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14 Supplier documentation

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Compact diesel engine operating instructions of firm Perkins
Generator documentation
Electric motor documentation
Heat exchanger documentation



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Warranty

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Certificates/audits

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13 Warranty

When taking delivery of the Refrigerated Transport System TKD 7000 the following documentation is handed over

- User Manual
- Service Log with a Handing Over Statement
- Service Point Booklet

and

- a warranty card.

The Maintenance Manual is available at the authorized service center.

Warranty period:

The manufacturer grants the contract partner a warranty of **12 months** for the usability of the Refrigerated Transport System TKD 7000 provided the system is operated within the permitted limits.

The general warranty terms of Konvekta AG at the time of purchase apply.



12 Certificates/test reports

The following certificates/test reports are available for the Refrigerated Transport TKD 7000 System:

- ATP test	TÜV Bau- und Betriebstechnik GmbH München Zentralabteilung Kälte und Klimatechnik, ATP-Prüfstelle	26.11.98
- Environment audit in acc. with IEC 529	Test laboratory for climatic, mechanical and corrosive environment factors of AUCOTEAM GmbH Berlin	29.03.99
- EMV test	TÜV Technische Überwachung Hessen GmbH Kassel	03.05.00
- Noise level measurement	Noise protection test point Ingenieur- und Sachverständigen-gesellschaft für Bauphysik, Wärme und Schallschutz, Dr. Blechschmidt-Kayszner- Reinhold, Grosslohra	13.04.99
- Device safety test	IMG Institut für Maschinen, Antriebe und elektronische Gerätetechnik GmbH Nordhausen	12.04.99



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Replacement/wearing parts

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10 Technical data

Refrig. transport system	Type TKD 7 000	Coolant	Water + antifreeze
Operating voltage	3 AC 400 V/ 50-60 Hz	Engine oil	(1:1) approx. 3.5 l
Temperature ranges:		Battery	7,5 l see chapter 9
Outdoor temperature	-30 °C to +43 °C		12 V / 60 Ah
Temperature in truck	-30 °C to +20 °C	Refrigerant compressor	Type FK3
Noise	< 66 dB (A)	Rated speed	2000/1400
Refrigerant (chlorine-free)	R 404 A	Oil fill	1.5 l
Perm. gauge pressure	28 bar	Oil grade	DEA TRITON SE55
Filling	4 kg	Generator	Type TR1-D/2
Rated output	6 KW	Voltage	3 AC 400 V/50 Hz
Rated current	15 A	Output	6.5 KVA
Diesel engine	Type 103-10/PD 253 Q1	Speed	3000 min ⁻¹
Maker	Firm Perkins	Electric motor	Type SG 112 M-4PC
Cylinders	3	Voltage	400 V/50 Hz
Output	14.2 kW	Output	5.5 kW
Swept volume	954 cm ³	Speed	1420 /min ⁻¹
Fuel	Diesel (DIN 51601)		

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Technical specification

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11 Replacement and wearing parts

Repair and maintenance work on the Refrigerated Transport System TKD 7000 must be carried out by an authorized service center.

For a list of authorized service centers, see the service point booklet.

Replacement and wearing parts of the Refrigerated Transport System TKD 7000 are compiled in a replacement parts list which is available with the distributor.

Use only original parts, otherwise all warranty claims are void.

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Replacement/wearing parts

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Heat exchanger	Type VD 7000	
Heat exchange surface	Condenser 24.8 m ²	Evaporator 21.5m ²
Fan	Condenser	Evaporator
Type	Multi wing type 375	Axial fan EBM S4D350-APO8-58
Air flow, free blow out	-	3601m ³ /h
Expansion valve	Type TERO A4	
Heater and defroster	Type 230 V, 3x1500 W	
Rated output	5 KW	
Rated current	12.5 A	
Control unit		
Remote control control unit	Thermotronik TK4	
Refrigerating capacity at 30° C Outdoor temperature		
Indoor temperature	Electric	Diesel
1 2°C	7.52 kW	8.87 kW
0 °C	5.86 kW	6.99 kW
- 2 0°C	3.18 kW	3.79 kW

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Technical specifications

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Technical specifications

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9 Operating fluids

- Diesel fuel:

Use only commercial branded diesel fuel containing max. 0.5% sulfur.
Use winter-grade diesel in the cold season,
add vaporizing oil if the outdoor temperature is below -16 °C. The amount which is added depends on the outdoor temperature

- Engine oil:

We recommend engine oil SAW 15 W 40.
Other oils can be used depending on the ambient temperature.
API classification: API CC/SE MIL-L-461S2 CC MC 01

- Cooling water:

Use soft and clean water if possible.

Cooling water composition:	50% water
(freeze protected to -37 °C)	50% corrosion inhibitor/antifreeze

The corrosion inhibitor/antifreeze can remain in the cooling water during the warm season.
Check the antifreeze concentration 1x every year before onset of the cold season.
Change the coolant every two years.

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Operating fluids

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Cleaning

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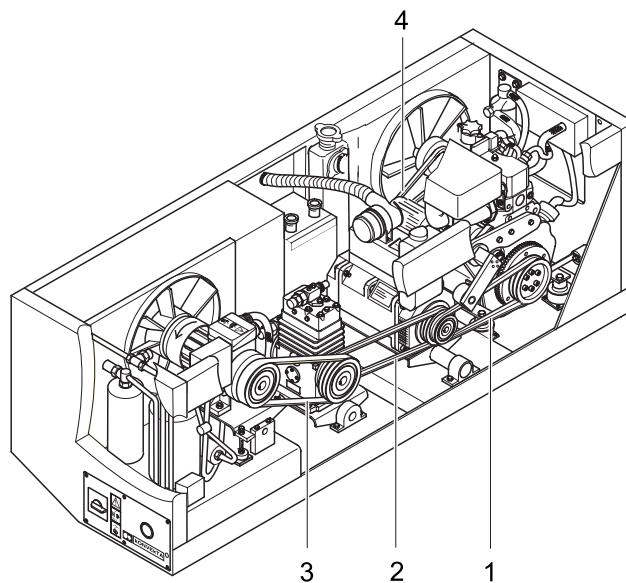


Fig. 7-3 v-belts on the diesel engine overview

- 1 Generator/diesel engine v-belt
- 2 Generator/refrigeration compressor v-belt
- 3 Refrigeration compressor/electric motor v-belt
- 4 Diesel engine v-belt

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Maintenance/repairs

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8 Cleaning

WARNING



Clean the diesel generating set only when the system is electrically isolated.

When in diesel mode, set the main switch on the operator console of the control unit to "0".

When in mains mode, pull the mains plug.

NOTE



The truck with the installed Refrigerated Transport System TKD 7000 can be cleaned in a truck wash.

Do not use aggressive cleaners or solvents. Clean only with water. The radiator and condenser ribs can be cleaned with compressed air.

WARNING



The use of high-pressure cleaning equipment is forbidden.



Checking the v-belt:

- When moderate pressure of a thumb (1.0 kg) is applied in the middle of the unsupported length of the belt, the belt deflection shall not be larger than 5 mm.

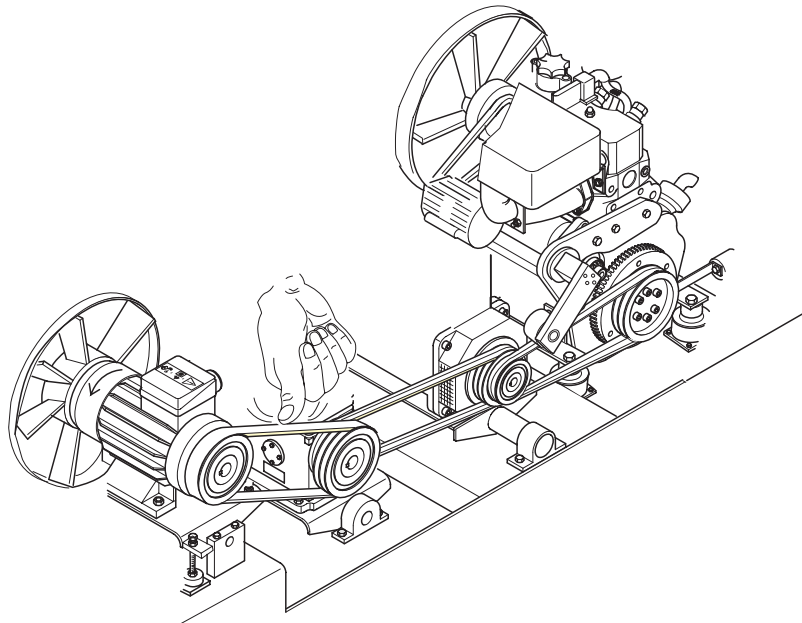


Fig. 7-4 v-belt deflection

7.2.6 Maintenance of the electric system

Maintenance/repairs to the electric system shall only be carried out by an authorized service center.

