MODEL INFORMATION
CANNED MOTOR PUMPS TYPE TCN / TCAM

HERMETIC  E-Line
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**GENERAL INFORMATION**

**Information**

**Operational areas / applications**
For the safe transport of aggressive, toxic, hot, explosive, valuable and flammable liquids and liquefied gases.

Application sectors are tank farms, terminals chemical and off-shore plants, gas accumulators, and industrial plants. In addition to the optimum design for TCN and TCAM pumps there are various mounting options.

**Model / design TCN**
Horizontal, sealless spiral housing pumps in process design with completely closed canned motor with radial impeller, single-stage, single-flow. The connection measurements of the housing comply with EN 22 858 / ISO 2858.

**Model / design TCAM**
Horizontal, sealless section-type pumps with completely closed canned motor, with radial impellers, multi-stage, single-flow.

**Drive**
The rotor lining, one of our core competences, is manufactured using the compact extrusion method and as a nickel-base alloy, it is an essential component of the highly efficient canned motor. The pressure-resistant enclosed version of our canned motor complies with explosion protection according to Directive 2014 / 34 / EU. The canned motor filled with liquid accelerates to the operating speed in seconds. It is wear-free and maintenance-free during continuous operation due to the hydrodynamic sleeve bearings. The canned motor with low noise and vibration and offers double security to prevent leaks.

**Operating data**

<table>
<thead>
<tr>
<th></th>
<th>50 Hz</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output power [P2]:</td>
<td>max. 520 kW</td>
<td>max. 622 kW</td>
</tr>
<tr>
<td>Conveyed material temperature [t]:</td>
<td>–160 °C to +250 °C</td>
<td>–160 °C to +250 °C</td>
</tr>
<tr>
<td>Operating pressure:</td>
<td>16 to 100 bar</td>
<td>16 to 100 bar</td>
</tr>
</tbody>
</table>

(Extended rating scheme available on request)

**Pump and hydraulic denomination**

**TCN 50 – 32 – 200 N34L-2**

- Motor
- Nominal impeller diameter in mm
- Nominal discharge nozzle diameter in mm
- Nominal suction nozzle diameter in mm
- Model series

**TCAM 30 / 5 N34L-2**

- Motor
- Number of stages
- Size
- Model series
**Functional principle**

**TCN**
The partial flow for cooling the motor and lubricating the slide bearings is branched off at the periphery of the impeller and, after having passed through the motor, is carried back again through the hollow shaft to the suction side of the impeller.

**TCNF (liquefied gas design)**
The partial flow for cooling the motor and lubricating the slide bearings will be branched off at the periphery of the impeller and, after having passed through the motor sealing cover, is carried back again to the pressure line via a connecting line. An auxiliary impeller serves to overcome the hydraulic losses encountered along the way. The connection line serves at the same time to vent the pump and motor.
**FUNCTION**

**Functional principle**

**TCAM**
The flow rate is delivered through the impellers and diffusers arranged one behind the other to the pressure nozzles and in this way an increase in pressure is achieved depending on the number of stages. The partial flow for cooling the motor and lubrication the slide bearings is tapped off on pressure side after the last impeller and after flowing through the motor it is lead out again through the hollow shaft between the stages.

**TCAMF (liquefied gas design)**
The flow rate is delivered through the impellers and diffusers arranged one behind the other to the pressure nozzles and in this way an increase in pressure is achieved depending on the number of stages. The partial flow for cooling the motor and lubrication the slide bearings is tapped off at the periphery of the impeller and after flowing through the motor it flows back to the motor cover via a connection line to the pressure line. At the same time, the connection line serves to vent the pump and motor.
Bearings

The hermetically sealed design requires the arrangement of the bearings within the pumped liquid. Therefore, only hydrodynamic slide bearings are used in most cases. During normal operation slide bearings have the advantage that there is no contact between the sliding surfaces of the bearing. In continuous operation, they are wear- and maintenance-free. Service life of 8 to 10 years can be easily achieved by using hermetically sealed pumps.

