# Outdoor Combined Transformers Type EJGF 170

## Service and Maintenance Manual

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# 1 Description of the design

## 1.1 Structure

Combination of inductive voltage transformer and current transformer in head type design for system voltage of 245 up to 550 kV. The transformer fully meets the IEC standard 60044-3 as well as national standards. Dimensions according to the related outline drawing. Range of ambient temperature: -40° C to +40° C. Other temperature ranges on request. The metal housings are made of corrosion-resistant aluminum alloys.
The voltage transformer active part of the inverted designed voltage transformer is placed in the top part of the head housing. The magnetic core is on high voltage potential. The secondary windings are installed in an aluminum shielding electrode around the primary winding. The secondary leads and the low voltage potential connection of the primary winding are guided through the core housing of the CT part and the bushing tube inside the insulator to the secondary terminal box. The layer insulation of the primary winding consists of SF6 gas-impregnated polyester films.

The current transformer part with the current transformer ring cores, placed in a thick walled core protection housing, is located below the voltage transformer part in the lower part of the head housing. The primary current may flow one time or depending on the design option for primary re-connection design two or four times through the ring cores. The secondary leads are guided through a bushing tube inside the composite insulator to the secondary terminal box.

A field graded bushing is installed inside the composite insulator.
A spacious terminal box, the SF6-filling valve and the density monitor with test valve are located at the bottom side housing of the composite insulator.

A rupture disc, made of a corrosion-resistant nickel alloy, is installed on top of the transformer, protected by an aluminum hood. The nominal opening pressure of the rupture disc is adjusted at a pressure of pe = 9 bar / 20° C. The rated diameter is about 150 mm.

All gaskets are made of chambered, single-piece O-rings.

## 1.2 Insulator

The transformers are equipped with composite insulators with silicone rubber sheds.

## 1.3 SF6-gas and density monitor

Pure SF6 insulating gas in accordance with IEC 376 is used for insulation. For the Gas-filling the transformer is equipped with a Dilo DN 20 type valve terminal.
The maximum leakage rate of the transformer is <0.5% per year. The gas density is monitored by using a temperature-compensated density monitor (see Figure 9). The density monitor is mounted on a self-closing gauge coupling with a test valve. Therefore the density monitor has not to be removed for inspection. It also must not be removed for filling the transformer. The display of the density monitor is equipped with a red and a green area in the scales and has a diameter of> 80mm. There are two alarm contacts:
**First Alarm:** Minimum operating pressure pe = 3.5 bar / at 20 ° C / and below is reached. At this pressure all dielectric tests are performed.
**Second Alarm:** At pe = 2.9 bar / at 20°C / and below => shutdown required!
The alarm contacts are connected to terminals inside the terminal box.

Dew Point: <= -25 ° C, relative to 20°C, related to the gas at 1 bar abs. /20°C.

## 1.4 Terminals

### 1.4.1 Primary terminals

For the dimensions of the terminals please refer to the related drawing. The drawings are in accordance with the specified standards.

### 1.4.2 Secondary terminals

The secondary windings are connected to a gas tight secondary gas-air bushing. Insulated wires are connecting the bushing and the secondary terminals inside the terminal box. A predetermined fuse link in the secondary circuit wiring in the terminal box protects the secondary windings against damage by short circuit near the secondary terminals.

The connectors are standard terminal blocks, optional connecting bolts (M10), made of high quality copper alloy are available. Each terminal can be earthed to an earthing bus. The terminal designations are in accordance with the specified standards.
Located at the bottom of the terminal box a 295 x 55 mm removable gland plate (see Figure 1) for insertion of cables with max. 26 mm diameter is provided. A vent hole with a sieve provides ventilation for the terminal box. The protection class of the terminal box is IP 54.

### 1.4.3 Earthing terminals

Two earthing terminals are provided at the base of the transformer ( 4 holes diameter 14 mm, spaced 60 mm for a minimum of 2 x M12 x 55 mm), located at the front left and rear right (refer to fig.1).

