Instruction Manual

COBRA ATEX

Dry Screw Vacuum Pumps

NC 0600 C (water-cooled version)
NC 0630 C (water-cooled version)

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Zone industrielle, 2906 Chevenez
Switzerland

0870201731/-0001_en / Original instructions / Modifications reserved

27/09/2017

Table of Contents

1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.

Read this manual carefully before use and keep for future reference.

This instruction manual remains valid as long as the customer does not change anything on the product.

The machine is intended for industrial use. It must be handled only by technically trained personnel.

Always wear appropriate personal protective equipment in accordance with the local regulations.

The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.

NOTICE

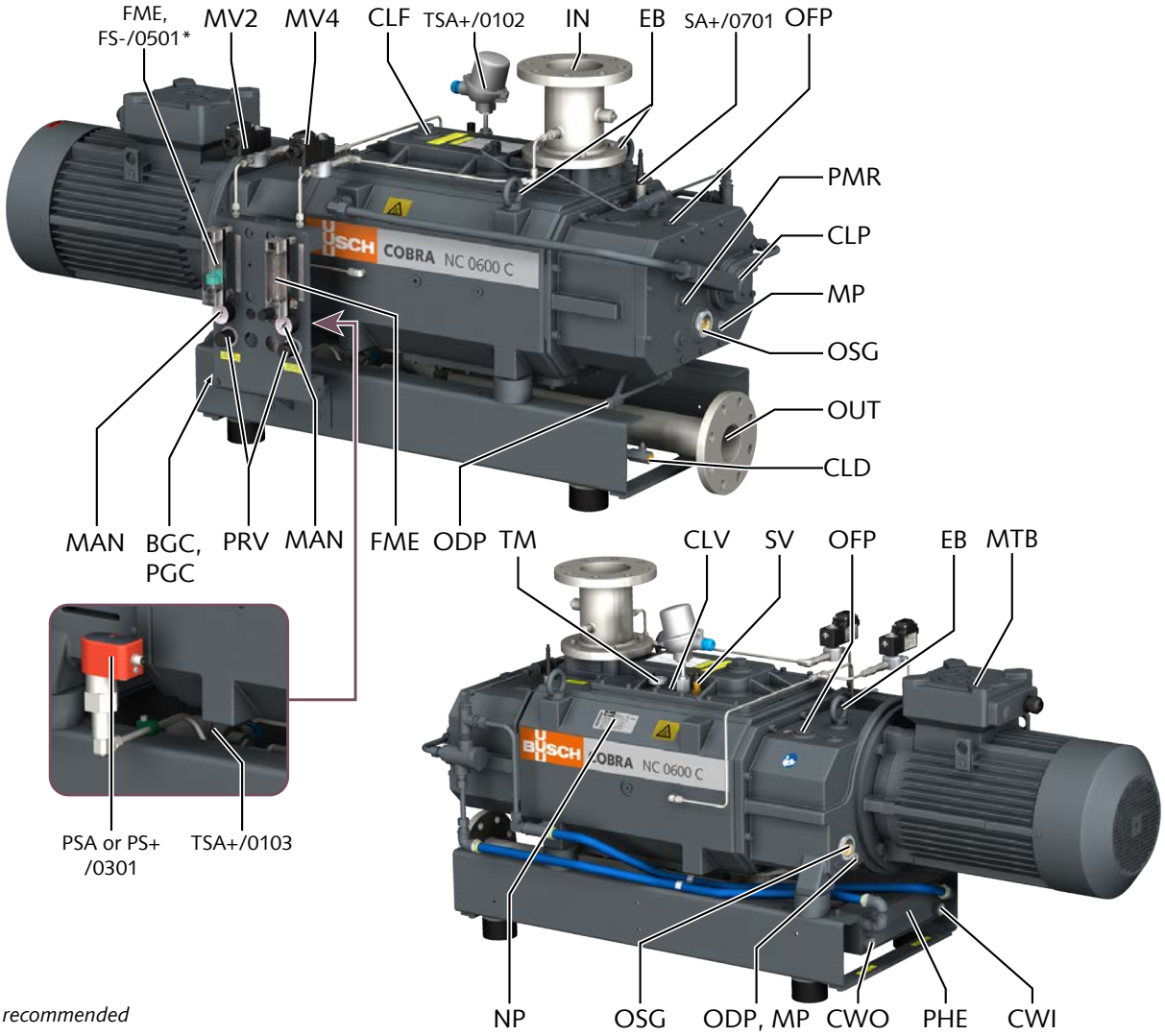
... indicates a potentially dangerous situation that could result in damage to property.

NOTE

... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

2 Product Description

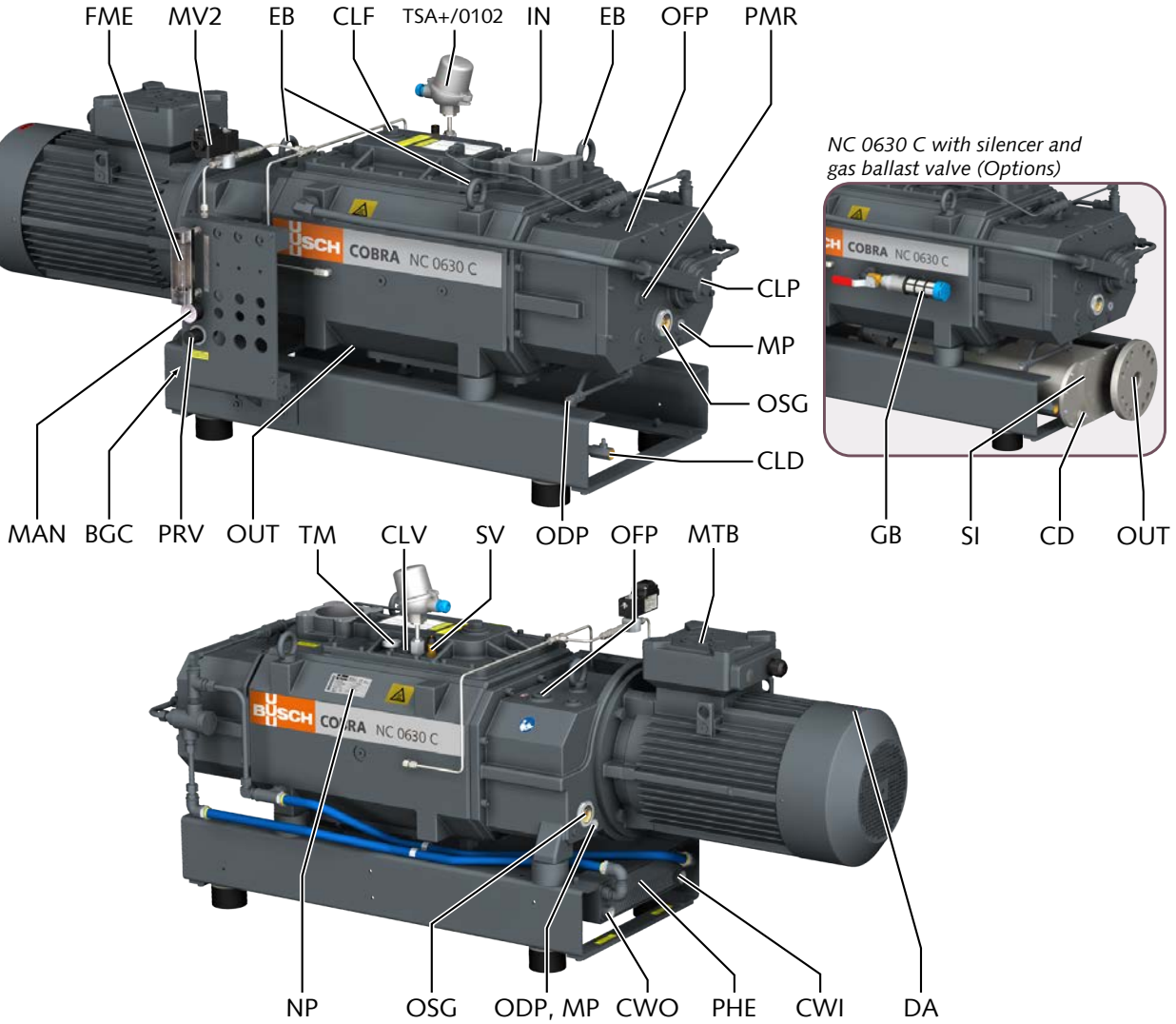
NC 0600 C ATEX 2G(i/o) IIB T3(i/o) (only the obligatory accessories are illustrated)



* *recommended*

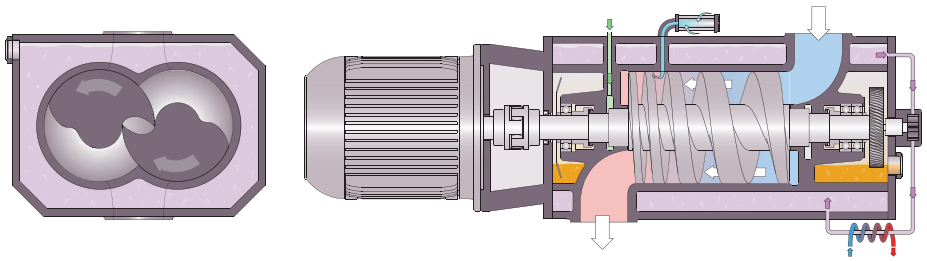
BGC	Barrier gas connection	CD	Condensate drain
CLD	Cooling liquid drain valve	CLF	Cooling liquid fill plug
CLP	Cooling liquid pump	CLV	Cooling liquid vent plug
CWI	Cooling water inlet	CWO	Cooling water outlet
EB	Eye bolt	FME	Flow meter
FS	Flow switch	IN	Suction connection
MAN	Manometer	MP	Magnetic plug
MTB	Motor terminal box	MV	Solenoid valve
NP	Nameplate	ODP	Oil drain plug
OFP	Oil fill plug	OSG	Oil sight glass
OUT	Discharge connection	PGC	Purge gas connection
PHE	Plate heat exchanger	PMR	Plug for manual rotation of rotors
PRV	Pressure regulating valve	PS/PSA	Pressure switch/transmitter
SA	Vibration transmitter	SV	Safety valve
TM	Thermometer	TSA	Temperature transmitter

NC 0630 C ATEX 3G(i/o) IIB T2(i)/T3(o) (only the obligatory accessories are illustrated)



BGC	Barrier gas connection	CD	Condensate drain
CLD	Cooling liquid drain valve	CLF	Cooling liquid fill plug
CLP	Cooling liquid pump	CLV	Cooling liquid vent plug
CWI	Cooling water inlet	CWO	Cooling water outlet
EB	Eye bolt	FME	Flow meter
GB	Gas ballast valve	IN	Suction connection
MAN	Manometer	MP	Magnetic plug
MTB	Motor terminal box	MV	Solenoid valve
NP	Nameplate	ODP	Oil drain plug
OFP	Oil fill plug	OSG	Oil sight glass
OUT	Discharge connection	PHE	Plate heat exchanger
PMR	Plug for manual rotation of rotors	PRV	Pressure regulating valve
SI	Silencer	SV	Safety valve
TM	Thermometer	TSA	Temperature transmitter

2.1 Operating Principle



The machine works on the one-stage, twin-screw pump principle.

Two screw rotors are rotating inside the cylinder. The pumping medium is trapped between the individual screw coils, compressed and transported to the gas discharge. During the compression process, the two screw rotors do not come into contact with each other nor with the cylinder. There is no need for a lubrication or an operating fluid in the process chamber.

2.2 Application

The machine is intended for the suction of air and other dry, non-aggressive and non-toxic gases.

Explosive gases and vapour mixtures can be drawn in according to the scope of the Directive ATEX 2014/34/EU.

Depending on the equipment, the machine is intended for suction of explosive gases according to the data given on the nameplate of the machine (NP), see Explanation of ATEX Classification [▶ 10].

Conveying of other media leads to an increased thermal and/or mechanical load on the machine and is permissible only after a consultation with Busch.

The machine is intended for the placement in a potentially explosive environment according to the data given on the nameplate of the motor and the nameplate of the machine (NP), see Explanation of ATEX Classification [▶ 10].

In case Busch delivered the machine without motor and coupling, the following must be observed:

- In regards to its explosive atmosphere protection class, the motor and the coupling must have at least the same ATEX classification as the machine for the outside area “Outside (o)”.

The machine is capable of maintaining ultimate pressure.

The machine is suitable for continuous operation.

Permitted environmental conditions see Technical Data [▶ 44].

2.3 Standard Features

2.3.1 Water Cooling

The machine is cooled by a cooling liquid circuit in the cylinder cover and cylinder.

The cooling liquid pump (CLP) allows a recirculating flow in the cooling liquid chamber.

The cooling liquid is cooled by a plate heat exchanger (PHE) which must be connected to the water main.

2.3.2 Thermometer

The thermometer allows a visual display of the cooling liquid temperature.

2.3.3 Sealing Systems

The machine is equipped with labyrinth seals on the motor side and suction side.

Other sealing systems are optionally available, see Mechanical Seals [▶ 9].

Sealing systems prevent the process gas going to the bearings chambers.

Depending on the application, the sealing systems efficiency can be improved with a barrier gas system, see Barrier Gas System [▶ 8].

2.3.4 Barrier Gas System

The barrier gas system allows the supply of compressed air or nitrogen into the motor side shaft seals in order to improve the sealing efficiency.

2.3.5 Nitrogen Panel

The nitrogen panel fitted to the base frame allows the supply of nitrogen to a number of different points on the machine.

Each device consists of a solenoid valve to open or close the gas circuit, a pressure regulator and a flow meter to adjust pressure and volume flow separately.

The following devices are available:

- The barrier gas system for sealing systems on motor side. This device is equipped with an flow switch integrated to the flow meter to switch off the machine if the nitrogen volume flow drops below the minimum set flow value.
- The dilution gas ballast prevents the formation of condensates or dilutes them, depending on the application. The nitrogen is fed into the cylinder.
- The purge gas system fitted at the inlet flange allows to flush the machine after use or during operation. The nitrogen is fed into the inlet flange.

2.4 Accessories

NOTE

Depending on the ATEX classification of the machine, some of the following accessories may be mandatory, see ATEX Classifications and Associated Accessories [▶ 10].

2.4.1 Gas Ballast Valve

The gas ballast valve mixes the process gas with a limited quantity of ambient air to counteract the condensation of vapour inside the machine.