The almost universal bearing combination materials based on tungsten carbide (W5) and silicon carbide (SiC30) have proven to be the best choice. These combinations consist of a metallic shaft sleeve made of stainless steel (1.4571) coated with tungsten carbide by means of a “High Velocity Oxygen Fuel” process and a fixed bearing bushing made of ceramic material (SiC30) that is surrounded by a sleeve made of stainless steel. SiC30 is a mixed material of silicon carbide and graphite, combining the product advantages of both materials. Conditions of mixed friction, as they may arise for example during start-up and stopping of the pump, can be easily handled with SiC30. Moreover, this material is thermal shock resistant (high resistance against changes in temperature), as well as chemically inert, blister resistant (no formation of bubbles at material surface) and abrasion resistant.
Installation vessel pump

The HERMETIC canned motor submersible pump provides the optimum solution for difficult installations. Essentially there are two different installations in the tank and in the vessel:

a) direct placing in the tank (figure 1)
b) installation of the pump with the opportunity to separate the pump from the liquid in the vessel (figure 2)

Installation vessel pump

The direct placing of the submersible pump in the tank is recommended for small container volumes, e.g. for NPSHA improvement in vessel loading/unloading stations.
Installation pump with the opportunity to separate the pump from the liquid in the vessel

If it is necessary that the submersible pump with a filled tank is removed and reinstalled during a revision, the installation when the pump is separate from the liquid has proved to be the best optimum solution.

In this system, there is a shut-off valve close to the tank bottom, which can be operated with a gear or with a pressure medium run system.

The delivery medium can be pushed back into the tank by inertisation. After closing of the valve and releasing the pressure the submersible pump can be removed or installed without emptying the vessel.

Figure 2
CHARACTERISTIC MAPS

TCN / 2900 rpm 50 Hz

Denomination of hydraulics shown in the characteristics maps

1 25-160 7 40-160 13 50-250 19 80-200
2 25-200 8 40-200 14 50-315 20 80-250
3 32-125 9 40-250 15 65-160 21 80-315
4 32-160 10 40-315 16 65-200 22 100-200
5 32-200 11 50-160 17 65-250 23 100-250
6 32-250 12 50-200 18 65-315 24 100-315
CHARACTERISTIC MAPS

TCN / 1450 rpm 50 Hz

Denomination of hydraulics shown in the characteristics maps

1 25-160 8 40-200 15 65-160 22 100-200 29 150-250 36 200-500
2 25-200 9 40-250 16 65-200 23 100-250 30 150-315 37 250-315
3 32-125 10 40-315 17 65-250 24 100-315 31 150-400 38 250-400
4 32-160 11 50-160 18 65-315 25 100-400 32 150-500 39 250-500
5 32-200 12 50-200 19 80-200 26 125-250 33 200-250 40 300-400
6 32-250 13 50-250 20 80-250 27 125-315 34 200-315 41 300-500
7 40-160 14 50-315 21 80-315 28 125-400 35 200-400
Denomination of hydraulics shown in the characteristics maps

1 25-160  
2 25-200  
3 32-125  
4 32-160  
5 32-200  
6 32-250  
7 40-160  
8 40-200  
9 40-250  
10 40-315  
11 50-160  
12 50-200  
13 50-250  
14 50-315  
15 65-160  
16 65-200  
17 65-250  
18 65-315  
19 80-200  
20 80-250  
21 80-315  
22 100-200  
23 100-250  
24 100-315
CHARACTERISTIC MAPS