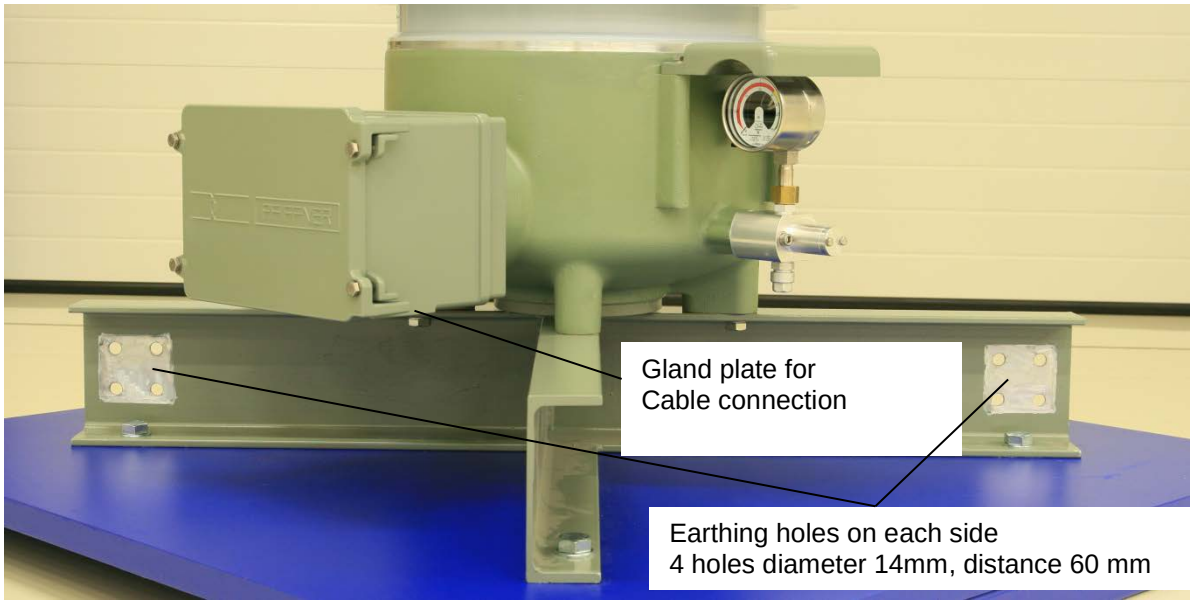



fig 1: Location of earthing holes at the transformers base and of gland plate at the terminal box

# 2 Transport

## 2.1 Transport by Truck

- Transportation in horizontal position. The terminal box is facing forward and is located to the side, the rating plate shows upwards and the density monitor is located upwards. (see Figure 2).

➔ Secure the transformer firmly by using straps connected to the truck.

The base and the head of the transformer have to be supported by using suitable wooden wedges.

Put vibration pads between transformer and wooden wedges to protect the transformer against impacts (see Figure 2).

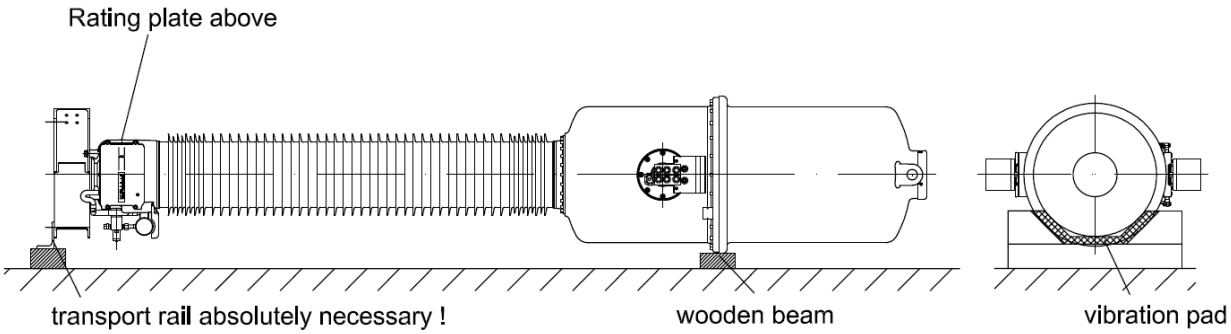



fig 2: Transport position ( principle )

