

Three Phase Motors with
Flameproof Enclosures (Ex db) up to 10 MW

Schorch has been the technology leader for motors with flameproof enclosures (Ex db) for more than 50 years. Three phase induction motors in TEFC design (IC411) up to 1.200 kW and tube-cooled design (IC511) up to 10.000 kW are produced in the factory in Mönchengladbach, Germany. Motors are certified acc. 2014/35/EU (ATEX directive) and the latest version of IECEx..

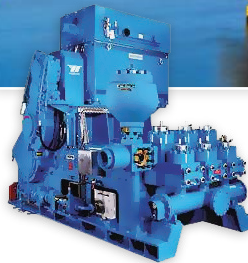
Explosion-proof Schorch motors are mainly used in the chemical and petrochemical industry in hazardous areas. Motors of the protection types 'Flameproof Enclosure', 'Increased Safety', and 'Pressurized Apparatus' are used in Zone 1 installations and motors of protection type 'Non-sparking' in Zone 2.

Ex db motors are designed to contain a possible pressure increase during an internal motor failure in a way that the external explosive atmosphere will not be ignited.

The design is the result of decades of close cooperation with users, consultants, national certification bodies, and leading manufacturers of driven machines. It is thus a well-proven design, subject to continuous development and improvement, tried and tested in a vast number of applications worldwide under the most difficult operating and site conditions.



Mud pump for use on drilling platforms, Ex eb II T3, 1.655 kW, 690 V, 2-pole



Drives for crude oil pumps, Ex db (ec) IIB T4, 1.500 kW, 10 kV, 4-pole

Technical Details

3

Design Features, Marking, and Outputs

Design

To latest version of standards IEC, VDE, DIN, ISO, EN

Degree of protection IP55, possible up to IP65, Cooling methods IC411 (TEFC, rib-cooled) and IC 511 (tube-cooled)

- Type of protection Ex db (eb) IIA, IIB or IIC T3 or T4 Gb in accordance with IEC EN 60079-0, IEC EN 60079-1, IEC EN 60079-7
- Terminal boxes also available in Ex db IIC Gb degree of protection
- Rated voltages from 2 kV to 11 kV
- Rated frequency 50 Hz or 60 Hz
- DOL or VFD operation
- Speed range 200-3.600 RPM
- Construction IM B3 and IM V1 (others on request)
- Flexible designs to meet any customer specification
- Motors can be designed for voltages < 1.000 V or for converter-fed operation

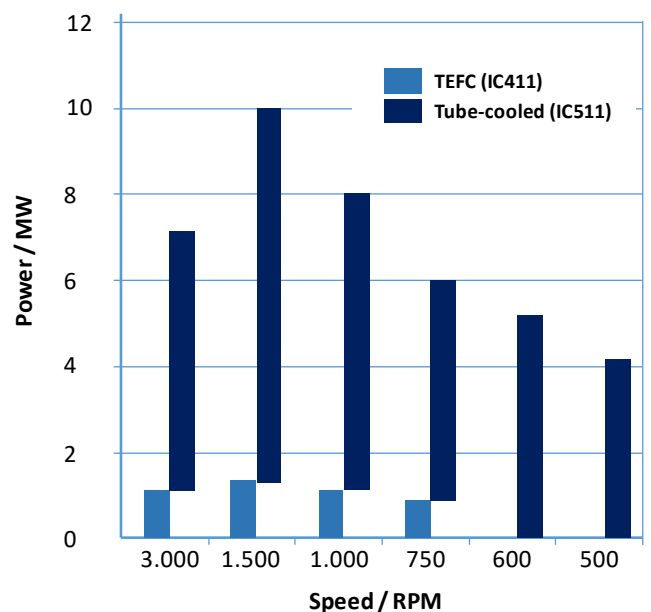


New marking since February 26, 2014

As a result of the certification procedure in accordance with EU Directive 2014/34/EU (ATEX) and the CE marking, the following marking must be used for electrical apparatus:

CE	CE marking
123	Identification number of the notified body
Ex	Marking for explosion protection
II	Equipment group
2	Category (Zone 0, 1, 2)
G	Explosive atmosphere (G, D)
Ex	Explosion-proof
db	Type of protection (p, d, e)
IIB	Explosion Group (A, B, C)
T3	Thermal Class (T3 to T4)
Gb	Equipment Protection Level (EPL)