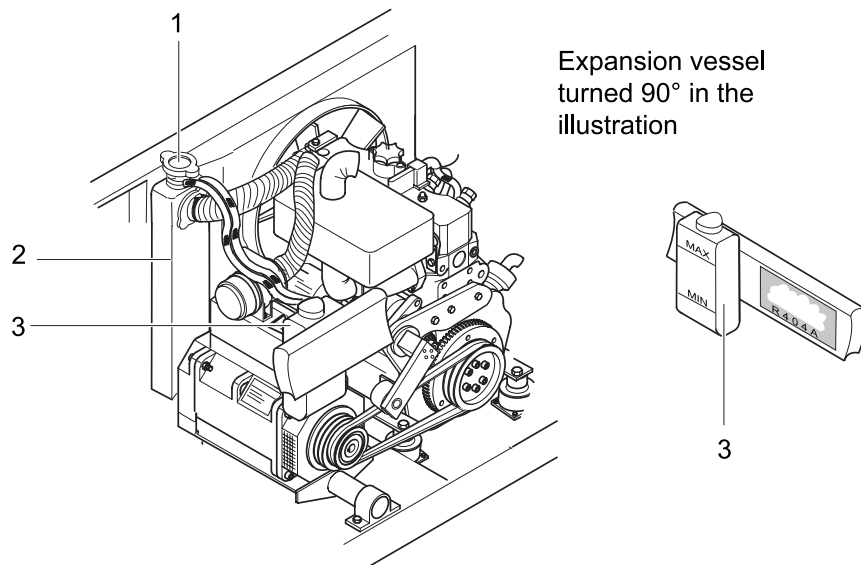


Fig. 7-2 Radiator/expansion tank

- 1 Filling neck cover
- 2 Radiator
- 3 Expansion tank

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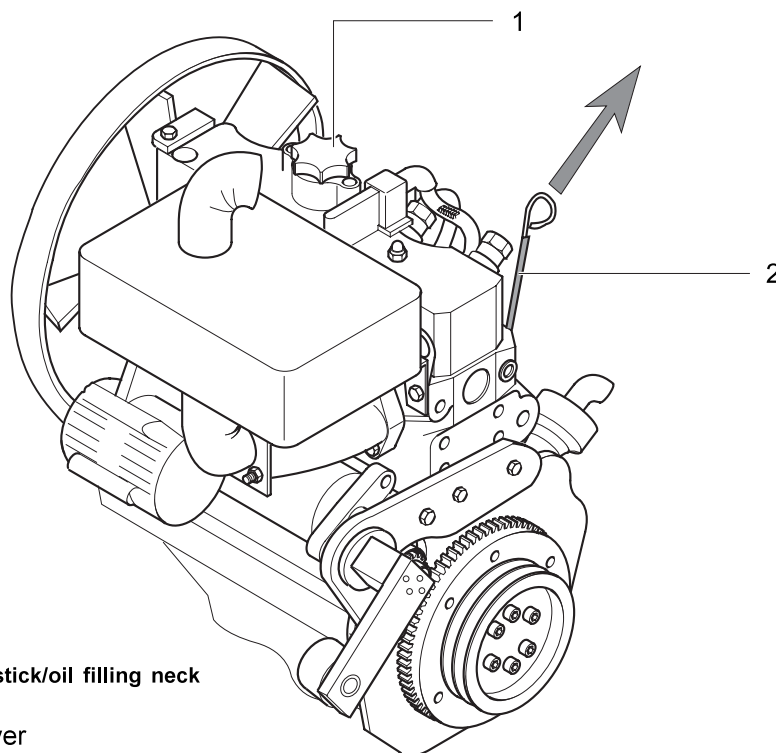


Fig. 7-1 Diesel engine oil dipstick/oil filling neck

- 1 Oil filling neck cover
- 2 Oil dipstick

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7.2.4 Checking the battery

Check the accumulator acid level in the battery during the cold season.

7.2.5 Checking the v-belt tension

To prevent early v-belt wear, ensure that all v-belts always have optimum tension. Have worn v-belts replaced in time by the authorized service center.

WARNING



Turn off the Refrigerated Transport System TDK 7000 using the remote control unit. Set the main switch on the diesel generating set to "0" before beginning to work. Then remove the protective grate.



7.2.3 Checking the cooling water level

Check the cooling water level in the expansion tank on the crossbeam of the diesel generating set while the engine is running.

WARNING



Do not remove the radiator neck cover when the radiator is hot and under pressure. Boiling water can gush from the opening and cause severe scalding. Let the radiator cool down.

Do not use sea water or other corrosive additions in the coolant.

- Do not remove the protective grate.
- Check the water level in the expansion tank (3).
- The cooling water level must be between the high and low marks.
- If the cooling water level is low, fill water.
- Unscrew the cover on the filling neck (1).
- Fill cooling water with antifreeze (see operating fluids) in the filling neck (1) above the radiator (2). Do not fill to above the high mark on the expansion tank.
- Replace the cover on the filling neck (1).

Check if enough antifreeze is used in the cold season.



- Do not carry out maintenance on the diesel set while standing on a loose ladder. The housing can deform.

If increased wear is found on visual inspection and this wear is likely to have been caused by operating mistakes, the driver shall again be instructed in the handling of the refrigerated transport system TKD 7000.

7.2 Safety instructions for the truck driver

7.2.1 Maintenance intervals

Interval	Maintenance activity	by whom?
Weekly	Check oil level Check cooling water level Check v-belt tension	Driver Driver Driver

Table 11 Maintenance and inspection schedule

TKD 7000	Maintenance/repairs	7- 5
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7 Maintenance/repairs

The warranty granted by the manufacturer does not relieve the user of the Refrigerated Transport System TKD 7000 of the obligation and the necessity of regular preventive maintenance and cleaning from the start-up of the machine.

Regular inspections by an authorized service center are a „must“ in order to ensure optimum performance of the Refrigerated Transport System TKD 7000 and reduce down time to a minimum. (see chapter 5.1)

For maintenance intervals at the service center, refer to the service log .

For a list of authorized service centers, see the service point booklet .

7.1 Safety instructions for maintenance/repairs

WARNING



Repairs required specialized knowledge and particular skills (both of which are not communicated by this User Manual). Repairs shall only be carried out by trained technical personnel.

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7.2.2 Checking the engine oil level

Check the engine oil when the diesel engine is not running and the vehicle is parked on level ground.

- Pull out the oil dipstick (2) through the grate, wipe it clean and install it again.
- Pull out the oil dipstick (2) again.
- The oil level must be between the high/low marks on the dipstick (2).
- If the oil level is low, fill in oil.
- Unscrew the cover on the oil filling neck (1) .
- Slowly fill oil of the specified grade (see last oil change) in the oil filling neck (1). Fill to the high mark on the oil dipstick. Do not overfill.

Oil change and oil drain should be made by an authorized service center.

Observe the service intervals.



WARNING



Never open the housing of a unit. internal repairs and settings to the electronic equipment shall only be made by the authorized service center.

WARNING



**Work on the refrigeration equipment shall only be made by the authorized service center.
The refrigeration compressor is pressurized. Do not separate any connection from or to the compressor.**

- Do not let the diesel set run when guards are removed.
Note that a running fan may not always be visible.
For operating fluids and filling volumes, refer to chapters 9 and 10.
- Do not expose the battery to sparks or open flame; there is explosion hazard especially when the battery is being charged. Accumulator acid can be self-igniting.
It is harmful to the skin and eye.
- Environmental pollution hazard
Oil, fuel and other fluids shall be collected in suitable containers.
Do not dispose these fluids in the sewer or in the atmosphere.



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Maintenance/repairs

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Fault	Possible cause	Remedy
Unnormal running noise	Check v-belt, defective refrigerant compressor, check oil level	Contact authorized service center
Poor refrigeration	e.g., expansion valve defective, refrigeration compressor defective, no refrigerant, filter clogged, solenoid valve does not close, condenser fans not working, condenser soiled, gas or moisture in refrigerant	Contact authorized service center

Table 9 Faults on the refrigerator compressor

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Troubleshooting and remedy

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6.1.3 Faults on the electric motor

Fault	Possible cause	Remedy
- Motor is not working	- Motor not running e.g., motor defective Motor protection switch has tripped	Check power supply (mains connection with 16A slow fuse) Contact authorized service center Contact authorized service center (see chapter 5.2)
- Unnormal noise	e.g., motor defective, foreign material in housing, impeller wheel not running true and contacts the condenser body, check v-belt	Contact authorized service center

Table 8 Faults on the electric motor

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TKD 7000

Troubleshooting and remedy

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Engine not running true	Controller, defective injection pump, clogged filter	
Engine stalls	e.g., no fuel defective engine, clogged filter Filter	Check fuel in tank refuel if necessary otherwise contact authorized service center
Engine becomes very hot	e.g., lack of refrigerant, clogged radiator or radiation system, oil lack. clogged oil filter	Check refrigerant or oil level fill if necessary otherwise contact authorized service center (see chapter 5.2)
Exhaust - white or blue	e.g., too much oil or thin-body oil in the oil sump wrong setting of the injection pump	Contact authorized service center

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TKD 7000

Troubleshooting and remedy

6- 5



6.1.4 Faults on the refrigerator compressor

Fault	Possible cause	Remedy
Compressor turns off /compressor not working - Compressor does not start	e.g., Check electricals, - check v-belt, - fault on the electro-magnetic coupling (diesel mode), - compressor or - motor fault	Contact authorized service center
- Compressor starts but then stalls	e.g., low pressure or high pressure switch cuts out (see chapter 5.2)	Contact authorized service center
Unnormal running noise	e.g., rubbing noise on the electro-magnetic coupling indicates a defect	Contact authorized service center



Exhaust - dark grey	Wrong fuel high injection volume engine defective or overload clogged air filter	Use correct fuel contact authorized service center
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Table 6 Faults on the diesel engine

6.1.2 Faults on the generator

Fault	Possible cause	Remedy
Unnormal noise /	e.g., v-belt slip,	Contact authorized service center
Generator supplies no power/ generator not running true	defective generator engine speed high	Contact authorized service center

Table 7 Faults on the generator



6 Troubleshooting and remedy

6.1 Faults / causes / remedy

Any change from the normal can indicate a fault. If the function of the Refrigerated Transport System TKD 7000 is effected, contact an authorized service center.