TCN / 1750 rpm 60 Hz

Denomination of hydraulics shown in the characteristics maps

1 25-160  8 40-200  15 65-160  22 100-200  29 150-250  36 200-500
2 25-200  9 40-250  16 65-200  23 100-250  30 150-315  37 250-315
3 32-125 10 40-315  17 65-250  24 100-315  31 150-400  38 250-400
4 32-160 11 50-160  18 65-315  25 100-400  32 150-500  39 250-500
5 32-200 12 50-200  19 80-200  26 125-250  33 200-250  40 300-400
6 32-250 13 50-250  20 80-250  27 125-315  34 200-315  41 300-500
7 40-160 14 50-315  21 80-315  28 125-400  35 200-400
TCAM / 3000 rpm 50 Hz

1. TCAM 1 to TCAM 80 with maximum number of stages
TCAM-Tandem / 3000 rpm 50 Hz

1. TCAM 2 to TCAM 80 with maximum number of stages
TCAM / 3600 rpm 60 Hz

1. TCAM 1 to TCAM 80 with maximum number of stages
TCAM-Tandem / 3600 rpm 60 Hz

1. TCAM 2 to TCAM 80 with maximum number of stages
Advantages of the canned motor pump

Best Available Pump Technology according to IPCC / TA-LUFT

Leakage-free, long-lasting operation: protection of personnel and environment

No shaft seals

Low space requirement

High level of reliability

Low expenditure for repairs / spare parts

Simple assembly and installation

Long service life of pump and motor

Low life cycle costs

Very smooth running
Advantages of hermetically sealed motor-driven submersible pumps

The hydraulic part is arranged above close to the vessel bottom. The pressure line is placed in parallel to the pump drive shaft via manhole door to the outside. The impeller is arranged at the shaft which is fixed by medium-lubricated guide bearings. Depending on the immersion depth several bearings will be required. The following reference value will apply: according to the pump size, one guide bearing per 1.2 m to 1.6 m is required. The bearings are installed in a support pipe that is fixed to the manhole door. The sealing to the atmosphere is effected by using a mechanical seal. The conventional drive motor is installed outside the vessel and can be used for every protection type according to the explosion requirements.

The basic and outer construction of a conventional pump with mechanical seal can be compared with the design of a submersible pump with magnetic drive. The difference of sealing to the atmosphere is the containment shell of the magnetic coupling that is directly installed to the pump component. The containment shell ensures an absolute leakage-free pump operation and can also be installed on the outside of the vessel.

Because of that, the drive shaft of this construction type is not medium-lubricated but operates in a dry place. The bearings used are prelubricated roller bearings which are placed in a support tube under dry conditions. The cable passage at the manhole door is sealed by a mechanical seal. According to the depth of assembly several bearings need to be installed here as well. Conventional electric motors can also be used here as a drive. When installing canned motor pumps the drive shaft having a length according the immersion depth is no longer needed. The rotating parts of the pump shaft are placed in the canned motor pump and are therefore extremely short. The pump is fixed to a support pipe which is arranged at the manhole door. The single task of the support pipe is to carry the pump and to lead the cables to the outside. Medium-lubricated guide bearings or prelubricated roller bearings are not necessary since the usually used long drive shaft is not required for operational reasons. Therefore, in case of vertical submersible pumps with canned motor, the length of the drive shaft is irrespective of the immersion depth.

This figure clearly shows the proportion of the rotating shafting depending on the construction and same immersion depth.

