Control and feedback systems

GEA T.VIS® M-20 FDD

Operating instruction (Translation from the original language)

430BAL014475EN_3

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1 General Information

1.1 Information on the Document

The present Operating Instructions are part of the user information for the product. The Operating Instructions contain all the information you need to transport, install, commission, operate and carry out maintenance for the product.

1.1.1 Binding Character of These Operating Instructions

These Operating Instructions contain the manufacturer's instructions to the operator of the product and to all persons who work on or use the product regarding the procedures to follow.

Carefully read these Operating Instructions before starting any work on or using the product. Your personal safety and the safety of the product can only be ensured if you act as described in the Operating Instructions.

Store the Operating Instructions in such a way that they are accessible to the operator and the operating staff during the entire life cycle of the product. When the location is changed or the product is sold make sure you also provide the Operating Instructions.

1.1.2 Notes on the Illustrations

The illustrations in these Operating Instructions show the product in a simplified form. The actual design of the product can differ from the illustration. For detailed views and dimensions of the product please refer to the design documents.

1.1.3 Symbols and Highlighting

In these Operating Instructions, important information is highlighted by symbols or special formatting. The following examples illustrate the most important types of highlighting.

Danger

Warning: Fatal Injuries

Failure to observe the warning can result in serious damage to health, or even death.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Warning: Explosions

Failure to observe the warning can result in severe explosions.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Warning!

Warning: Serious Injuries

Failure to observe the warning can result in serious damage to health.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Caution!

Warning: Injuries

Failure to observe the warning can result in minor or moderate damage to health.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Notice

Warning: Damage to Property

Failure to observe the warning can result in serious damage to the component or in the vicinity of the component.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Carry out the following steps: = Start of a set of instructions.

1. First step in a sequence of operations.
2. Second step in a sequence of operations.

   → Result of the previous operation.

→ The operation is complete, the goal has been achieved.

Hint!

Further useful information.

1.2 Manufacturer address

GEA Tuchenhagen GmbH
Am Industriepark 2-10
21514 Büchen

1.3 Contact

Tel.:+49 4155 49-0
Fax:+49 4155 49-2035

flowcomponents@gea.com
www.gea.com

1.4 EU Declaration of Conformity

EU Declaration of Conformity

Manufacturer: **GEA Tuchenhagen GmbH**
Am Industriepark 2-10
21514 Büchen, Germany

We hereby declare that the devices named below

Model:	Control Top T.VIS M-20
Type:	24 VDC AS-i

due to their design and construction as well as in the versions sold by us, meet the basic safety and health requirements of the following guideline:

Relevant EC directives:	2014/30/EU 2011/65/EU	EMC RoHS
Applicable harmonized standards, in particular:	EN IEC 61000-6-2: 2019 DIN EN 61000-6-4: 2011-09 DIN EN 61326-1:2013#	
Other applied standards and technical specifications:	EN 62026-2: 2013	

Remarks:

- The above mentioned standards have been taken into account in accordance with the respective scope of application

Person authorised for compilation and handover of technical documentation:

GEA Tuchenhagen GmbH
CE Documentation Officer
Am Industriepark 2-10
21514 Büchen, Germany

Büchen, 26 August 2021

Franz Bürmann
Managing Director

Matthias Südel
Head of Engineering

1.5 Translated copy of the EU Declaration of Conformity

Manufacturer:	**GEA Tuchenhagen GmbH** **Am Industriepark 2-10** **21514 Buchen, Germany**

We hereby declare that the devices named below

Model:	Control top T.VIS M-20
Type:	24 VDC AS-i

due to their design and construction as well as in the versions sold by us, meet the basic safety and health requirements of the following guideline:

Relevant EC directives:	2014/30/EU EMC 2011/65/EU RoHS
Applicable harmonized standards, in particular:	EN IEC 61000-6-2: 2019 DIN EN 61000-6-4: 2011-09 DIN EN 61326-1:2013
Other applied standards and technical specifications:	EN 62026-2: 2013

Remarks:

- The standards stated have been taken into consideration according to the respective application area.

Person authorised for compilation and handover of technical documentation:	**GEA Tuchenhagen GmbH** **CE Documentation Officer** **Am Industriepark 2-10** **21514 Büchen, Germany**

Büchen,

Franz Bürmann
Managing Director

i.V. Matthias Südel
Head of Engineering

2 Safety

2.1 Intended use

The control top T.VIS M-20 FDD can be used for the pneumatic and electrical connection of Tuchenhagen FDD process valves with VARIVENT adaptation. Using the device for any other purpose is considered contrary to its designated use.

The control top T.VIS M-20 FDD is available as

- without solenoid valve as position indicator
- with 1 solenoid valve as control top

The control top T.VIS M-20 FDD is completely installed on the dedicated actuator/adapter of the process valve by means of a clamp connection. The control top is able to feed air to the process valve externally through an air hose.

With T.VIS M-20 FDD the following can be carried out for all valves:

- monitoring the non-actuated position of the valve disk,
- monitoring the actuated position of the valve disk,
- coloured visualization of the valve position and status via the illuminated dome fitted on the control top.

The control top T.VIS M-20 FDD may not be used in areas where an explosion protection approval is required (e.g. ATEX, IECEx, CCCEx, HazLoc and other).

For a suitable control top with explosion protection approval (e.g. ATEX, IECEx, CCCEx, HazLoc and other), please contact GEA Tuchenhagen at flowcomponents@gea.com.

Hint!

The manufacturer will not accept any liability for damage resulting from any use of the valve which is not in accordance with the designated use of the valve. The risk is borne solely by the operating company.

2.1.1 Requirements for operation

The prerequisite for reliable and safe operation of the component is proper transportation and storage as well as professional installation and assembly. Operating the unit within the limits of its designated use also involves adhering to the operating, inspection and maintenance instructions.

2.1.2 Improper operating conditions

The operational safety of the component can not be guaranteed under improper operating conditions. Therefore avoid improper operating conditions.

The operation of the component is not permitted if:

- Persons or objects are in the danger zone.
- Safety devices are not working or were removed.
- Malfunctions have been detected on the component.

- Damage to the component has been detected.
- Maintenance intervals have been exceeded.

2.2 Operator’s Duty of Care

The operating company of the component has a special responsibility for the proper and safe handling of the component within their company. Only use the component when it is in perfect operating condition in order to prevent danger to persons and property.

This operating manual contains information that you and your employees need for safe operation over the life of the component. Be sure to read these Operating Instructions carefully and ensure that the measures described here are observed.

The operator's duty of care includes planning the necessary safety measures and monitoring that these measures are observed. The following principles apply:

- Only qualified personnel may work on the component.
- The operating company must authorize personnel to carry out the relevant tasks.
- Order and cleanliness must be maintained at the work stations and in the entire area surrounding the component.
- Personnel must wear suitable work clothing and personal protective equipment. As the operating company must ensure that work clothing and personal protective equipment are used.
- Inform personnel regarding any properties of the product which might pose a health risk and the preventative measures to be taken.
- Have a qualified first-aid representative on call during the operation. This person must be able to initiate any necessary first-aid measures in case of an emergency.
- Clearly define procedures, competences and responsibilities for those working in the area of the component. Everybody must know what to do in case of an emergency. Instruct the staff in this respect at regular intervals.
- The signs on the component must always be complete and easy to read. Check, clean and replace the signs as necessary at regular intervals.
- Observe the Technical Data specified and the limits of use!

Hint!

Carry out regular checks. This way you can ensure that these measures are actually observed.

2.3 Subsequent changes

No technical modifications should ever be made to this component. Otherwise you will have to undergo a new conformity process in accordance with the EC Machinery Directive on your own.

In general, only original spare parts supplied by GEA Tuchenhagen GmbH should be fitted. This ensures that the component is always operating properly and efficiently.

2.4 IP Protection classes

The control top T.VIS M-20 FDD in its standard version fulfils the requirements of protection class IP66, IP 67 and IP69 (DIN EN 60529) and protection class IP6k9k (ISO 20653).

IP classes provide information about the degree of protection an electrical device housing provides against the ingress of solids (first digit) or humidity (second digit). So-called IP codes are assigned to the protected systems. Its digits represent common possible errors the system is protected from. The code always starts with the letter IP for “international protection”.

First digit *		**Meaning**	
ISO 20653	**DIN EN 60529**	**Protection against contact**	**Protection against solids**
6k	6	Complete contact protection	Complete protection against dust ingression (dustproof)
Second digit *		**Meaning**	
ISO 20653	**DIN EN 60529**	**Protection against humidity**	
5	5	Protected against water jet (nozzle) from any angle	
6	6	Protected against powerful water jets	
6k		Protected against powerful water jets under increased pressure	
7	7	Protected against temporary immersion	
	9	Protected against high pressure spray downs	
9k		Protected against high pressure spray downs	
* For additional digits and more detailed descriptions please refer to the pertinent standard.			

Digits not to be mentioned can be replaced by the letter x (e. g. IPx6). Concerning the ingress of humidity, IPx6 includes all lower IP classes. This is, however, not the case for the higher protection class IPx7!

Hint!

The specified IP classes only apply if the connectors are connected correctly, if the cable gland is properly sealed and if the control top is fitted on the valve, see Chapter 6, Page 29.

2.5 General safety instructions and dangers

The component is safe to operate. It was built according to state-of-the-art science and technology.

Nevertheless, dangers can arise from the component, if:

- the component is not used as intended
- the component is used improperly
- the component is operated under impermissible conditions

2.5.1 Principles for safe operation

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the staff.

To ensure safe operation of the valve the following principles apply:

- The Operating Instructions must be kept ready to hand at the valve's place of use. They must be complete and in clearly legible form.
- Only use the valve for its intended use.
- The valve must be functional and in good working order. Check the condition of the valve before starting work and at regular intervals.
- Wear tight-fitting work clothing for all work on the valve.
- Ensure that nobody can get hurt on the parts of the valve.
- Immediately report any faults or noticeable changes on the valve to the person responsible.
- Never touch the pipes and the valve when these components are hot! Avoid opening the valve unless the process plants have been emptied and depressurised.
- Observe the accident prevention regulations and all local regulations.

2.5.2 Environmental Protection

Harm to the environment can be avoided by safety-conscious and proactive behaviour of the staff.

For environmental protection the following principles apply:

- Substances harmful to the environment must not be discharged into the ground or the sewage system.
- Always observe the pertinent regulations relating to waste avoidance, disposal and utilization.
- Substances harmful to the environment must be collected and stored in suitable containers. Clearly mark the containers.
- Dispose of lubricants as hazardous waste.