For a list of authorized service centers, see the service point booklet

WARNING



To avoid extensive damage, turn off the Refrigerated Transport System TKD 7000 if a fault occurs. In some cases the control system turns off the TKD 7000 automatically. Contact an authorized service center without delay.

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Fault display/ light emitting diode	Cause	Effect/remedy
 red	Generator (12V) defective (Normally lights when engine is started, extinguishes after a few seconds.)	Consult authorized service center
	Battery defective	Consult authorized service center

Table 5 Fault and failure displays on the remote control panel overview

NOTE



To save perishable cargo, the refrigeration system can be mains-powered if a fault occurs in the diesel system and vice versa. If the complete system fails, the cargo may have to be stored in a cold storage.


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Service and fault messages

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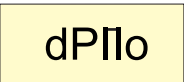


Fault display/ light emitting diode	Cause	Effect/remedy
 blinks	Oil/water pressure fault - low oil pressure, or - high cooling water temperature of the diesel engine - no diesel fuel supply (tank empty, diesel pump defective)	Diesel engine turns off. Fault to be repaired by an authorized service center.

WARNING



Burn / scalding hazard!
When the oil/water pressure fault is displayed, check the oil level and the cooling water level of the diesel engine immediately. Allow the engine to cool before you begin to work.

 blinks	Motor protection switch of the electric motor (operation from mains) is defective (the motor protection switch is activated automatically in normal operation)	Change to diesel mode. Fault to be repaired by an authorized service center.
--	--	---

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TKD 7000

Service and fault messages

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CAUTION

Make sure to have the Refrigerated Transport System TKD 7000 inspected by an authorized service center. Otherwise all guarantee claims will be void

5.2 Fault and failure displays

WARNING

If a failure occurs an authorized service center shall be consulted without delay.

If a wrong temperature is displayed, the temperature sensors may have been connected the wrong way.

Room temperature sensor F1 (blue)

Evaporator temperature sensor F2 (yellow)

The function of the Refrigerated Transport System TKD 7000 is monitored by the electronic control system while the refrigeration system is running. If a fault is detected, it is displayed on the remote control panel.

5 Service and fault messages on the remote display panel

WARNING

Repair and maintenance work shall only be carried out by an authorized service center.

For a list of authorized service centers, see the service point booklet.

5.1 Service interval display

The service interval display - first inspection information blinks automatically after the first 20 run hours of the diesel engine.

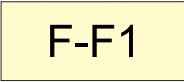
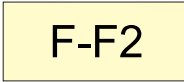
The next inspection prompt is displayed after 500 diesel engine run hours.

Further inspections arrear after every 500 run hours.




Fault displays on the remote control panel:


Faults are displayed on the display panel or by light emitting diodes.


Fault display/ light emitting diode	Cause	Effect/remedy
 blinks	Room temperature sensor fault F1 (blue) e.g., - broken cable - short circuit - sensor not connected	Control unit turns off. Fault to be repaired by an authorized service center.
 blinks	Evaporator temperature sensor fault F2 (yellow) e.g., - broken cable - short circuit - sensor not connected	Control unit turns off. Fault to be repaired by an authorized service center.





Information on the display panel:

 Blinks Have the Refrigerated Transport System TKD 7000 inspected

 Press 1x Display extinguishes;
 This information is displayed with every new start, only an authorized service center can delete it.

 The cargo space temperature is displayed.

NOTE:

 If the fault display is not confirmed with key  it blinks as long as the cause is not repaired.



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Service and fault messages

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4.7 Turning off the Refrigerated Transport System TKD 7000

Always turn off the Refrigerated Transport System with the remote control unit.

- Turn off the "ON/OFF" switch and if operating from a power mains, pull the mains plug.

NOTE



For maintenance the diesel generating set can be turned off at the main switch (position "0") and the remote control unit need not be turned off for this.







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TKD 7000

Start-up/operating state

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	Diesel mode	Mains operating mode
Automatic defrosting	<ul style="list-style-type: none"> - Starts when refrigeration mode is active - Pressure difference sensor on evaporator is active <p> Extinguishes, evaporator fans off</p> <p> Extinguishes, magnetic clutch off</p> <p> Lights, electrical heater is active</p> <ul style="list-style-type: none"> - Defrosting temperature and defrosting time, resp. reached 	<ul style="list-style-type: none"> - Starts when refrigeration mode is active - Pressure difference sensor is active <p> Extinguishes, evaporator fans off</p> <p> Extinguishes, motor off</p> <p> Lights, electrical heater is active</p> <ul style="list-style-type: none"> - Defrosting temperature and defrosting time, resp. reached

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Start-up/operating state

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


	Diesel drive	Mains operating mode
Heating mode is activated automatically if the cargo space temperature is 2K below the setpoint temperature	<ul style="list-style-type: none"> - <u>Heating mode stops</u> if the cargo space temperature is the same as the setpoint temperature <p> Extinguishes, electric heater stops</p> <p> Extinguishes, condenser fans stop</p> <p> Extinguishes, the engine is again in idling gear</p>	<ul style="list-style-type: none"> - <u>Heating mode stops</u> if the cargo space temperature is the same as the setpoint temperature <p> Extinguishes, electric heater stops</p> <p> Extinguishes, condenser fans stop</p>

Table 3 Heating with diesel or mains power overview

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TKD 7000

Start-up/operating state

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	Diesel mode	Mains operating mode
Automatic defrosting	 Extinguishes, electric heater off - Refrigeration mode starts - Starts when refrigeration mode is active	 Extinguishes, electric heater off - Refrigeration mode starts
Manual defrosting	- Starts when refrigeration mode is active  Press 1x to activate the manual defrosting mode - The information IdF-Hi is displayed 5 s  Lights, electrical heater is active - Defrosting temperature and defrosting time, resp. reached  Extinguishes, electric heater off - Refrigeration mode starts	

Table 4 Automatic/manual defrosting with diesel or mains power



4.6 Defrosting with diesel or mains power

If the evaporator temperature drops below 0°C, the humidity in the cargo space can cause icing up of the evaporator. The air resistance on the evaporator's fins increases and the refrigeration output of the evaporator drops. When the air resistance is 2 mbar, the pressure difference sensor switches automatically to defrosting mode, i.e., the refrigeration compressor and the evaporator fan are turned off and the electric heater is turned on. The defrosting mode is terminated when the evaporator temperature rises to +15°C or after maximum 10 minutes defrosting. This is necessary in order to protect the perishable cargo if the electric heater does not operate as intended.

Defrosting mode can be entered manually from refrigeration mode.

NOTE



The atmospheric moisture in the cargo space condenses on the fins of the evaporator. Defrosting also produces water. It is therefore important that the water can drain outside.

	Diesel drive	Mains operating mode
Cooling mode is activated automatically if the cargo space temperature is 2K above the setpoint temperature	Lights , The evaporator cools and the evaporator fans are running. These switch operations depend on the sensed temperature.	- <u>Cooling mode stops</u> if the room temperature (F1) is the same as the setpoint temperature.
	- <u>Cooling mode stops</u> if the room temperature (F1) is the same as the setpoint temperature.	Extinguishes, compressor and condenser fans stop running
	Extinguishes, compressor and condenser fans stop running	Extinguishes, evaporator fans off
	Extinguishes, evaporator fans off	
	Extinguishes, engine again in idling gear	

Table 2 Refrigeration with diesel or mains power overview

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TKD 7000

Start-up/operating state

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4.3 Polling run hours and target temperature

NOTE



This menu item is displayed for 5 seconds. After this the actual cargo space temperature is again displayed.

Key	Action	Remote control display
	Press 1x	Displays the refrigeration compressor run hours
	Press 1x	Displays the diesel engine run hours
	Press 1x	Displays the required target temperature

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




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Start-up/operating state

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









4.5 Heating with diesel or mains power

	Diesel drive	Mains operating mode
Heating mode is activated automatically if the cargo space temperature is 2K below the setpoint temperature	 Lights because diesel engine is idling - Room temperature (F1) > Setpoint temperature - <u>Heating mode starts</u>	- Room temperature (F1) > Setpoint temperature - <u>Heating mode starts</u>
	 Lights; diesel engine is at load speed, generator at rated speed and supplies 400V  Lights, electric heater is on	 Lights, electric heater  Lights; evaporator fans start running . This operation is time-controlled.
	 Lights, the evaporator fans start running. This operation is time-controlled.	






