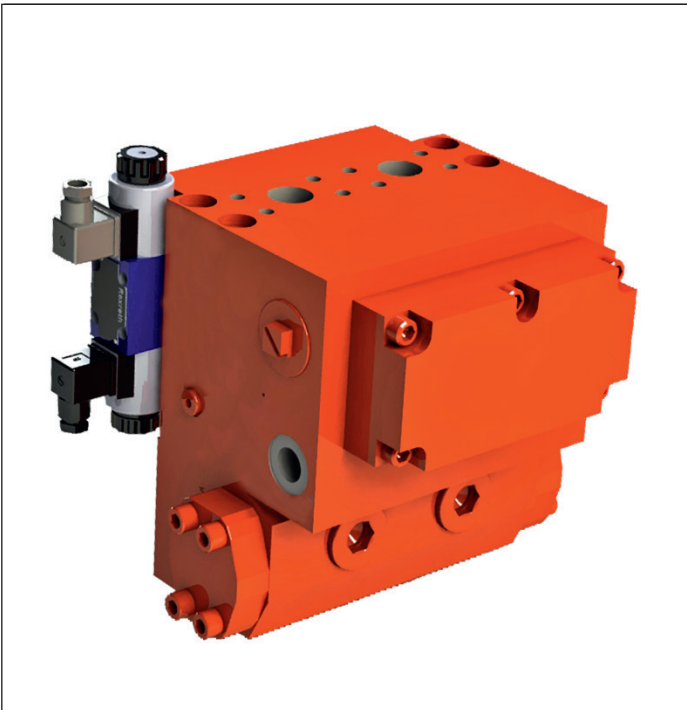


# Free circulation valve Häggglunds VFCCA 1000

Includes valves for ATEX environment 



## Valid for:

- ▶ Häggglunds motor CA, CB, CBm
- ▶ Maximum flow 1000 l/min (264 gpm)  
Maximum pressure 350 bar ( 5076 psi)
- ▶ Open and closed loop hydraulic system

## Features

- ▶ Compact and robust design
- ▶ Mounted directly on Häggglunds motors
- ▶ Free circulation function with minimal pressure drop
- ▶ Free circulation shift allowed up to 40 rpm
- ▶ Free-wheeling function
- ▶ Shifting from drive operation into free-wheeling allowed up to 10 rpm

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## 1 Safety instructions

### 1.1 Safety messages

This documentation includes safety messages placed before sequential operating procedures that may involve the risk of personal or property damage. The described precautionary measures must be observed.

Safety messages are structured as shown below:

 <b>SIGNAL WORD</b>
<b>Type and source of risk</b> Consequences if disregarded ▶ Precautionary measures ▶ <listing>




**Warning sign:** draws attention to the risk

**Signal word:** identifies the hazard level


**Type and source of risk:** identifies the type and source of the hazard

**Consequences:** describes what occurs when the safety messages are not complied with

**Precautions:** indicates how the hazard can be avoided

Warning sign, signal word	Meaning
 <b>DANGER</b>	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
<b>NOTICE</b>	Indicates potential property damage: the product or the environment may be damaged.

The following symbols identify notices that are not safety-relevant, but enhance the comprehensibility of the documentation.

Symbol	Meaning
	When this information is not observed, optimum use or operation of the product cannot be ensured.
▶	Single, independent step
1.	Numbered instructions:
2.	The number indicates that the different steps are to be performed successively.
3.	

## 2 Ordering code

In order to identify Häggglunds equipment exactly, the following ordering code is used. These ordering codes should be stated in full in all correspondence e.g. when ordering spare parts.

Example: Valve VFCCA 1000 :

<b>VFCC</b>	<b>A</b>	<b>1000</b>	<b>E</b>	<b>1</b>	<b>0</b>	<b>00</b>	<b>00</b>	<b>VA</b>
01	02	03	04	05	06	07	08	09

01	<b>Free circulation valve</b>	<b>VFCC</b>
02	<b>Version</b>	<b>A</b>
03	<b>Maximum flow (l/min)</b>	<b>1000</b>
04	<b>Operation</b>	
	Electric operated	<b>E</b>
	Hydraulic operated	<b>H</b>
05	<b>Electric details</b>	
	No	<b>0</b>
	24 VDC	<b>1</b>
06	<b>Explosive environment</b>	
	Non explosive environment	<b>0</b>
	Explosive environment	<b>1</b>
07	<b>Modification *)</b>	<b>00</b>
08	<b>Design</b>	
	Standard	<b>00</b>
	Special index *)	<b>01-99</b>
09	<b>Valve adapter</b>	
	None	<b>XX</b>
	VA 1000 10	<b>VA</b>