2.5.3 Electrical Equipment

For all work on electrical equipment, the following principles apply:

- Access to electrical equipment should only be allowed to qualified electricians. Always keep unattended switch cabinets locked.
- Modifications of the control system can affect the safe and reliable operation. Modifications are only permitted with the express permission of the manufacturer.
- After completion of all work, check that the protective devices are fully functional.

2.6 Supplementary Regulations

In addition to the instructions in this documentation the following also has to be observed:

- pertinent accident prevention regulations,
- generally accepted safety rules,
- national regulations applicable in the country of use,
- work and safety instructions applicable in the facility,
- installation and operating regulations for use in potentially explosive areas.

2.7 Qualification of personnel

This section provides information on how the personnel working on the component must be trained.

Operating and maintenance personnel must

- have the necessary qualification to carry out their tasks,
- be instructed with regard to possible dangers,
- know and observe the safety instructions given in the documentation.

Only allow qualified electricians to carry out work on the electrical equipment or have a qualified electrician supervise the work.

Only allow specially trained personnel to carry out work on an explosion-protected system. When working on explosion-protected equipment observe the standards DIN EN 60079-14 for gases and DIN EN 50281-1-2 for dusts.

The following minimum qualifications are required:

- Training as a specialist for working independently on the component.
- Adequate instruction to work on the component under the supervision and guidance of a trained specialist

Each employee must meet the following requirements to work on the component:

- Personal suitability for the respective task.
- Sufficient professional qualification for the respective task.
- Received instruction about the functionality of the component.
- Received instruction about operating sequences on the component.
- Familiar with the safety devices and their function.
- Familiar with these Operating Instructions, especially with the safety instructions and the information which is relevant for the task on hand.
- Familiar with the basic regulations with regard to occupational health and safety and accident prevention.

When working with the component, a distinction is made between the following user groups:

User groups	
Staff	**Qualifications**
Operating personnel	Adequate instruction and sound knowledge in the following areas: • Functionality of the component • Operating sequences on the pump • What to do in case of an emergency • Lines of authority and responsibilities with respect to the task
Maintenance personnel	Appropriate training and a sound knowledge of the structure and functionality of the component. Sound knowledge in the following areas: • Mechanical equipment • Electrical equipment • Pneumatic system Authorization with regard to safety engineering standards to carry out the following tasks: • Setting devices into operation • Earthing of devices • Marking of devices The relevant certificates of qualification must be submitted before work can be carried out on ATEX certified machines.

2.8 Safety equipment

2.8.1 Signs

Dangerous points on the control top are indicated by warning signs, prohibition signs and mandatory signs.

The signs and notes on the control top must always be legible. Any illegible signs must be replaced immediately.

Signs on the control top	
Sign	**Meaning**
 Fig.1	General hazard warning
 Fig.2	Warning Crushing

2.9 Residual dangers

Dangerous situations can be avoided by safety-conscious and proactive behaviour of the personnel and by wearing personal protective equipment.

Residual dangers on the control top and measures		
Danger	**Cause**	**Measure**
Danger to life	Inadvertent switch-on of the control top	Effectively disconnect all components, effectively prevent switch-on.
	Electric power	Observe the following safety rules: 1. Isolate from the power supply. 2. Take appropriate measures to prevent switch on. 3. Test absence of voltage. 4. Earthing and short-circuiting. 5. Cover or safeguard any adjacent live parts.
Damage to property	Welding can cause damage to the electronics or result in data loss.	Do not carry out any welding work in the vicinity of the control top or make sure electronics are properly protected.

2.9.1 Electrostatically Endangered Components and Modules

The control top contains electronic components that are sensitive to electrostatic discharge (ESD). Contact with electrostatically-charged persons or objects can endanger these components. In the worst case they are destroyed immediately or fail after being put into operation.

To minimize or prevent the possibility of damage resulting from sudden electrostatic discharge,

- observe the requirements of DIN EN 61340-5-1 and 5-2,
- be careful not to touch the electronic components,
- also take care not to touch electronic components when supply voltage is present.

Use ESD-compliant packaging when returning electronic components. (Contact GEA Tuchenhagen if you have any questions.)

2.10 Danger zones

Please observe the following notes:

- In the event of malfunctions, shut down the control top (disconnect from the power and air supply) and secure it against being used.
- Before starting any service, maintenance or repair work, disconnect the control top from the power supply and secure it against inadvertently being switched back on again.
- Only allow a qualified electrician to carry out any work on the electrical power supply.
- Check the electrical equipment of the control top at regular intervals. Immediately remedy loose connections and molten cables.
- If work on live parts cannot be avoided, call in a second person, who can operate the main switch in case of an emergency.

3 Description

3.1 Design

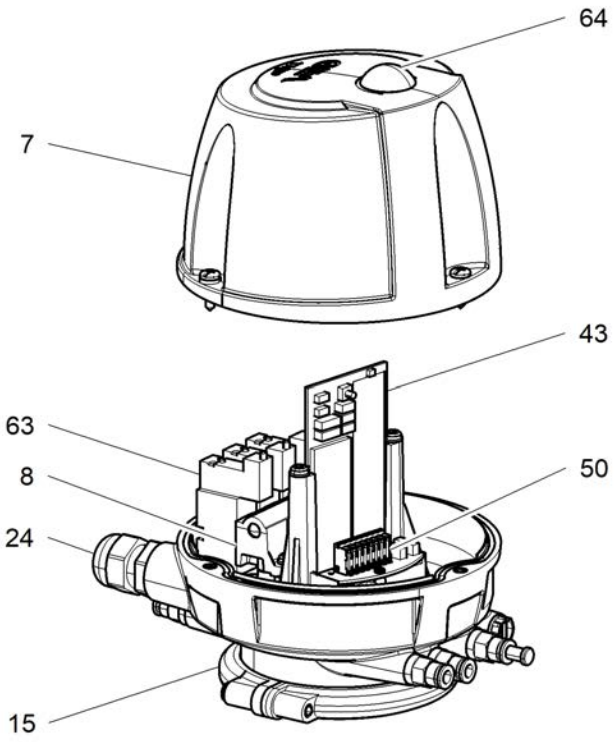

Fig.3

No.	Designation	No.	Designation
7	Cap	43	Sensor module
8	Pneumatic block	50	Terminal strip unit
15	Clamp connection	63	Solenoid valves
24	Cable gland	64	Status light-emitting diode

The control top T.VIS M-20 FDD consists of:

- a 24 V DC sensor module for the detection of the two valve actuated positions,
- a terminal strip unit for the switch-on type 24 V DC,
- a maximum of one solenoid valve for the actuation of the main stroke.

Sensor module structure

Printed circuit board switch-on type 24 VDC

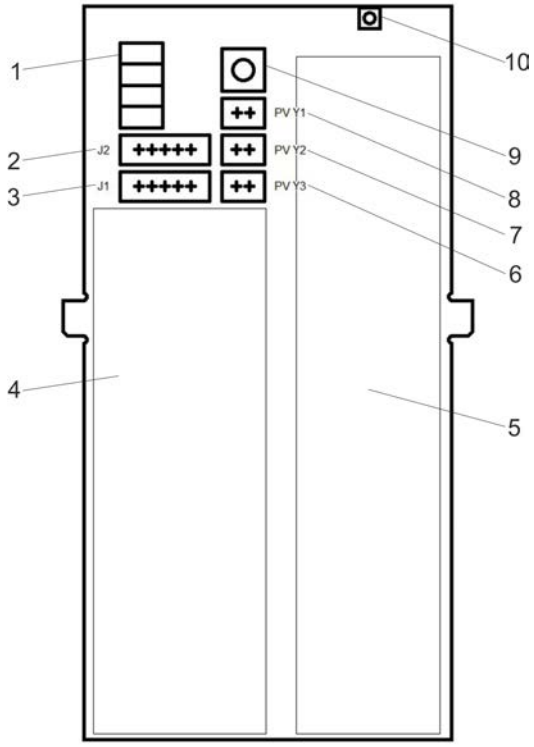

Fig.4

1	DIP switch
2	J2
3	J1
4	Electronics
5	Measuring track
6	PV Y3
7	PV Y2
8	PV Y1
9	Reset
10	LED

3.2 Functional description

3.2.1 Operation Principle

The control top T.VIS M-20 FDD works with a microprocessor that contains the software for operation, visualization and intelligent position detection.

The valve stroke is detected by a contactless position measuring system integrated in the control top and the information is supplied to the microprocessor.

Pneumatic and electronic components are located inside the control top. The pneumatic components in this case are solenoid valves, the number of which varies between 0 and 1, depending on the intended purpose. Control air is supplied to the relevant control air chambers via air connections at the outside of the control top. On the VARIVENT valve FDD, the main control air is supplied to the actuator via a separate air connection on the control top through a hose.

The main task of the 24V DC sensor module with its integrated path measuring system is to determine the valve position on the basis of the position of the valve stem and to generate the corresponding feedback signals for this position in order to send them to a higher-level control system.

Due to the illuminated dome integrated in the hood of the control top the light emitting diodes arranged on the sensor module can be seen even if the hood is closed. The light-emitting diode allows visualisation of the remaining functions of the valve, see Section 6.5, Page 32.

3.2.2 Control top without solenoid valves

The control top T.VIS M-20 FDD without solenoid valves works as a position indicator. During and after SETUP it indicates the status of the process valve locally by a coloured LED under the illuminated dome so that it is visible over a long distance.

The position feedback signals are supplied to the user by means of the following communication method:

- 24V DC PNP switching output

3.2.3 Control Top with Solenoid Valves

The control top with solenoid valves acts as a control top. The signalling takes place in the same way as with the control top without solenoid valves. with the difference being that the solenoid valve integrated in the base is operated in accordance with the control signals.

The control signals are given by the user's process control system or by operating the solenoid valves manually. To do this, use a screwdriver to turn the screw (S) from 0 to 1, see figure.

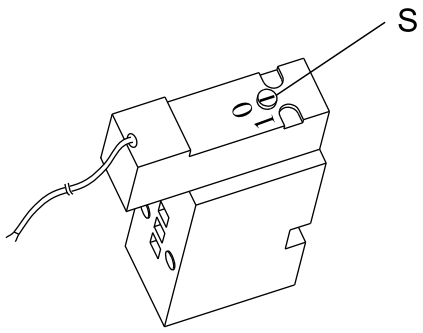

Fig.5

3.2.4 Control Top with Cap

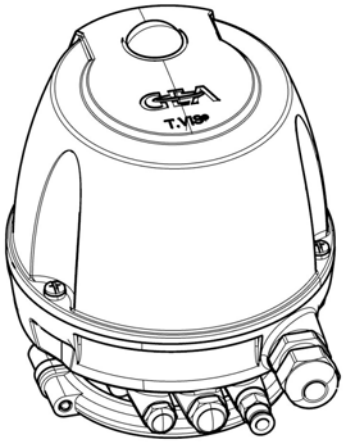

Fig.6: Control Top with Cap

The control top T.VIS M-20 FDD in its standard version fulfils the requirements of protection class IP66, IP67 and IP69 (DIN EN 60529) and protection class IP6k9k (ISO 20653).