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## Technical specification

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<th>TCAM</th>
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</thead>
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<td><strong>Function / Design</strong></td>
<td>single-stage, in vertical or horizontal design</td>
<td>multistage, in vertical or horizontal design</td>
</tr>
<tr>
<td><strong>Pump capacity</strong></td>
<td>max. 1800 m³/h</td>
<td>max. 850 m³/h</td>
</tr>
<tr>
<td><strong>Pumping head</strong></td>
<td>max. 220 m</td>
<td>max. 2000 m</td>
</tr>
<tr>
<td><strong>Viscosity</strong></td>
<td>max. 300 mm²/s</td>
<td>max. 300 mm²/s</td>
</tr>
<tr>
<td><strong>Operating pressure</strong></td>
<td>PN 16 to PN 100</td>
<td>PN 16 to PN 100</td>
</tr>
<tr>
<td><strong>Materials (casing)</strong></td>
<td>Nodular cast iron (JS 1025)</td>
<td>Nodular cast iron (JS 1025)</td>
</tr>
<tr>
<td></td>
<td>Cast steel (1.0619+N)</td>
<td>Cast steel (1.0619+N / 1.0460 / 1.0570)</td>
</tr>
<tr>
<td></td>
<td>Stainless steel (1.4408)</td>
<td>Stainless steel (1.4571 / 1.4581)</td>
</tr>
<tr>
<td></td>
<td>(special materials / higher pressure ratings are possible on demand)</td>
<td>(special materials / higher pressure ratings are possible on demand)</td>
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</tbody>
</table>
**Canned motors**

**Canned motor data**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>Output power P2:</td>
<td>max. 520 kW (50 Hz) / max. 622 kW (60 Hz)</td>
</tr>
<tr>
<td>Voltage (±10%) / frequency / circuit:</td>
<td>400V / 50 Hz / delta</td>
</tr>
<tr>
<td></td>
<td>480V / 60 Hz / delta</td>
</tr>
<tr>
<td></td>
<td>500V / 50 Hz / delta</td>
</tr>
<tr>
<td></td>
<td>600V / 60 Hz / delta</td>
</tr>
<tr>
<td></td>
<td>690V / 50 Hz / star</td>
</tr>
<tr>
<td></td>
<td>(all canned motors are suitable for inverter operation)</td>
</tr>
<tr>
<td>Insulation class:</td>
<td>H-180 / C-220 / C-400</td>
</tr>
<tr>
<td>Operating mode:</td>
<td>S1 according to EN 60034-1</td>
</tr>
<tr>
<td>Protection class:</td>
<td>IP 68 (stator), IP 65 (terminal box)</td>
</tr>
<tr>
<td>Motor protection in winding:</td>
<td>Thermistor KL180 (for H-180 winding), Thermistor KL210 (for C-220 winding), alternative PT100 Thermometer (for all windings) / PT100 for C-400 winding (inclusive)</td>
</tr>
<tr>
<td>Rotation monitoring:</td>
<td>ROMi (from motor size N34 / T34)</td>
</tr>
</tbody>
</table>

Explosion protection according to Directive 2014 / 34 / EU
Incl. EC type-examination certificate
Marking: II 2 G Ex de IIC T1 to T6

**Noise expectancy values [examples of different motor sizes]**

<table>
<thead>
<tr>
<th>Motors</th>
<th>N34L-2</th>
<th>N34XL-2</th>
<th>N54XL-2</th>
<th>N64XL-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output power [P2 at 50 Hz]</td>
<td>8.0 kW</td>
<td>14.8 kW</td>
<td>24.0 kW</td>
<td>41.0 kW</td>
</tr>
<tr>
<td>max. expected sound pressure level dB(A) at 50 Hz</td>
<td>57</td>
<td>59</td>
<td>61</td>
<td>64</td>
</tr>
<tr>
<td>Output power [P2 at 60 Hz]</td>
<td>10.5 kW</td>
<td>17.2 kW</td>
<td>27.0 kW</td>
<td>48.0 kW</td>
</tr>
<tr>
<td>max. expected sound pressure level dB(A) at 60 Hz</td>
<td>58</td>
<td>60</td>
<td>62</td>
<td>64</td>
</tr>
</tbody>
</table>
## Documentation and tests

### Documentation according to HERMETIC Standard, consisting of:

- Operating manual for the HERMETIC pump
- Technical specifications
- Sectional drawings with position numbers
- Dimensional drawing
- Cable connection diagram
- Acceptance report and pump characteristic curve
- Electric test report
- Slip ring report / gap size report, slide bearing clearances
- EC type-examination certificate PTB 99 ATEX
- EU Declaration of Conformity