The gas ballast valve has an influence on the ultimate pressure of the machine, see Technical Data [▶ 44].

A ball valve enables to open or close the gas ballast flow.

2.4.2 Silencer

A silencer at the discharge connection (OUT) can be provided to reduce the exhaust gas noise.

2.4.3 Resistance Thermometer

The resistance thermometer monitors the cooling liquid temperature. A second resistance thermometer might be installed to monitor the exhaust gas temperature.

A warning and an alarm signals must be set, see Wiring Diagram Resistance Thermometer [▶ 27].

2.4.4 Pressure Transmitter

The pressure transmitter monitors the gas pressure at the discharge connection (OUT).

A warning and an alarm signals must be set, see Wiring Diagram Pressure Transmitter [▶ 28].

2.4.5 Pressure Switch

The pressure switch monitors the gas pressure at the discharge connection (OUT). It can be installed instead of the pressure transmitter.

The machine must be stopped when the gas reaches a certain pressure, see Wiring Diagram Pressure Switch [▶ 27].

2.4.6 Vibration Analysis System

The vibration analysis system monitors the correct mechanical operation of the machine.

This unit is composed of a vibration sensor (SA) and a transmitter (delivered loose).

The machine must be stopped when the vibration limit value (preset at the factory) is reached, see Wiring Diagram Vibration Sensor [▶ 28].

2.4.7 Mechanical Seals

The sealing systems can be equipped with mechanical seals. The following variants are possible:

- Oil lubricated single mechanical seals on the motor side and labyrinth seals on the suction side.
- Oil lubricated single mechanical seals on the motor side and suction side.

2.4.8 Liquid Flushing Device

The liquid flushing device allows the machine to be flushed with the appropriate liquid according to the process type. The system consists of a solenoid valve which enables to open and close the flushing liquid circuit.

Furthermore, two level switches (LS-/0201 and LS-/0202) monitor the flushing liquid quantity.

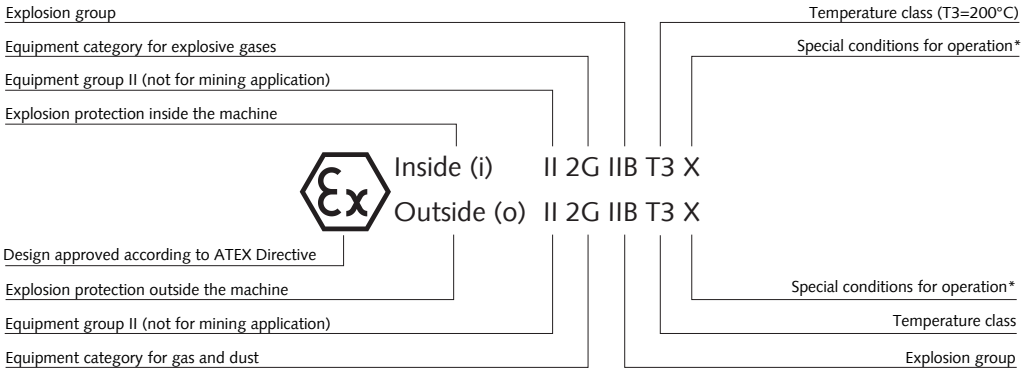
Upper level switch (LS-/0201) ► L_{alarm})	Early warning
Lower level switch (LS-/0202) ► L_{trip})	Trip, the flushing must be stopped

2.4.9 Terminal box

The machine can be optionally equipped with a terminal box. The motor and all electrical devices are already wired to the terminal box.

2.5 Explanation of ATEX Classification

The ATEX classification is written on the nameplate of the machine (NP), see below a marking example:



** The specific operating conditions are determined in this instruction manual.*

2.6 Safety concept

The safety concept is based on the prevention of sparks and excessive temperatures by means of various accessories.

The monitoring accessories must be integrated into the system control such that operation of the machine will be inhibited if the safety limit values are exceeded. The limit values of each accessory are defined in the wiring diagram chapters, see Electrical Connection of the Monitoring Devices [▶ 26].

To have more details about the monitoring procedure, see Flowchart [▶ 30].

2.6.1 ATEX Classifications and Associated Accessories

The following table defines the obligatory accessories depending on the ATEX classification.

	ATEX classification	TSA+ /0102	TSA+ /0103	PSA+/0301 PS+/0301	FS- /0501	SA+ /0701	ATEX MOT IIB	ATEX MOT IIC	ATEX CPL	ECP	MV
A	(i) II 2G IIB T3 X (o) II 2G IIB T3 X	X	X	X	(X)**	X	X		X	X	MV4 (MV2)**
B	(i) II 2G IIB T3 X (o) II 2G IIC T3 X	X	X	X	(X)**	X		X	X	X	MV4 (MV2)**
C	(i) II 3G IIB T2, T3* X (o) II 3G IIB T3 X	X					X		X	X	MV2
D	(i) II 3G IIB T2, T3* X (o) II 3G IIC T3 X	X						X	X	X	MV2

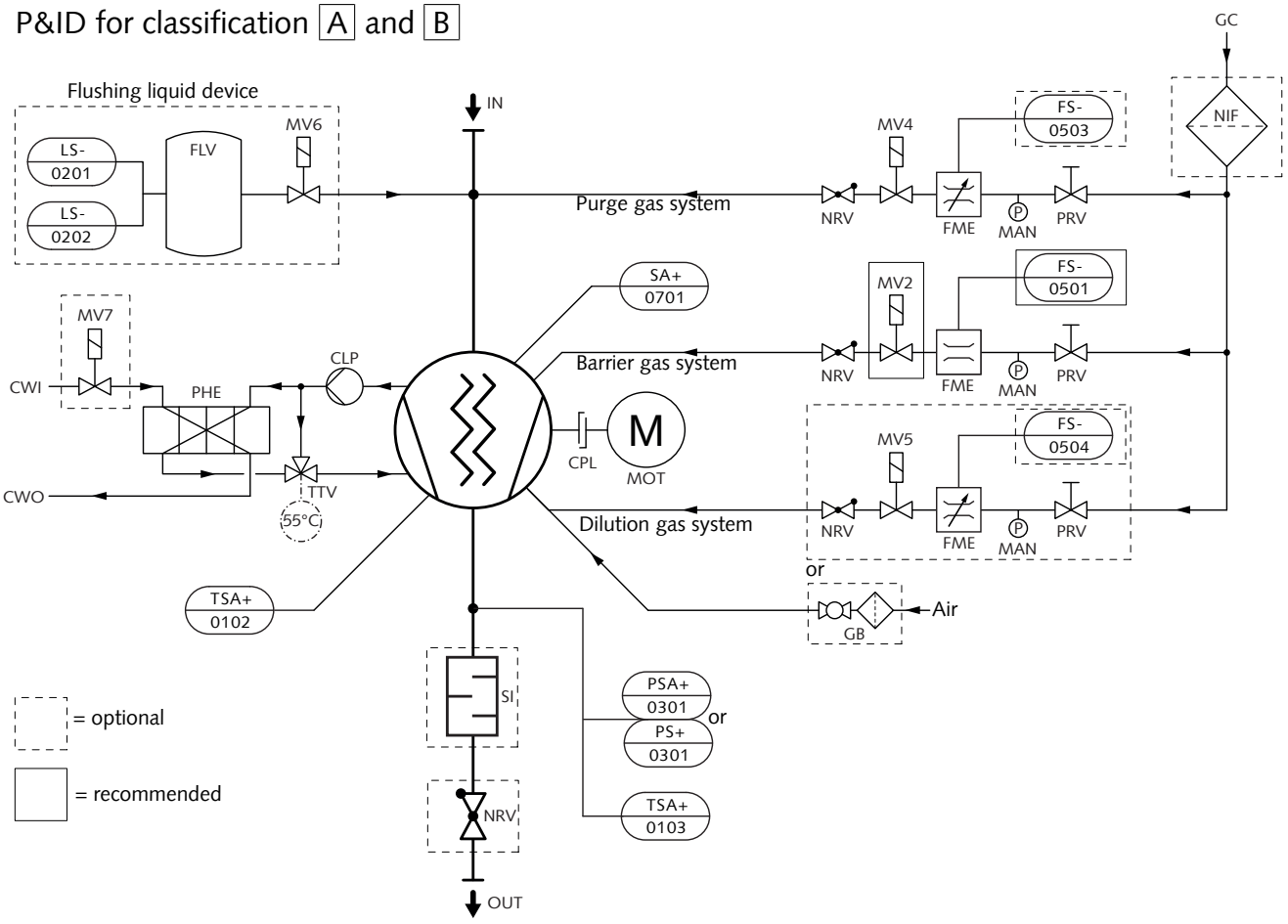
** temperature class: T2 for NC 0630 C and T3 for NC 0600 C*

*** recommended*

CPL	Coupling	ECP	Pump earth connection
FS	Flow switch	MOT	Motor (IIB or IIC)
MV	Solenoid valve	PSA	Pressure transmitter
PS	Pressure switch	SA	Vibration transmitter
TSA	Resistance thermometer		

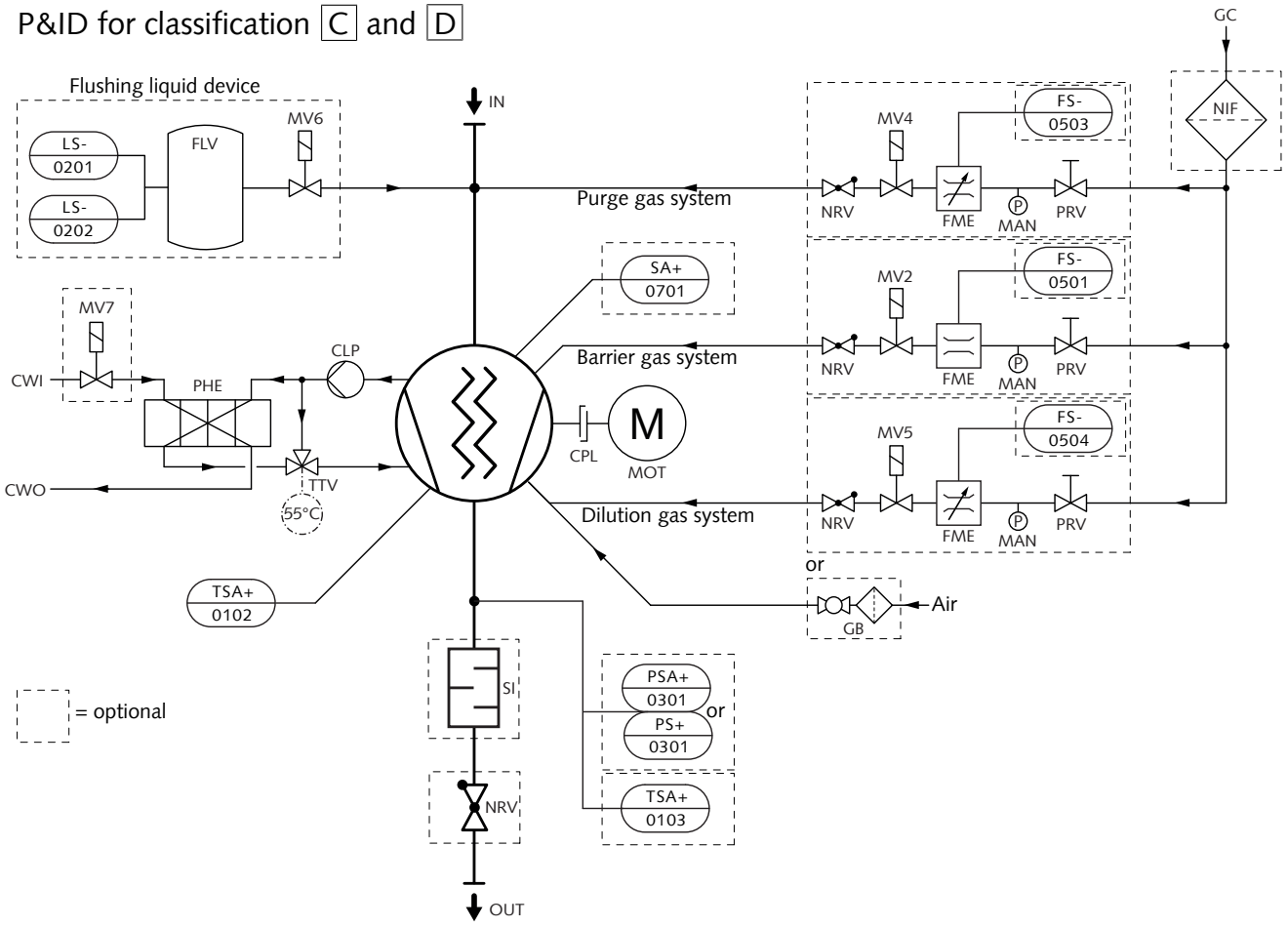
2.6.2 P&ID "Piping and Instrumentation Diagram"

P&ID for classification A and B



CLP	Cooling liquid pump	CPL	Coupling
CWI	Cooling water inlet	CWO	Cooling water outlet
FLV	Flushing liquid vessel	FME	Flow meter
FS	Flow switch	GB	Gas ballast valve
GC	Gas connection	IN	Suction connection
LS	Level switch	MAN	Manometer
MOT	Motor	MV	Solenoid valve
NIF	Nitrogen inlet filter	NRV	Non-return valve
OUT	Discharge connection	PHE	Plate heat exchanger
PSA	Pressure transmitter	PS	Pressure switch
SA	Vibration transmitter	SI	Silencer
TSA	Resistance thermometer	TTV	Three-way thermostatic valve

P&ID for classification C and D



CLP	Cooling liquid pump	CPL	Coupling
CWI	Cooling water inlet	CWO	Cooling water outlet
FLV	Flushing liquid vessel	FME	Flow meter
FS	Flow switch	GB	Gas ballast valve
GC	Gas connection	IN	Suction connection
LS	Level switch	MAN	Manometer
MOT	Motor	MV	Solenoid valve
NIF	Nitrogen inlet filter	NRV	Non-return valve
OUT	Discharge connection	PHE	Plate heat exchanger
PSA	Pressure transmitter	PS	Pressure switch
SA	Vibration transmitter	SI	Silencer
TSA	Resistance thermometer	TTV	Three-way thermostatic valve

3 Transport

WARNING

Suspended load.

Risk of severe injury!