3.2.5 Safety Air Exhaust/Installation Position

To provide protection against excess pressure which can build up in the inside of the control top, a vent plug (E2) is fitted in the base.

In operating mode, the exhaust air from the lifting actuators is discharged via this vent plug. In the unlikely event of a damaged solenoid valve or in case of sealing problems, pressure relief is ensured.

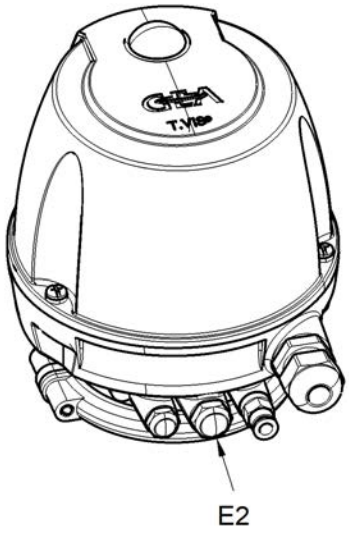

Fig.7: Control Top with Cap

This vent plug is a safety device that must be handled as such. Do not cover the vent plug. When fitting the control top note that the installation position of the vent plug (E2) must never be pointing vertically upwards.

3.2.6 Reset function

In order to change saved positions (e.g. after seal replacement), the saved positions have to be deleted (reset). The reset button must be pressed for 3 – 7 sec. for this.

- Reset function is only possible live.
- After the button has been pressed for 3 seconds, the reset is initiated and the LED goes off.
- The actual reset is carried out as soon as the button is released. This must take place within 4-7 seconds of pressing.
- If the reset switch is not released after 7 seconds, no reset takes place and the previously learnt actuated and non-actuated positions are retained and/or normal mode is resumed. It is irrelevant how long the reset switch is pressed.
- The learning process starts automatically 1-2 seconds after reset

→ Red steady light for 1-2 seconds. The LED flashes red until the signal of the non-actuated position is recorded.

- Learning process completed

→ Steady light green (with DIP1=0) with additional flashing of the yellow LED (green 750 ms/ yellow 250 ms) or yellow steady light (with DIP1=1) with additional flashing of the green LED (yellow 750 ms/ green 250 ms).

Position of the non-actuated position within the tolerance is signalled with the LED as steady light in accordance with tab. 1 and 2, or as described before! As long as the actuated position has not been saved, the position of the non-

actuated position is signalled within the tolerance with the LED as steady light and additional flashing of the LEDs in accordance with Tab. 1 and 2, or as described before.

Activate solenoid valve Y1 for main stroke (activate by operating the manual override device or by actuation of the higher-order control). Learning is completed when actuated and non-actuated position have been detected and learnt. If voltage is only switched off with one learnt position, the position already learnt is discarded. If the actuated and non-actuated positions have been detected and learnt, the saved positions are retained when the device is switched back on again following disconnection of the voltage supply. If the positions of the non-actuated and actuated position are saved, the detection of every position outside the position tolerance is signalled by the yellow or green LED flashing, see Deactivate the solenoid valve.

Observe the general instructions regarding ESD protection.

4 Transport and storage

4.1 Storage conditions

You must first dry and preserve the control top to prevent damage if the control top is exposed to temperatures ≤ 0°C during transport or storage.

Hint!

We recommend that the valve should be stored at a temperature of ≥ 5 °C for a period of 24 hours prior to any handling (disassembling the housings / activation of actuators) so that any ice crystals formed by condensation water can melt.

4.2 Transport

For transport, the following principles apply:

- Only use suitable lifting gear and slings for transporting the package units/ control tops.
- Observe the pictograms on the package.
- The synthetic materials of the control tops are susceptible to breaking. Take care when transporting the control top. Do not grip sensitive parts of the unit to lift or push the unit or to support yourself.

4.2.1 Scope of supply

After taking delivery of the component, check if

- the details on the type plate correspond to the data in the order and delivery documents,
- the equipment is complete and all components are in good order.

5 Technical data

5.1 Type plate

The type plate is used to uniquely identify the control top.

Fig.8: Type plate on control top (optional:UL/CSA marking)

Code/Type	TM20	P	8	B	A	Z
Item in the order code	14	15	16	17	18	19

Explanation of the items in the order code		
Item in the order code	**Designation**	**Explanation**
14	**Feedback location**	
	T M 20	Control top T.VIS M-20
15	**Control top type**	
	N	without solenoid valve
	P	1 solenoid valve Y1
16	**Feedback**	
	8	2 digital feedback signals
17	**Type of interface/mode**	
	B	24 V DC, 3-wire, PNP
18	**Solenoid valve**	
	A	24 V DC 0.85 W
	0	without
19	**Screw connection**	
	Z	Air connection Inch, 0.5" NPT cable gland
Options	/50	Metal plate engraved (valve no.)
	/51	Metal plate US version (valve no.)

Explanation of the items in the order code		
Item in the order code	**Designation**	**Explanation**
	/52	Adhesive plate (valve no.)
	/UC	Certification UL/CSA For indoor use

5.2 Technical data

Refer to the following tables for the key technical data of the control top:

Technical data: temperatures and compressed air supply	
Designation	**Description**
Ambient temperature	-20 to +55 °C
Control air	acc. to ISO 8573-1:2010
- Solid particle content:	Quality class 6 (recommended) Particle size max. 5 µm Part density max. 5 mg/m3
- Water content:	Quality class 4 max. dew point +3 °C If the unit is used at higher altitudes or at low ambient temperatures, the dew point must be adapted accordingly.
- Oil content:	Quality class 3 preferably oil free, max. 1 mg oil to 1 m^3 air
Air hose	
- Inch	Material PA Outside Ø 6.35 mm Inside Ø 4.3 mm
Control air pressure	max 8 bar, min 2 bar
Sound pressure level using sound absorber	max. 72 dB

Technical data: materials	
Designation	**Description**
Housing	PA 12/L
Seals	FKM and NBR

Technical data: electrical specifications	
Designation	**Description**
Protection class ISO 20653	IP69k - high pressure
Fitting position	Restriction through ventilation E2: Never direct ventilation (E2) vertically upwards
EC EMC directives	2014/30/EU
Immunity for industrial environments Radio frequency interference	EN 61000-6-2: 2005 EN ISO 61000-6-4:2007 + A1: 2011
EC Low Voltage Directive	73/23/EEC
Electrical wiring configuration	– Terminal strip

Hint!

Switching point tolerances, see Section 5.4, Page 27

5.3 Specification sensor module 24V DC Version

Type designation: 221-589,108

Technical data: supply	
Designation	**Description**
Supply voltage UV	24 V DC (+20 % … -25 %)
Current consumption	
– No-load current – per solenoid valve NC – max. load of the feedback 50 mA	≤ 30 mA 35...45 mA 50 mA
Total	approx. 125 mA

Technical data: outputs	
Designation	**Description**
Output voltage	High = UV - ≤ 1 V Low = ≤ 5 V
Max. current per output	100 mA short circuit proof
Switching frequency (ohmic + inductive loads ≤ 25 mH)	2 Hz

5.4 Switching point tolerances and signal output

5.4.1 Signal output

Hint!

Only use preset DIP switch configuration. Further positions lead to non-intended use.

Main stroke - signal output								
Pilot valve actuation			Valve position	DIP switch	Illumination		Feedback	
PV Y1	PV Y2	PV Y3		1	Green	Yellow	S1	S2
0	0	0	not actuated	0	1	0	1	0
1	0	0	main stroke / stroke in S1 tolerance	0	1	0	1	0
1	0	0	Main stroke / stroke movement	0	0	1Hz	0	0
1	0	0	main stroke / stroke in S2 tolerance	0	0	1	0	1
0	0	0	main stroke / stroke in S2 tolerance	0	0	1	0	1
0	0	0	Main stroke / stroke movement	0	1Hz	0	0	0
0	0	0	not actuated	0	1	0	1	0

5.4.2 Signal output inverted

Main stroke - signal output inverted								
Pilot valve actuation			Valve position	DIP switch	Illumination		Feedback	
PV Y1	PV Y2	PV Y3		1	Green	Yellow	S1	S2
0	0	0	not actuated	1	0	1	0	1
1	0	0	main stroke / stroke in S2 tolerance	1	0	1	0	1
1	0	0	Main stroke / stroke movement	1	1Hz	0	0	0
1	0	0	main stroke / stroke in S1 tolerance	1	1	0	1	0
0	0	0	main stroke / stroke in S1 tolerance	1	1	0	1	0
0	0	0	Main stroke / stroke movement	1	0	1Hz	0	0
0	0	0	not actuated	1	0	1	0	1

5.5 Lubricants

Lubricants	Material no.
Rivolta F.L.G. MD-2	413-071
PARALIQ GTE 703	413-064

5.6 Equipment

Technical data - equipment	
Equipment	**Material no.**
Solenoid valve NC • 24 V DC (+20% / -12.5%), 0.85 W • Ambient temperature: -20...+60°C • Protection class IP 51 • Pressure range: 2.0...8.0 bar	512-169
Sound absorber G 1/8" • Filter material: stainless steel wool • Ambient temperature: -20...+70°C • max. pressure 10 bar	933-175
Sound absorber G 1/4" • Filter material: stainless steel wool • Ambient temperature: -20...+70°C • max. pressure 10 bar	933-174

6 Assembly and installation

6.1 Safety instructions

Hazardous situations during installation can be avoided by safety-conscious and proactive behaviour of the personnel.

For installation, the following principles apply:

- Only qualified personnel are allowed to set-up, install and commission the component.
- Ensure that adequate working and traffic areas are available at the place of installation.
- Observe the maximum load-bearing capacity of the installation surface.
- Observe the transport instructions and markings on the part(s) to be transported.
- Remove any nails protruding from transport crates immediately after opening the crate.
- Under no circumstances should anyone stand under a suspended load.
- Safety devices of the component may not work effectively during installation.
- Reliably secure sections of the plant which have already been connected against inadvertently being switched on.