# 3 Commissioning

## 3.1 Unpacking

After opening the shipping container or the crates if used the transformer should be checked for signs of damage in accordance with chapter 3.2.
In case of faults PFIFFNER Germany or the country's representatives should be informed immediately.

## 3.2 Inspection

The transformers are individually tested and supplied with a transport gas pressure of pe = 0.5 bar / 20° C.
Before mounting the transformer should be checked for damage:
- No detectable gas leakage
- The density monitor has to display a transport pressure of pe = 0.5 + / -0.1 bar at 20°C
- No signs of damage at insulator, primary connectors and cover, terminal box and density monitor.

- The two outside glued shock indicators for 20g and 30g should not be triggered**.**

If the 20g indicator is triggered: Check packaging and transformer for visual damage. If no further damage can be seen, the transformer can be put into operation.

If the 30g indicator is triggered alone or together with the 20g indicator: The transformer has to be sending back for inspection to the factory.

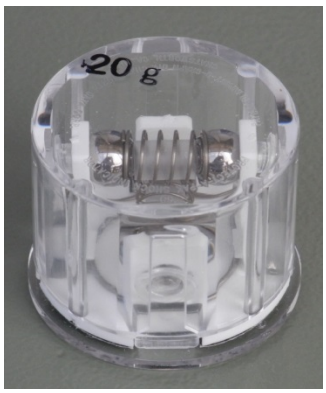


Fig 3: Indicator not tripped

Fig 4: Indicator tripped

- For certified transformers official seals on the flanges and the sealing of the access protection on the secondary terminals in the junction box have to be checked for integrity.

## 3.3 Installation of the transformer

**Center of gravity S of the transformer: Refer to outline drawing**

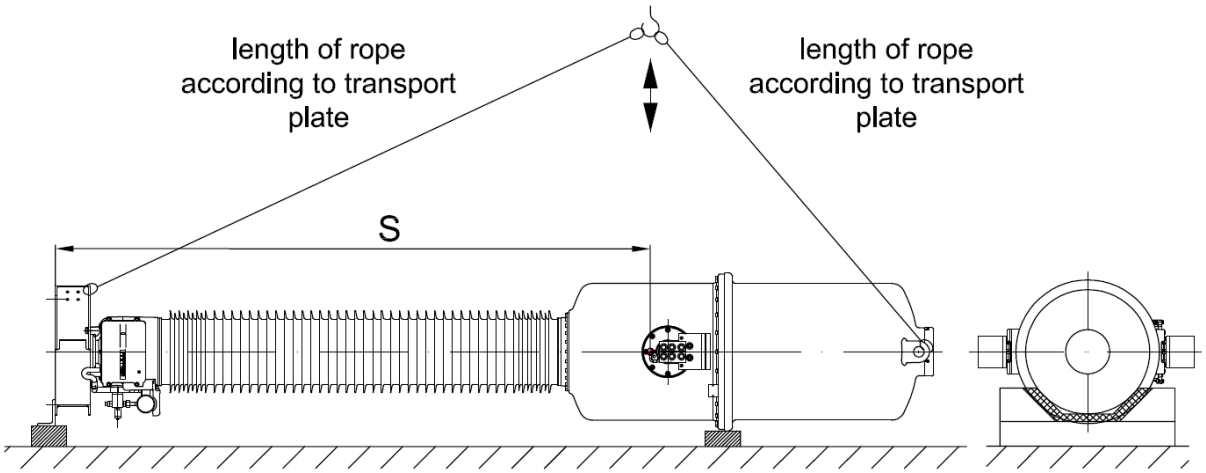



fig 5: Lifting of the transformer

The transformer is lifted by using of the appropriate lifting lugs at the tank (see Figure 5, 6 and 7).