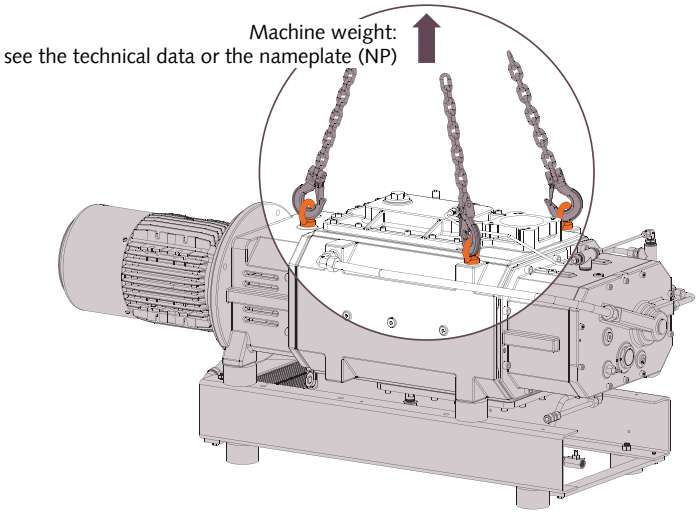
- Do not walk, stand or work under suspended loads.

NOTICE

In case the machine is already filled with oil.

Tilting a machine that is already filled with oil can cause large quantities of oil to ingress into the cylinder.

- Drain the oil prior to every transport or always horizontally transport the machine.



WARNING

Lifting the machine using the motor eye bolt.

Risk of severe injury!

- Do not lift the machine using the eye bolt fitted to the motor. Only lift the machine as previously shown.

- Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

4 Storage

- Seal all apertures with adhesive tape or reuse provided caps.

If the machine is to be stored for more than 3 months:

- Wrap the machine in a corrosion inhibiting film.
- Store the machine indoors, dry, dust free and if possible in original packaging preferably at temperatures between 5 ... 55 °C.

5 Installation

5.1 Installation Conditions

WARNING

The installation conditions are not respected in an ATEX environment.

Risk of severe injury!

Risk of explosion!

- Take care that the installation conditions are fully complied with.

- Make sure that the environment of the machine complies with the ATEX classification of the machine according to the data given on the nameplate of the motor and the nameplate of the machine (NP).
- Make sure that the ambient conditions comply with the Technical Data [▶ 44].
- Make sure that the environmental conditions comply with the protection class of the motor.
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that cooling air inlets and outlets of the motor fan are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that the oil sight glass (OSG) remains easily visible.
- Make sure that enough space remains for maintenance work.
- Make sure that the machine is placed or mounted horizontally, a maximum of 1° in any direction.
- Check the oil level, see Oil Level Inspection [▶ 34].
- Check the cooling liquid level, fill up if necessary, see Filling Cooling Liquid [▶ 22].
- Make sure that the cooling water complies with the requirements, see Cooling Water Connection [▶ 16].

If the machine is installed at an altitude greater than 1000 meters above sea level:

- Contact your Busch representative, the motor should be derated or the ambient temperature limited.

If additional electrical components not included in scope of delivery should be added:

- Make sure that they have a better or equal ATEX classification than that of the machine, see the ATEX marking on the nameplate (NP).

5.2 Connecting Lines / Pipes

- Make sure that the connection lines cause no stress on the machine‘s connection; if necessary use flexible joints.
- Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of very long connection lines it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

WARNING

The connection lines can be built up by electrostatic charge.

Risk of severe injury!

Risk of explosion!

- The connection lines must be made out of conductive material or provisions must be made against creating an electrostatic charge.

5.2.1 Suction Connection

WARNING

Unprotected suction connection.

Risk of severe injury!

- Do not put hand or fingers in the suction connection.

NOTICE

Intruding foreign objects or liquids.

Risk of damage to the machine!

If the inlet gas contains dust or other foreign solid particles:

- Install a suitable filter (5 micron or less) upstream from the machine.

Connection size:

– DN100 ISO-K, DIN 28404

If a purge gas system or a liquid flushing device being installed:

– DN100 PN16, EN 1092-1

If the machine is used as part of a vacuum system:

- Busch recommends the installation of an isolation valve in order to prevent the machine from turning backwards.

5.2.2 Discharge Connection

Connection size:

At the machine discharge connection:

– DN100 ISO-K, DIN 28404

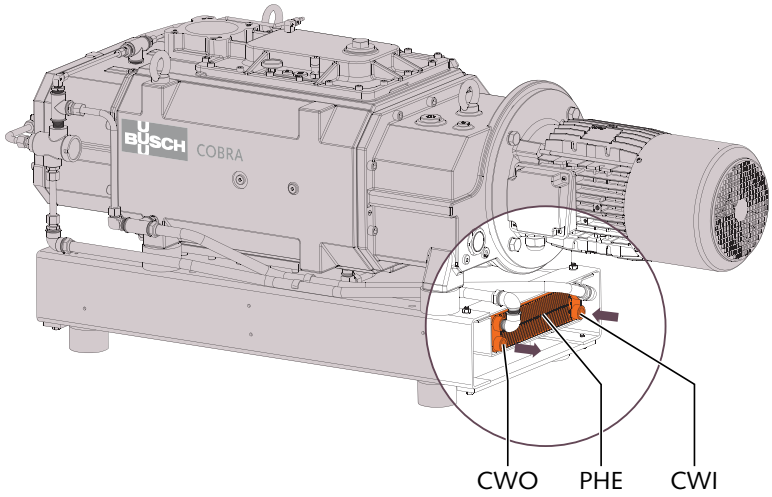
At the silencer (SI) discharge connection (two optional versions available):

– DN80 PN16 + ANSI/ASME B16.5-3" class 150 lbs

– R3

- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurised air source.
- Make sure that the counter pressure at the discharge connection (OUT) does not exceed the admissible pressure, see Technical Data [▶ 44].

5.2.3 Cooling Water Connection



CWI	Cooling water inlet	CWO	Cooling water outlet
PHE	Plate heat exchanger		

Connection size:

– G1/2, ISO 228-1 (CWI / CWO)

• Make sure that the cooling water complies with the following requirements:

Supply capacity	l/min	12
Water pressure	bar	1 ... 6
Supply temperature	°C	+5 ... +30
Required pressure differential across supply and return	bar	≥ 1

• To reduce the maintenance effort and ensure a long product lifetime we recommend the following cooling water quality:

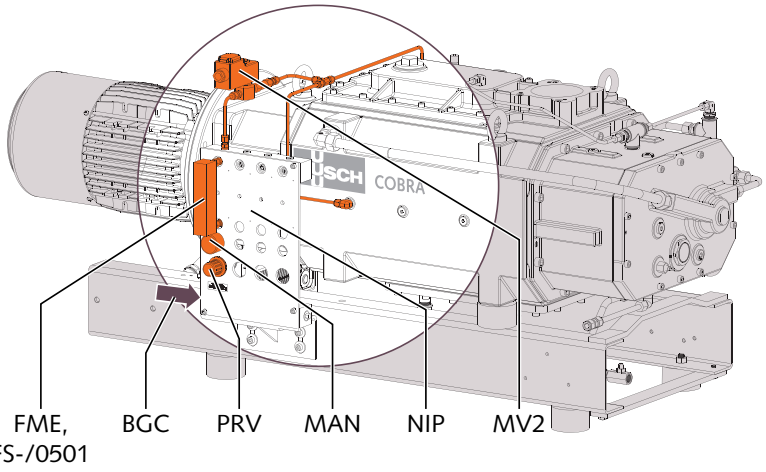
Hardness	mg/l (ppm)	< 90
Properties	Clean & clear	
PH value		7 … 8
Particle size	µm	< 200
Chloride	mg/l	< 100
Electrical conductivity	µS/cm	≤ 100
Free chloride	mg/l	< 0.3
Materials in contact with the cooling water	Stainless steel	

NOTE

Water hardness unit conversion.

1 mg/l (ppm) = 0.056 °dh (german degree) = 0.07 °e (english degree) = 0.1 °fH (french degree)

5.2.4 Barrier Gas System Connection



BGC	Barrier gas connection	FME	Flow meter
FS	Flow switch	MAN	Manometer
MV	Solenoid valve	NIP	Nitrogen panel
PRV	Pressure regulating valve		

Connection size:

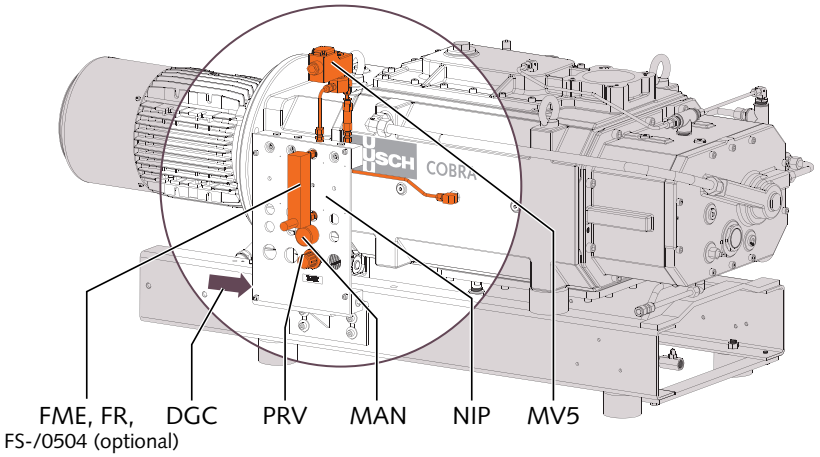
– G1/4, ISO 228-1

- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [▶ 26].
- Electrically connect the flow switch (FS) of the flow meter, see Wiring Diagram Flow Switch [▶ 29].
- Make sure that the gas complies with the following requirements:

Gas type	Dry nitrogen or air	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar	3
Filtration	µm	5
Recommended flow rate	SLM*	3.5 ... 5.5

** standard litre per minute*

5.2.5 Dilution Gas System Connection (Optional)



DGC	Dilution gas connection	FME	Flow meter
FR	Flow regulator	FS	Flow switch
MAN	Manometer	MV	Solenoid valve
NIP	Nitrogen panel	PRV	Pressure regulating valve

Connection size:

– G1/4, ISO 228-1

- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [▶ 26].

If a flow switch is installed:

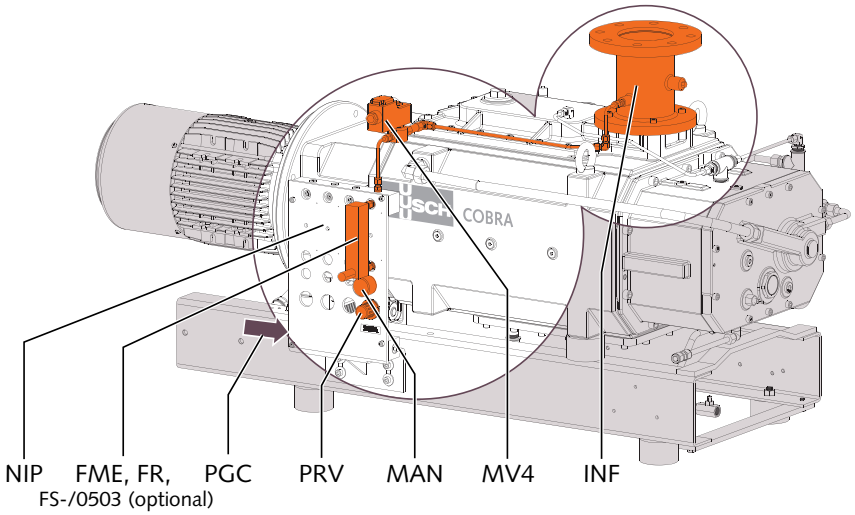
- Electrically connect the flow switch (FS) of the flow meter, see Wiring Diagram Flow Switch [▶ 29].

- Make sure that the gas complies with the following requirements:

Gas type	Dry nitrogen	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar	2.5
Filtration	µm	5
Recommended flow rate	SLM*	30

** standard litre per minute*

5.2.6 Purge Gas System Connection



PGC	Purge gas connection	FME	Flow meter
FR	Flow regulator	FS	Flow switch
INF	Inlet flange	MAN	Manometer
MV	Solenoid valve	NIP	Nitrogen panel
PRV	Pressure regulating valve		

Connection size:

– G1/4, ISO 228-1

- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [▶ 26].

If a flow switch is installed:

- Electrically connect the flow switch (FS) of the flow meter, see Wiring Diagram Flow Switch [▶ 29].

- Make sure that the gas complies with the following requirements:

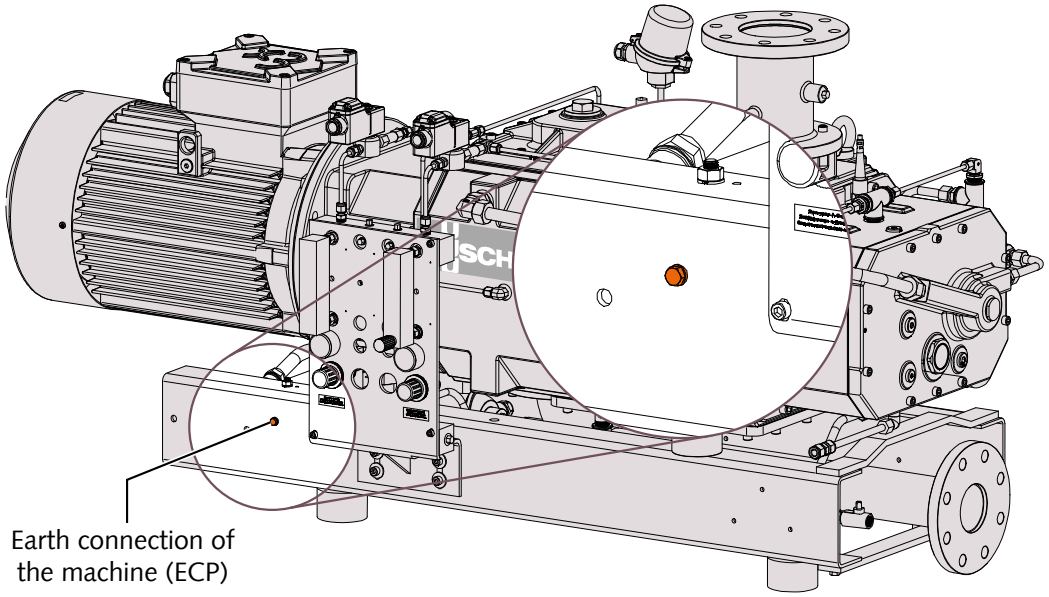
Gas type	Dry nitrogen	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar	2.5
Filtration	µm	5
Recommended flow rate	SLM*	≥ 100

** standard litre per minute*

5.3 Earth Connection

In order to prevent the machine from creating an electrostatic charge:

- Connect the earth connection of the machine (ECP)



Earth connection of the machine (ECP)

5.4 Filling Oil

NOTICE

Use of an inappropriate oil.