6.2 Establishing hose connections

To ensure reliable operation, the compressed air hoses must be cut exactly at a right angle.

Tools required:

- Hose cutter

Carry out the following steps:

1. Shut off the compressed air supply.
2. Use the hose cutter to cut the pneumatic hoses at a right angle.
3. Push the air hose into the air connector (P) on the control top.
4. Re-open the compressed air supply.

→ Done.

Hint!

Avoid kinks in the pneumatic hoses!

6.3 Pneumatic connections

6.3.1 Control Top with 1 Solenoid Valve or Without Solenoid Valve

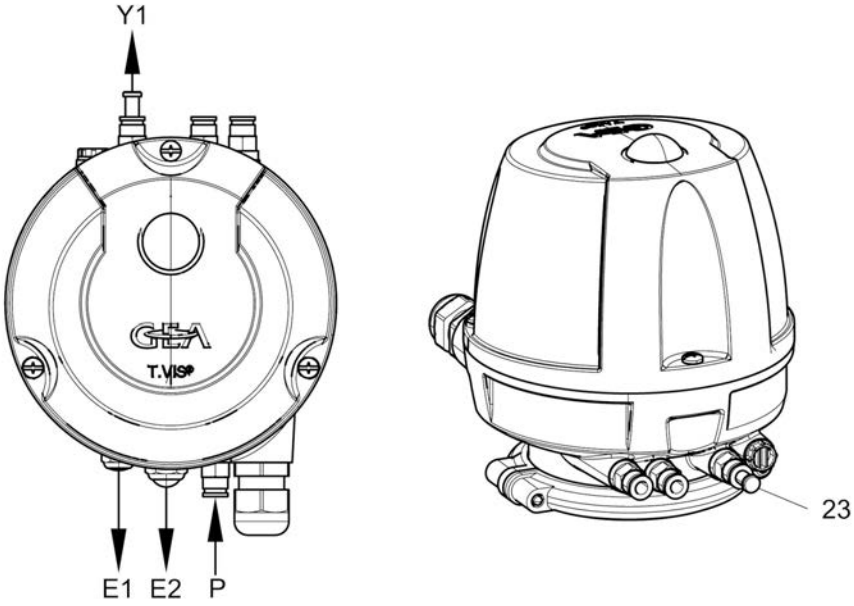

Fig.9

E1	Exhaust air of the main stroke Y1 (sound absorber) Connection E1 must not be closed!
E2	Safety vent against excess pressure Connection E2 must not be closed!
P	Central air supply with integrated filter
N	not used
Y1	Air connection for external main stroke connection
23	Plug Control air pressure can be present at the plugs for the air connections! Before removing a sealing plug (23), make sure that the respective air connection is pressure-free!

On the VARIVENT valve FDD, the main control air is supplied to the actuator via a separate air connection on the control top through a hose.

6.4 Electrical connections

Danger

To satisfy the UL requirements, use a protective insulation power-limited power supply according to UL/IEC 60950 or power limited according to UL/IEC 61010-1 3cd cl. 9.4 or a Class II power supply according to NEC.

►

6.4.1 Electrical 24V DC Wiring

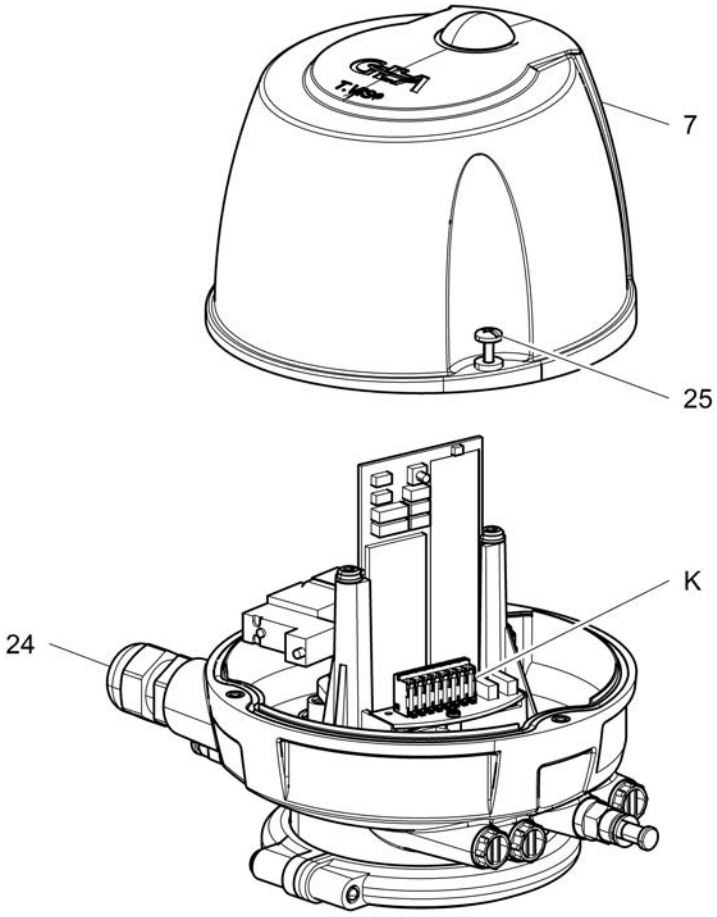

Fig.10

Danger

Only allow properly qualified staff to carry out work on the electrical equipment. Prior to establishing electrical connections check the maximum permissible operating voltage.

▶

Carry out the following steps:

1. Release the cheese head screws (25) and take off the cap (7).
2. Pass the cable (Ø6-12 mm) through the cable gland (24) and connect it to the terminals (K) in the control top in accordance with the wiring diagram. Use wires with ferrules, max. 1.5 mm².
3. Secure the cable in the cable gland at a torque of 2.5 Nm.

Hint!

The electrical cable must be long enough to allow the control top to be removed via the switch bar!

The cables must be suitable for use in the required temperature range!

24V DC Cable Gland

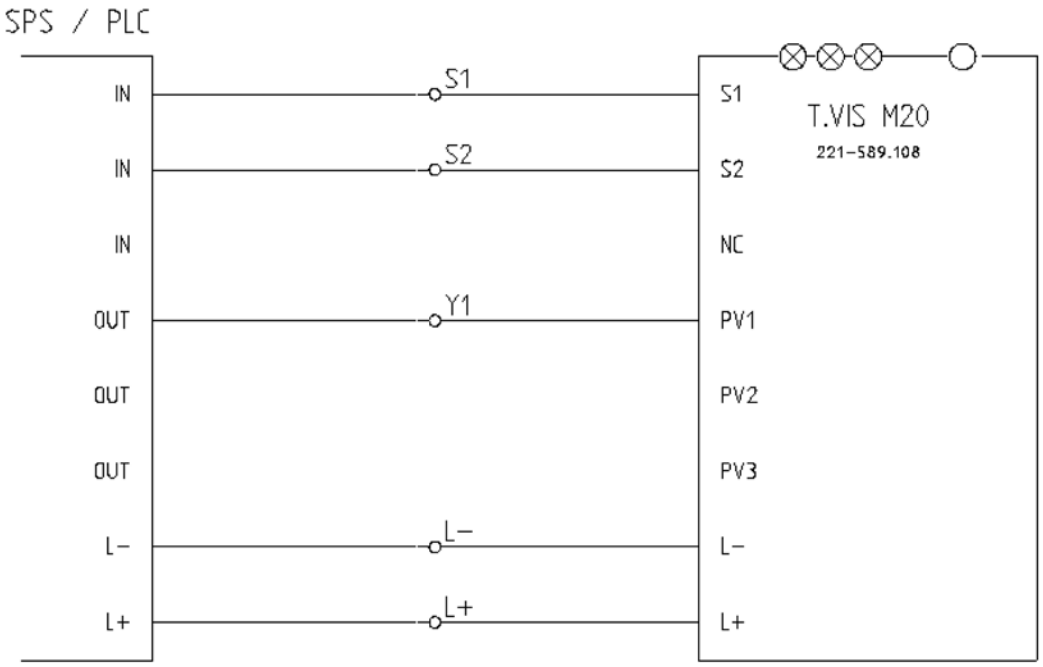

Fig.11: Terminal assignment of terminal strip unit 24V DC (78), material no. 221-589.108

6.5 Visual Display

6.5.1 Illuminated dome

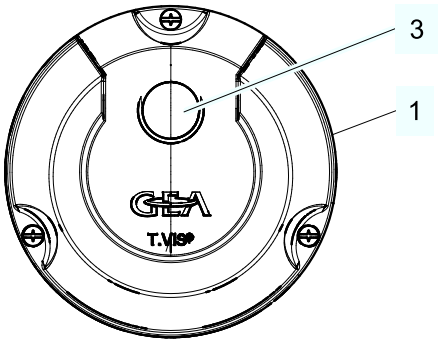

Fig.12

Key	
Position	**Description**
1	Cap
3	Illuminated dome

The following statuses are visualized by the illuminated dome:

- LED green, steady light: non-actuated position of the non-actuated process valve reached.
- LED green, steady light with yellow flashing light: non-actuated position saved or actuated position not yet reached after main stroke (green 750ms/ yellow 250ms).
- LED green, flashing: position between non-actuated and actuated position for movement towards the actuated position visualised by the green steady light (starting from the position previously visualised with yellow steady light).
- LED yellow, steady light: actuated position of the actuated process valve reached.
- LED yellow, flashing: position between non-actuated and actuated position for movement towards the actuated position visualised by the yellow steady light (starting from the position previously visualised with green steady light).
- LED red, flashing: fault/setup.
- LED red, flashing for 1 sec. / pause for 1 sec. / .... Default.
- There is a tolerance of 10% for all flashing cycles.

There is a power failure if no signal is displayed for more than 5 seconds!

6.5.2 Colour Changeover

The "colour changeover" function allows you to swap the colour from green to yellow or yellow to green for the following visualizations: valve in non-actuated position, valve in actuated position and travel

Carry out the following steps:

1. Disconnect the control top from the power supply.
   Switch DIP 1 from position 0 to position 1.
   Switch the power supply back on.

→ Done.

Hint!

When the colours are swapped, the feedback signals are also swapped!

6.6 Control Top Fitted to VARIVENT Valve FDD

This chapter describes how the control top is fitted to and removed from a VARIVENT valve FDD. Observe the following notes when doing so.

Notice

The vent plug E2 is a safety element.

If the element is not installed correctly or if the vent is covered, the safety function is no longer guaranteed.

► The installation position of the vent plug E2 must never be pointing vertically upwards.
► The vent plug E2 must never be covered.