The transformer is put in upright position manually (see Figure 6).

For the lifting of the transformer the lifting lugs at the tank are used as well (see Figure 6 and 7)

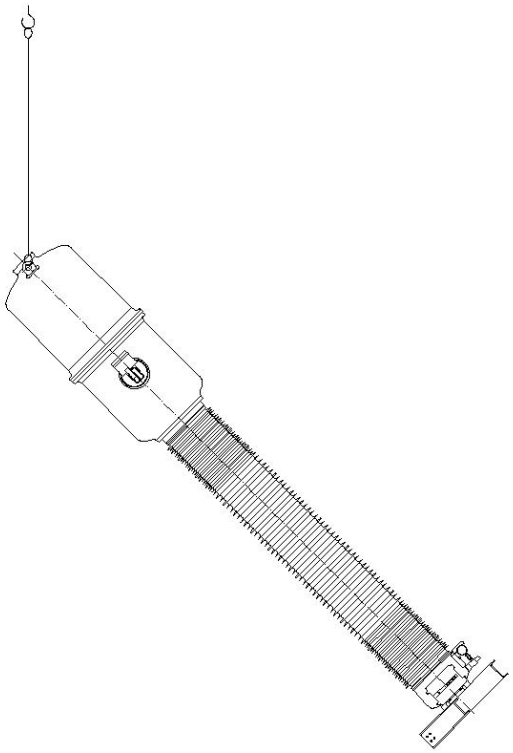


fig. 6: Lifting to upright position

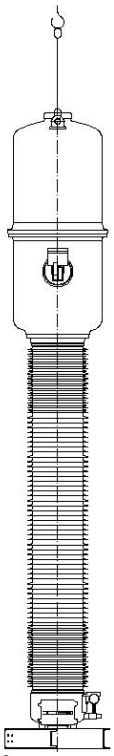


fig. 7: Vertical lifting

If the installation platform is not totally flat appropriate adjustments measures should be done first.

## 3.4 Connection

### 3.4.1 Primary terminals

Before mounting remove the oxide layer on the contact surface of the terminals by using a brush. Lubricate the contact surfaces with contact grease.

### 3.4.2 Secondary terminals

For delivery one end of each secondary winding of the transformer is connected to earth. The winding is short circuited.

For bolt type terminals: The bolt is connected to the earthing bar by using a grounding link.

The primary winding "N" ("X") has always to be grounded! (See also section 3.4.5)

**=>Never operate a voltage transformer with short circuited secondary windings!**

**=>Never ever operate a current transformer with open secondary windings!**

### 3.4.3 Earthing pads

Before mounting remove the aluminum oxide layer on the contact surface by using a brush. Lubricate the contact surfaces with contact grease.

### 3.4.4 Earthing in open-delta connection

If earth fault windings are connected in open-delta circuit only one phase must be earthed!

### 3.4.5 Earthing in high voltage winding

The neutral end of the primary winding “N” (“X”) has always to be grounded!

### 3.4.6 Torque

| | |
|---|---|
| Secondary-Bolts M10 | 10 Nm |
| Earthing Connections M12 | 72 Nm |
| Cover of the terminal box | 10 Nm |

### 3.5 Gas-filling

After commissioning, prior to put in service the transformer has to be filled with SF6 gas up to the operating pressure in accordance with the nameplate value.

## 4 Maintenance

### 4.1 Gas monitoring

The monitoring of the gas pressure is provided by the alarm-contacts of the density monitor.

### 4.2 Maintenance and conservation

Exterior cleaning in accordance with the substation inspection rules of the user.
Aeration sieve in the terminal box checked for cleanliness.

### 4.3 Primary terminals

Checking of all connections and torque moments.