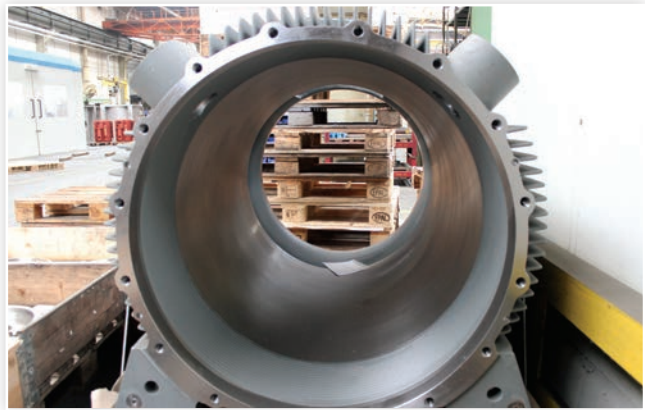
Rated outputs at 6 kV 50 Hz



TEFC design (IC411): Frame and end shields are made of cast iron.

Tube-cooled design: The frame is a compact and rigid fabricated steel design. It consists of two end plates connected by robust axial bars. These bars are welded to each other to form a rigid cage in order to support the outer housing plates. On horizontal machines, motor feet provide additional mechanical strength. Cooling tubes are inserted into the end plates and then expanded.

Both frame designs are torsionally stiff and vibration resistant. They are mechanically reinforced in accordance with the relevant rules for explosion-proof machines.



Schorch's paint systems are permanently optimized to improve the durability and to reflect changing environmental legislation. They do not contain any lead, heavy metals, or silicone.

Prior to painting - either by flooding or spraying - all surfaces are thoroughly sandblasted.

The standard paint system consists of a coat of primer, an intermediate and a finishing coat. Standard color is RAL 7031. Other colors are available upon request.

The paint systems are suitable for both indoor and outdoor installation, including industrial and sea atmospheres. It is resistant to light and to temperatures from -55°C to $+120^{\circ}\text{C}$. It is non-porous, elastic, and resistant to shock and wear.

For specific operating and site conditions, Schorch offers special paint systems upon request.

Anti-friction Bearings

The type of bearings to be used is determined by the explosion group, the construction (IM B3 or V1), the speed, the output, and any additional loads of the motor. Depending on these parameters or the customer's specification, anti-friction or sleeve bearings are provided.

For particularly high radial loads, motors can be provided with an additional cylindrical roller bearing at the DE. Shaft seals are maintenance-free and provide protection against the ingress of dirt and water sprays in accordance with degree of protection IP55. Lubricators and grease retaining rings ensure constant proper lubrication of the bearings. Outer bearing covers are provided with a sufficiently large space for spent grease and - where required - a grease drain.

TEFC Design

Standard IM B3 motors are equipped with a locating ball bearing at the DE and with a floating cylindrical roller bearing at the NDE.

On the motor side of the bearing, a gap seal is provided, and on the outside, a labyrinth ring.

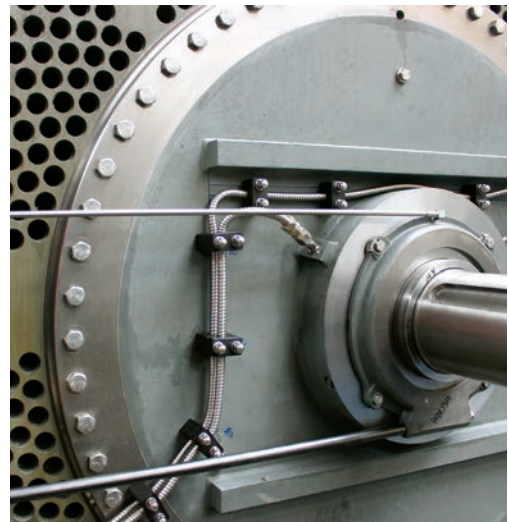
Tube-cooled design

Standard IM B3 motors are equipped with a locating ball bearing at the DE and with a floating cylindrical roller bearing at the NDE.