6.6.1 Replacing Control Tops

When replacing the control top observe the following warning note:

⚠ **Caution!**

Spring tension being released if the wrong switch bar is used

When a valve is used with the wrong type of switch bar, there is a risk of injury as the spring tension can suddenly be released.

► When replacing a predecessor model (only T.VIS M-15 FDD) with a control top T.VIS M-20 FDD the switch bar must always be replaced!

7 Start-up

7.1 Safety precautions

Initial commissioning

For initial commissioning, the following principles apply:

- Take protective measures against dangerous contact voltages in accordance with pertinent regulations.
- The control top must be completely assembled and correctly adjusted. All screw connections must be securely tightened. All electrical cables must be installed correctly.
- Reliably secure machine parts which have already been connected against inadvertently being switched on.
- After conversion of the control top, residual risks must be reassessed.

Commissioning

For commissioning, the following principles apply:

- Only allow properly qualified staff to set the control top into operation.
- Make sure all connections are properly established.
- The safety devices for the control top must be complete, fully functional and in perfect condition. Check the function before starting any work.
- When the control top is switched on, the danger zones must be free.
- Remove any liquids that have escaped without leaving residues.

7.2 Commissioning – Control Top without Solenoid Valve

Commissioning can take place if the control top has been mounted correctly on the valve and if the electrical and pneumatic connections have been established correctly.

Requirement:

- The process valve must be in the safety position, i.e. an external solenoid valve must not be actuated.

Carry out the following steps:

1. Check the function of the external solenoid valve.
2. Switch on the power supply.
3. Activate automatic programming mode (keep reset key pressed for 3 - 7 sec.), see
4. The learning process starts automatically 1 - 2 seconds after reset.

→ Red steady light for 1 - 2 seconds.

As long as the actuated position has not been saved, the position of the non-actuated position is signalled within the tolerance with the LED as steady light and additional flashing of the LED, see Section 6.5.2, Page 33.

5. If necessary, activate the external solenoid valve until the process valve has reliably reached its actuated end position.

   Learning is completed when actuated and non-actuated position have been detected and learnt. If voltage is only switched off with one learnt position, the position already learnt is discarded. After separating the voltage supply, the saved positions remain when reactivated!

6. Deactivate external solenoid valve.

→ Steady light green (with DIP1=0) with additional flashing of the yellow LED or yellow steady light (with DIP1=1) with additional flashing of the green LED, see Section 5.4, Page 27

→ Actuated position programming completed.

Hint!

When the colours are swapped, the feedback signals are also swapped!

Checking the Control Top

Carry out the following steps:

7. Activate and deactivate the external solenoid valve in order to check the proper function of the T.VIS feedback signals.

→ This completes commissioning.

7.3 Commissioning - Control Top with Solenoid Valve

Hint!

Commissioning can take place if the control top has been mounted correctly on the valve and if the electrical and pneumatic connections have been established correctly.

Activating the Control Top

Carry out the following steps:

1. Switch on the control air supply.
2. Check the valve functions by activating the solenoid valve:

→ Switch the solenoid valve on and then off again.

→ Use a screwdriver to turn the screw (S) 0 in direction 1, see Section 3.2.4, Page 20

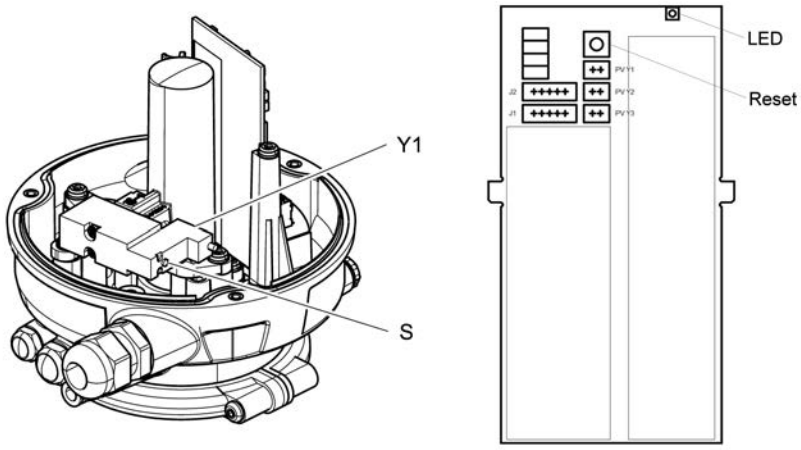

Fig.13

3. Switch on the power supply.
4. Activate automatic programming mode (keep reset key pressed for 3 - 7 sec.), see .
5. The learning process starts automatically 1 - 2 seconds after reset.

→ Red steady light for 1 - 2 seconds.

As long as the actuated position has not been saved, the position of the non-actuated position is signalled within the tolerance with the LED as steady light and additional flashing of the LED, see Section 6.5.2, Page 33 .

6. Activate solenoid valve Y1 (activate by operating the manual override device or by actuation of the higher-order control).

   Learning is completed when actuated and non-actuated position have been detected and saved. If voltage is only switched off with one learnt position, the position already learnt is discarded.

   If the actuated and non-actuated positions have been detected and learnt, the saved positions are retained when the device is switched back on again following disconnection of the voltage supply. If the positions of the non-actuated and actuated position are saved, the detection of every position outside the position tolerance is signalled by the yellow or green LED flashing, see Section 6.5.2, Page 33.
7. Deactivate the solenoid valve.

→ Steady light green (with DIP1=0) with additional flashing of the yellow LED or yellow steady light (with DIP1=1) with additional flashing of the green LED, see Section 5.4, Page 27.

→ The control top is activated.

Hint!

When the colours are swapped, the feedback signals are also swapped!

Checking the Control Top

Carry out the following steps:

8. Activate the solenoid valves in succession via the PLC in order to check the proper function of the T.VIS M-20 FDD feedback signals.
9. The I/O test can take place parallel to commissioning.

→ This completes commissioning.

7.4 Service Function

If maintenance must be conducted on a process valve that is fitted with a control top T.VIS M-20 FDD, the valve core must be pulled out of the housing. For this purpose, the valve disk pretension of the process valve must be relieved by actuating the main actuator.

Another option with the hood removed is the manual override on the solenoid valve, see “Control top with solenoid valves” .

8 Operation and control

8.1 Safety instructions

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the personnel.

For operation, the following principles apply:

- Monitor the component during operation.
- Safety devices must not be changed, removed or taken out of service. Check all safety devices at regular intervals.
- All guards and hoods must be fitted as intended.
- The installation location of the component must always be properly ventilated.
- Structural changes to the component are not permitted. Report any changes to the component immediately to the person in charge.
- Always keep danger zones clear. Do not leave any objects in the danger zone. Only allow persons to enter the danger zone when the machine is de-energized.
- Regularly check that all emergency stop devices are working correctly.

9 Cleaning

9.1 Cleaning

Observe the safety data sheets supplied by the detergent manufacturers.

Only use detergents which are not aggressive towards synthetic materials and the sealing materials used and which are non-abrasive.

Hint!

After all cleaning work, make sure that the control top still complies with all safety instructions in this operating manual and thus that intended use is still given.

10 Maintenance

10.1 Safety precautions

Maintenance and repair

Before carrying out maintenance and repair work on the component's electrical equipment, perform the following steps in accordance with the "5 safety rules":

- Isolate from the power supply
- Take appropriate measures to prevent switch on
- Test absence of voltage
- Earthing and short-circuiting
- Cover or safeguard any adjacent live parts.

For maintenance and repair, the following principles apply:

- Observe the intervals specified in the maintenance schedule.
- Only qualified personnel may carry out maintenance or repair work on the component.
- The component must be switched off and secured against being switched back on before maintenance or repair work. Work may only be started once any residual energy has been discharged.
- Block access for unauthorized persons. Put up notice signs which draw attention to the maintenance or repair work going on.
- Do not climb on the component. Use suitable access aids and working platforms.
- Wear suitable protective clothing.
- Only use suitable and undamaged tools to carry out maintenance work.
- When replacing parts only use approved, fully functional load suspension devices and lifting accessories which are suitable for the intended purpose.
- Before setting the unit back into operation, refit all safety devices as originally provided in the factory. Then check that all safety devices are working correctly.
- Make sure lubricants are used properly.
- Check pipes are firmly secured, also check for leaks and damage.
- Check that all emergency stop devices are working correctly.

Disassembly

For removal, the following principles apply:

- Only qualified personnel are allowed to dismantle the component.
- The component must be switched off and secured against being switched back on before it is disassembled. Work may only be started once any residual energy has been discharged.

- Disconnect all power and utility lines.
- Markings, e.g. on lines, must not be removed.
- Do not climb on the component. Use suitable access aids and working platforms.
- Mark the lines (if unmarked) prior to disassembly to ensure they are not confused when re-assembling.
- Protect open line ends with blind plugs against ingress of dirt.
- Pack sensitive parts separately.
- For longer periods of standstill, observe the storage conditions, see Section 4.1, Page 23.

10.2 Inspections

Checking parts are firmly secured

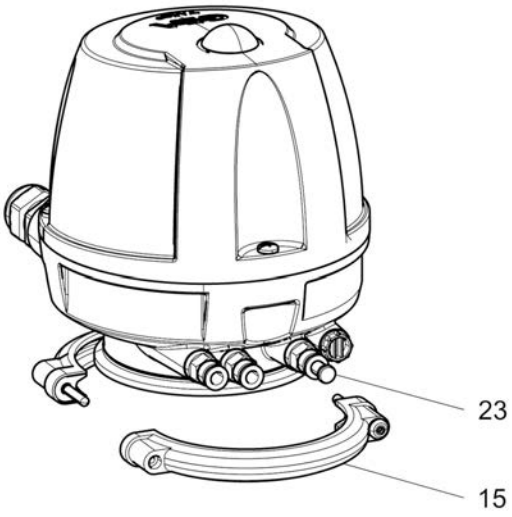

Fig.14

Carry out the following steps:

1. Check that the electrical connectors are properly secured.
2. Check that the air hose connections are firmly secured.
3. Check that the clamp (15) is firmly in place.
4. Check the sound absorber, filter, non-return valve and the exhaust air throttle for soiling.
5. Check the housing for mechanical damage.
6. Check the union nut for the cable glands for a tight fit.
7. Check the solenoid valves for pressure-sealed seat.

8. Check hood and base for firm screws. Tighten all three screws to 1 Nm if necessary.

10.3 Maintenance intervals

To ensure the highest operational reliability, all wearing parts should be replaced at longer intervals.