### Standard tests

- Hydrostatic pressure test with 1.5x nominal pressure
- Test run according to DIN EN ISO9906, Class 2 B (5 measuring points)
- Balancing of the shaft and impeller according to DIN ISO 1940, 6.3 [without report]
- Axial thrust measurement
- Leak test for the complete pump with $N_2$ at 6 bar

### Additional testing possible on request, e.g.:

- NPSH-test / Helium leakage test / vibration test
- Ultrasonic test / PMI-test
Overview of the safety- and function-related monitoring equipment

Hermetically sealed centrifugal pumps are principally manufactured for use in potentially explosive atmospheres. For this reason the pumps comply with electrical as well as non-electrical explosion protection requirements.

Level monitoring of the pumped liquid for detecting and avoiding dry run

The pump’s interior and rotor chamber must be always filled with the pumped liquid for reasons of safety. HERMETIC provides suitable level monitoring equipment for each pump complying with the explosion protection requirements according to directive 2014 / 34 / EU. Level monitoring can be recommended principally for application cases which do not mandatory comply with explosion protection requirements. Level monitoring prevents the pump from running dry and to be affected by major damages such as by destruction of the slide bearings or by exceeding inadmissible high temperatures caused by missing cooling and lubricating flow. In addition the pump can be prevented from cavitation damages by means of level monitoring equipment which are caused by evaporation of boiling liquids in the suction pipe.

Temperature monitoring for detecting and avoiding inadmissible high temperatures in the pump and the motor

Temperature monitoring ensures that the pump is switched off when achieving inadmissible high temperatures. HERMETIC provides suitable temperature monitoring equipment for each pump complying with explosion protection requirements according to directive 2014 / 34 / EU. Monitoring of the liquid temperature allows a reliable control to ensure the operation of the pump within the admissible range and to ensure the internal motor cooling of a canned motor pump. For liquids with a pour point that is higher than the ambient temperature, the liquid temperature monitoring can also be used to prevent the start-up of the pump as long as the maximum admissible viscosity of the liquid is reached.

In order to protect canned motors against inadmissible high temperatures, the winding is equipped either with PTC thermistors or PT100 resistance thermometers.

Rotor position monitoring for detecting and avoiding axial wear

Axial thrust balancing is mainly influenced by the operating method of the pump, plant conditions and various physical properties of the pumped liquid. For an early detection of an imminent malfunction it is recommended to install a rotor position monitoring device. This electronic protection equipment monitors the axial shaft position of the rotor during operation in a hermetically sealed and contact-free way. Combined with the level and temperature monitoring an efficient detection of imminent failures is possible.

Rotation monitoring for detecting and avoiding incorrect phase sequence

The correct rotating direction of hermetically sealed centrifugal pumps with canned motor cannot be checked visually from the outside. Due to a wrong phase sequence in the power line the pump is operated with an incorrect rotating direction without being noticed what might result in considerable damages to the pump. By default, hermetically sealed centrifugal pumps with canned motor are equipped with an electronic rotation monitor in the form of a phase sequence relay.
Overview of the safety- and function-related monitoring equipment

Level monitoring of the pumped liquid for detecting and avoiding dry running

- **Level monitoring by / with:**
  - KSR magnetic float switch [LS]
  - Vibration limit switch [LS]
  - Optoelectronic liquid level limit transducer [LS]

Temperature monitoring for detecting and avoiding inadmissible high temperatures in the pump and the motor

- **Temperature monitoring by / with:**
  - Resistance thermometer PT100 [TI]
  - Thermistor [TS]

Rotor position monitoring for detecting and avoiding axial wear

- **Rotor position monitoring by / with:**
  - MAP [GI]

Rotation monitoring for detecting and avoiding incorrect phase sequence

- **Rotation monitoring by / with:**
  - ROMi [GS]