558-1)
<b>BSE60K</b>	outside of 47 .. 63 cSt (*)	150 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g
<b>BSE85K</b>	outside of 68 .. 92 cSt (*)	150 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g
<b>BSG68K</b>	outside of 58 .. 78 cSt (*)	800 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g

Tab. 8: Warning values for used BITZER oils for R744.

(\*): that is  $\pm 15\%$  of the value for new oil

## Elastomer compatibility

Relevant literature recommends the following seal materials for polyolester oils (POE) and polyalkylene glycol oils (PAG) with R744:

- hydrogenated acrylonitrile butadiene rubber, nitrile content >36%
- ethylene propylene diene rubber
- fluorinated rubber



## 6 Oils for refrigerant R290 (propane)

### Characterising the oils

Oil	Oil type	Applications	Designation on compressor
SHC226E	poly-alpha-olefin oil (PAO)	standard oil charge	"P" (e.g. 4VESP-10P)
BSG68K	polyalkylene glycol oil (PAG)	option for compact refrigerating circuits	"Z"

Tab. 9: BITZER oils for R290

### Material safety data sheets

Apart from this document, please observe the material safety data sheet (MSDS) for the respective oil. It contains information on toxicity, handling, personal protective equipment and disposal of the oil. Material safety data sheets for all BITZER oils are available *on request*.

### Application range



#### DANGER

Risk of explosion and thus danger of death in the event of refrigerant outlet and in the presence of an ignition source!

Refrigerant can ignite and also form an explosive atmosphere depending on its concentration in air! Avoid open fire and ignition sources in the machinery room and in the hazardous zone!

Owing to the particularly high solubility of R290 in customary oils, BITZER compressors are charged with a special oil of a high viscosity index and particularly good tribological characteristics.

In view of the solubility, the design, operating mode and control of the compressor and the system are subject to particular requirements. Low or insufficient superheat in operation and insufficient heating of the oil sump during shut-off periods lead to a substantial reduction of the oil viscosity in the compressor. This results in reduced performance, heavy wear on drive gear parts, increased oil carry over and foaming. Secure compressor against "wet operation" and guarantee a sufficiently high suction gas temperature – for reciprocating compressors, suction gas superheat must be at least 20 K!

- Low oil temperatures and a high suction side standstill pressure must be avoided. An oil heater is absolutely required and an additional pump down system must be provided if necessary.
- Avoid quick changes in suction pressure – risk of border lubrication due to strong gas discharge of the refrigerant from the oil and unstable suction gas superheat.
- Avoid quick changes in condensing pressure – risk of strong foaming in the oil separator!

For further information on the use of R290 in semi-hermetic compressors: see Technical Information [AT-660](#)

### Technical data

	BSG68K	SHC226E	Unit
Density at 15°C	1.003	0.830	g/ml
Flashpoint	> 200	250	°C
Pour point	-46	-45	°C
Kinematic viscosity			
at 40°C	68	67	cSt
at 100°C	16	10	cSt

Tab. 10: Technical data of oils for R290 in BITZER reciprocating compressors

## Miscibility gaps

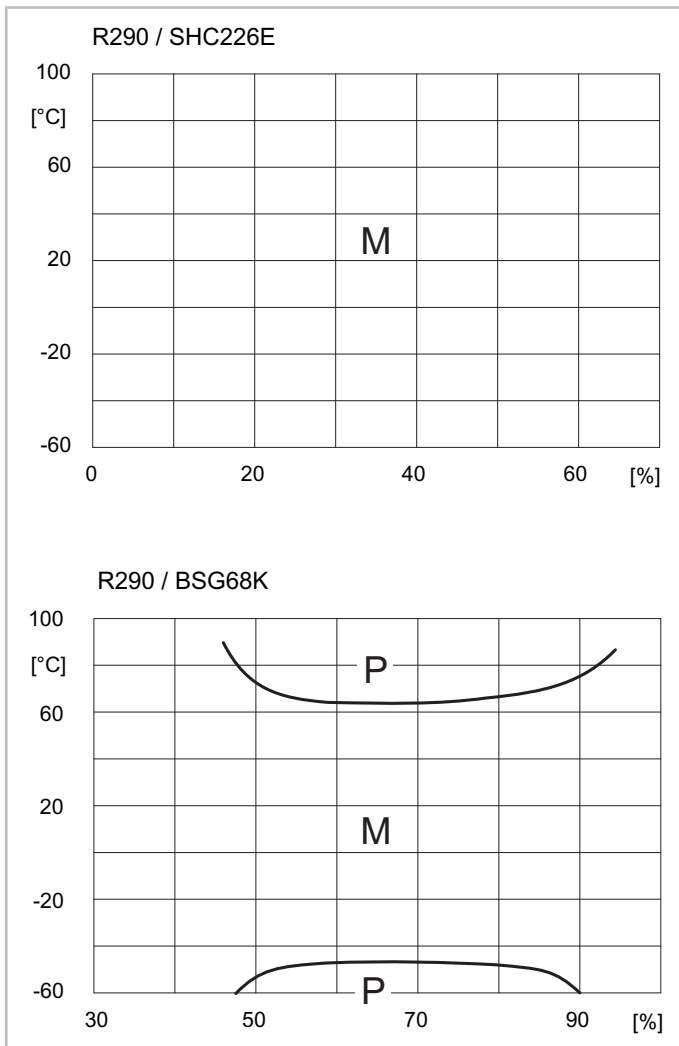


Fig. 8: Miscibility gaps for R290: Limit temperature depending on oil content (mass % of oil in oil refrigerant blend).  
M: Range of complete miscibility.  
P: Phase separation range (miscibility gap).