The actual maintenance intervals can only be determined by the user since they depend on the operating conditions, for instance:

- daily period of use,
- switching frequency,
- type and temperature of the product,
- type and temperature of the cleaning solution,
- ambient conditions.

Maintenance Intervals	
Applications	**Maintenance intervals (guideline values)**
Media at temperatures of 60 °C to 130 °C (140 °F to 266 °F)	approx. every 3 months
Media at temperatures of < 60 °C (< 140 °F)	approx. every 12 months

10.4 Tool

List of tools	
Tool	**Material no.**
Hose cutter	407-065
Hex key, size 3	408-121
Pin-type face spanner, pin dia. 4	9065837
Open end spanner a/f 12x13	408-034
Open end spanner a/f 14x17	408-045
Open-ended wrench a/f 20	---
Open-ended wrench a/f 22	408-039
Open end spanner a/f 24x27	408-040
Open-ended wrench a/f 25	408-268
Screw driver Torx 10 IP	---
Screw driver Torx 20 IP Plus	---

List of tools	
Tool	**Material no.**
Crosstip screwdriver size 2	---
Slotted screw driver A 0.4 x 2.5	---
Flat-nose pliers	---
Pin punch/mandrel Ø6.0 mm	---

10.5 Removing the Control Top from the Valve

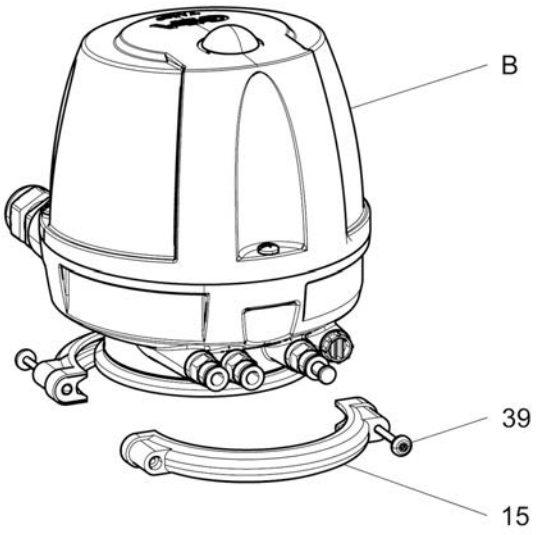

Fig.15

Requirement:

- Make sure that the solenoid valve is not actuated.

Hint!

The pneumatic and electrical connections can remain on the control top.

Carry out the following steps:

1. Release the screw connection (39) and remove the clamp ring (15).
2. Pull the control top vertically off the valve.
   → The green light goes off and is replaced with a yellow flashing light.

→ Done

Hint!

When the colours are swapped, the feedback signals are also swapped!

10.6 Dismantling the Control Top into its Components

10.6.1 Variants of the Control Top

The control top can be fitted with:

- 1 NC solenoid valve or
- without solenoid valve with 1 valve plate.

10.6.2 Removing the Cap

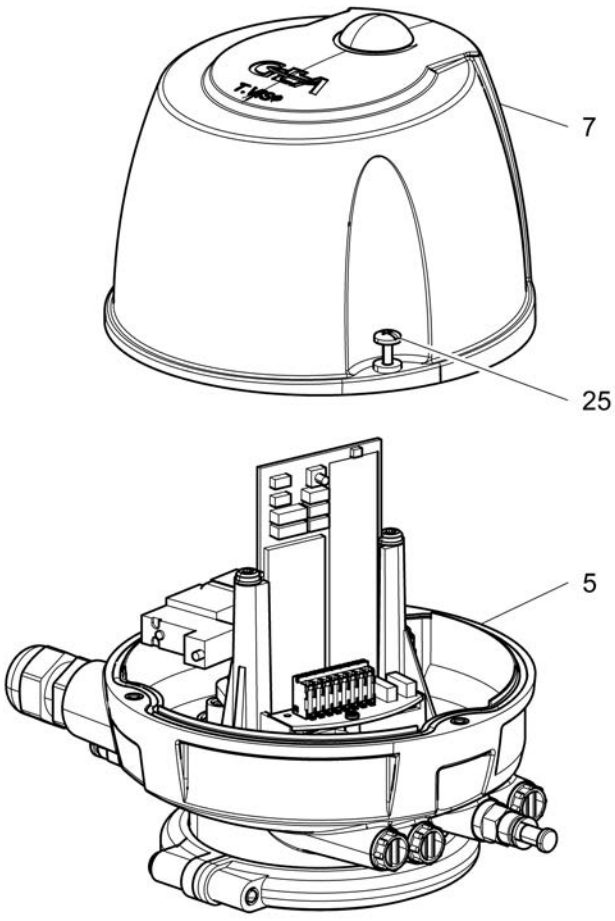

Fig.16

Danger

Electrical voltage

Danger to life

► Switch off the voltage supply and the control air before removing the control top.

Carry out the following steps:

1. Undo the 3 screws (25) of the cap (7) and remove the cap (7) from the base (5).

→ Done

10.6.3 Removing the Solenoid Valve or the Valve Plate

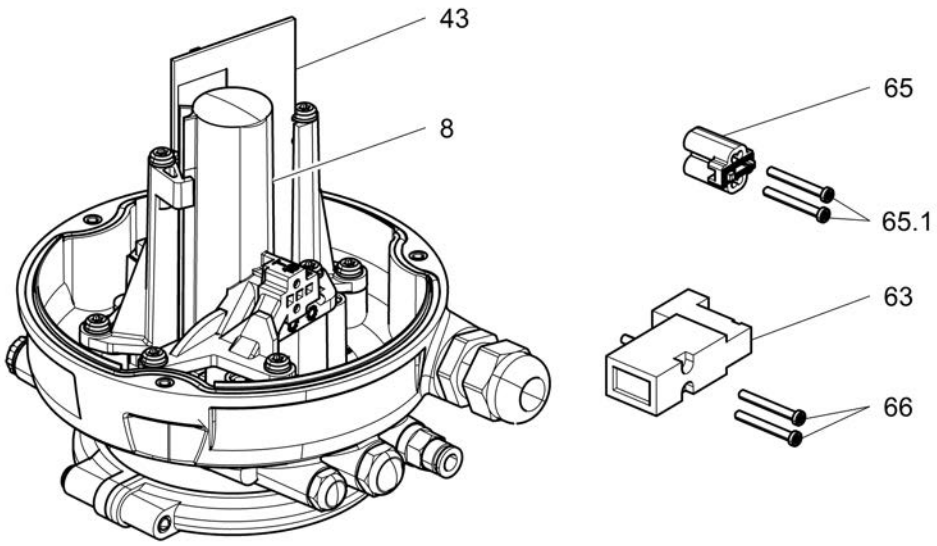

Fig.17

Requirement:

- Only use solenoid valves specified in chapter “Technical data”.

Hint!

In order to avoid or minimize the possibility of damage from electrostatic discharge:

- Observe the requirements of DIN EN 61340-2-1 and 5-2.

- Be careful not to touch the electronic components!

⚠ Caution!

Risk of burns from the solenoid valve as a result of long switch-on time and high ambient temperature

Risk of burns from the solenoid valve

► Allow to cool before dismantling.

Carry out the following steps:

1. Undo the connector of the solenoid valve at the sensor module (43)
2. Undo the screws (66) and separate the solenoid valve (63) from the pneumatic block (8).
3. Undo the screws (65.1) or, if present, separate the valve plate (65) from the pneumatic block (8).

→ Done

Hint!

Fit the solenoid valve or valve plate in reverse order.

Lightly grease the seals before fitting them to prevent them from falling out!

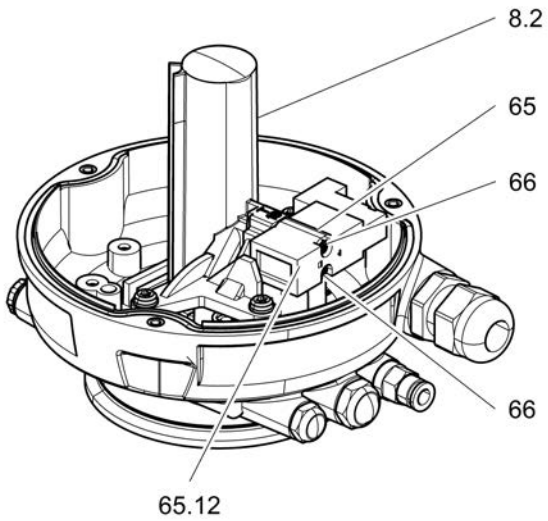

Fig.18

Pneumatic block (8.2) for max. 1 solenoid valve

Hint!

When using the pneumatic block (8.2) with one valve plate (65), the groove (65.12) must be fitted on the left side. The two screws (66) are located in the left mounting holes.

Tighten the screws (66) to a max. tightening torque of 0.8 Nm.

10.6.4 Removing the sensor module

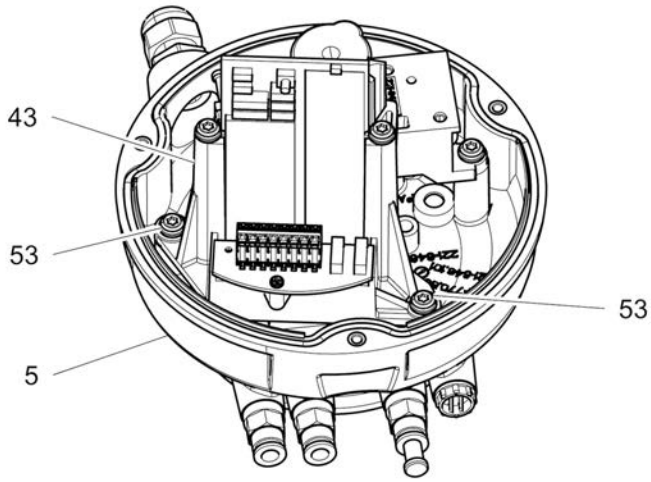

Fig.19

Carry out the following steps:

1. Loosen all the cables and connectors on the sensor module and remove them.
2. Unscrew and remove the screws (53).
3. Grip the sensor module (43) by the mountain bracket and take out of the base (5). Ensure ESD-compliant handling.

→ Done

Hint!

Fit the sensor module in the reverse order. Observe the wiring diagrams, see Page 18

10.6.5 Removing the pneumatic block

Requirement:

- If only O-rings (42) and (55) are to be changed, solenoid valves (63) / valve plate (65) can remain on the pneumatic block (8).