4.4 Refrigeration with diesel or mains power

	Diesel drive	Mains operating mode
	 Lights because diesel engine is idling - Room temperature (F1) > Setpoint temperature	- Room temperature (F1) > Setpoint temperature
Cooling mode is activated automatically if the cargo space temperature is 2K above the setpoint temperature	- <u>Cooling mode starts</u>  Lights because the bypass line is active for soft start  Lights, diesel engine is at load speed, generator at rated speed and supplies 400V  Lights, magnetic clutch is on  Extinguishes, bypass line is closed to ensure that the full refrigerant flow passes the evaporator	- <u>Cooling mode start</u>  Lights because the bypass line is active for soft start  Lights, electric motor starts running  Extinguishes, bypass line is closed to ensure that the full refrigerant flow passes the evaporator  Lights; the evaporator cools and the evaporator fans are running. These switch operations depend on the sensed temperature.



4.2 Setting and changing the target temperature

If you want to set, or change the setting, of the target temperature, proceed as follows:

Key	Action	Remote control display
		Actual cargo space temperature is always displayed, without pressing a key, e.g., 21 °C
	Press 1x	Set target temperature
	Press 1x	Temperature display decrements by 1°C
	e.g., press 8x	Press until the required target temperature is reached
	Press 1x	or temperature display decrements by 1°C

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TKD 7000

Start-up/operating state

4-9



4.1.2 Starting from mains supply

NOTE



Check the v-belt tension before starting.

CAUTION



**The cover and the protective grating must be in place. There must be no foreign material in the system.
Turn off the diesel mode on the remote control unit before starting from mains supply.**

The main switch on the control unit must be at position 1 „Main switch On“.

1. Make the mains connection
Plug the supply cable in the 400 V socket outlet.

WARNING



The socket outlet must be fused 16A slow. The rotating field is identified. An r.c.c.b switch with 30mA must be connected on the line side.


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TKD 7000

Start-up/operating state

4-7



	e.g., press 2x	Press until the required target temperature is reached	18°
	Press 1x 5s	Saves the new target temperature, then display returns to the current cargo space temperature	21°

NOTE



If you do not press the key within 5 seconds, the previous target temperature is maintained in the memory and the change is not saved.



2. Turn on the Refrigerated Transport SystemTKD 7000



Turn on the „ON/ OFF“ switch → remote control (display panel is activated)

The following information appears in succession on the display panel:

- 4.5 Software version of the control software for 1 second
- 0000 Refrigeration compressor run hours for approx. 2 seconds
- 0000 Diesel engine run hours for approx. 2 seconds
- 18° Last entered target temperature blinks for about 5 seconds → the target temperature can be changed, see chapter 4.2

3. The regulation function is activated

4. The following information appears on the display panel:

- 21° Cargo space temperature, e.g., 21 °C

4.5

Software version of the control software
for 1 second

0000

Refrigeration compressor run hours for approx. 2 seconds

0000

Diesel engine run hours for approx. 2 seconds

18°

Last entered target temperature blinks for about 5 seconds
→ the target temperature can be changed, see chapter 4.2

4. The "Glow" LED extinguishes, the preheating time is up. "Go" is now displayed on the display panel.

-GO-

Press the starting switch for diesel operation once until the diesel engine starts.
The „GO“ display extinguishes when the engine has built up sufficient oil pressure.

NOTE

If the engine does not start when the starter switch is pressed, the next start attempt can only be made after turning off the remote control (start repeat lock is activated). Now the next start attempt can be made. If the engine does not start within 60 seconds after turning on, it is blocked by the control software. "OFF" blinks in the display panel. Set the "ON/OFF" switch „Off“ and attempt a new start.

4 Start-up / operating states

WARNING

Study all controls and indicators before start-up and beginning to work. Before starting the Refrigerated Transport System TKD 7000 make certain that it is in good technical and operating state.

4.1 Start-up of the system

4.1.1 Starting from the diesel engine

NOTE

Before starting the diesel engine, check the oil level, the cooling water, the diesel fuel and the v-belt tension.

CAUTION

The cover and the protective grating must be in place. There must be no foreign material in the system.



6. The regulation function is activated.
7. The following information appears on the display panel:

21°

Cargo space temperature, e. g., 21 °C

Starting from the control unit - only for service work

1. Check the switches on the control module
If the main switch is at 0, the main power circuit for operation from a mains and the control circuit for diesel operation are open. To start the system, set the main switch to position 1.
2. Turn on the "ON/ OFF" switch on the remote control (display panel is activated),
3. Press the start switch on the control unit: Starting from the diesel engine (observe preheating time)

NOTE



If the engine does not start when the starter switch is pressed, the next start attempt can only be made after turning off the remote control (start repeat lock is activated). Now the next start attempt can be made.
If the engine does not start within 60 seconds after turning on, it is blocked by the control software. "OFF" blinks in the display panel. Set the "ON/ OFF" switch „Off“ and attempt a new start.



WARNING



Do not let the diesel engine run in a closed room. The exhaust contains CO, which is toxic if inhaled in a high concentration.

Remote starting:

1. Check the switches on the control module
If the main switch is at 0, the main power circuit for operation from a mains and the control circuit for diesel operation are open. To start the system, set the main switch to position 1.
2. Turn on the "ON/ OFF" switch on the remote control → light emitting diodes 17, 18, 19 (Fig. 2-6) light
 - Light emitting diode "Batt." (17) Ignition on
 - Light emitting diode "Gen." (18) Battery /12V Generator control shines red (normal at start)
 - Light emitting diode "Glow" (19) Preheating; preheating time: approx. 20-30 seconds
3. The following information appears in succession on the display panel:

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TKD 7000

Start-up/operating state

4-1

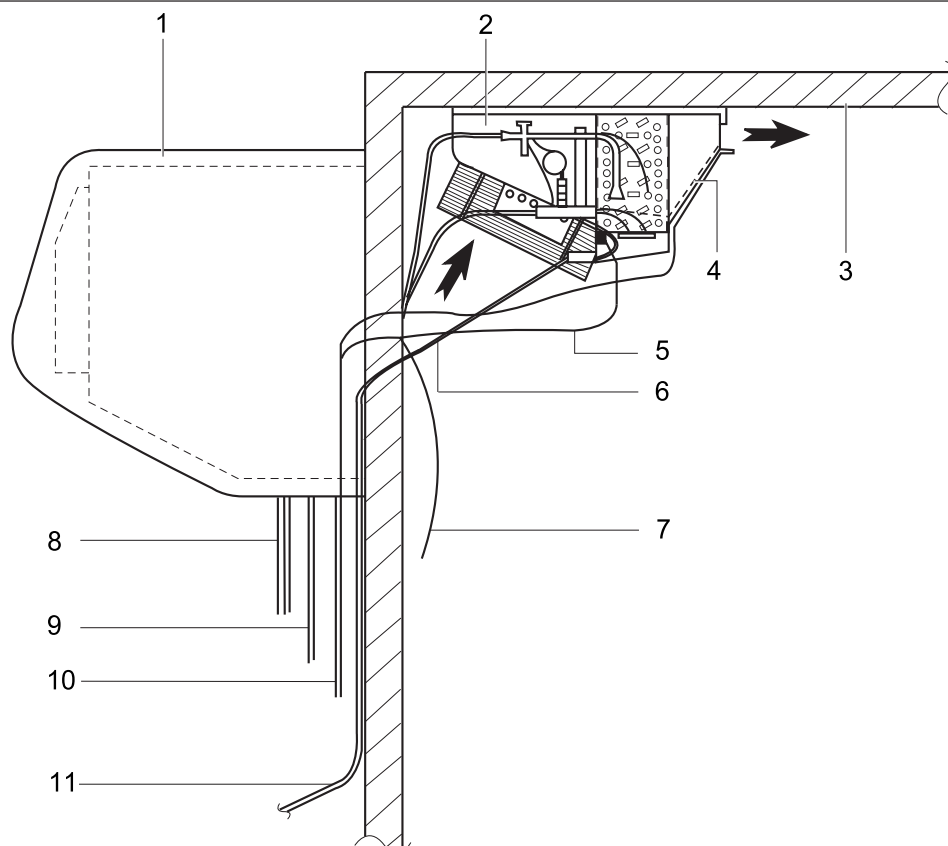


Fig. 3-1 Installation layout of Refrigerated Transport System TKD 7000

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TKD 7000

Erection/removal and finish

3-3



NOTES

4-2 Start-up/operating state TKD 7000

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3.2 Finish

The Refrigerated Transport System TKD 7000 is available in two custom finish versions:

Finish:

- ASA PMMA RAL 9010 standard white
- ASA pure white for later finish in the color of the truck body

The finishing specification can be obtained from the maker.

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2.4 Environment note and economy of operation

ENVIRONMENT NOTE



Every person working on the Refrigerated Transport System TKD 7000 must have sufficient knowledge of the safe handling of substances which can constitute a health or environment hazard, e.g., fuel, oil, cleaning agents, lubricating grease, paints, coolants, refrigerants, etc.

Oil, cleaning substances, paint, etc. shall be stored in suitable containers and handled and stored in accordance with the manufacturer's safety instructions.

Operating fluids when drained during maintenance or repair and oil when changed shall be collected in suitable containers and disposed of in accordance with EG directive 75/439/EWG and ordinances pursuant to §§ 5a, 5b AbfG and AltöIV.

Spilling oil, diesel fuel, coolant, etc., must not seep in the soil. There is significant hazard of contamination of the ground water.

Dyke in, take up and dispose of any spills as required by law.

Dispose of contaminated filter, e.g., fuel filter inserts, as hazardous waste of the category according to the filtered medium.

Batteries contain caustic sulfuric acid.

Handle batteries with particular care. Spent batteries must be returned to the battery distributor.