## Refrigerant solubility in oil

The following diagrams can be used to read off the refrigerant content in the lubricant depending on refrigerant pressure and oil temperature.

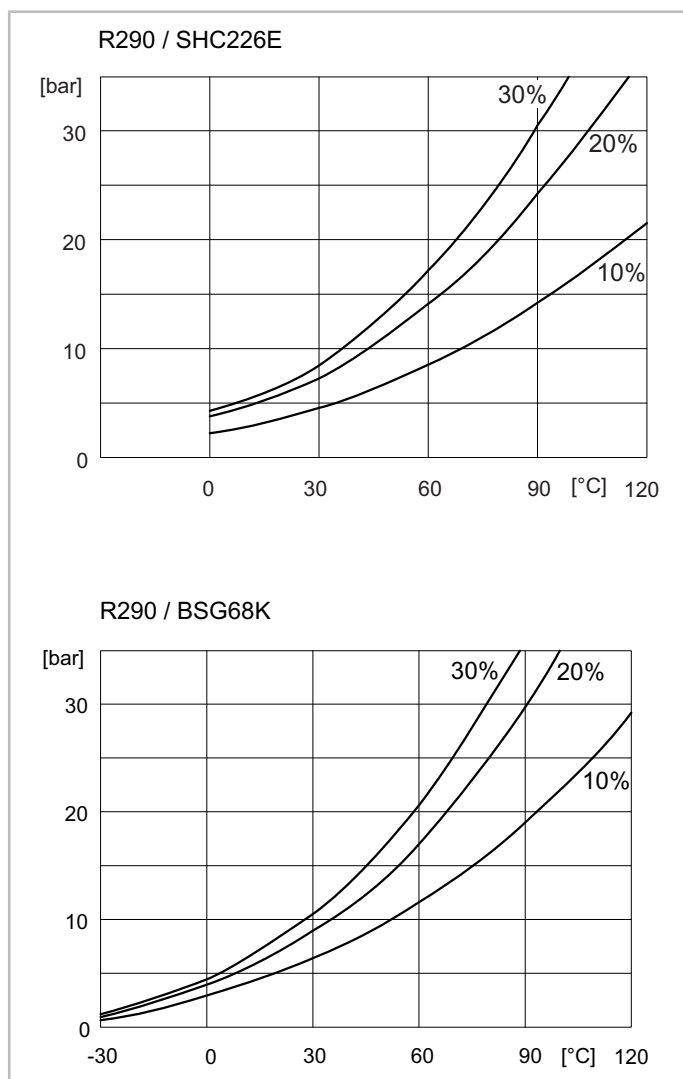


Fig. 9: Oils for R290: Refrigerant pressure depending on the oil temperature and the refrigerant content (mass % of refrigerant in oil-refrigerant blend).

## Warning values for used oils

The listed oils SHC226E (PAO) and BSG68K (PAG) are categorized as group KE according to DIN51503, Part 1. To determine the used condition of the oil, e.g. with respect to water content or total acid number (TAN), the reference values of DIN 51503, Part 2, apply.

Oil	Kinematic viscosity at 40°C (DIN EN ISO3104)	Max. water content (DIN51777-2)	Total acid number (DIN51558-1)
<b>SHC226E</b>	outside of 57 .. 76 cSt (*)	80 mg H <sub>2</sub> O/kg oil	0.1 mg KOH/g
<b>BSG68K</b>	outside of 58 .. 78 cSt (*)	800 mg H <sub>2</sub> O/kg oil	0.2 mg KOH/g

Tab. 11: Warning values for used BITZER oils for R290.

(\*): that is ± 15% of the value for new oil

In case of maintenance, be sure to observe the following:

**!** **NOTICE**  
 Danger of spark formation due to unintended switching operations or overheating of the oil heater during oil change.  
 Prior to interventions in the refrigerant circuit, interrupt the power supply on the main switch!  
 Observe special regulations for storage and transport of flammable gases.  
 When performing maintenance work indoors, always switch on room ventilation!

**!** **NOTICE**  
 Danger of spark formation, when discharging electrostatic charges!  
 Take measures against electrostatic charging of non-metallic components, tools, auxiliaries and clothing!  
 For example: Wear suitable antistatic clothing, use spark-free tools. If necessary, perform additional earthing of conducting parts.

**!** **NOTICE**  
 Fire hazard!  
 The used oil contains a relatively large amount of dissolved refrigerant.  
 Pack used oil safely. Dispose of in an environmentally friendly manner.

R290 or R1270 dissolve very well in refrigeration compressor oil. Used oil from such systems may still contain relatively high percentages of dissolved R290 or R1270 even at atmospheric pressure. These components gas out. Observe during storage and transport:

- ▶ Fill used oil into pressure resistant containers.
- ▶ Fill containers with nitrogen as a protective gas and close them.
- ▶ Mark them, e. g. with the warning sign "flammable substance" W022 from ISO7010.

## Elastomer compatibility

Relevant literature recommends the following seal materials for polyalkylene glycol oils (PAG) and poly-alpha-olefin oils (PAO) with R290:

- chlorobutadiene rubber, e.g. neoprenes
- acrylonitrile butadiene rubber, nitrile content >36%
- hydrogenated acrylonitrile butadiene rubber, nitrile content >36%
- fluorinated rubber

## **7 Oils for refrigerant R717 (NH<sub>3</sub>)**

The oils for refrigerant R717 (NH<sub>3</sub>) for open drive BITZER compressors are described in the Technical Information [AT-640](#) (chapter "Application ranges and oils").