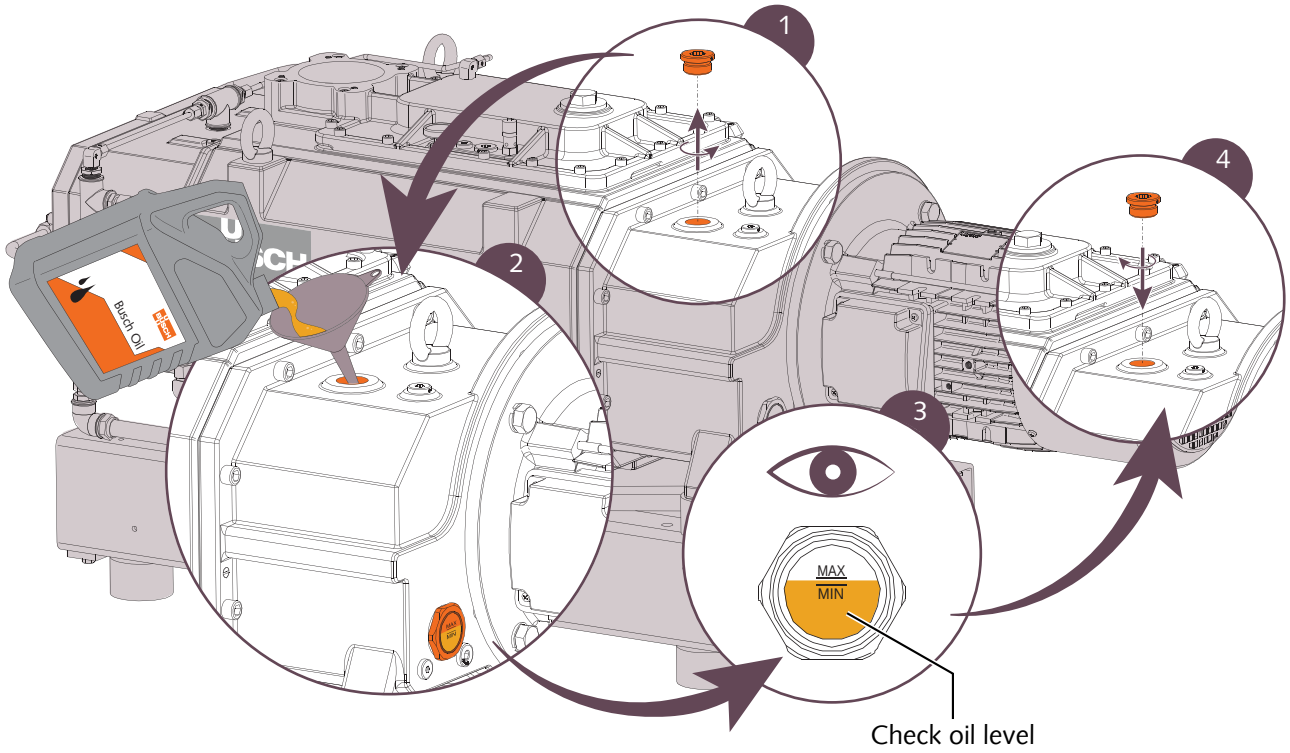
Risk of premature failure!

Loss of efficiency!

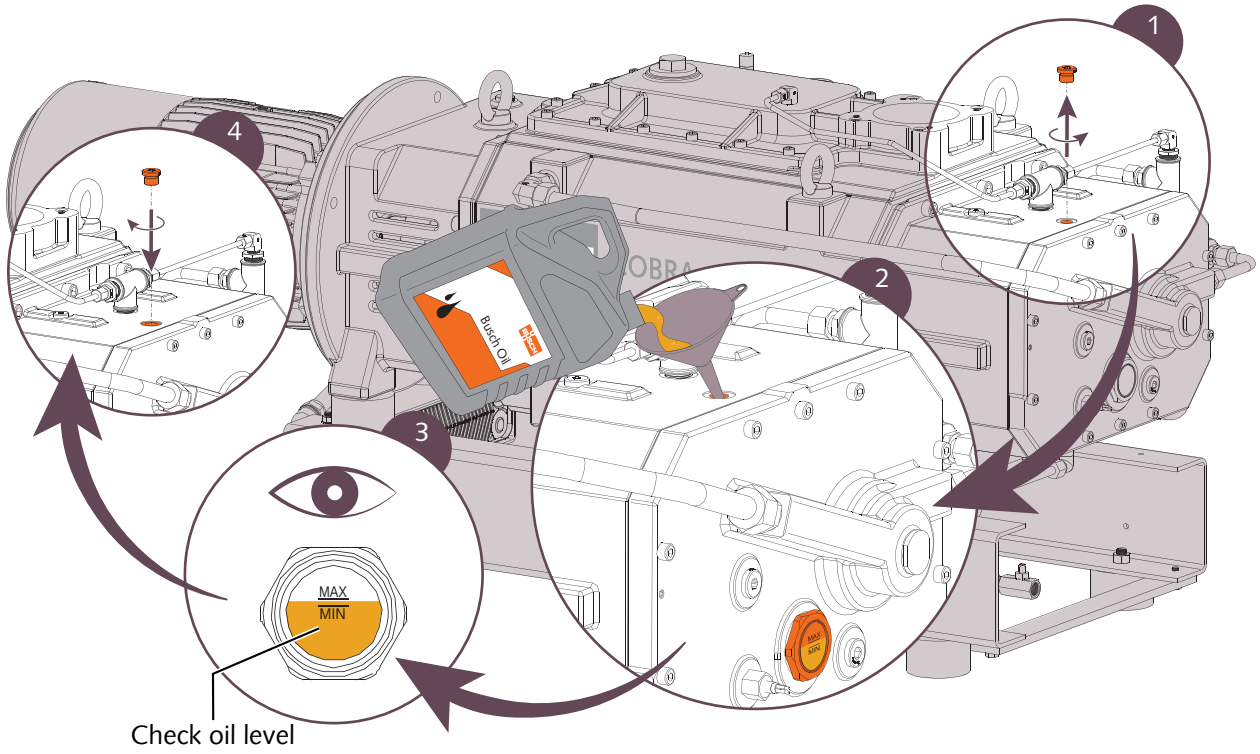
- Only use an oil type which has previously been approved and recommended by Busch.

For oil type and oil capacity see Technical Data [▶ 44] and Oil [▶ 44].

Oil filling at the motor side

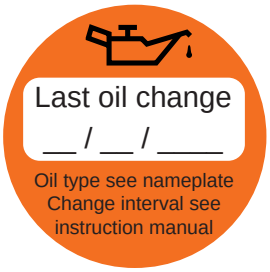


Oil filling at the suction side



When the oil filling is achieved:

- Write down the oil change date on the sticker.

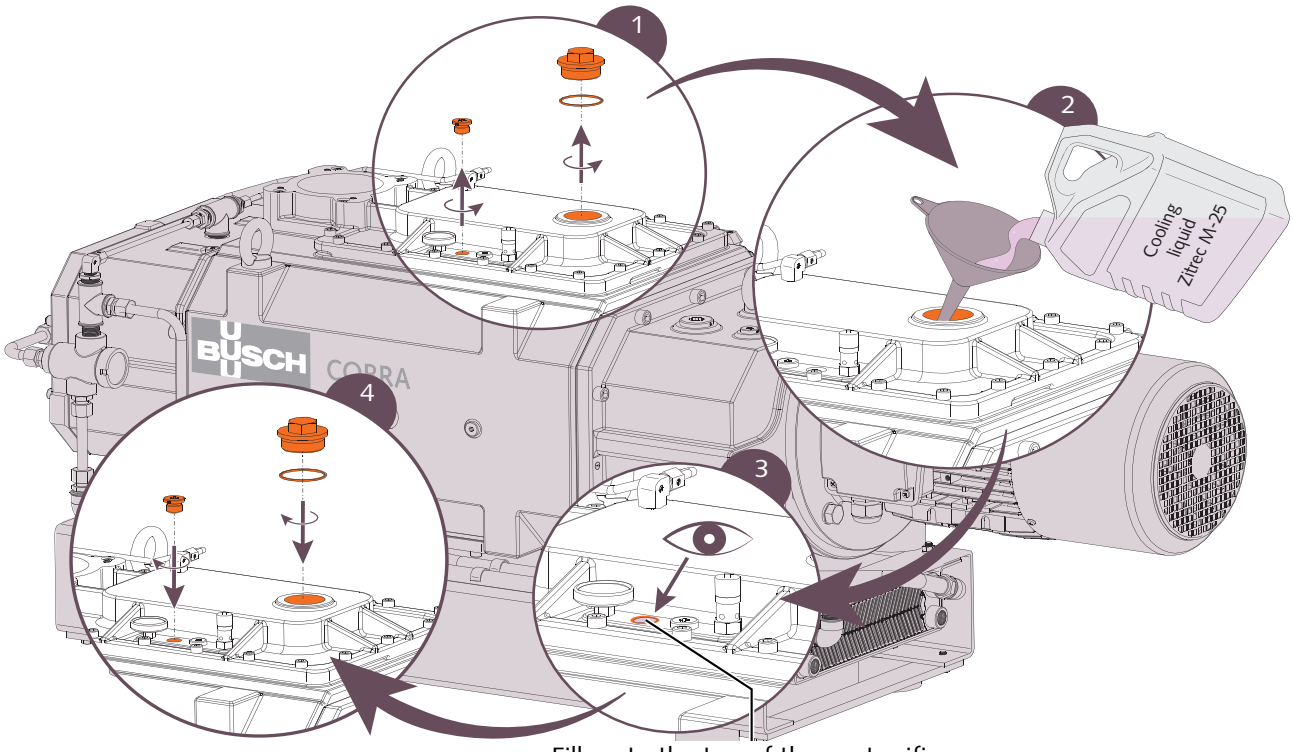


If there is no sticker on the pump:

- Order it from your Busch representative.

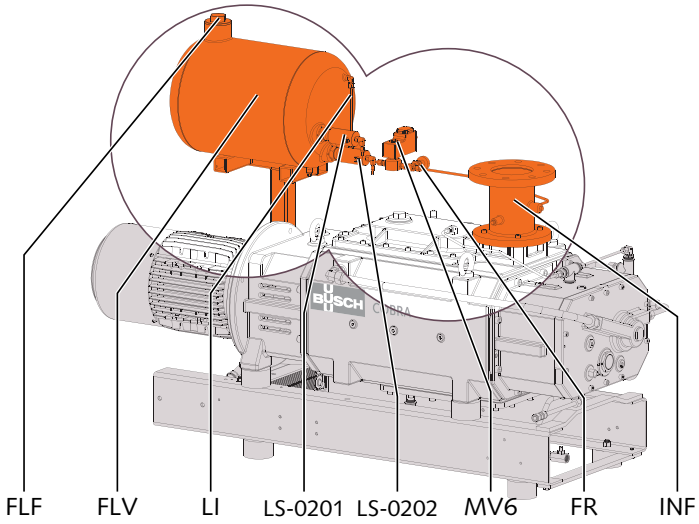
5.5 Filling Cooling Liquid

For cooling liquid type and cooling liquid capacity see Technical Data [▶ 44] and Cooling Liquid [▶ 44].



Fill up to the top of the vent orifice

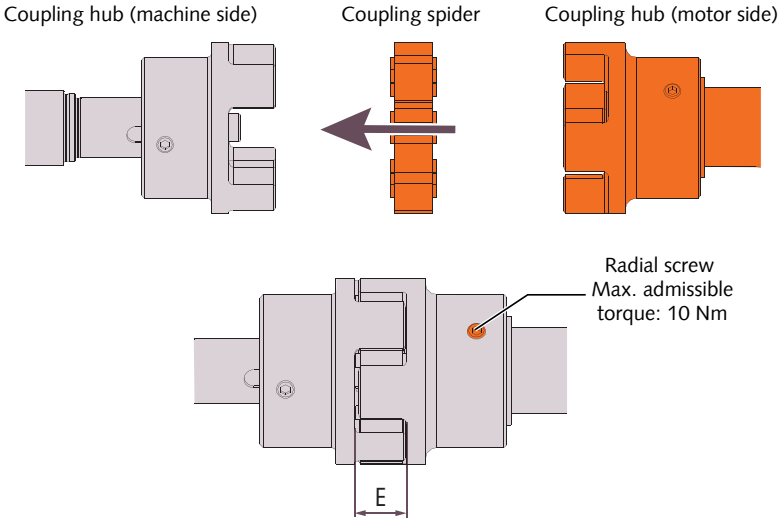
5.6 Liquid Flushing Device Installation (Optional)



FLF	Flushing liquid fill plug	FLV	Flushing liquid vessel
FR	Flow regulator	INF	Inlet flange
LI	Level indicator	LS	Level switch
MV	Solenoid valve		

- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [▶ 26].
- Electrically connect the two level switches (LS), see Wiring Diagram Level Switch [▶ 29].
- Fill the flushing liquid vessel (FLV) with a process compatible flushing liquid.

5.7 Fitting the Coupling



Machine type	Coupling size	Value “E” (mm)
NC 0600 C	ROTEX® 42	26
NC 0630 C		
NC 0630 C	ROTEX® 48	28

In case of a machine delivery without motor:

- Fit the second coupling hub on the motor shaft (separately delivered).

- Axially adjust the hub in such a way until value "E" is reached.
- When the coupling adjustment is done, lock the coupling hub by tightening the radial screw.
- Mount the motor on the machine by including the coupling spider.

5.8 Electrical Connection

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- Provide overload protection according to EN 60204-1 for the motor.
- Make sure that the motor of the machine will not be affected by electric or electro-magnetic disturbance from the mains; if necessary seek advice from Busch.
- Connect the protective earth conductor.
- Electrically connect the motor.

NOTICE

The admissible motor nominal speed exceeds the recommendation.

Risk of damage to the machine!

- Check the admissible motor nominal speed (n_{max}) on the nameplate of the machine (NP).
- Make sure to comply with it.
- Consult the Technical Data [▶ 44] to get more information.

NOTICE

The motor frequency is below 20 Hz.

Risk of damage to the machine!