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3 Installation / removal and finish of the Refrigerated Transport System TKD 7000

3.1 Installation / removal

The Refrigerated Transport System TKD 7000 is installed/removed by the stilled personnel of an authorized service center (see list of authorized service centers).

All authorized service centers have a copy of the installation instructions for reference and reading.

Installation layout:

Refer to the installation layout for the arrangement of the components of the Refrigerated Transport System TKD 7000.

The remote control is located at a convenient place in the driver's cab.

- | | |
|---|---|
| 1 Diesel generating set | 6 Water drain inside truck |
| 2 Evaporator | 7 Room temperature sensor F1 (blue) |
| 3 Vehicle chassis | 8 Electrical line for remote control and to the diesel pump, external socket outlet |
| 4 Evaporator temperature sensor F2 (yellow) (in evaporator fin pack) | 9 Diesel pump feed and return line |
| 5 2 electrical feeding lines to control the evaporator | 10 Room and evaporator temperature sensor - connection on remote control unit |
| | 11 Water drain outside truck |

3-2

Erection/removal and finish

TKD 7000

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Economy of operation:

Economy of operation of the Refrigerated Transport System TKD 7000 can be ensured if the following recommendations are followed:

- Keep the doors of the refrigerated body closed.
Open the doors only for loading and unloading cargo.
- Load pre-refrigerated goods.
- Park the truck in the shade, do not park it in bright sunlight.
- Keep the cargo space dry.
- Make regular checks of all fluids (e.g. engine oil, refrigerant, etc.) to avoid refrigeration problems.
- Have all units serviced regularly (checks of operating fluids, etc.), only a flawless system is economical to use



2.3.2.3 Remote control

The remote control is placed suitably in the driver's cab.

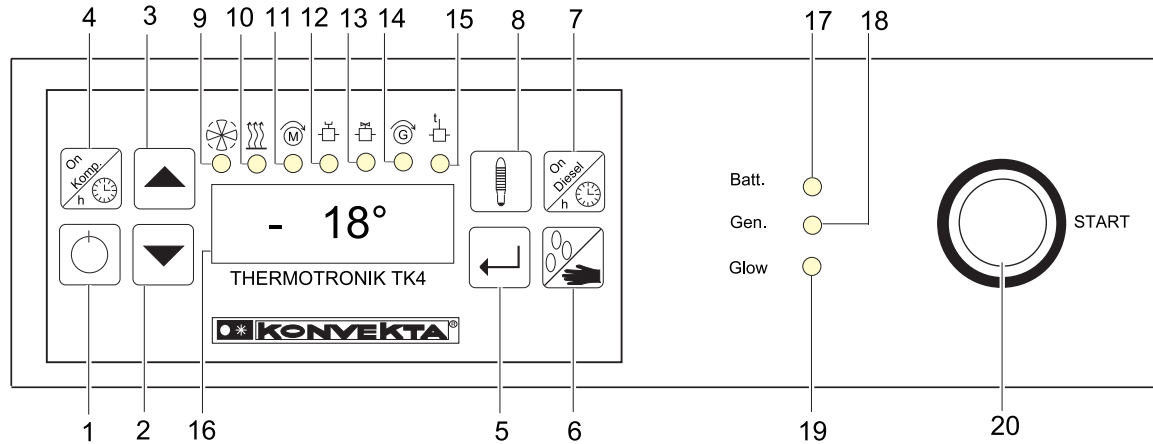


Fig. 2-6 Overview of remote controls in driver's cab

Controls (buttons):

- | | | | |
|---|--------------------------|---|--|
| 1 | ON / OFF switch TKD 7000 | 5 | Saves the required value |
| 2 | Decrements a value | 6 | Starts the manual defrost cycle |
| 3 | Increments a value | 7 | Diesel engine run hours |
| 4 | Compressor run hours | 8 | 2 sec display time |
| | 2 sec display time | | Displays the required target temperature |

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TKD 7000

Description

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Controls:

Main switch (A):

Position 0

Position 1

Switches the power circuits on/off

Main power circuit for mains and diesel operation and control circuits „OFF“

Main power circuit for mains and diesel operation and control circuits „ON“

Starter switch (B):

Starts the diesel generation (observe preheating time)

2.3.2.2 Evaporator VD7000

The evaporator VD7000 is mounted in the cargo space. The high air rate and throw of the 380 V 3-phase fans of the evaporator ensure quick and uniform refrigeration/heating even of large bodies.

A maintenance-free electric heater supplies maximum heating output even at low outdoor temperature.

Hoar frost and icing up of the evaporator can reduce the refrigeration output and the air rate. The high air resistance (due to iced up ribs) causes the pressure difference sensor to start the defrosting cycle at evaporator temperatures below 0°C. The refrigeration compressor, the condenser fan and the evaporator fans are turned off and the electric heater turns on. The defrosting cycle terminates when the temperature on the evaporator sensor is 15°C or the maximum defrosting time of 10 min is exceeded.

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TKD 7000

Description

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Indicating elements (light emitting diodes):

- 9 Evaporator working
- 10 Heater on
- 11 3-phase motor on (compressor drive by 3-phase motor)
- 12 Magnetic clutch on (compressor drive by diesel engine)
- 13 By-pass line open
- 14 Generator mains /fuel throttle
- 15 Engine at diesel load speed
- 16 4-digit 7-segment display panel
- 17 Diesel engine ignition On
- 18 Generator control
 - red Generator (12V) defective → normal when started
 - green Battery defective
- 19 Diesel engine preheating
- 20 Diesel engine starter switch

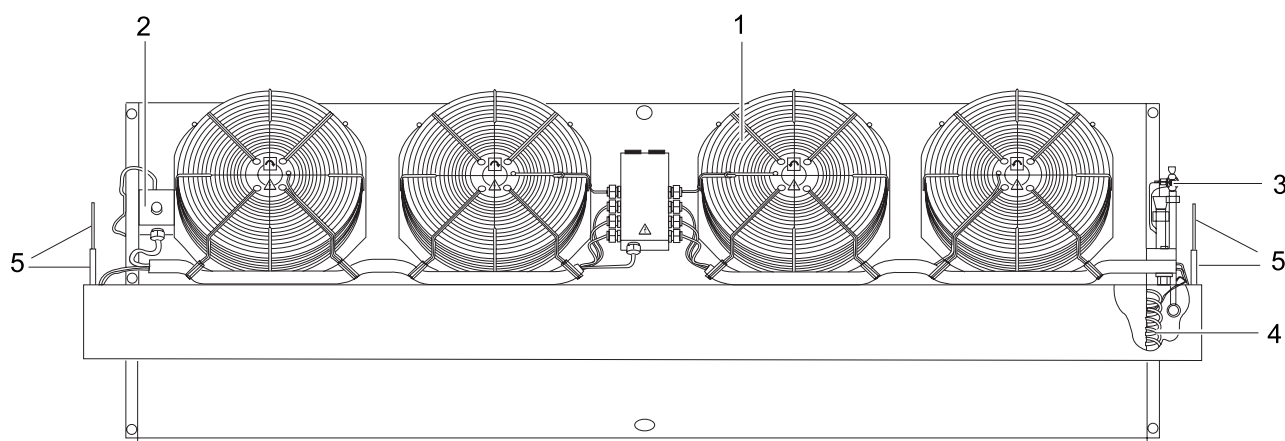


Fig. 2-5 Evaporator VD7000

- 1 Evaporator fan
- 2 Differential pressure sensor
- 3 Expansion valve
- 4 Tubular heater
- 5 Water drains with heater cable

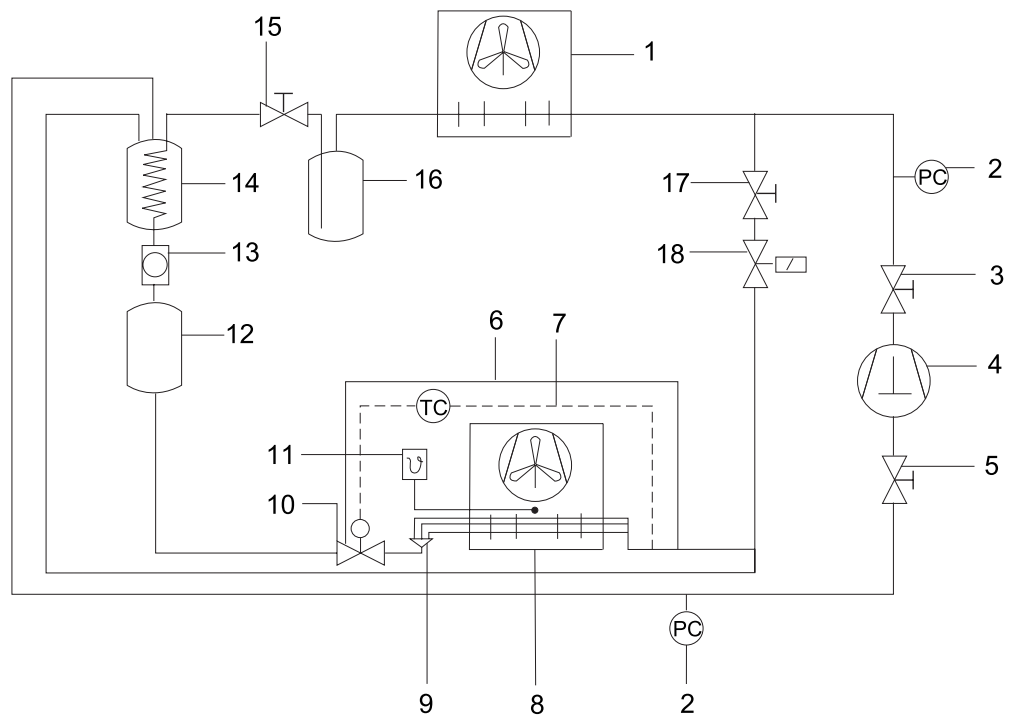


Fig. 2-3 Refrigeration system

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The diesel engine is mounted on specially selected vibration dampers. The generator, the refrigeration compressor and the electric motor are mounted on rockers. The adjustment of the inclination of these components controls the tension of the v-belts. A damping idler on the v-belt of the diesel engine generator compensates vibration of the diesel engine.