\*) To be filled in by Bosch Rexroth AB

### 3 Functional description

#### 3.1 General

The free-circulation valve with freewheeling function is designed for use with Hägglunds Compact motors CA, CB and CBm. The valve is normally mounted on the motor via an adapter. The valve provides a means of putting the motor safely into free circulation mode. The valve is also suitable for free-wheeling mode by disengaging the pistons and allowing the cylinder block to freely rotate on its bearings. This is achieved by pressurizing the motor case and thus pushing the piston assemblies towards the motor centre. Additional circuitry is required to achieve full free-wheeling mode.

Maximum operating pressure is 350 bar (5076 psi) and maximum flow 1000 l/min (264 gpm)

#### The valve is available in two configurations:

1. VFCCA 1000 H Free circulation valve Hydraulic operated
2. VFCCA 1000 E Free circulation valve Electric operated 24VDC

#### Note!

Only one valve is to be used on the Hägglunds CBm.  
For more than one valve, contact Technical Helpdesk.

#### 3.2 Function Default drive mode

The motor is put into free circulation mode by switching the main control poppet's (510) and (520) in the valve. When the poppet's are in neutral position they allow flow from P to Am and C to Cm. When the poppet's are switched, P and C are blocked and Am and Cm are connected to T. The pressure in T connection must be according to the corresponding and needed charge pressure. The charge pressure is dependent of motor speed and motor type. See table "Recommended charge pressure", Technical data in the Data Sheet for respectively motor CA, CB and CBm.

For exchange of oil in the loop the connection on the adapter FAm or FCm has to be used dependent of the direction of rotation.

The poppet's are switched by a hydraulic pilot valve which is controlled either hydraulically or electrically and the poppet's are spring returned to their blocked position. For electric operation a solenoid operated directional valve is fitted. The pilot pressure from the directional valve is fed by a pair of check valves (540) and (560) which are connected to the C and A motor lines respectively. The directional valve is detent. That means, if one solenoid is operated the valve spool is held in that position until the opposing solenoid is operated.

For hydraulic operation the valve is replaced by a block which connects XFW to the main poppets. The main poppet's will normally be held over by their springs but pressure applied to XFW will cause the main poppets to switch. Connection T3 must be connected to drain line. Shifting is allowed up to a speed of 40 rpm. At speed above 10 rpm the charge pressure level has to be checked.

### Free-wheeling

All compact motors can be operated in free-wheeling mode by retracting the pistons from the cam ring and allow the cylinder block to rotate freely on its bearings. The valve is operated in the same way as with free circulation but T has to be connected directly to tank. A system is required to ensure that the motor is stationary before switching from free-wheeling position into drive position. Free-wheeling is achieved by maintaining pressure into the motor case causing the piston to be lift off the cam ring and pushed in to the cylinder block. The rotating section of the motor comprising the cylinder block, pistons and cam rollers can then rotate on the main bearings without oil through the motor main ports.

The case pressure has to be generated by ensuring that there is a flow through the casing. Required case flow is depending of motor speed. See data sheet for the motors, "oil volume for free-wheeling". The case pressure shall be controlled with a pressure relief valve on the casing drain maintaining a pressure of 1bar (14.5 psi) to 1.5 bar (22 psi), (one of the D ports). To ensure a good free-wheeling function, connect the drain line from the pressure relief valve to the main drain line T on the valve.

A typical response for a Häggglunds CA210 motor with case flow of 60 l/min (16 gpm) would be 1 seconds to change into free-wheeling mode.

For additional information see Technical data in the Data Sheet for respectively motor CA, CB and CBm. Shifting from drive position to free-wheeling is allowed up to a speed of 10 rpm.