## 4.4 Checking of the density monitor

A function check of the density monitor alarm contacts should be done during the routine substation shut down. Guidance for the use of the density monitor test connection can be given on request.

Attention: The disassembly of the density monitor (see Figure 9) for review is not required. In case a replacement of the density monitor should become necessary the connecting nut of the density monitor connection valve is to be loosened (see Figure 8). When refitting the monitor the nut should only be fastened manually or **very carefully and softly with an SW 32 open-end wrench.**

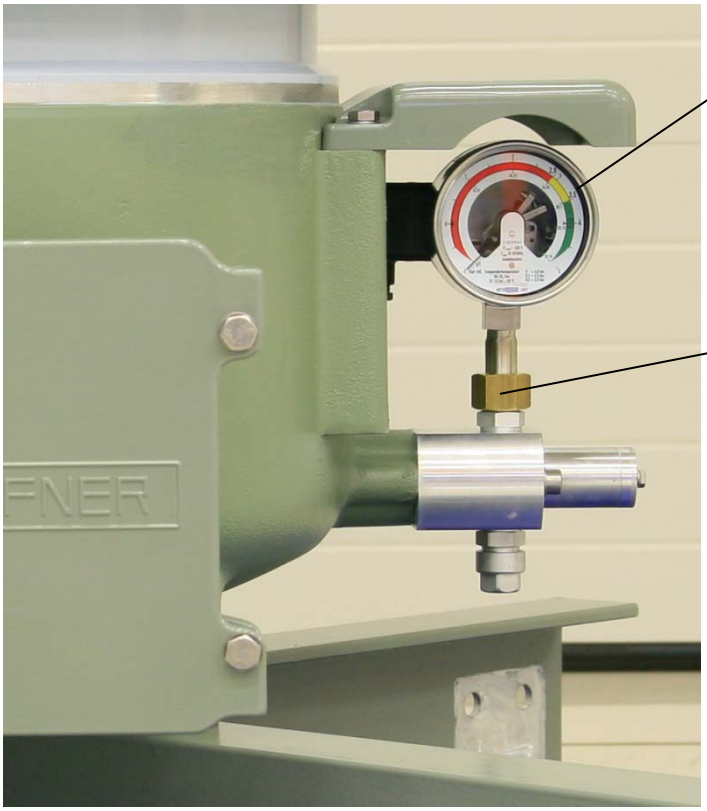



fig 8: Connection of the density monitor

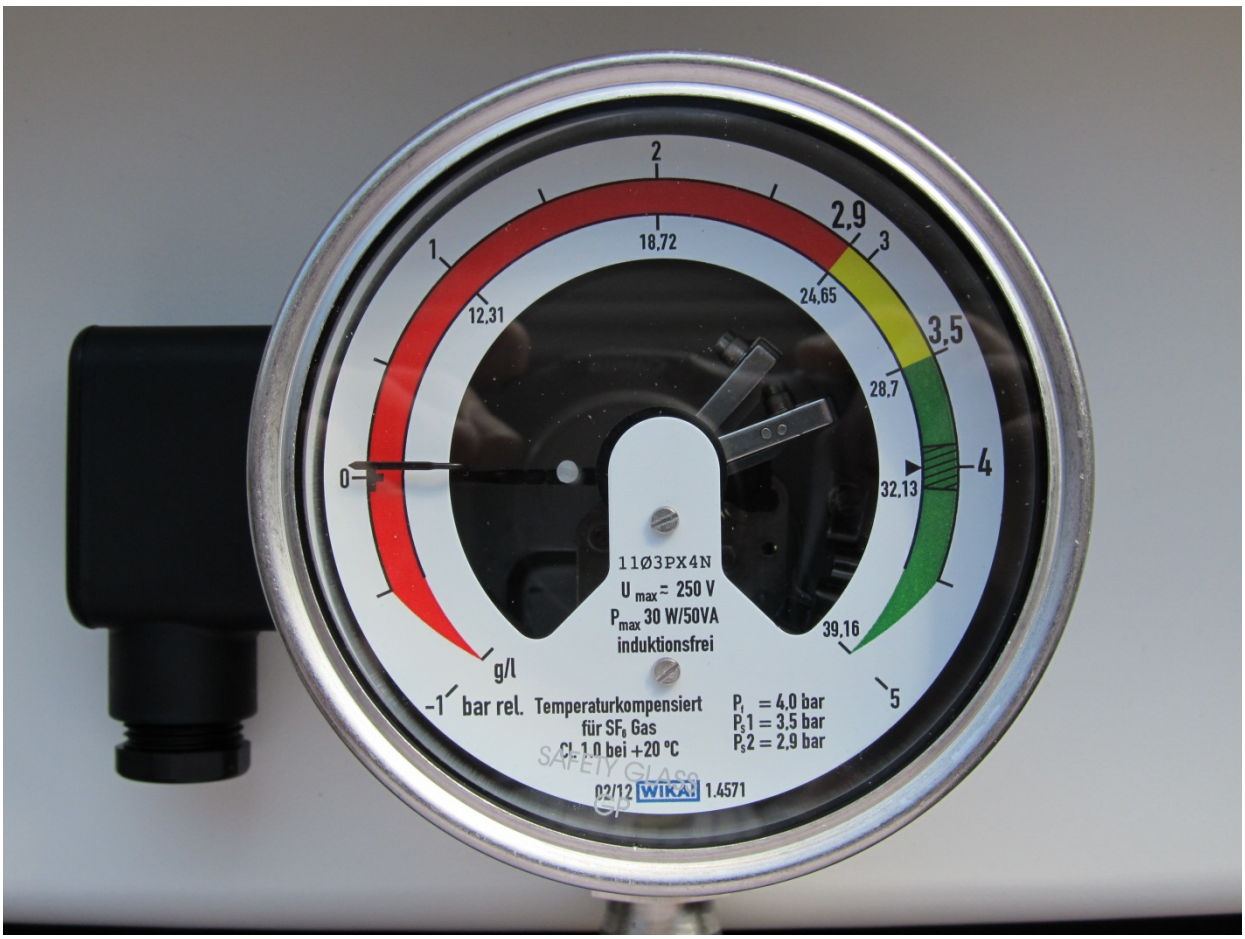


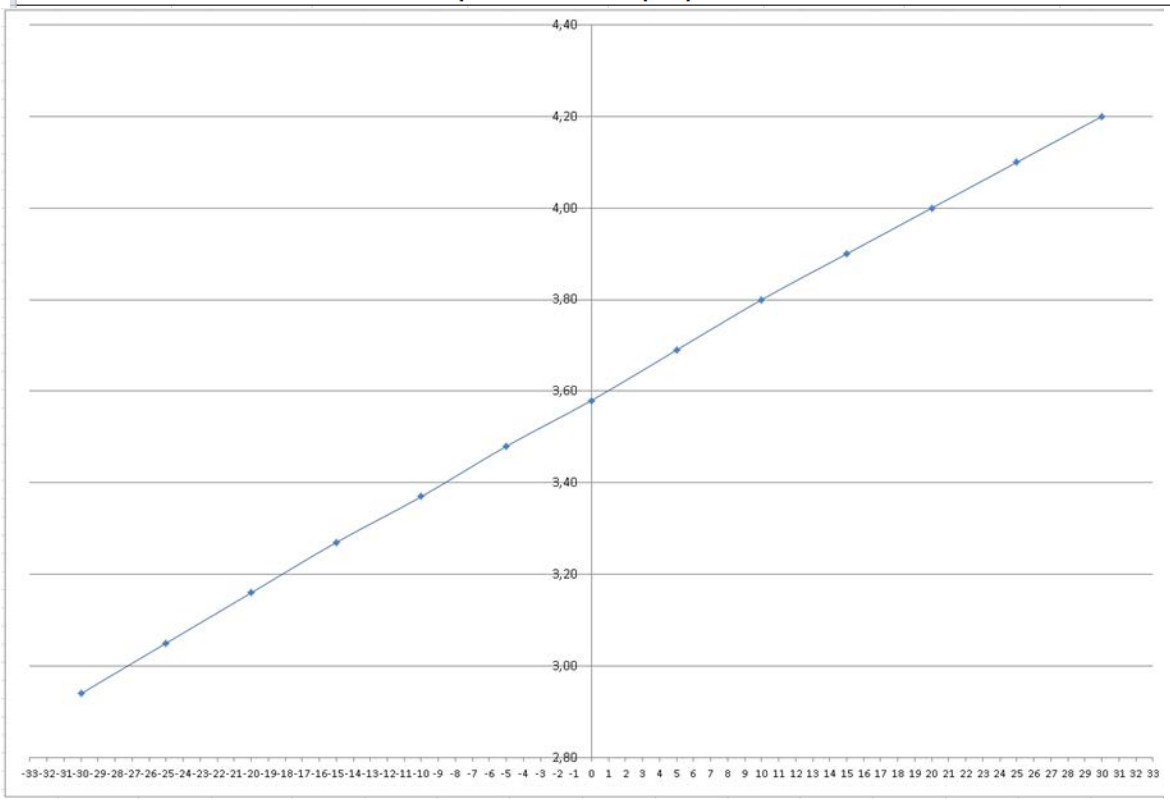