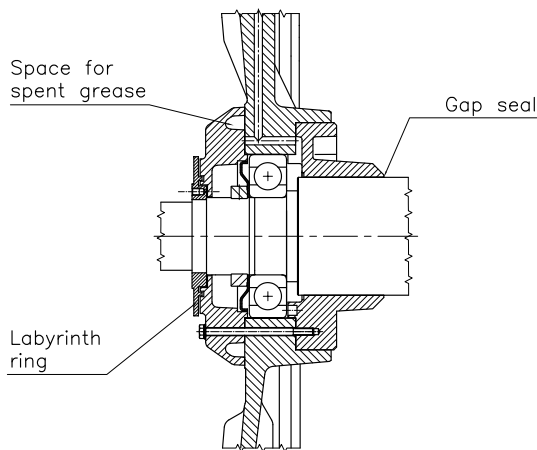
A labyrinth is as a shaft sealing at the motor side of the bearing and a V-ring is used for the external sealing.



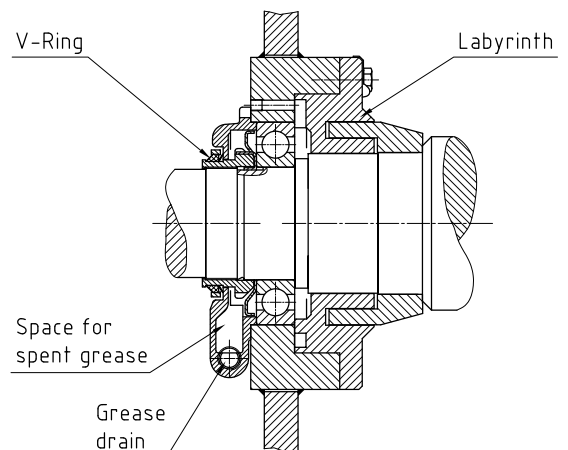
Anti-friction bearing with lubricator



Anti-friction bearing with lubricator and grease drain



Anti-friction bearing arrangement



Anti-friction bearing arrangement

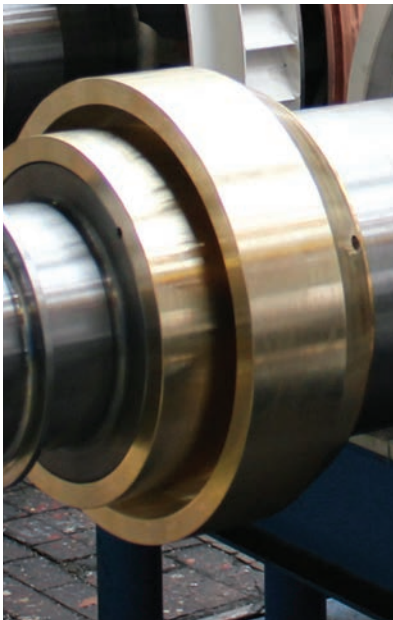
Sleeve Bearings

Tube-cooled motors can be supplied with sleeve bearings upon request. These are of the split, flange type.

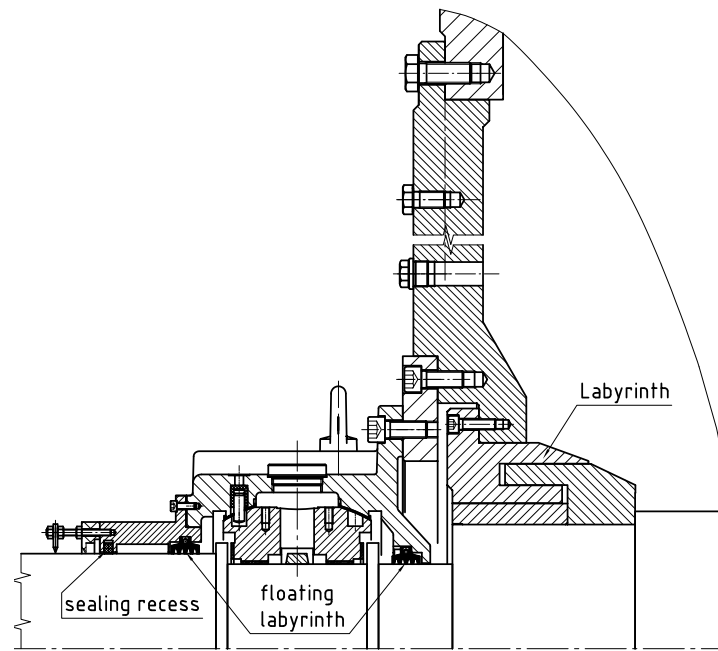
Depending on the bearing load in service, self-lubricated bearings or forced lubricated are supplied. On site conversion from self to forced lubrication is possible.