## NOTICE

### Shifting from free wheeling position into drive position during running of motor

Damage on piston parts and camring

- ▶ Shifting from free-wheeling position into drive position must only be carried out when the motor is standing still

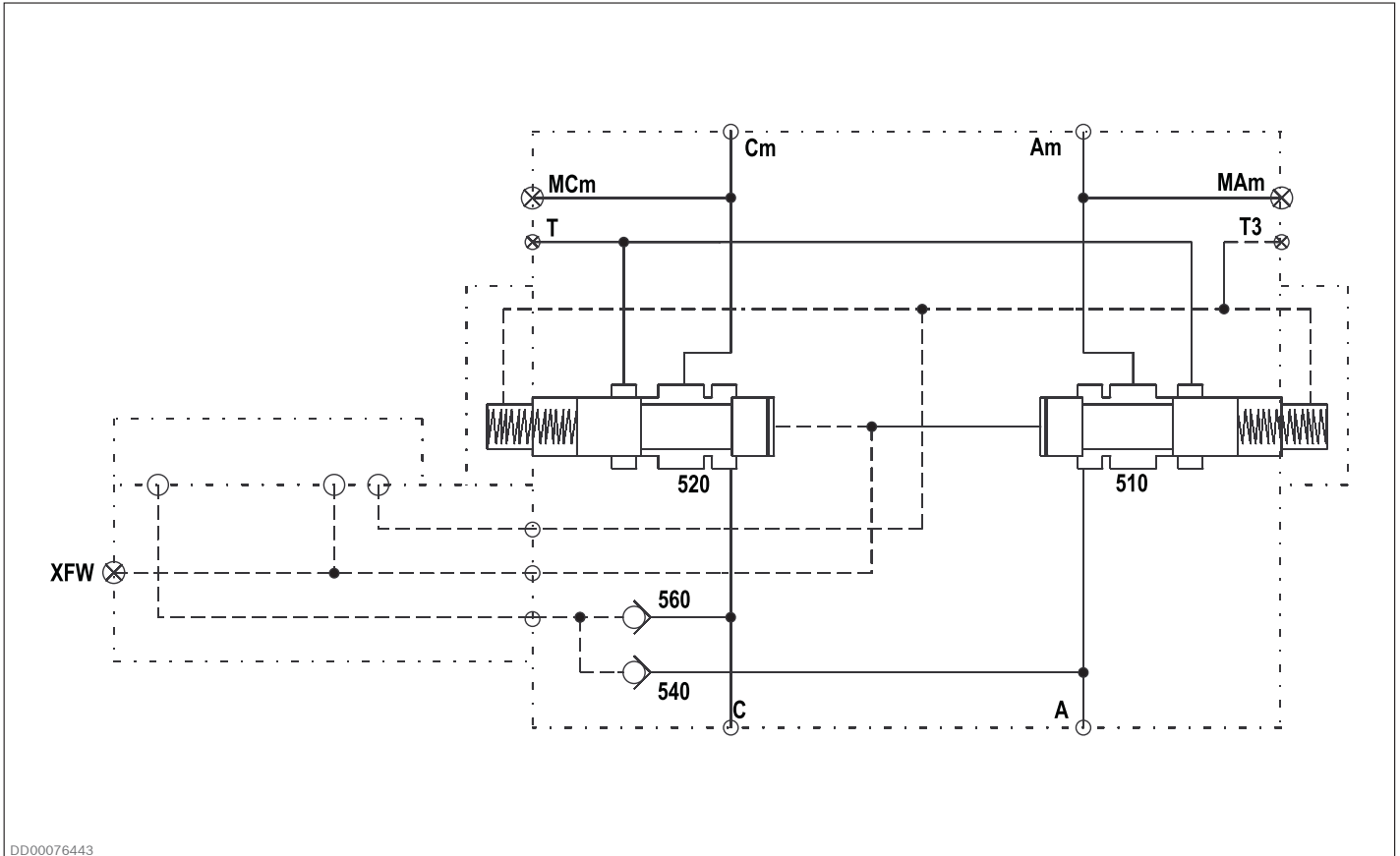


Fig. 1: Hydraulic circuit VFCCA 1000 H

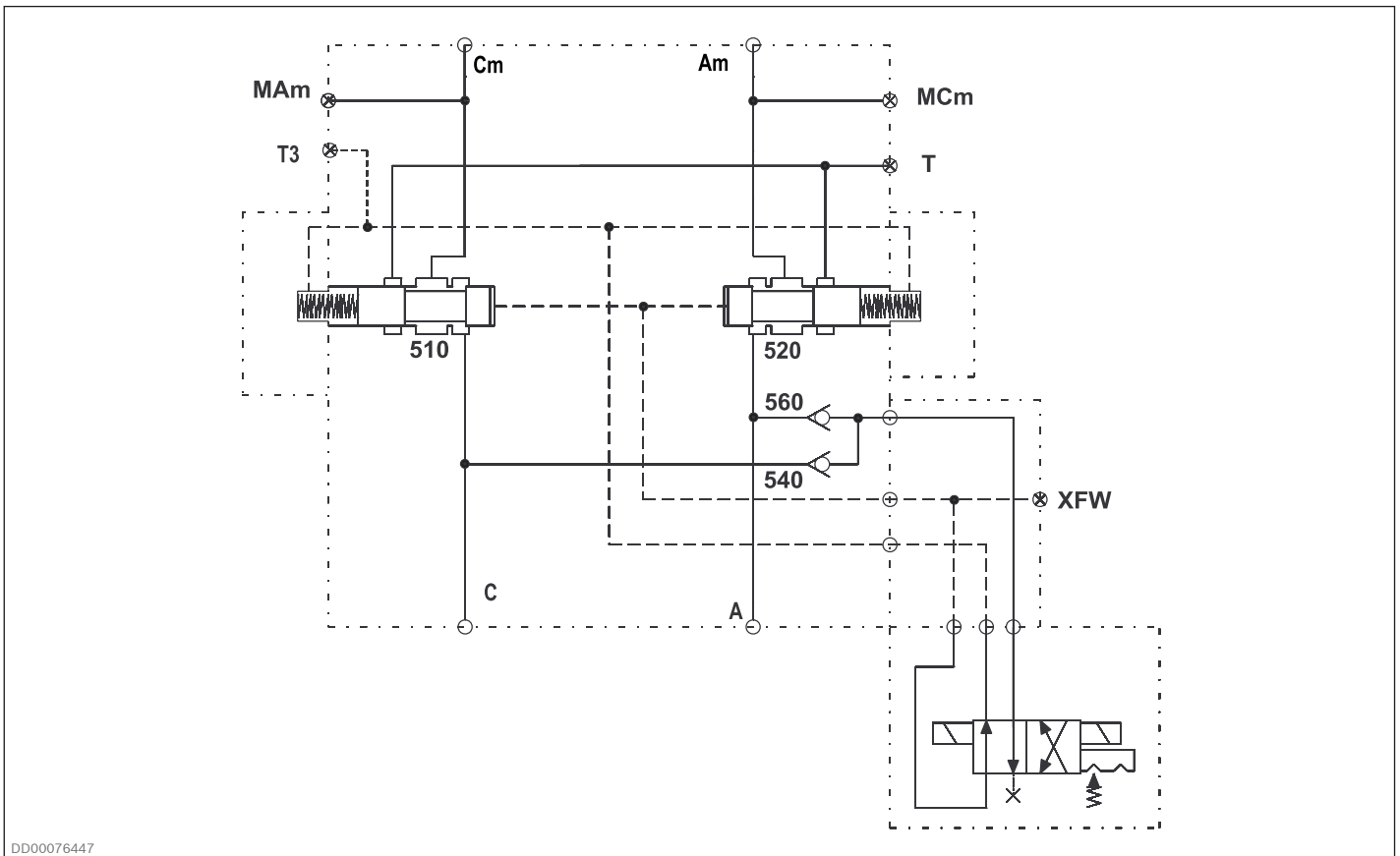


Fig. 2: Hydraulic Circuit VFCCA 1000 E

## 4 Technical data

### 4.1 General data

Table 1: General data

		Metric	US
<b>Mechanical specification</b>			
Maximum operating pressure		350 bar	5076 psi
Pilot pressure (to shift main cartridges)		10 to 350 bar	145 to 5076 psi
Case pressure at freewheeling (to lift piston assemblies)		1 to 1.5 bar	14.5 to 21.8 psi
Maximum Flow (see chapter 5 Pressure loss diagram page 10)		1000 l/min	264 gpm
<b>Hydraulic fluid (refer to Data sheet RE 15414 Hydraulic fluid quick reference )</b>			
Maximum fluid temperature		+70 °C	+158 °F
Minimum fluid temperature		-25 °C	-13 °F
Maximum viscosity range		380 cSt	1760 SSU
Minimum viscosity range		20 cSt	98 SSU
Recommended operating viscosity		40 cSt	187 SSU
Pilot valve interface		CETOP 03	CETOP 03
<b>Weights</b>			
Free circulations valve	typical VFCCA 1000	57 kg	126 lb
Adapter	VA 1000 10	24 kg	53 lb
<b>Pilot valve (electrical operated)</b>			
Solenoid protection class		IP65	
Solenoid current (24 VDC)		1,25 A	
Solenoid power (24 VDC)		30 W	
<b>Surface protection</b>			
Standard Painting System		SS-EN ISO 12944 C3, durability range M (Std colour RAL 2002)	