NOTE



This is not a tensioning idler.

A high-speed, water cooled diesel engine powers a 400-volt 3-phase generator and the refrigeration compressor via wear-resistant v-belts.

In refrigeration service the magnetic clutch engages ensuring that the v-belts between the generator and the refrigeration compressor become active. At the same time the condenser fan which is mounted on the shaft of the electric motor, also starts rotation.

When the refrigeration system is powered from an external 400 V 3-phase source the diesel engine generator and the magnetic clutch are not switched on. In this case the electric motor drives the condenser fan and at the same time the refrigeration compressor directly via wear-resistant v-belts.

To ensure a soft start-up the refrigerant bypass opens for a few seconds. Refrigeration of the cargo space is ensured by the evaporator VD 7000 installed there. The evaporator is described in the refrigeration system.

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TKD 7000	Description	2-7
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Control module on the diesel generating set

The control module with the operator console is mounted on the side of the diesel generating set on the left side seen in drive direction. It is installed in the frame underneath the refrigeration equipment.

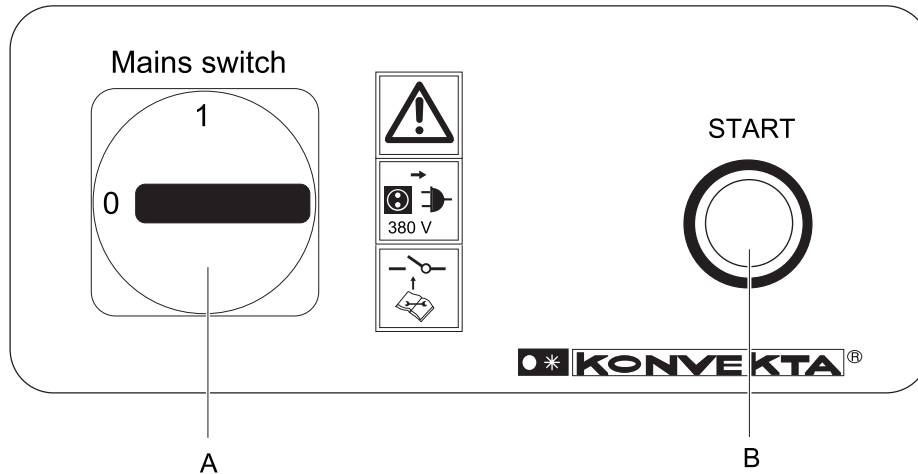


Fig. 2-4 Control module on diesel generating set

- A Main switch
- B Starter switch for diesel generation

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Description

TKD 7000

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The refrigeration system is charged with refrigerant R 404A which moves in a closed loop system. The useful cold is produced by the evaporation of the liquid refrigerant in the evaporator inside the vehicle. The latent heat which is produced by this process cools the room air.

The refrigeration system:

During the first few seconds after start-up, the compressed refrigerant gas flows through the open solenoid valve (18) of the bypass line (to ensure soft start-up) and directly in the intake space of the refrigerant compressor. When the bypass line closes, the compressed refrigerant gas flows to the condenser (1) and turns liquid. The liquid refrigerant collects in reservoir (16) and passing the heat exchanger of the liquid separator (14), sight glass (13) and dryer (12) it flows to expansion valve (10). In expansion valve (10) the refrigerant pressure is reduced to intake pressure level, which causes the temperature to drop to evaporation temperature level. The refrigerant absorbs heat in evaporator (8) – which causes refrigeration of the cargo space – and enters liquid separator (14), where the remaining liquid drops are separated, which if not separated can effect the refrigeration compressor.

Shut-off valves (3, 5, 17, 15) are open and can be closed when maintenance work is carried out.

- | | | | |
|---|--|----|------------------|
| 1 | Condenser | 10 | Expansion valve |
| 2 | Combined high pressure/
low pressure switch | 11 | Control device |
| 3 | Pressure valve | 12 | Dryer |
| 4 | Refrigerating compressor | 13 | Sight glass |
| 5 | Intake valve | 14 | Liquid separator |
| 6 | Compensation line | 15 | Shutoff valve |
| 7 | Capillary tube with sensor | 16 | Reservoir |
| 8 | Evaporator | 17 | Ball valve |
| 9 | Manifold | 18 | Solenoid valve |

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Description

TKD 7000

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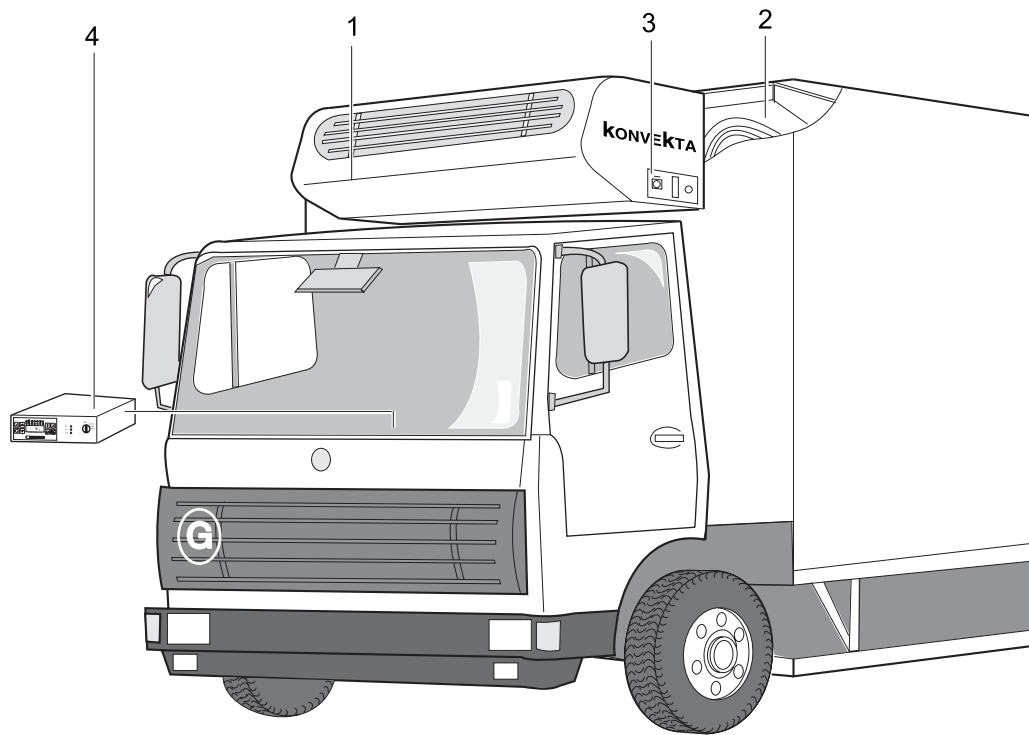


Fig. 2-1 Component overview

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2 Description of the Refrigerated Transport System TKD 7000

2.1 Use

The Refrigerated Transport System TKD 7000 is used to maintain a controlled temperature in the cargo spaces of trucks independent of the outdoor temperature.

If a 380/400V 3-phase power source with a slow 16A fuse is available, the TKD 7000 can operate with mains power. The rotating field is identified automatically. The TKD 7000 can also be operated without mains power. In this case power is supplied by a combustion engine. Commercial diesel fuel is used. The diesel engine is supplied with diesel fuel by a diesel pump from the vehicle tank.

The refrigeration compressor, the condenser fan and the generator are v-belt driven. The generator supplies the require electric voltage to feed the evaporator. It must **not** be used for any other purpose.

Mains power should be used in noise sensitive environment.

A generously dimensioned cooling/heating of the cargo space protects perishable goods in transport.

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2.3.2 Description of components

2.3.2.1 Diesel generating set

The diesel generating set is mounted on the front of the truck body above the driver's cab.

It supplies power to the heating/refrigeration system and works separately from the truck engine.