Sleeve bearings are non-locating with an axial float of max. ± 3 mm. On request, a locating bearing can be provided at the DE. The internal bearing sealing is achieved by a floating labyrinth seal and a stationary labyrinth. The external sealing consists of a floating labyrinth seal and an additional sealing ring.

Shaft seals are maintenance-free. They provide reliable protection against the ingress of dust and water up to degree IP55.



Sleeve bearing with ring oiler



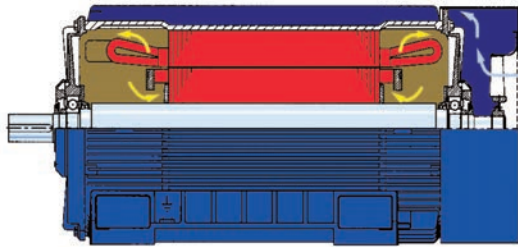
Shaft seals for sleeve bearings

Ventilation System

TEFC design (IC411): The ventilation system is characterized by the shape of the fan, the fan cowl and the arrangement of the cooling ribs.

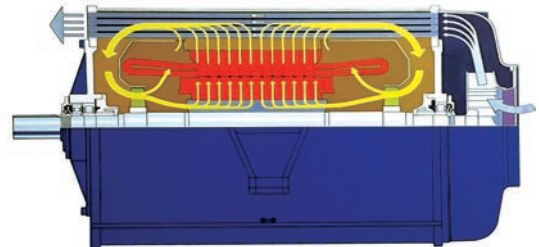
The unidirectional external fan is installed at the NDE.

To enhance the internal airflow, short-circuiting rings have integral fan blades.



Tube-cooled design (IC511): Tubes, concentrically arranged around the active part, act as air/air heat exchangers.

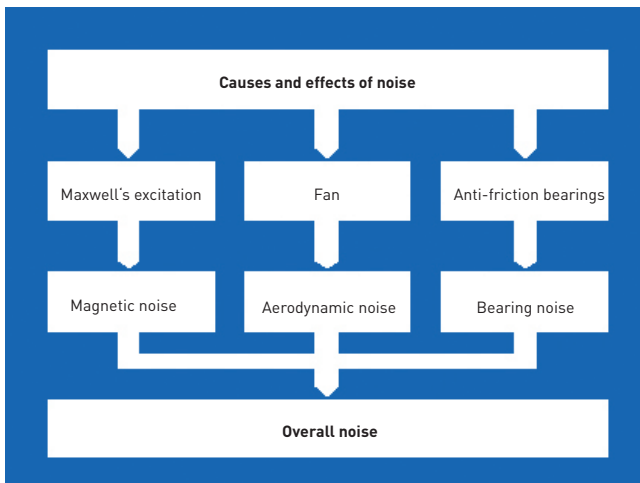
The internal airflow through axial air ducts in the shaft and radial air ducts in the active part ensures a uniform temperature distribution in the motor.



Noise

Due to more stringent regulations concerning the protection of the environment and workplace safety, reducing motor noise is of particular importance.

Schorch motors have already been designed for low noise levels. Please refer to the graphic for the noise sources.



Sources of noise in electrical machines

Noise Reduction

Where extreme noise requirements are specified, various tailor-made solutions are available.

TEFC machines are supplied with noise reduction measures in the housing and the fan cowl.

With tube-cooled machines, depending on the number of poles and the overall machine design, acoustically treated absorbers for air inlet and outlet and/or an acoustically treated frame mantles are used. Combined, these measures can offer noise reductions of up to 12 dB.



Fan cover with noise reduction measures

VPI (Vacuum Pressure Impregnation) is state of the art in winding insulation technology. The well-proven V-Celastik ® insulation has been used in Schorch for many decades. Since its introduction motor damage from winding failure have become rare.