Carry out the following steps:

1. Undo the screws (57.1, 57.2).

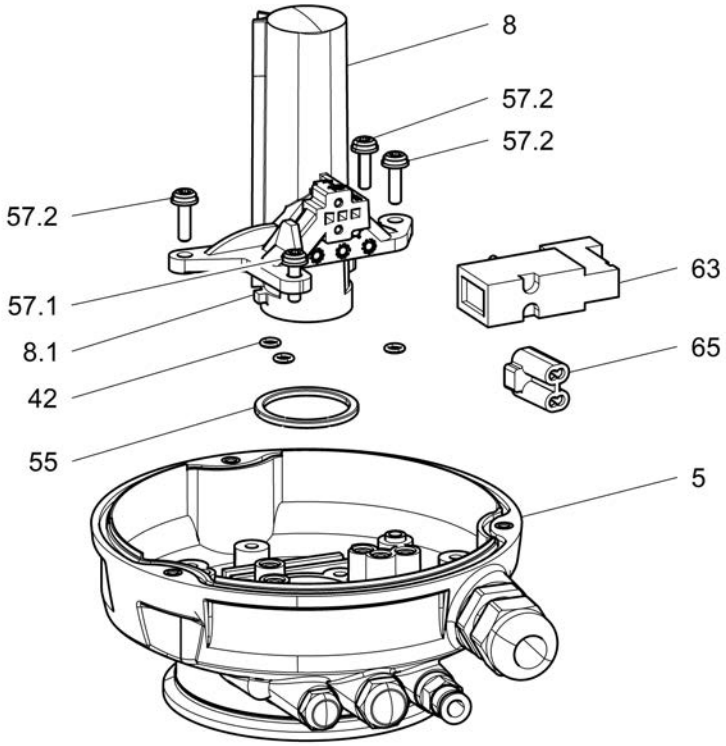

Fig.20

2. Pull off the pneumatic block (8).
3. Change the 6 O-rings (42) of the base (5).
4. Replace the O-ring (55).

→ Done

10.6.6 Fitting the Pneumatic Block

Requirement:

- When fitting the pneumatic block, make sure that it is compatible!
- Insert the journal (8.1) on the pneumatic block into the groove of the base (5)!

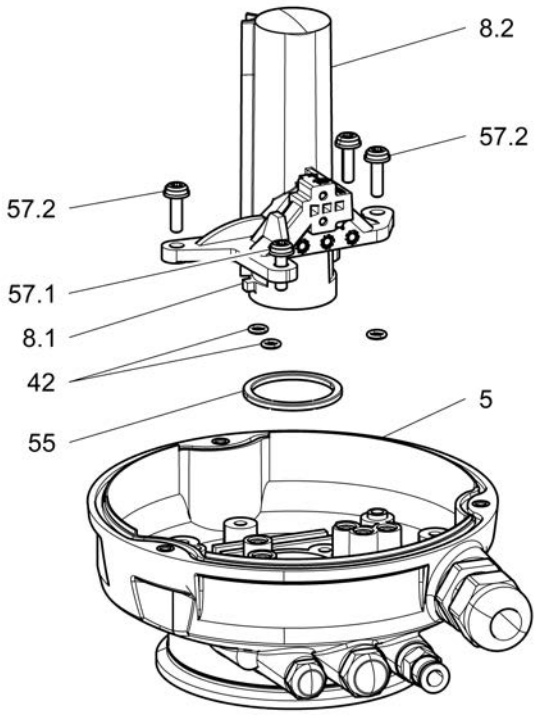

Fig.21

Pneumatic block (8.2) for max. 1 solenoid valve

Carry out the following steps:

1. Fit the pneumatic block in the reverse order.

   ! Pneumatic block (8.2): First tighten screw (57.1), then screws (57.2): tightening torque 1.5 Nm (1.0 lbft).

2. For fitting the other mounting parts (sensor module, solenoid valve or valve plate).

→ Done

10.6.7 Install pneumatic connections

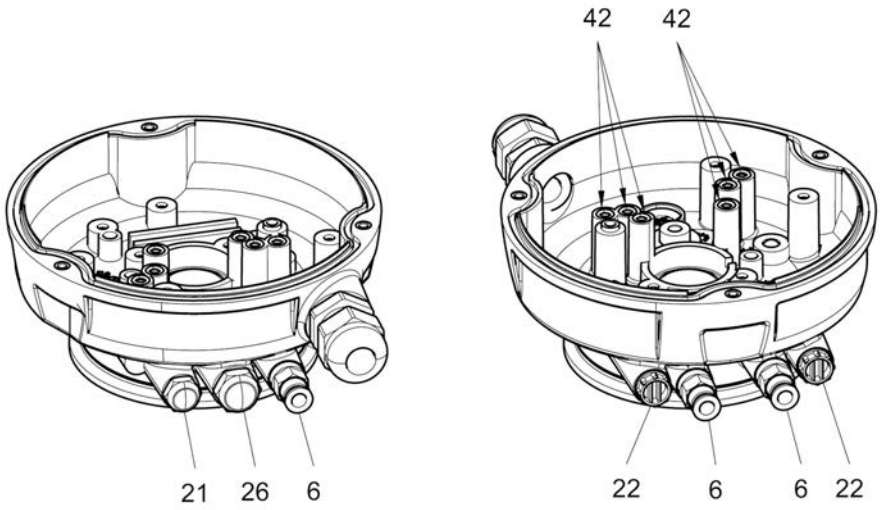

Fig.22

No.	Designation	Tightening torques
6	Screw-in plug connection	2.0 Nm
21	Sound absorber	2.0 Nm
22	Locking screw	0.5 Nm
26	Sound absorber	2.0 Nm
42	O-ring	

Carry out the following steps:

1. Establish the pneumatic connections in accordance with the codes on the control top.

→ Done

10.6.8 Mounting hood

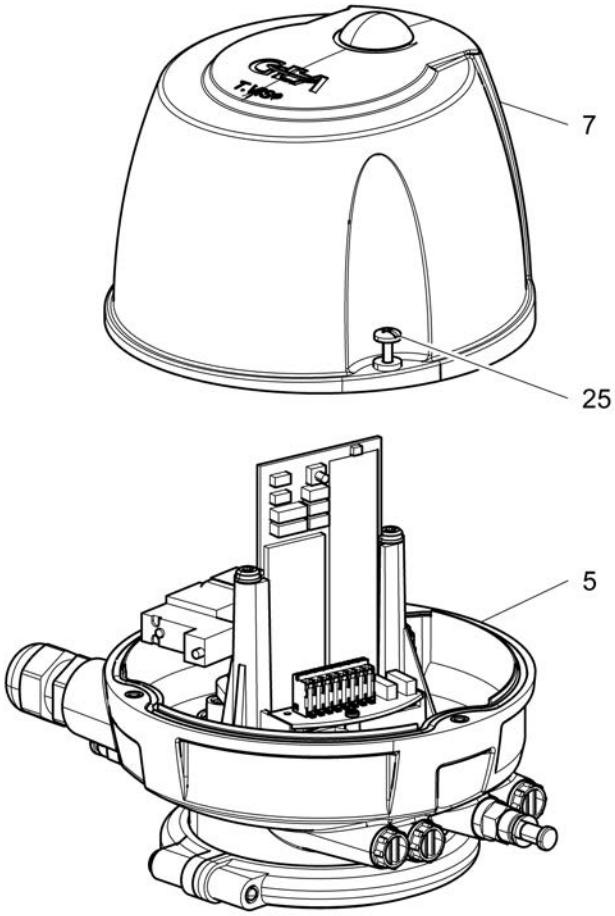

Fig.23

Carry out the following steps:

1. Use three screws (25) to fasten the hood (7) on the base (5) to tightening torque 1 Nm.

→ Done

10.7 Maintenance

10.7.1 Replacing the Seals on the Base

Only use sound absorber (21, 26) specified in chapter “Technical data” . Do not grease these spare parts before fitting them.

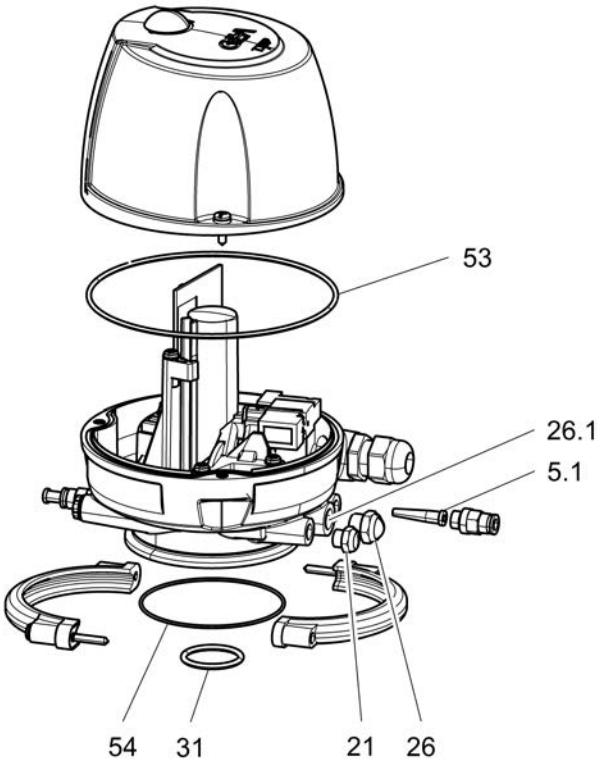

Fig.24

⚠ Caution!

► On VARIVENT actuators with a vent hole in the actuator cover the control top may only be fitted without O-ring (54)!

Carry out the following steps:

1. Take out the O-rings (31, 53, 54) and replace them with new ones.
2. Check that the control air can exit freely from the sound absorbers (21, 26), filter (5.1) and reflux valveVe (26.1) and replace the parts if necessary.

→ Done

Carrying out a Reset – Back to Default Standard

Carry out the following steps:

1. Press the reset key for 3-7 sec.
2. After the button has been pressed for 3 seconds, the reset is initiated and the LED goes off.
3. The learning process starts automatically 1-2 seconds after reset red continuous light for 1-2 seconds.

→ Done

11 Alarms

11.1 Malfunctions and remedies

In the event of malfunctions immediately deactivate the valve and secure it against inadvertent reactivation. Malfunctions may only be remedied by qualified staff, who must observe the safety precautions.