- The motor nominal speed must always be higher than 1200 min^{-1} (20 Hz).

NOTICE

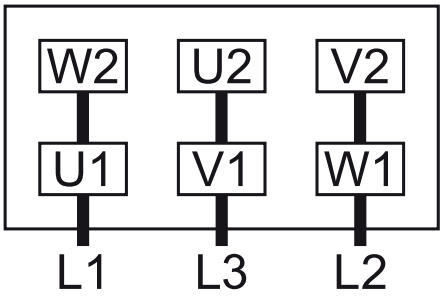
Incorrect connection.

Risk of damage to the motor!

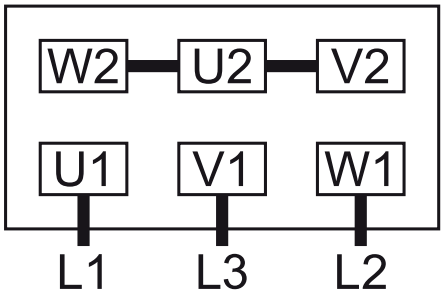
- The wiring diagrams given below are typical. Check the inside of the terminal box for motor connection instructions/diagrams.

5.8.1 Wiring Diagram Three-Phase Motor (Pump Drive)

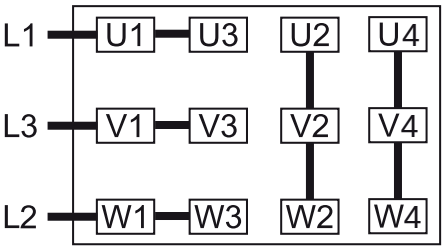
Delta connection (low voltage):



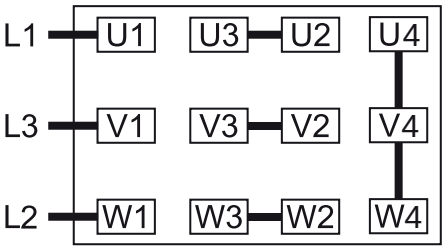
Star connection (high voltage):



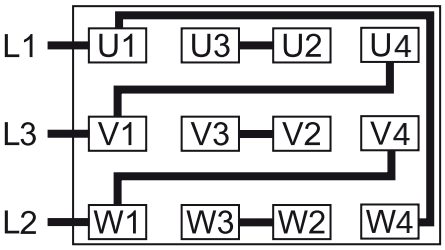
Double star connection, multi-voltage motor with 12 pins (low voltage):



Star connection, multi-voltage motor with 12 pins (high voltage):



Delta connection, multi-voltage motor with 12 pins (middle voltage):



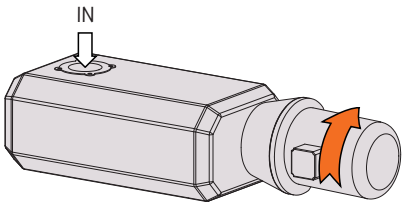
NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

The intended rotation direction of the motor is defined by the illustration below:

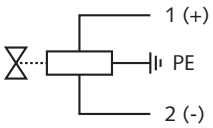


- Jog the motor briefly.
- Watch the fan wheel of the motor and determine the direction of rotation just before the fan wheel stops.

If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

5.8.2 Wiring Diagram Solenoid Valve



Part no.	Supplier reference	P&ID position	Specifications		Maintenance procedure
0654 000 092	Parker Lucifer 495905 C2	MV2 ; MV4 ; MV5 ; MV6	DN 3 with seal in FFKM	Ex db mb IIC T4 U_i = 24 VDC	Procedure G [▶ 40]
0654 538 544	Parker Lucifer 495910 N7	MV2 ; MV4 ; MV5	DN 1.5 with seal in PUR	Ex ia IIC T4 U_i = 24 VDC	Procedure G [▶ 40]
0654 532 461	Bürkert Type 262 (pneumatic) Type 6014 C (electric)	MV2 ; MV4 ; MV5 ; MV7	DN 12 with seal in PTFE pneumatic 3.3 ... 6 bar	Ex ia IIC T6 U_i = 24 VDC	Procedure G [▶ 40] or Procedure H [▶ 40]
0654 547 028	Parker Lucifer 495905 F4	MV2 ; MV4 ; MV5	DN 3 with seal in FFKM	Ex dm IIC T4 U_i = 230 VAC	Procedure G [▶ 40]
0654 552 169	Parker Lucifer 495910 N7	MV6	DN 1.5 with seal in Rubis	Ex ia IIC T6 U_i = 24 VDC	Procedure H [▶ 40]
0654 536 403	Bürkert Typ 6014	MV6	DN 0.9 with seal in PFM	Ex ia IIC T6 U_i = 24 VDC	Procedure H [▶ 40]
0654 518 062	Parker Lucifer 495905 C2	MV7	DN 12 with seal in FKM	Ex db mb IIC T6 U_i = 24 VDC	Procedure H [▶ 40]
0654 545 633	Parker Lucifer 483580.01	MV7	DN 15 with seal in PTFE pneumatic 3.5 ... 10 bar	Ex ia IIC T6 U_i = 24 VDC	Procedure H [▶ 40]
0654 518 061	Parker Lucifer 495905 F4	MV7	DN 12 with seal in FKM	Ex d mb II T3/T4 U_i = 230 VAC	Procedure H [▶ 40]

5.9 Electrical Connection of the Monitoring Devices

NOTE

In order to prevent potential nuisance alarms, Busch allows that the control system is configured with a time delay of 2 seconds.

NOTE

The accessories below are considered as standard.

If other specific components should be used, refer to the instruction manual of the accessory in question.

5.9.1 Wiring Diagram Resistance Thermometer

Part no.:
PT100: 0651 550 436
Transmitter: 0643 536 800

Supplier reference:
PT100: Albert Balzer AG
ref. TWBa-ADX50XG1/4X90DACB
Transmitter: Endress+Hauser
ref. TMT 187-B41FJA

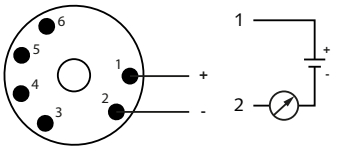
Maintenance procedure:
Procedure A [▶ 39]

P&ID position:
TSA+/0102 "cooling liquid temp."
TSA+/0103 "exhaust gas temp."

U_i = 30 VDC ; I_i = 100 mA ; P_i = 750 mW ; L_i = 0 µH ; C_i = 0 pF

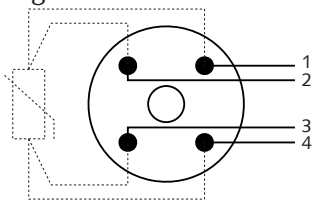
4 ... 20 mA ▶ 0 ... 300 °C

Wiring with transmitter:



1 = Brown ; 2 = Blue

Wiring without transmitter:



1 and 2 = Red ; 3 and 4 = White

Warning signal:
$T_{warning}$ (TSA+/0102) = 60°C ▶ 7.2 mA (for NC 0600 C)
$T_{warning}$ (TSA+/0102) = 65°C ▶ 7.47 mA (for NC 0630 C)
$T_{warning}$ (TSA+/0103) = 180°C ▶ 13.6 mA (for NC 0600 C)
$T_{warning}$ (TSA+/0103) = 230°C ▶ 16.27 mA (for NC 0630 C)

Trip signal:
T_{trip} (TSA+/0102) = 65°C ▶ 7.47 mA (for NC 0600 C)
T_{trip} (TSA+/0102) = 70°C ▶ 7.73 mA (for NC 0630 C)
T_{trip} (TSA+/0103) = 190°C ▶ 14.13 mA (for NC 0600 C)
T_{trip} (TSA+/0103) = 240°C ▶ 16.8 mA (for NC 0630 C)

5.9.2 Wiring Diagram Pressure Switch

Part no.: 0653 539 030

Supplier reference: United Electric Controls
H100 (100 Series)

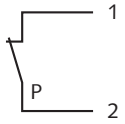
Maintenance procedure:
Procedure B [▶ 39]

P&ID position: PS+/0301

U_i = 49 VDC ; I_i = 3 A ; L_i = 0 µH ; C_i = 0 pF

Contact: Normally closed

Switch point: P (PS+/0301) = 1200 hPa (mbar) abs. (factory default adjustment)



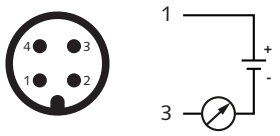
5.9.3 Wiring Diagram Pressure Transmitter

Part no.: 0653 537 031
0653 541 862 (Hastelloy® version)

Supplier reference: ACS Precont Ex S10

Maintenance procedure:
Procedure C [▶ 39]

Connector: M12x1, 4-pin



1 = Brown ; 3 = Blue

P&ID position: PSA+/0301

U_i = 27.3 VDC ; I_i = 140 mA ; P_i = 0.9 W ; L_i = 110 µH ; C_i = 19 nF

4 ... 20 mA ► 0 ... 300 mbar (relative)

Warning signal:
$P_{warning}$ (PSA+/0301) = 0.15* bar ► 12 mA
*1150 hPa (mbar) abs.

Trip signal:
P_{trip} (PSA+/0301) = 0.2* bar ► 14.67 mA
*1200 hPa (mbar) abs.

5.9.4 Wiring Diagram Vibration Sensor

NOTE

The wiring scheme is separately provided (specific sheet) with the machine.

Part no.:
Vibration sensor: 0658 569 597
Transmitter: 0646 564 555

Supplier reference:
Vibration sensor: CTC AC915-9C
Transmitter: ifm electronic VSE100 ► not ATEX certified, install an intrinsic safety barrier.

Maintenance procedure: Procedure D [▶ 40]

P&ID position: SA+/0701

U = 24 VDC ; I = 100 mA

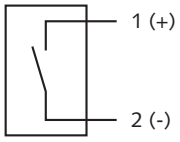
Normal operation	Warning signal	Trip signal
Output 1 ► 24 V	Output 1 ► 0 V	Output 1 ► 0 V
Output 2 ► 24 V	Output 2 ► 24 V	Output 2 ► 0 V

5.9.5 Wiring Diagram Flow Switch

Part no.: No Busch ref. (integrated in the flow switch)

Supplier reference:
Pepperl+Fuchs RC15-14-N3

Maintenance procedure:
Procedure E [▶ 40]



1 = Brown ; 2 = Blue

P&ID position:
FS-/0501 "barrier gas flow"
FS-/0503 "purge gas flow"
FS-/0504 "dilution gas flow"

U = 5 … 25 V ; I = 1 … 3 mA

Switching element function:
NAMUR, bistable

Contact: Normally open

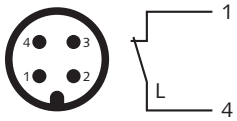
Switch point:
(FS-/0501) = 3 SLM barrier gas ▶ min. volume flow
(FS-/0503) = 100 SLM purge gas ▶ min. volume flow
(FS-/0504) = 25 SLM dilution gas ▶ min. volume flow

5.9.6 Wiring Diagram Level Switch

Part no.: 0652 556 531

Supplier reference:
Endress&Hauser FTL50

Maintenance procedure:
Procedure F [▶ 40]



1 = Brown ; 4 = Black

Connector: M12x1, 4-pin

P&ID position: LS-/0201 & LS-/0202

< 6 mW at I < 1 mA;
< 38 mW at I = 3.5 mA

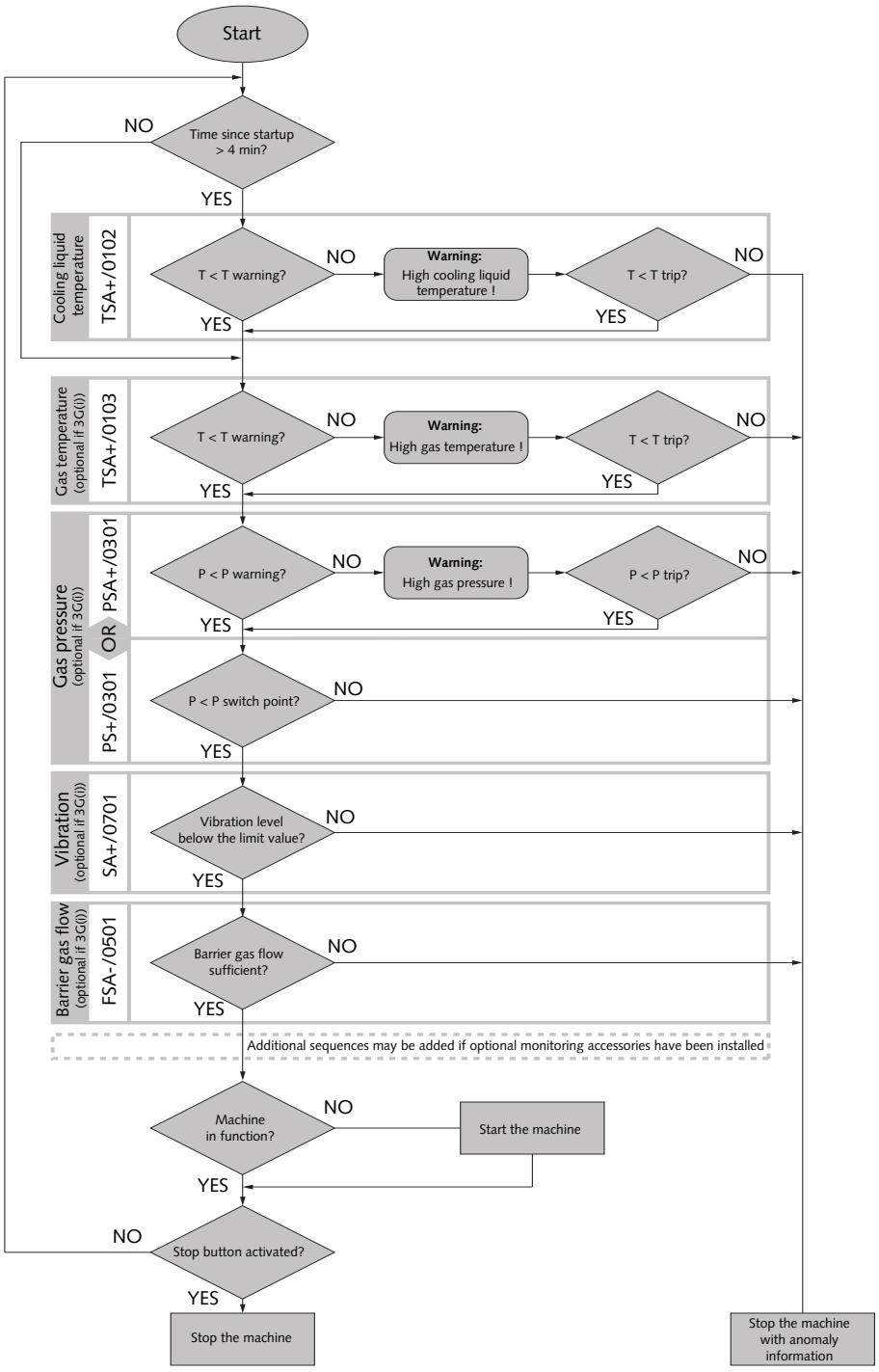
Switching element function: NAMUR

Contact: Normally closed

Switch point:
$L_{warning}$ = LS-/0201 ▶ pin 1 + 4 ▶ low level "warning"
L_{trip} = LS-/0202 ▶ pin 1 + 4 ▶ low level "stop flushing"

5.10 Flowchart

The machine safety depends on the monitoring accessories sequencing according to the following flowchart.