VPI technology applies a two component resin and hardener systems under vacuum to the stator winding. The result is a winding with excellent thermal, electrical and mechanical properties.

The constantly high quality of the high-voltage insulation is ensured by the latest in manufacturing equipment.



Coil-spreading machine



Coil-taping machine

Impulse Withstand Capability

The impulse withstand level of the windings is well above the specified minimum of $4 \times U_N + 5 \text{ kV}$ for DOL operation. Motors used in Power Drive Systems (PDS) with MV inverters can be insulated to higher levels depending on the topology of the inverter.

Mechanical Stability

Windings are designed to meet all mechanical stresses occurring in service. The latest software developed in cooperation with the University of Hannover is used to calculate the stress in the winding.

This calculation is based on the highest stresses to be expected, the reconnection against 100 % residual voltage in phase opposition.

Quality Assurance

The manufacture of windings is, as is the entire company, subject to a certified QA system acc. to DIN EN ISO 9001.

Materials, manufacturing techniques and processes are continually monitored and the results recorded. Additional tests on winding elements, or complete windings, can be carried out on request.

Squirrel Cage Rotor - Robust and Low-Loss

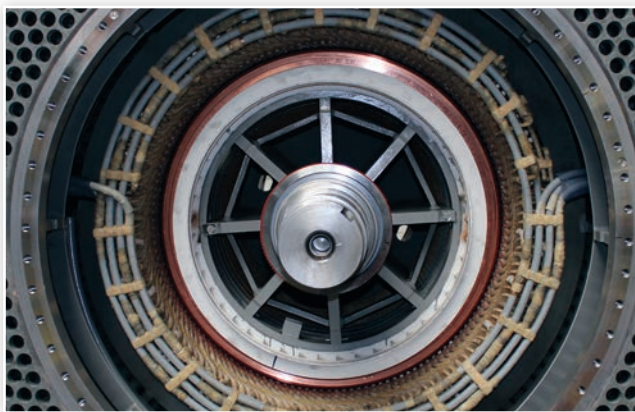
In the basic design, the squirrel-cage winding consists of copper bars brazed to the short-circuiting rings.

Depending on expected rotor stresses, either butt or grooved bar-to-ring joints are used.

The comparatively low resistance of the copper winding leads to low current/heat losses and, consequently, to high efficiencies.

The copper bars are inserted into the rotor slots and are caulked to ensure a tight fit. This prevents any movement of the cage winding relative to the rotor core, and ensures optimum heat transfer, essential for long acceleration or locked-rotor times.

For higher starting torques, or to meet the requirements of particular torque characteristics, special slot designs and materials are used.



Main leads of the stator winding

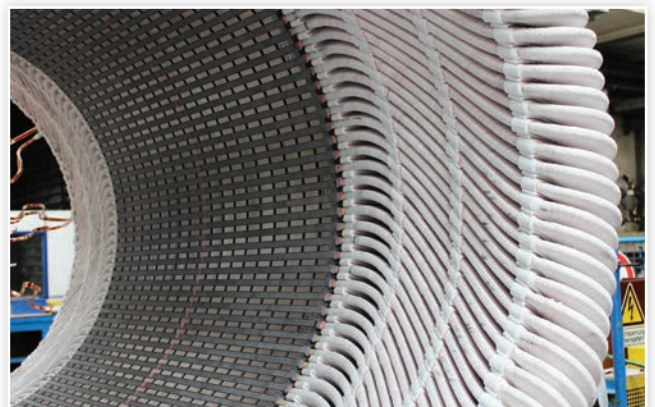


Rotor with copper cage winding

Stator Winding

The stator winding is a corded two-layer winding.

It is connected in a star, with the neutral formed in the winding overhang, or is formed in a separate neutral point terminal box on request. The three phases of the winding are connected in the main terminal box via flameproof cable glands.