Malfunction, signalling, cause, remedy			
Malfunction	**Signalling**	**Cause**	**Remedy**
Programming is not possible after connection of the supply voltage	No LED is lit	No voltage at connector (PIN 1 and 3) Polarity of PINs 1 and 3 mixed up No voltage at L+ and L- Polarity at L+ and L- mixed up	Check the electrical connections for correct wiring
Reset does not start	Green or yellow	Lift is activated	Deactivate lift
After connecting the supply voltage, green or yellow is indicated immediately	Green or yellow	Unit has already been programmed	Start reset if necessary and adapt the unit to the process conditions
Valve opens very slowly	Timeout in the PLC	Fault in the compressed air supply or filter clogged up	Check the compressed air supply Clean or replace filters Open the supply air throttles further
Faulty feedback and illumination at valve disk lift	LED flashes yellow at valve disk lift, green steady light is expected or Green steady light at valve disk lift, yellow flashing is expected	DIP switch 4 not set correctly	Check setting DIP switch 4
Programming cannot be completed	Flashing green 750ms / yellow 250ms or Flashing yellow 750ms / green 250ms	Actuated positions cannot be reached	Check control pressure:
		due to lack of control pressure due to faulty fitting or incorrect switch bar Throttle settings are incorrect	Observe the minimum pressure on the type plate Check and tighten the installed adapter, see "Changing the seals on base" (cross reference), see Check switch bar Open the supply air throttle further Open the exhaust air throttle further
No feedback signal is pending at the PLC although one of the actuated positions has been reached	Red LED flashing or Red LED permanently lit	T.VIS M-20 is currently in programming mode	Wait until programming mode has been completed
	Green or yellow	Feedback signals for the non-actuated and actuated positions to the PLC not connected	Check the electrical connections for correct wiring

12 Decommissioning

12.1 Safety precautions

For shutting down, the following principles apply:

- Switch off the compressed air.
- Switch off the component with the main switch.
- Padlock the main switch (if fitted) in the off position to prevent it from being switched back on. The key to the padlock must be deposited with the person responsible until the machine is restarted.
- For longer periods of standstill, observe the storage conditions, see Section 4.1, Page 23.

12.2 Disposal

12.2.1 General notes

Dispose of the component in an environmentally safe manner. Observe the statutory waste disposal regulations applicable at the place of installation.

The component consists of the following materials:

- Metals
- Synthetic materials
- Electronic parts
- Lubricants containing oil and grease

Separate the different materials and dispose of them correctly sorted. Also observe the instructions regarding disposal in the operating instructions for the individual components.

13 Spare parts list - control top T.VIS M-20 FDD

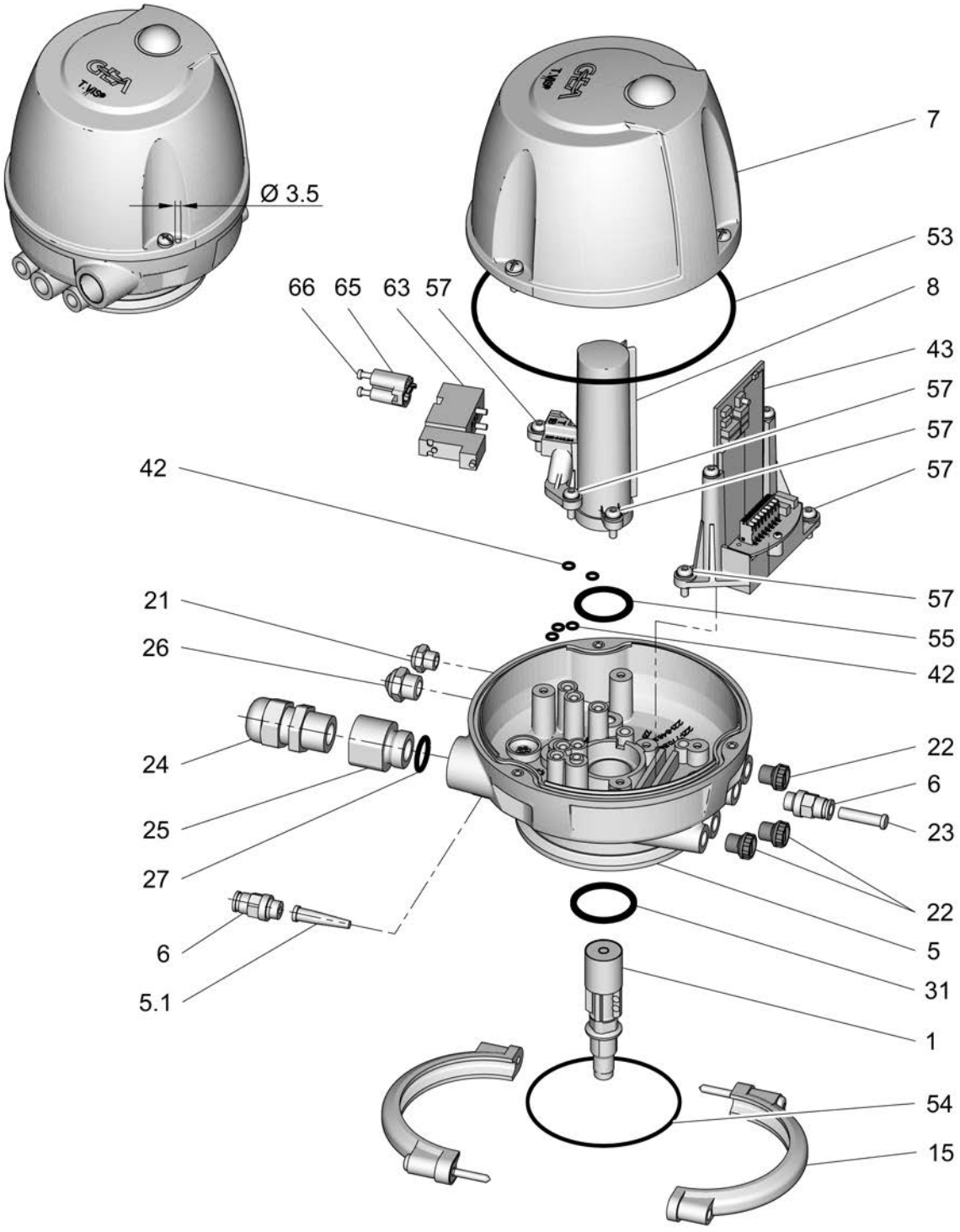

Fig.25: (Ø 3.5 mm drilled hole for seal)

Item	Designation	Material	24V DC	
			with 1 solenoid valve	without solenoid valve
			FDD-P	FDD-N
	Control top T.VIS M-20 FDD cpl.		221-664.85	221-664.86
1	Switch bar T.VIS/FLOWVENT A-15/M-20	PA6/GB30/ KONDIT.	221-589.104	221-589.104
5	Base T.VIS-T18	PA12/L	221-646.101	221-646.101
5.1	Filter	PE	221-003869	221-003869
6	Screw-in plug connection D 6.35	MS CV	933-173	933-173
7	Hood T.VIS M/A-15	PA12/L	221-646.88	221-646.88
8	Pneumatic block T.VIS 1PV	PA12/L	221-646.94	221-646.94
15*	Clamp connection KU	--	221-507.08	221-507.08
21	Sound absorber G1/8"	MS CV	933-175	933-175
22	Locking screw G1/8"	PE-HD	922-369	922-369
23	Plug	PP	922-280	922-280
24	Cable gland G1/2"	PA	508-915	508-915
25	Adapter G1/2"	PA	221-004094	221-004094
26	Sound absorber G1/4"	MS CV	933-174	933-174
27	O-ring	NBR	930-017	930-017
31	O-ring	NBR	930-041	930-041
42	O-ring	FKM	930-169	930-169
43	Sensor module T.VIS 24VDC/ZUS/1PV	--	221-589.108	221-589.108
53	O-ring	NBR	930-833	930-833
54	O-ring	NBR	930-117	930-117
55	O-ring	NBR	930-038	930-038
57	Thread-forming screw	A2	514-750	514-750
63	Solenoid valve NC 24VDC	PBT	512-169	--
65	Valve plate	PPO	--	221-589.27
66	Thread-forming screw	A2	514-761	514-761
*Item 15 is not included in control top T.VIS M-20/FDD cpl. and must be ordered separately if required.				

14 Appendix

14.1 Lists

14.1.1 Abbreviations and terms

Abbreviation	Explanation
BS	British Standard
bar	Unit of measurement of pressure [bar] All pressure data expressed in [bar/psi] is assumed to be gauge pressure [barg/psig] unless explicitly specified otherwise.
approx.	approximately
°C	Unit of measurement of temperature [degree Celsius]
dm^3_n	Unit of measurement of volume [cubic decimetre] Standard volume (standard litre)
DN	DIN nominal width
DIN	German standard issued by DIN (Deutsches Institut für Normung e.V., German Institute for Standardization)
EN	European Standard
EPDM	Material designation Short designation according to DIN/ISO 1629: Ethylene Propylene Diene Rubber
°F	Unit of measurement of temperature [degree Fahrenheit]
FKM	Material designation, short designation according to DIN/ISO 1629: Fluorine rubber
h	Unit of measurement of time [hour]
HNBR	Material designation Short designation according to DIN/ISO 1629: Hydrogenated Acrylonitrile Butadiene Rubber
IP	Protection class
ISO	International standard issued by the International Organisation for Standardisation
kg	Unit of measurement of weight [kilogram]
kN	Unit of measurement of force [kilonewton]
Kv value	Flow coefficient [m³/s] 1 KV = 0,86 x Cv
l	Unit of measurement of volume [litre]
max.	maximum
mm	Unit of measurement of length [millimetre]
µm	Unit of measurement of length [micrometre]

Abbreviation	Explanation
M	Metric
Nm	Unit of measurement of work [newton metre] Specification of torque 1 Nm = 0.737 lbft Pound-Force (lb) + Feet (ft)
PA	Polyamide
PE-LD	Low-density polyethylene
PPE	Polytetrafluoroethylene
psi	America measurement for pressure [Pound-forse per square inch] All pressure data expressed in [bar/psi] is assumed to be gauge pressure [barg/psig] unless explicitly specified otherwise.
PTFE	Polytetrafluoroethylene
SET-UP	Self-learning installation During commissioning and maintenance, the SET-UP procedure carries out all the necessary settings for the generation of messages.
AF	Specifications for the size of spanners width across flats
T.VIS	Tuchenhagen Valve Information System
V AC	Volt alternating current
V DC	Volt direct current
W	Unit of measurement of power [Watt]
TIG	Welding method Tungsten inert gas welding
Inch	Unit of measurement of length in the Anglo-American language area
Inch OD	Pipe measurement according to British Standards (BS), Outside Diameter
Inch IPS	American pipe measure - Iron Pipe Size

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