6 Commissioning

NOTICE

The machine is shipped without oil.

Operation without oil will ruin the machine in short time!

- Prior to commissioning, the machine must be filled with oil, see Filling Oil [▶ 20].

NOTICE

Lubricating a dry running machine (process chamber).

Risk of damage to the machine!

- Do not lubricate the process chamber of the machine with oil or grease.

CAUTION

During operation the surface of the machine may reach temperatures of more than 70°C.

Risk of burns!

- Avoid contact with the machine during and directly after operation.

CAUTION

Noise of running machine.

Risk of damage to hearing!

If persons are present in the vicinity of a non noise insulated machine over extended periods:

- Make sure that ear protection is being used.

- Make sure that the installation conditions (see Installation Conditions [▶ 14]) are complied with.
- Open the water supply.

If the machine is equipped with a barrier gas system:

  - Open the barrier gas supply.
  - Adjust the barrier gas pressure and volume flow.

- Switch on the machine.
- Make sure that the maximum permissible number of starts does not exceed 2 starts per hour.
- After few minutes of operation, perform an Oil Level Inspection [▶ 34].
- After few minutes of operation, perform a Cooling Liquid Level Inspection [▶ 34].

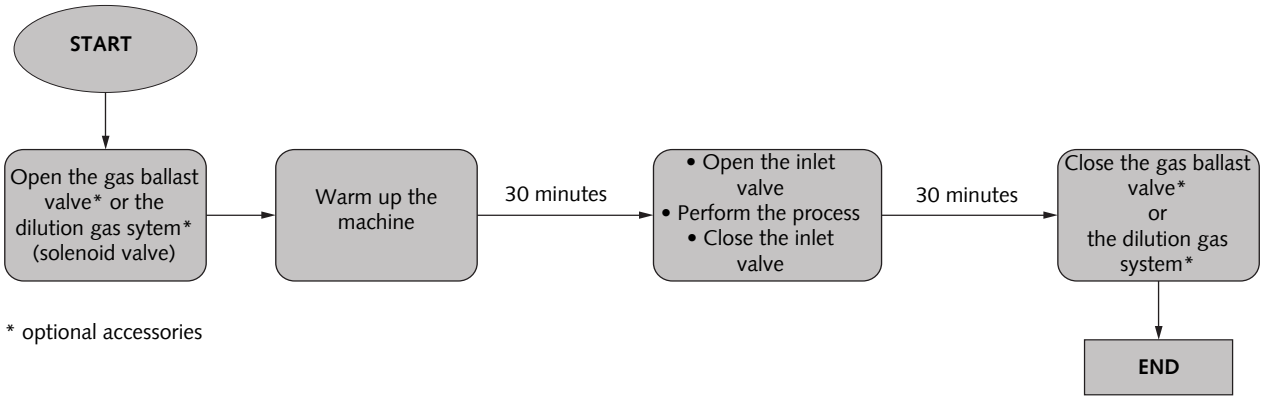
As soon as the machine is operated under normal operating conditions:

  - Measure the motor current and record it as reference for future maintenance and troubleshooting work.

6.1 Conveying Condensable Vapours

The machine, equipped either with a gas ballast valve or a dilution gas system, is suitable for the conveyance of condensable vapours within the gas flow.

If condensable vapours are to be conveyed:



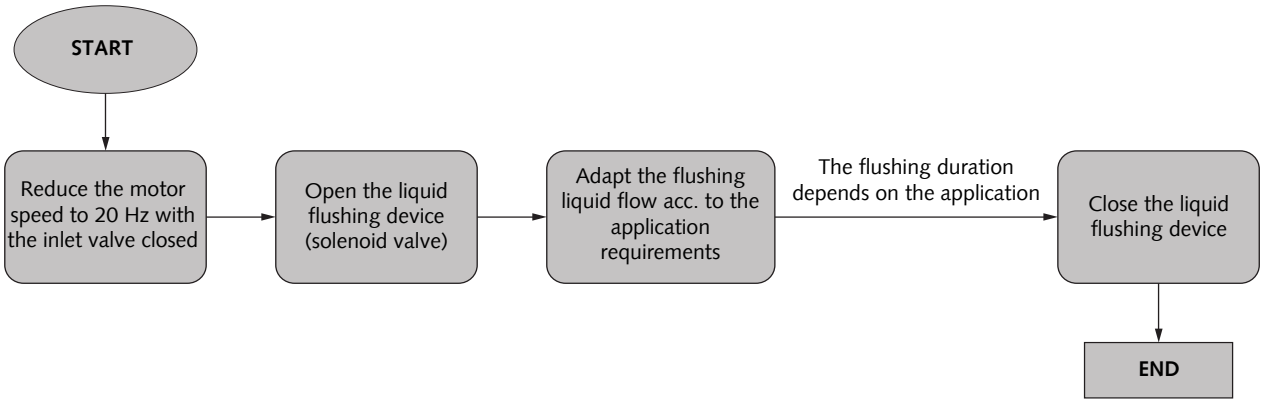
* optional accessories

- Continuously drain condensate from the condensate drain plug (CD) of the silencer (SI) (Optional).

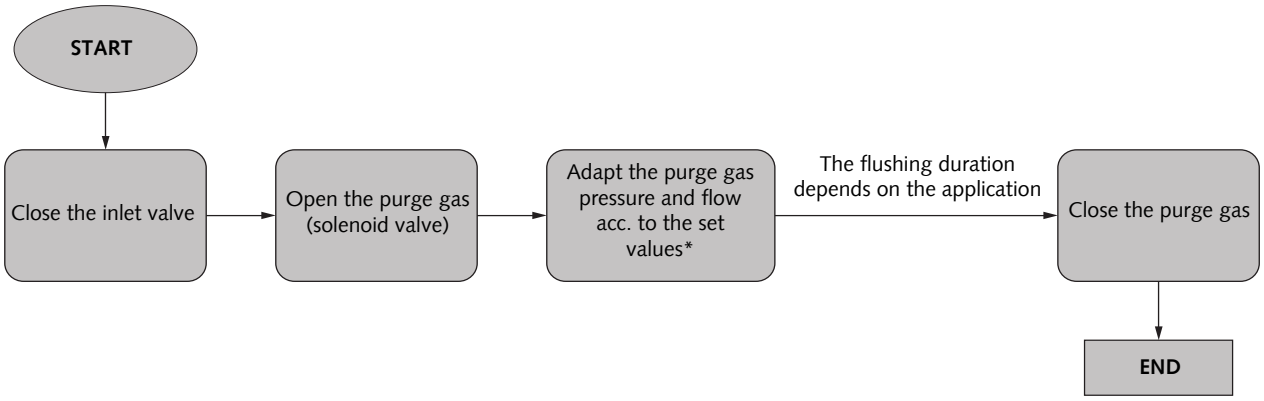
6.2 Process Chamber Flushing

The machine can optionally be equipped with a liquid flushing device and/or a purge gas system.

If after the application process a liquid flushing is required:



If after the application process a gas flushing is required, i.e. after a liquid flushing sequence or to render the process chamber inert:



* *the set values are defined in the chapter* Purge Gas System Connection (Optional).

7 Maintenance

WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

CAUTION

Hot surface.

Risk of burns!

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Turn off the water supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.

- Vent the connected lines to atmospheric pressure.

If necessary:

- Disconnect all connections.

7.1 Maintenance Schedule

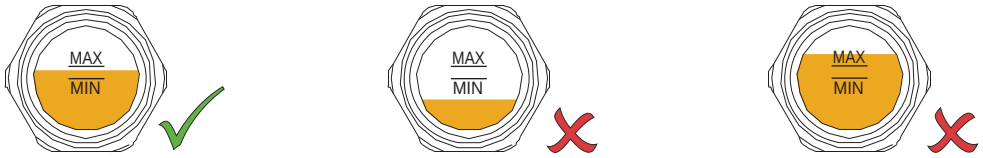
The maintenance intervals depend very much on the individual operating conditions. The intervals given below are desired to be considered as starting values which should be shortened or extended as appropriate. Particularly heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Interval	Maintenance work
Monthly	• Check the oil level, see Oil Level Inspection [▶ 34]. • Check the cooling liquid level, see Cooling Liquid Level Inspection [▶ 34]. • Check the machine for oil leaks - in case of leaks have the machine repaired (contact Busch).
Yearly	• Carry out a visual inspection and clean the machine from dust and dirt. • Check the electrical connections and the monitoring devices.
Yearly In case of those accessories being installed.	• Check the filter of the gas ballast valve (GB) and change it if necessary, see Replacing the Gas Ballast Filter (Optional) [▶ 35]. • Check the inlet filter cartridge, change it if necessary. • Check the silence (SI) and clean it if necessary.

Every 5000 hours, at the latest after 1 year	• Change the oil of the gear and bearing housings (both sides), see Oil Change [▶ 35]. • Change the cooling liquid, see Cooling Liquid Change [▶ 38]. • Clean the magnetic plugs (MP).
Every 16000 hours, at the latest after 4 years	• Have a major overhaul on the machine (contact Busch).

7.2 Oil Level Inspection

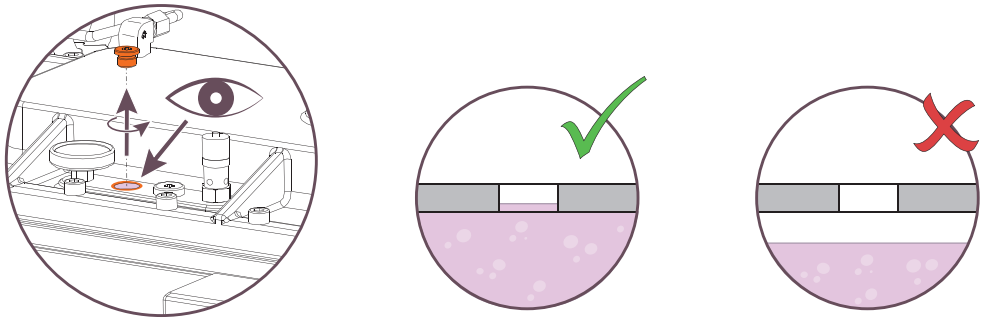
- Shut down the machine.
- When the machine is stopped, wait 1 minute before checking the oil level.



- Fill up if necessary, see Oil Filling [▶ 20].

7.3 Cooling Liquid Level Inspection

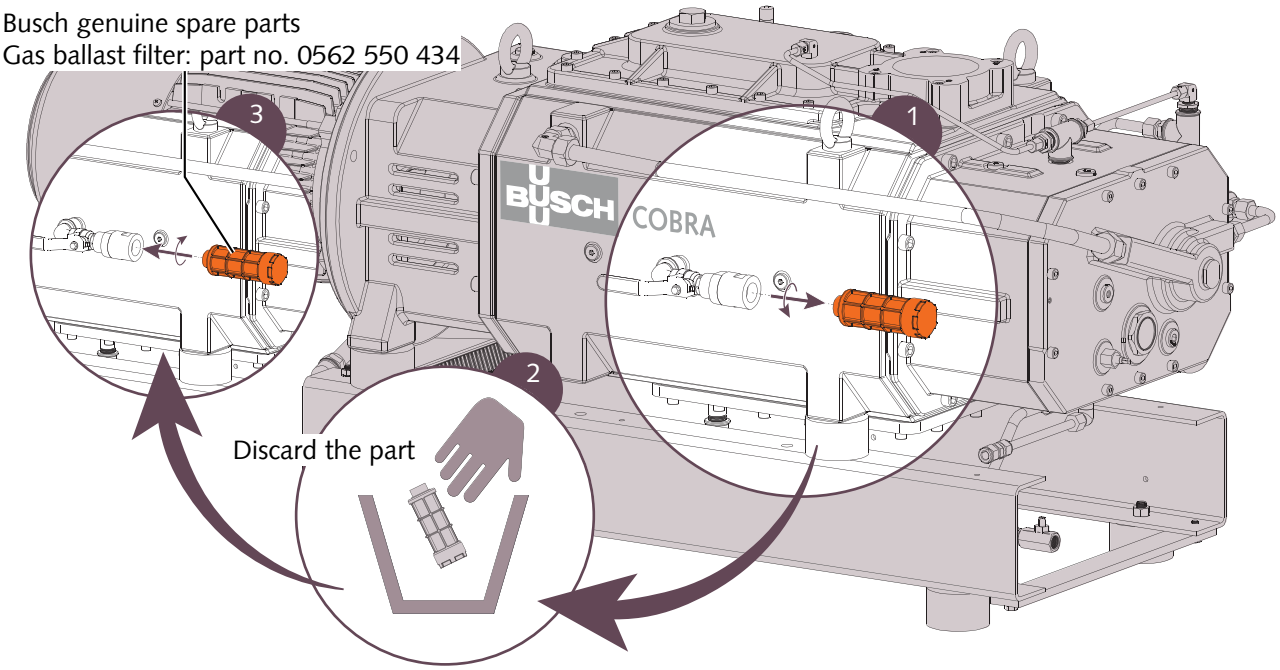
- Shut down the machine.
- Let the machine cool down.



- Fill up if necessary, see Filling Cooling Liquid [▶ 22].