- 1 Diesel engine
- 2 Water radiator
- 3 Starter battery
- 4 Generator
- 5 Refrigeration compressor
- 6 Condenser battery
- 7 Electric motor with impeller
- 8 Refrigeration components
- 9 Control module
- 10 Cover with protective grating
- 11 Remote control Thermotronic TK4 12V

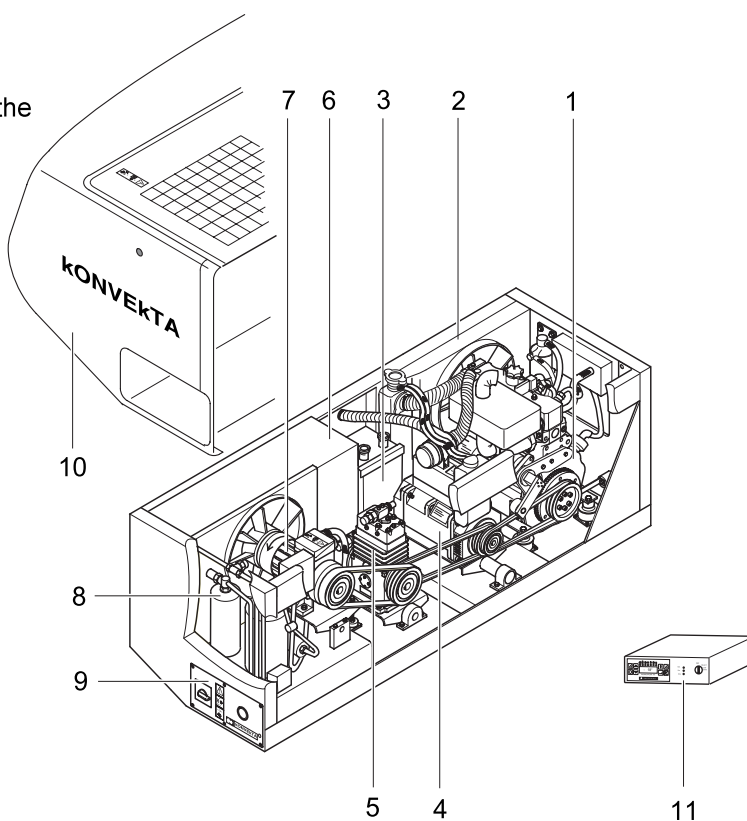


Fig. 2-2 Diesel generating set

2-6	Description	TKD 7000
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2.2 General functional description

The Refrigerated Transport System TKD 7000 is a heating/refrigerating system of split design.

A diesel generating set mounted outside the truck supplies the heating/refrigerating system with power. From the diesel generating set refrigerant and electrical lines pass through the insulated wall of the truck into the cargo space and to the evaporator VD 7000. The large air rate and wide throw of the evaporator ensures quick and efficient cooling/heating even of large bodies.

The Refrigerated Transport System TKD 7000 is serially supplied with a remote control unit for operation directly from the driver's seat.

For service work the Refrigerated Transport System TKD 7000 can be started and stopped from the operator console of the control module.

2.3 Construction of the Refrigerated Transport System TKD 7000

2.3.1 Component overview

- 1 Diesel generating set with control module
- 2 Evaporator VD7000
- 3 Control module with operator console
- 4 Remote control Thermotronic TK4 12V with display panel

2-4	Description	TKD 7000
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NOTE



Make sure that all nameplates and decals are in place and legible. Soiled, damaged or otherwise illegible decals and nameplates are a potential source of operating errors.

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NOTES

2-2 Description TKD 7000

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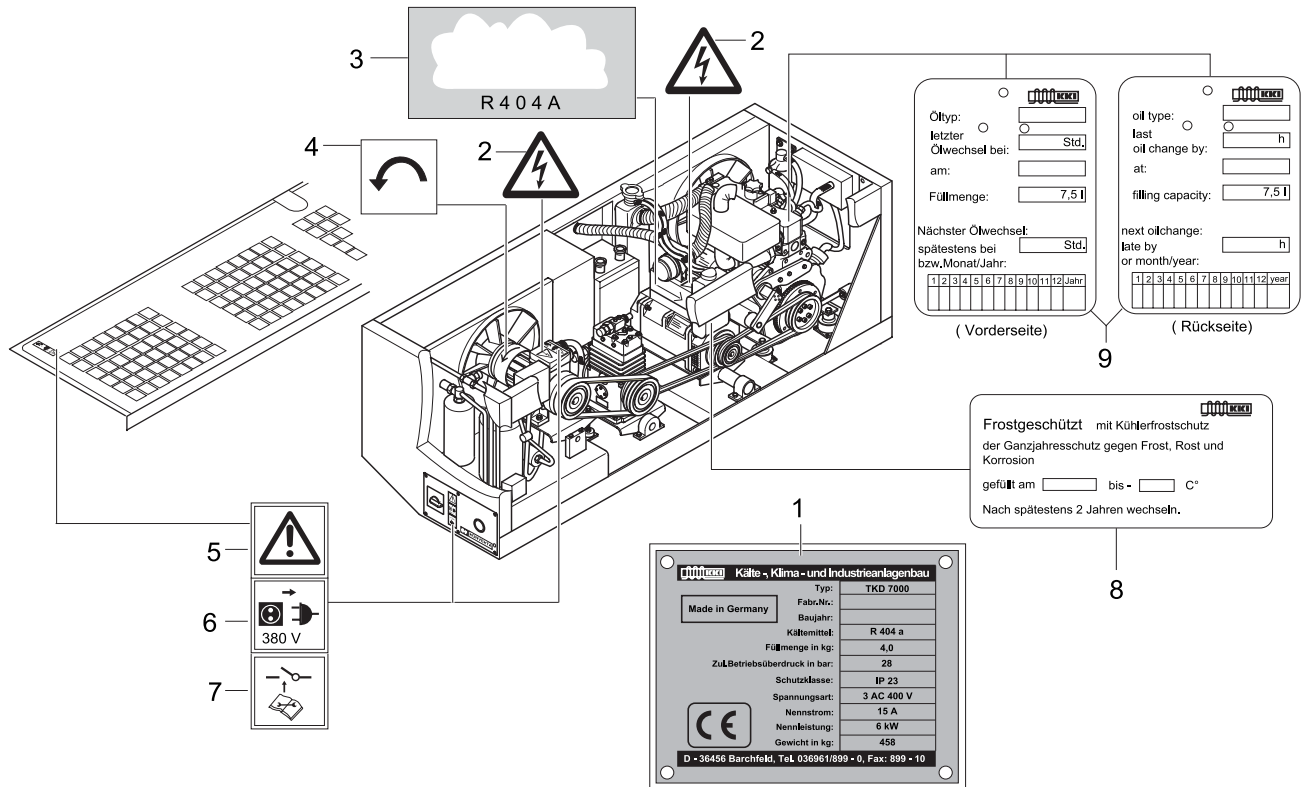


Fig. 1-1 Nameplate/decals on the diesel generating set

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TKD 7000

Safety

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1.5 Information on safety standard and regulations

In addition to the safety instructions in this User Manual, the following accident prevention regulations for vehicles, fire prevention regulations, laws and regulations, federal, state or local, shall be observed.

Knowledge of the following safety provisions and regulations is assumed:

- BGV A1 General provisions
- BGV A2 Electrical plant and equipment
- BGV A5 First Aid
- BGV A8 Hazard alerts at the workplace
- BGV B3 Noise
- BGV D4 Refrigeration systems, heat pumps and cooling equipment
- BGV D29 Vehicles
- VBG 5 Power operated equipment
- H 1/454 Safety regulations for vehicle repairs

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TKD 7000

Safety

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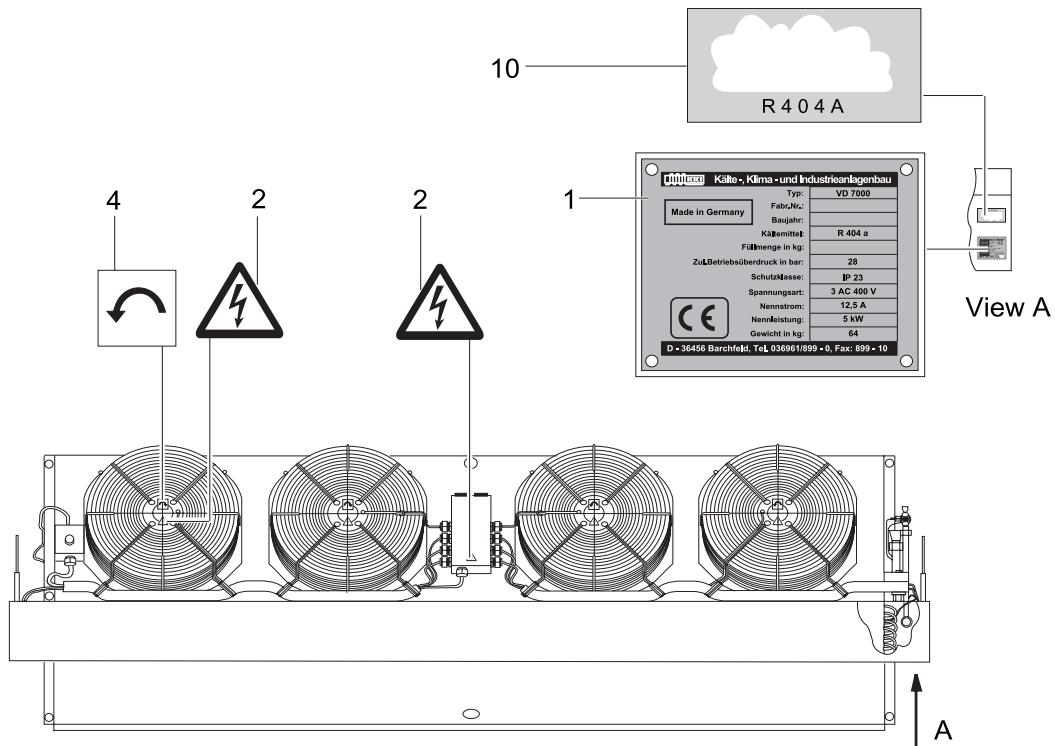


Fig. 1-2 Nameplate/decals on the VD 7000 evaporator



(German) federal laws

4th Immission prevention law (4. BImSchV) (clean air law)

EC and federal waste disposal law pursuant to EC directive 75/439/EEG, and

ordinances pursuant to §§ 5a, 5b AbfG (waste disposal law) and AltöIV (contaminated oil ordinance)

Users of the Refrigerated Transport System TKD 7000 outside the Federal Republic of Germany shall observe the accident prevention, safety and disposal laws and regulations in effect in their respective country.