Stator winding details

Operator Safety

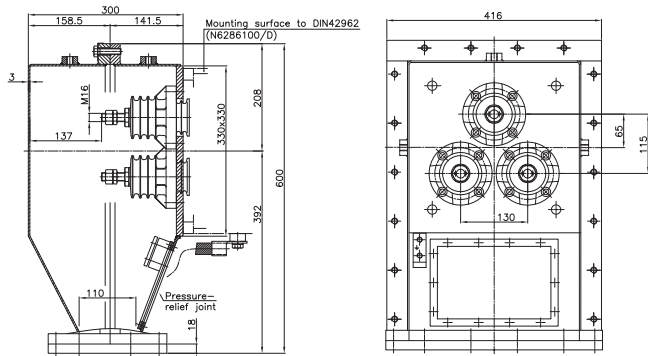
Our terminal boxes have a high short-circuit withstand capability (terminals) with a low risk of damaging the surroundings in case of a failure.

In the unlikely event of a fault, the internal pressure relief plate ruptures towards the motor only, preventing injuries from flying debris. These properties have been verified by an independent test laboratory.

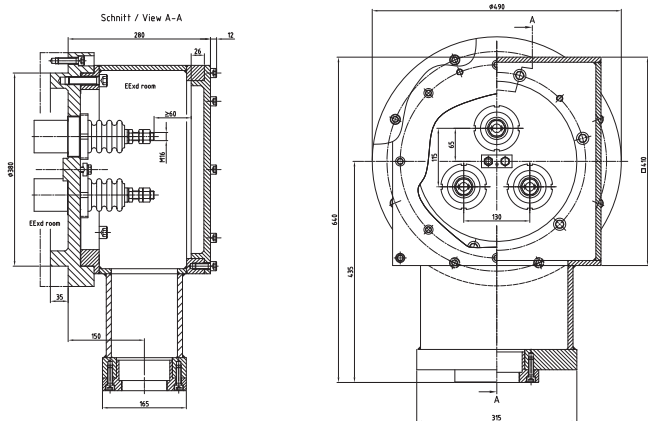
Terminal Boxes, Type of Protection 'Increased safety' Ex eb (Standard)

Ample space in the terminal boxes makes connection of the power supply cables easy and safe. For the connection, either cable lugs (standard) or terminal clamps (special) are provided. Compound filled cable entries are available upon request.

Terminal boxes meet the requirements of degree of protection IP55 to IEC 60529, and are suitable for outdoor installation.



Standard terminal box with 6 kV cast-resin bushings



Minimum Conductor cross-sections

In order to ensure the realization of our safety concept, the following min. conductor cross-sections shall be installed by the operator:

System fault level	Min. Cu conductor cross-section in mm ² at U _N	
	6 kV	10 kV
<200	70	70
>200-250	95	70
>250-350	150	95
>350-500	185	150
>500-1.200	-	185



Standard terminal box

Terminal Boxes, Type of Protection 'Flameproof Enclosure' Ex db IIC

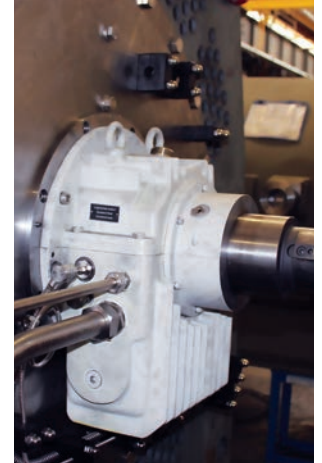
Ex db terminal boxes can be supplied upon request. They are made of fabricated steel and consist of a bushing plate, the box with cover, and a cable entry plate. Entries can be either cable entries to IEC EN 60079-1 or conduit entries. These terminal boxes are separately tested and certified.

Monitoring Devices

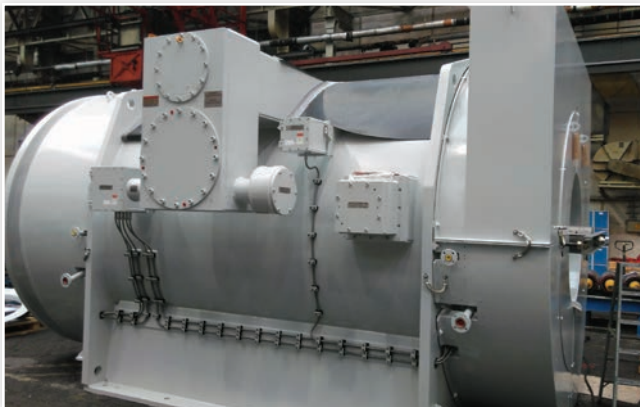
All motors are equipped with PT100 elements for bearing and winding temperature monitoring.