7.4 Replacing the Gas Ballast Filter (Optional)

Busch genuine spare parts
Gas ballast filter: part no. 0562 550 434



7.5 Oil Change

NOTICE

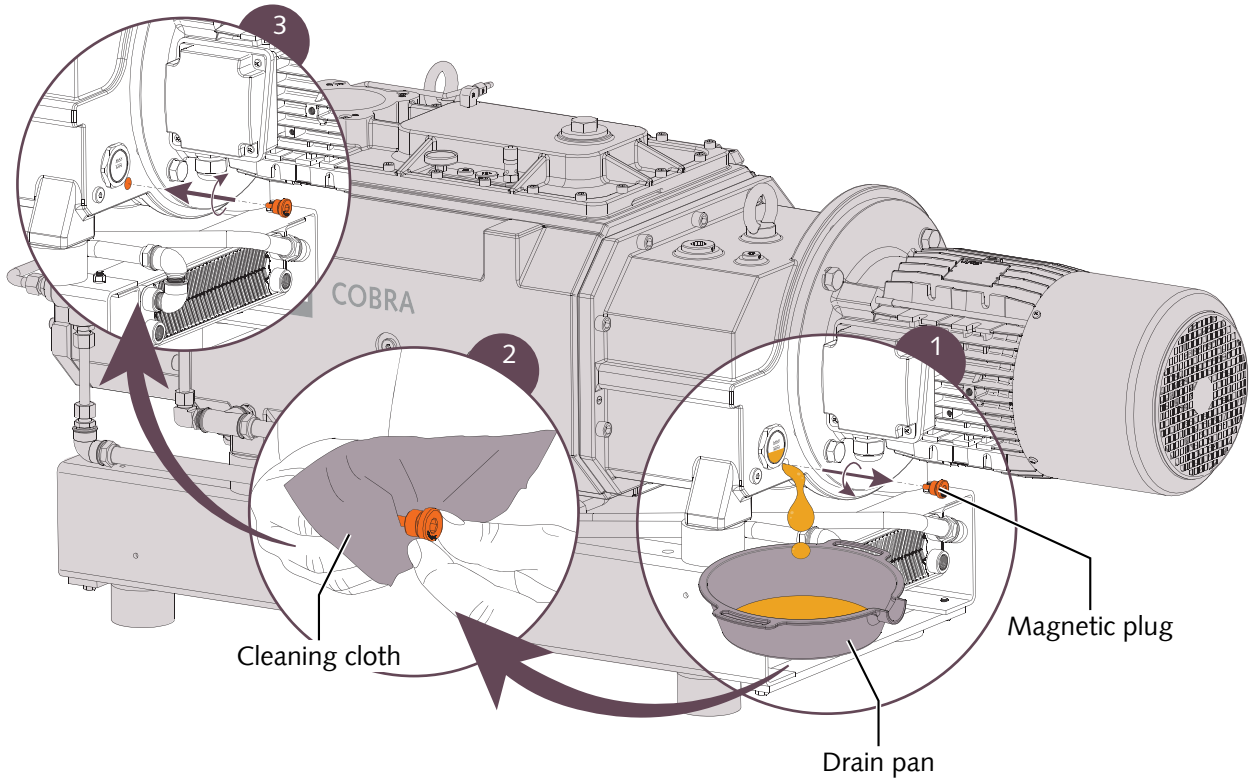
Use of an inappropriate oil.

Risk of premature failure!

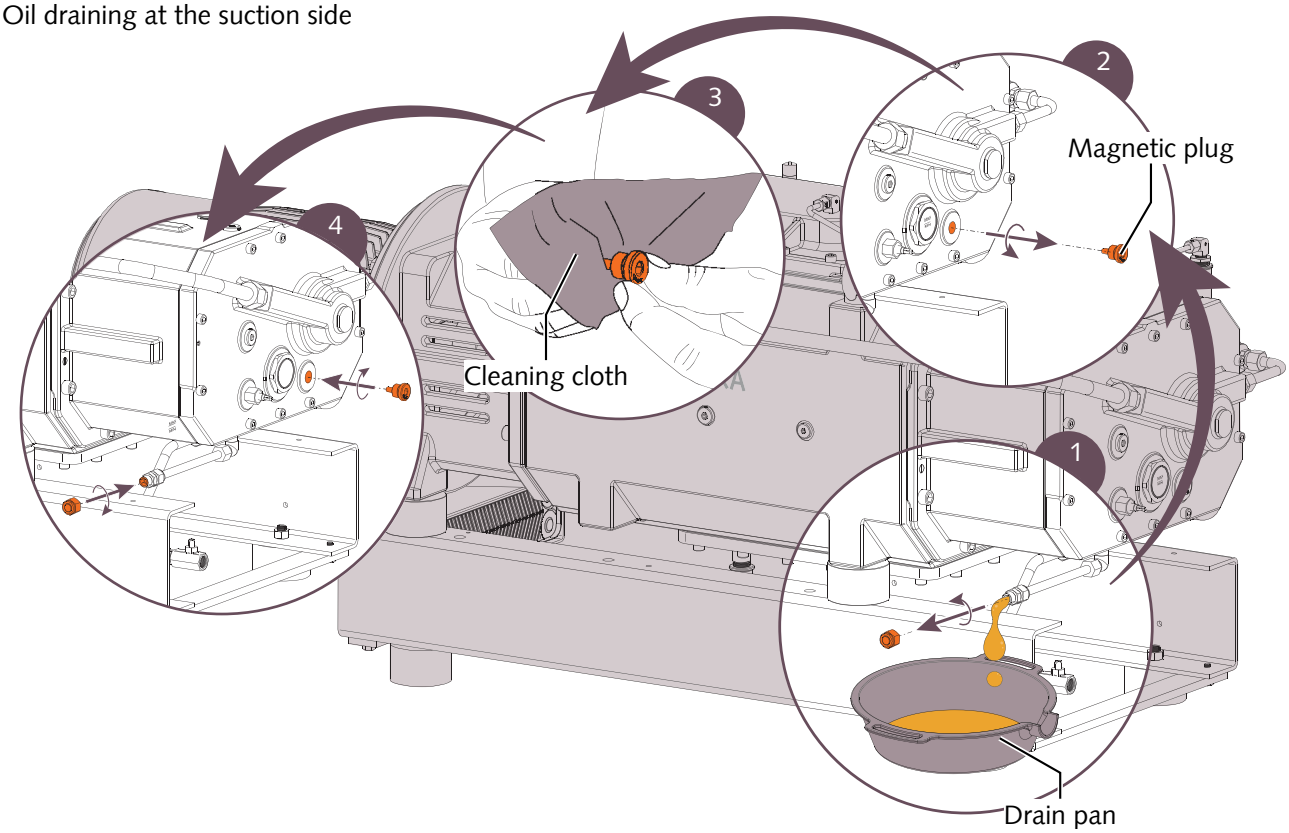
Loss of efficiency!

- Only use an oil type which has previously been approved and recommended by Busch.

Oil draining at the motor side

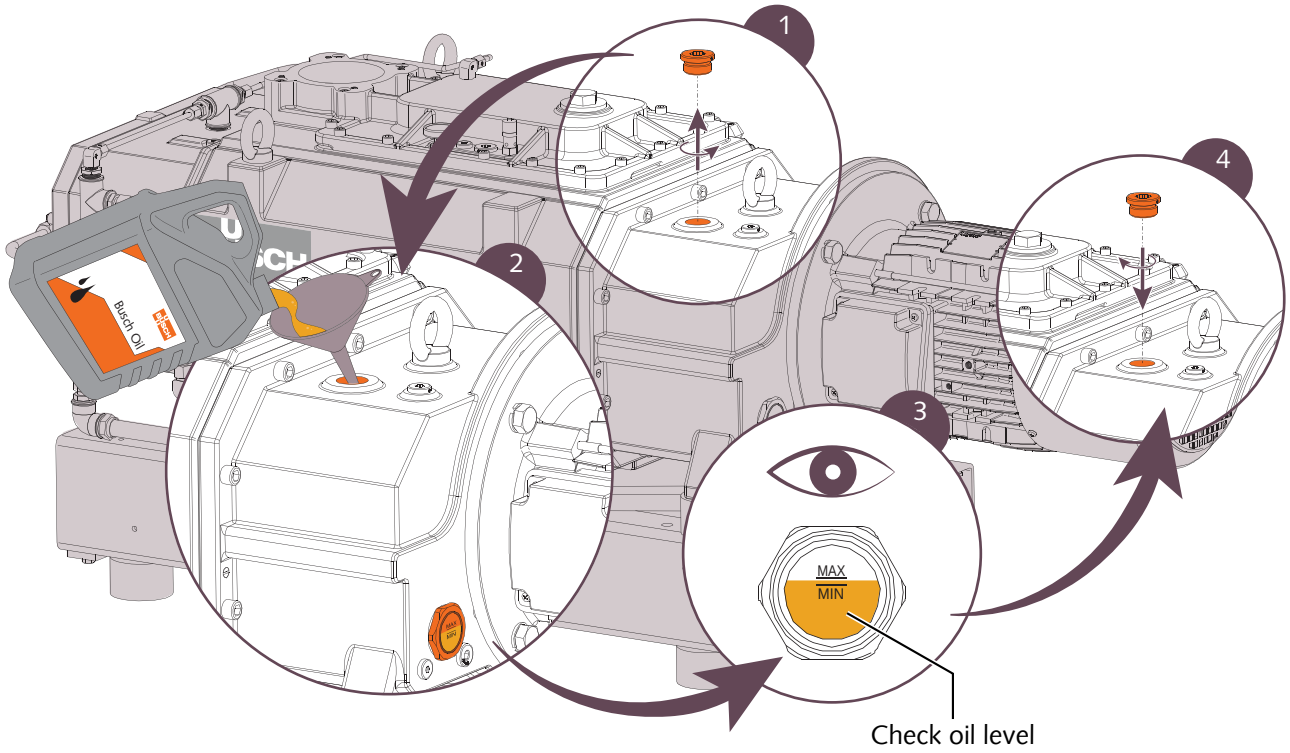


Oil draining at the suction side

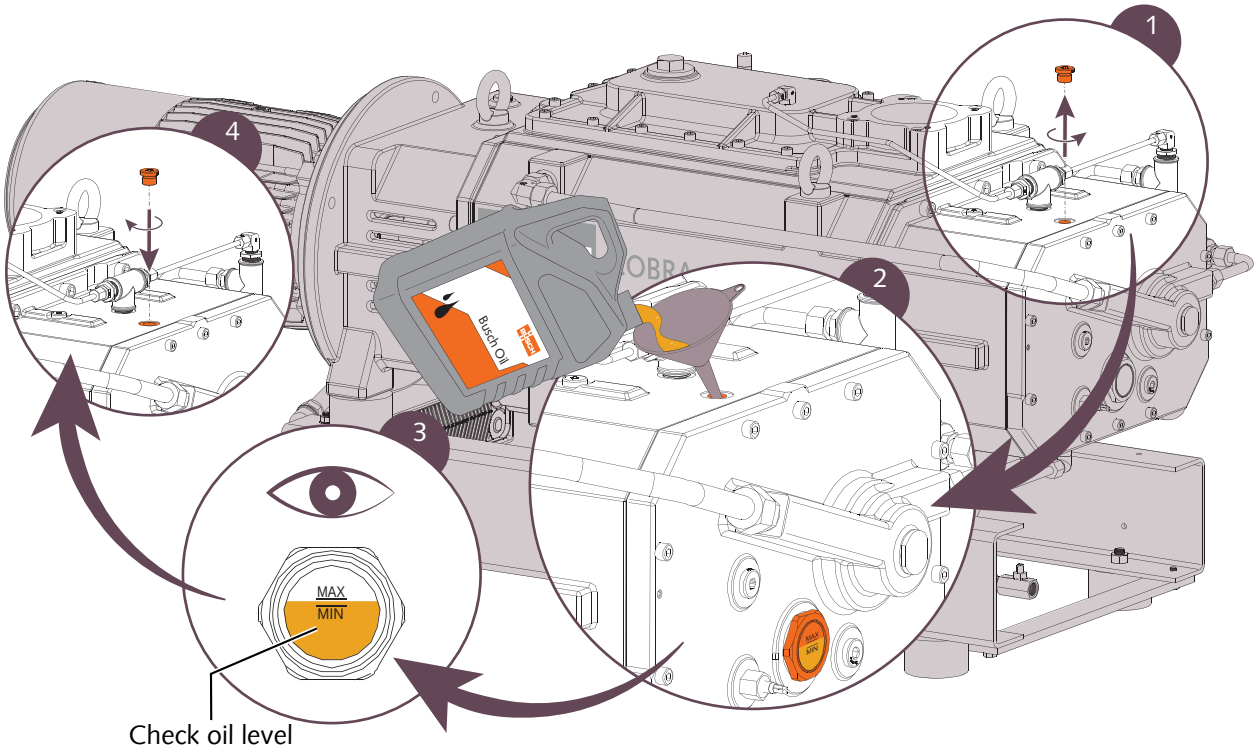


For oil type and oil capacity see Technical Data [▶ 44] and Oil [▶ 44].