fig 9: Density Monitor

**Filling of the transformer:**
The control of the filling pressure is normally done via the temperature-compensated density monitor.

If the filling is done using gas from the bottle:
Fill up first on only about 80% of the nominal operating pressure = pe = 2.6 bar / 20° C.
After about 4 hours the transformer can be filled to the nominal operating pressure.

Pressure control by using a non-temperature compensated pressure gauge: Refer to the table below and the following diagram.

| Filling Table ( temperature - pressure ) | | | | | | | |
|---|---|---|---|---|---|---|---|
| temperature | pressure | temperature | pressure | temperature | pressure | temperature | pressure |
| -30 | 2,94 | -15 | 3,27 | 1 | 3,6 | 16 | 3,92 |
| -29 | 2,96 | -14 | 3,29 | 2 | 3,63 | 17 | 3,94 |
| -28 | 2,98 | -13 | 3,31 | 3 | 3,65 | 18 | 3,96 |
| -27 | 3 | -12 | 3,33 | 4 | 3,67 | 19 | 3,98 |
| -26 | 3,03 | -11 | 3,35 | 5 | 3,69 | 20 | 4 |
| -25 | 3,05 | -10 | 3,37 | 6 | 3,71 | 21 | 4,02 |
| -24 | 3,07 | -9 | 3,39 | 7 | 3,73 | 22 | 4,04 |
| -23 | 3,09 | -8 | 3,42 | 8 | 3,75 | 23 | 4,06 |
| -22 | 3,11 | -7 | 3,44 | 9 | 3,77 | 24 | 4,08 |
| -21 | 3,14 | -6 | 3,46 | 10 | 3,8 | 25 | 4,1 |
| -20 | 3,16 | -5 | 3,48 | 11 | 3,81 | 26 | 4,12 |
| -19 | 3,18 | -4 | 3,5 | 12 | 3,84 | 27 | 4,14 |
| -18 | 3,2 | -3 | 3,52 | 13 | 3,86 | 28 | 4,16 |
| -17 | 3,22 | -2 | 3,54 | 14 | 3,38 | 29 | 4,18 |
| -16 | 3,24 | -1 | 3,56 | 15 | 3,9 | 30 | 4,2 |
| | | 0 | 3,58 | | | | |
| temperature in °C | | | | | | | |
| pressure relative ( Pe ) in bar | | | | | | | |



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