1.6 Nameplates and decals on the Refrigerated Transport System TKD 7000

The operator is informed of technical specifications, warnings and hazard alerts by nameplates and decals on the system.

- 1 Nameplate
- 2 Warning of dangerous electric voltage
- 3 Refrigeration machine is charged with R 404A refrigerant
- 4 Sense of rotation
- 5 General hazard warning
- 6 Unplug the power cord before opening
- 7 Turn off the system before carrying out maintenance or repair work
- 8 Fill cooling water
- 9 Oil change
- 10 Refrigerant plate



WARNING



All inspection or maintenance on internal parts of the diesel generating set shall only be carried out when the system is turned off and secured. The main switch of the diesel generating set shall be removed before any work on the Refrigerated Transport SystemTKD 7000 is carried out. The main switch shall be secured to ensure that it cannot be used accidentally or without authority.



CAUTION



Burn hazard
Some parts of the system become hot during operation. Allow the top protective grating on the system to cool sufficiently before opening.



WARNING



Consult an authorized service center without delay in case of failure of any part of the Refrigerated Transport System TKD 7000. This is the only way to keep possible damage to the system and the cargo as low as possible.

WARNING



Any intervention in the refrigerating machine is strictly forbidden. The refrigerating engine is pressurized. Any work on the machine shall be carried out by trained persons.

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1.2 Safety alerts and symbols

To alert the user to the possibility of personal injury or damage to the Refrigerated Transport System TDK 7000 property, several safety alert symbols are used in this Manual.

Alert word/ symbol	Damage to ...	Definition	Consequences if ignored ...
Warning 	Persons or property	potentially dangerous situation due to improper practices or prescribed procedures	potentially - death - most serious injury - extensive damage
Caution 	Persons or property	less hazardous situation due to improper practices or prescribed procedures	- minor injury - minor damage
Ecological hazard 	the environment	due to the use of materials which are a health or environment hazard	- extensive damage

Table 1 Safety alerts and symbols

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**WARNING****Cold hazard for locked up persons**

The driver shall not close and lock the door after loading the cargo unless he has convinced himself that all persons have left the refrigerated space.

WARNING

Any unauthorized modification or change to the equipment of the Refrigerated Transport System TKD 7000, to control, switchgear and safety equipment, is forbidden.

This also refers to all factory settings and the electronic equipment.

1.4 Qualification of maintenance and repair personnel

Repairs and maintenance, including preventive maintenance, shall only be carried out by instructed, trained personnel in an authorized service center.

**NOTE:**

In order to alert the user to a hazard quickly and in easy to understand form, the alert words are typographically emphasized and the alert symbol precedes the description of the hazard.

General safety notes can be found at the beginning of the User Manual. Special safety notes are given in each chapter of the Manual.

1.3 General hazard alerts for the user

WARNING

To avoid accident and operating errors the safety notes shall be observed by all users (operator, maintenance personnel) operating or cleaning the Refrigerated Transport System TKD 7000 .



1 Safety

1.1 General information

This User Manual contains all information for safe operation, maintenance and cleaning of the Refrigerated Transport System TKD 7000 in order to avoid hazards, operating errors, repair cost and downtimes for the user.

NOTE



Every user of the Refrigerated Transport System TKD 7000 shall inform himself of the system before using it. The distributor will give instructions when the system is delivered. This instruction shall be documented.

This User Manual shall be kept at a place to which the user has full access at any time so that he can consult the Manual.

Carefully comply with all safety instructions and accident prevention regulations.

If any failure occurs in the operation of the Refrigerated Transport System TKD 7000, consult an authorized service center without delay.

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Make sure that when you take delivery of the Refrigerated Transport System TKD 7000 you also receive a complete set of documents.

- Service log/ service point booklet
- User Manual



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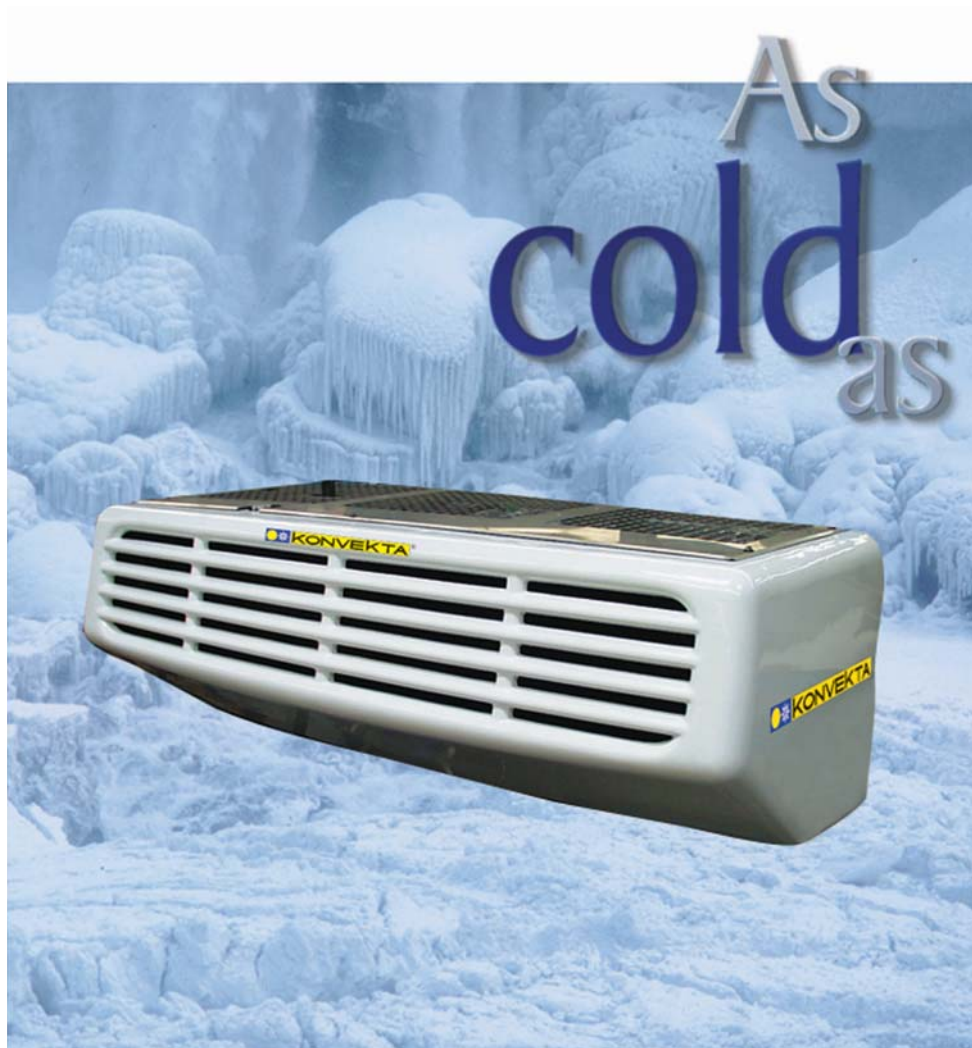
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Dear owner,

the reliability and life limit of your Refrigerated Transport System TKD 7000 are essentially determined by the quality of operation and maintenance. This User Manual contains important information on the operation, repair and maintenance of the Refrigerated Transport System TKD 7000 in a clear and neat layout. This will assist in avoiding hazards and operating errors and cut repair cost and downtime.

The Refrigerated Transport System TKD 7000 shall only be operated by instructed personnel in order to avoid operating errors.

The Refrigerated Transport System TKD 7000 consists of the diesel powered refrigeration machine, the evaporator VD7000 and the remote control. The purpose of the system is to maintain the temperature in all cargo spaces of the truck at a controlled level while the truck is driving or parked. Any other use is not allowed and not intended.

Any repair or maintenance work shall only be carried out by an authorized repair center, unless provided otherwise in this Manual.

The Refrigerated Transport System TKD 7000 is delivered with a Service Log.

The maintenance and inspection intervals in the Service Log shall be observed and all maintenance & service operations carried out by an authorized service center at the prescribed intervals.

The manufacturer is not liable for damage which is the result of non-compliance with the instructions in this Manual. The risk is entirely on the owner.

If you have questions or need further information on the Refrigerated Transport SystemTKD 7000, customer service, repair or replacement parts, please contact your authorized service center.

Our technical customer service staff will also assist you whenever you need assistance.

Please quote the name of the product, the serial number and the year of construction with all inquiries. You find the data on the nameplate of the machine.

We hope the Refrigerated Transport System TKD 7000 will give you many years of smooth and efficient service.

The Management

Closing date: 7/2000

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