Oil filling at the motor side

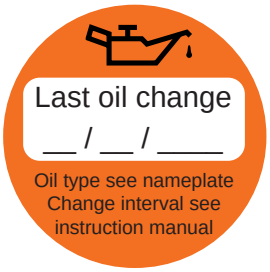


Oil filling at the suction side



When the oil filling is achieved:

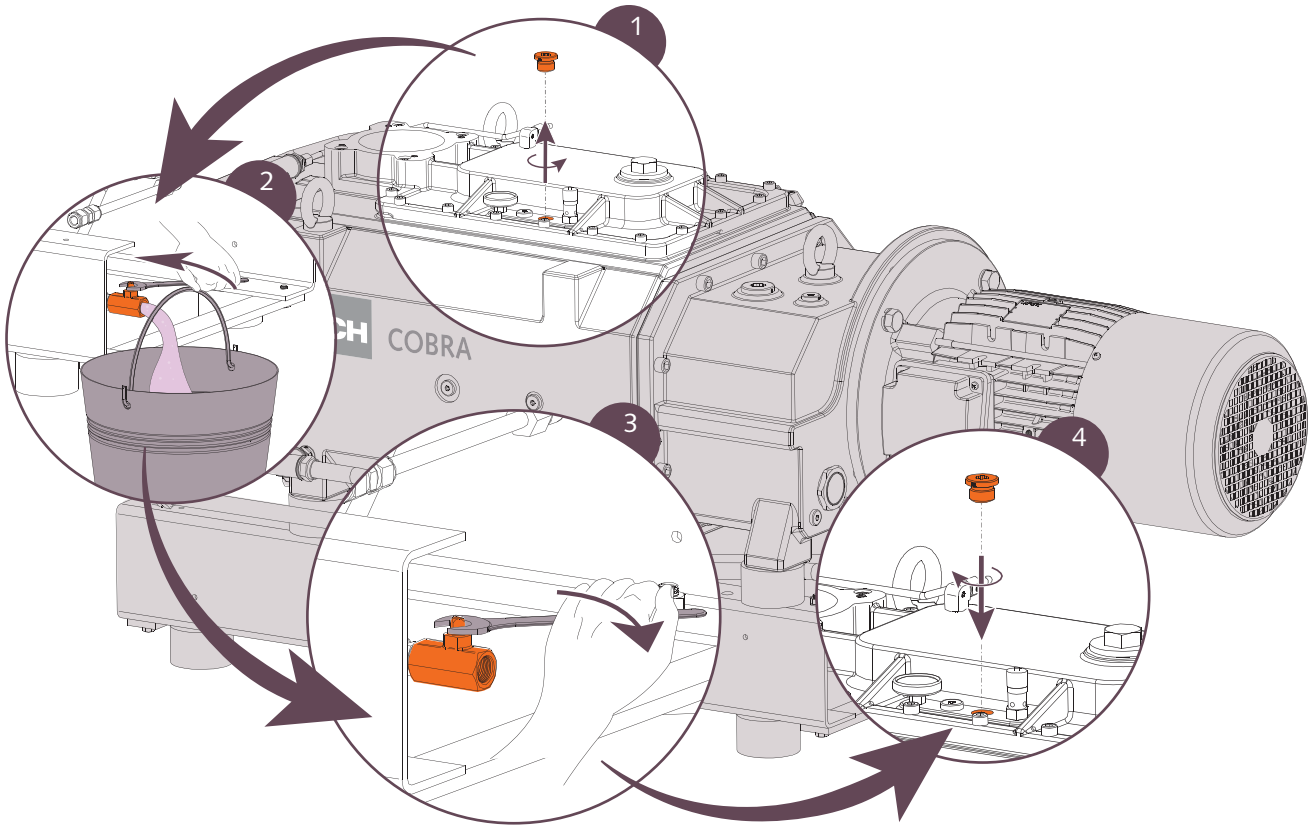
- Write down the oil change date on the sticker.



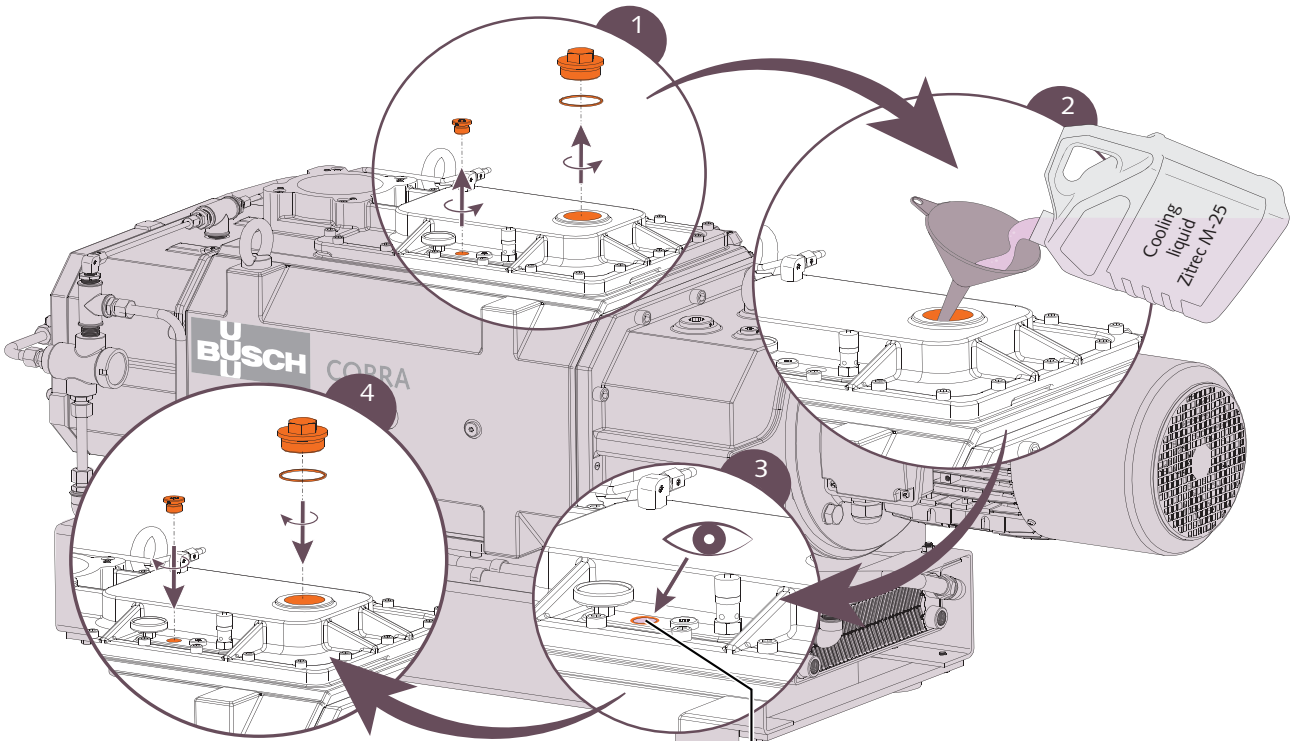
If there is no sticker on the pump:

- Order it from your Busch representative.

7.6 Cooling Liquid Change



For cooling liquid type and cooling liquid capacity see Technical Data [▶ 44] and Cooling Liquid [▶ 44].



Fill up to the top of the vent orifice

7.7 Calibration Procedure of the Electrical Devices

7.7.1 Procedure A

- Remove the resistance thermometer from the machine.
- Check it with a calibrated oven or send it to an approved laboratory for inspection.
- Reassemble the resistance thermometer on the machine.

7.7.2 Procedure B

- Remove the pressure switch from the machine.
- Compare it with another calibrated pressure switch or send it to an approved laboratory for inspection.
  It must trip when the pressure reaches the prescribed trip value.
- Reassemble the pressure switch on the machine.

7.7.3 Procedure C

- Remove the pressure transmitter from the machine.
- Compare it with another calibrated pressure transmitter or send it to an approved laboratory for inspection.
- Reassemble the pressure transmitter on the machine.

7.7.4 Procedure D

- Remove the vibration sensor from the machine.
- Control it with a calibration system or send it to:
  Ateliers Busch S.A.
  Zone Industrielle
  CH-2906 Chevenez
- Reassemble the vibration sensor on the machine.
- Perform a test of the control loop by disconnecting output 1 and 2.

7.7.5 Procedure E

- Check that the flow switch changes state when the ball of the flowmeter is passing. It is not necessary to disassemble the flowmeter or its switch.

7.7.6 Procedure F

- Check that the level switch changes state by using the test magnet.
- Hold the test magnet against the “target” marking.
- Make sure that the switching status is changed.
- Read the instruction manual of the level switch for more information.

7.7.7 Procedure G

- Check that the solenoid valve changes state by electrical supply.
- Perform a visual inspection of the solenoid valve sealing by means of the flow meter in order to ensure that the device is still gas tight.

7.7.8 Procedure H

- Check that the solenoid valve changes state by electrical supply.
- Perform a visual inspection of the solenoid valve sealing and ensure that there is no liquid leak.

8 Overhaul

NOTICE

Improper assembly.

Risk of premature failure!

Loss of efficiency!

- It is highly recommended that any dismantling of the machine that goes beyond anything that is described in this manual should be done through Busch.

⚠ WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

In case of the machine having conveyed gas that was contaminated with foreign materials which are dangerous to health:

- Decontaminate the machine as well as possible and state the contamination status in a 'Declaration of Contamination'.

Busch will only accept machines that come with a completely filled in and legally binding signed 'Declaration of Contamination'.
(Form downloadable from www.buschvacuum.com)

9 Decommissioning

- Shut down the machine and lock against inadvertent start up.
- Turn off the water supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.

- Vent the connected lines to atmospheric pressure.
- Disconnect all connections.

If the machine is going to be stored:

- See Storage [▶ 13].

9.1 Dismantling and Disposal

- Drain the oil.
- Drain the cooling liquid.
- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.

10 Spare Parts

There is no standard spare parts kits available for this product, if you require Busch genuine parts:

- Contact your Busch representative for the detailed spare parts list.

11 Troubleshooting

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	• Check the power supply.
	The rotors are jammed or seized.	• Turn the screw rotors manually from the rotor access plug (PMR). • Repair the machine (contact Busch).
	Solid foreign matter has entered the machine.	• Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet filter if necessary.
	The temperature switch (TS) reached the switch point.	• Let the machine cool down. • See problem "The machine runs too hot".
	Corrosion in the machine from remaining condensate.	• Repair the machine. • Check the process and follow the recommendation in case of Conveying Condensable Vapours [▶ 32].
	The motor is defective.	• Replace the motor.
The machine does not reach the usual pressure on the suction connection.	Suction or discharge lines too long or section diameter too small.	• Use larger diameter or shorter lines. • Seek advice from your local Busch representative.
	Process deposits on the pumping components	• Flush the machine.
	If an inlet screen or an inlet filter is installed, it can be partially clogged.	• Clean the inlet screen or replace the inlet filter cartridge.
	The machine runs in the wrong direction.	• Check the direction of rotation, see Wiring Diagram Three-Phase Motor.
	Internal parts are worn or damaged.	• Repair the machine (contact Busch).
The machine runs very noisily.	Wrong oil quantity or unsuitable oil type.	• Use one of the recommended oils in the correct quantity, see Oil [▶ 44].
	Defective gears, bearings or coupling element.	• Repair machine (contact Busch).

The machine runs too hot.	Insufficient cooling.	• Make sure to comply with the cooling water requirements, see Cooling Water Connection [▶ 16].
	Ambient temperature too high.	• Observe the permitted ambient temperature, see Technical Data [▶ 44].
	Temperature of the process gases at the inlet too high.	• Observe the permitted gas inlet temperature, see Technical Data [▶ 44].
	The cooling water pump is defective.	• Repair the machine.
	Oil level too low.	• Top up oil.
The oil is black.	Oil change intervals are too long.	• Drain the oil and fill in new oil, see Oil Change [▶ 35].
	The machine runs too hot.	• See problem "The machine runs too hot".

For the solution of problems not mentioned in the troubleshooting chart contact your Busch representative.

12 Technical Data

		NC 0600 C	NC 0630 C
Pumping speed (50Hz / 60Hz)	m³/h	600 / 600	630 / 630
Ultimate pressure (without gas ballast)	hPa (mbar) abs.	≤0.01	
Ultimate pressure (with gas ballast)	hPa (mbar) abs.	≤0.1	
Nominal motor rating (50Hz / 60Hz)	kW	18.5 / 18.5	15 / 17
Nominal motor speed (50Hz / 60Hz)	min^{-1}	3000 / 3600	
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤74 / ≤76	≤70 / ≤75
Ambient temperature range	°C	5 … 40	
Max. allowable counter pressure at the discharge	hPa (mbar)	200	
Max. allowable gas inlet temperature	°C	70	
Relative humidity	at 30 °C	90%	
Ambient pressure		Atmospheric pressure	
Cooling water requirements		See Cooling Water Connection [▶ 16]	
Oil capacity - motor side	l	1.7	
Oil capacity - suction side	l	0.6	
Cooling liquid capacity approx.	l	29	
Weight approx.	kg	600	

13 Cooling Liquid

	Zitrec M-25 (ready-to-use)
Part number 5 L packaging	0831 563 469
Part number 25 L packaging	0831 563 468

The cooling liquid Zitrec M-25 is ready-to-use and does not require additional water.

For further information, consult the website www.arteco-coolants.com.

14 Oil

	VE 101
ISO-VG	100
Part number 1 L packaging	0831 000 099
Part number 5 L packaging	0831 000 100

15 EU Declaration of Conformity

This Declaration of Conformity and the CE-mark affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer. When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-mark.

The manufacturer

Ateliers Busch S.A.
Zone Industrielle
CH-2906 Chevenez

declare that the machine(s) **COBRA 'ATEX' NC 0600 C; NC 0630 C**

with the serial number:

has (have) been manufactured in accordance with the European Directives:

- 'Machinery' 2006/42/EC
- 'ATEX Directive' 2014/34/EU, for use in potentially explosive areas according to classification written on the machine nameplate
- 'Electromagnetic Compatibility' 2014/30/EU
- 'RoHS' 2011/65/EU, restriction of the use of certain hazardous substances in electrical and electronic equipment

and following the standards.

Standard	Title of the Standard
EN ISO 12100:2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857:2008	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-1:2010	Compressors and vacuum pumps - Safety requirements - Part 1 and Part 2
EN 1012-2:1996 + A1:2009	
EN ISO 2151:2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN 61000-6-4:2007 + A1:2011	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
EN ISO 13849-1:2015 (1)	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 13463-1:2009	Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic methodology and requirements
EN 13463-5:2011	Non-electrical equipment for potentially explosive atmospheres - Part 5: Protection by constructional safety "c"
EN 13463-6:2005	Non-electrical equipment for potentially explosive atmospheres - Part 6: Protection by control of ignition source "b"
EN 1127-1:2011	Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology

Person authorised to compile the technical file:

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Chevenez, 12.01.2017

Christian Hoffmann, General director

(1) In case control systems are integrated.

Note

Note

Busch Vacuum Pumps and Systems

All over the World in Industry

Argentina
www.busch-vacuum.com.ar

Australia
www.busch.com.au

Austria
www.busch.at

Belgium
www.busch.be

Brazil
www.buschdobrasil.com.br

Canada
www.busch.ca

Chile
www.busch.cl

China
www.busch-china.com

Colombia
www.buschvacuum.co

Czech Republic
www.buschvacuum.cz

Denmark
www.busch.dk

Finland
www.busch.fi

France
www.busch.fr

Germany
www.busch.de

Hungary
www.buschvacuum.hu

India
www.buschindia.com

Ireland
www.busch.ie

Israel
www.busch.co.il

Italy
www.busch.it

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www.busch.co.jp

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www.busch.no

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Russia
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www.buschiberica.es

Sweden
www.busch.se

Switzerland
www.busch.ch

Taiwan
www.busch.com.tw

Thailand
www.busch.co.th

Turkey
www.buschvacuum.com

United Arab Emirates
www.busch.ae

United Kingdom
www.busch.co.uk

USA
www.buschusa.com

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