Vibration monitors with velocity sensors for motors with anti-friction bearings or shaft displacement sensors for sleeve bearing machines can be supplied upon request.

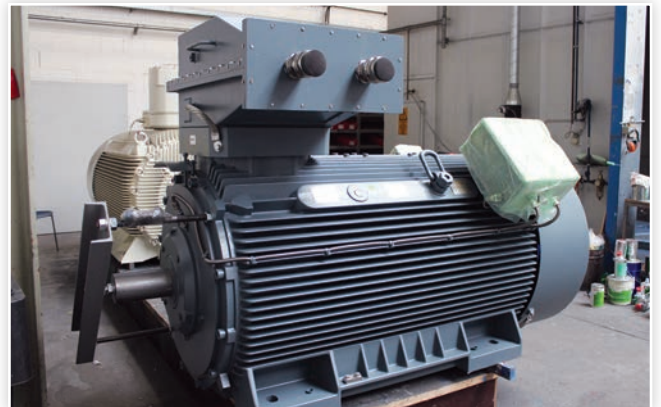
Other monitors such as partial discharge couplers or differential protection can also be provided upon request.



Design Variants



HP compressor drive, Ex db IIB T3, 9.200 kW, 11 kV, 4-pole. Low-noise design with absorber and air outlet silencers.



Drive for screw-type compressor, Ex db (eb) IIC T4, 315 kW, 6 kV, 2-pole



Drive for vertical pipeline oil pump, Ex db (eb) IIC T4 Gb, 600 kW, 3,3 kV, 6-pole; ambient temp. +58°C, bearings with force-feed lubrication.



Drive for pipeline oil pump, Ex db (eb) IIB T4 Gb, 1.350 kW, 6 kV, 2-pole; bearings with force-feed lubrication.

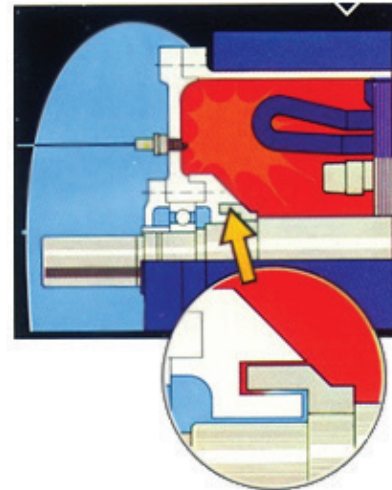
Modern Test Facilities

European (ATEX) and international standards (IECEX) require detailed test procedures for the verification of type of protection 'Flameproof Enclosure'. These tests serve to prove that the motor can withstand an internal explosion and the resulting pressure increase can be contained within the housing. By this an ignition of the surrounding atmosphere and an consequential explosion is prevented by means of adequate sealing.

For these tests, the motor is filled with a gas-air mixture, prescribed for the respective explosion group. This mixture is ignited by an electric spark, explosion pressures are measured, recorded and evaluated by a piezo quartz, an amplifier, and a digital scope.

Schorch is the only European motor manufacturer with an explosion testing facility within their own factory.

Tests are witnessed by a representative of an official testing body.



Ignited gas-air mixture into the motor enclosure

Labyrinth gland prevents ignition of the explosive surrounding atmosphere



Explosion test laboratory



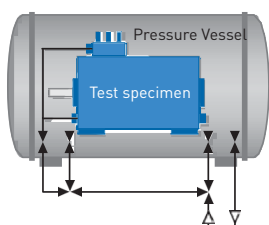
Pressure Vessel



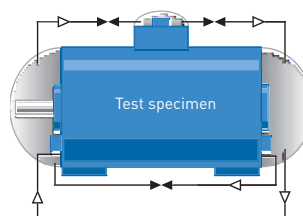
Equipment for mixing and monitoring the gas- air mixture



Evaluation of transient explosion pressures



Explosion test in a pressure vessel for test specimens up to 1,6 m diameter (≤Type 60..)



Explosion test in a polythene shroud for test specimens of more than 1,6 m diameter (>Type 60..)



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