### 4.2 Explosion protection information, hydraulic operated VFCCA 1000

Table 2: Explosion protection information hydraulic VFCCA 1000

Area of application according to ATEX directive 2014/34/EU	IM2, II2G, II2D, II3G, II3D
Protection of the valve by liquid immersion according to and constructional safety according to	Ex h (EN ISO 80079-37:2016)
Maximum surface temperature	+ 135 °C (+275 °F)
Temperature class	T4
Conforms to "Equipment and components intended for use in potentially explosive atmospheres and in underground mines"	EN ISO/IEC 80079-38:2016
ATEX Classification of valve	II 2G Ex h IIC T4 Gb / II 2G Ex h IIC T135°C Db / I M2 Ex h I Mb
Ambient temperature range	-20....+40 °C (-4....+104 °F)

### 4.3 Explosion protection information, pilot valve, electrical operated

**Table 3: Explosion protection information, electrical operated VFCCA 1000**

Area of application according to directive 2014/34/EU	II 2G
Type of protection valve according to EN 80079-36 <sup>1)</sup>	Ex h IIC T4 Gb X
Maximum surface temperature <sup>2)</sup>	120 °C (248 °F)
Temperature class	T4
Ambient temperature range	-20...+40 °C (-4....104 °F)

<sup>1)</sup> Ex h: structural safety c according to EN 80079-37.

<sup>2)</sup> Surface temperature > 50 °C, provide contact protection.

**Table 4: Electrical operated / data**

Voltage	24 VDC
Voltage tolerance	± 10%
Nominal power at ambient temperature +20 °C (68 °F)	17 W
Maximum power with 1,1 x nominal voltage and ambient temperature +20 °C (68 °F)	20,6 W
Protection class	IP66

### 4.4 Painting system

#### Corrosion protection

The painting system of Häggglunds motors and accessories are available in two different corrosivity categories regarding corrosion protection in accordance with SS-EN ISO 12944:

- C3 - Corrosivity category Medium - which is recommended for normal urban and industrial atmosphere.
- C5M - Corrosivity category Very High - which is recommended for marine environment with high salt load or other aggressive atmosphere.

#### Colour

Standard colour for Häggglunds motors and accessories is orange (RAL 2002)

## 4.5 Calculation

### Calculation for Exchange Oil Flow (Free Circulation)

When running in free circulation the motor pressure losses and valve losses appear as heat in the circuit. To maintain oil temperature within acceptable limits an exchange of oil may need to be made.

Example: Häggglunds CA 100 (Displacement 6.28 l/rev) running at 150 rpm.

### This calculation demonstrates how to establish the Motor Flow.

Flow through the motor  $q = V_i \cdot n$

$q$  = flow (l/min)

$V_i$  = motor displacement ( $\text{cm}^3 \cdot 1000$  /rev)

$n$  = speed (rpm)

Motor Flow  $q = 6.28 \times 150 = 942$  l/min

### This calculation demonstrates how to establish the Total Pressure Drop.

$dp$  = Pressure loss Am to Cm in the valve = 19,5 bar (from Pressure loss Diagram)

$dp_1$  = pressure loss for the motor = 12.5 bar (see Data sheet for CA motor, section Pressure loss diagrams)

Pressure Loss = 19.5 + 12.5 = 32 bar

### This calculation demonstrates how to calculate the Power Loss.

$$\text{Power loss } E = \frac{q(dp + dp_1)}{600} = \frac{942 \times 32}{600} = 50.2 \text{ kW}$$

To calculate the required flushing flow to keep the circuit temperature at a maximum  $\Delta T$  of 15 °C (59 °F) warmer than the flushing oil.

$$1) \begin{cases} q \text{ flushing} = 2.3 \times E \text{ l/min} \\ q \text{ flushing} = 0.61 \times E \text{ gpm} \end{cases}$$

The necessary flow to keep the circuit temperature at a maximum  $\Delta T$  of 15 °C (59 °F) warmer than the flushing oil is:

$$q \text{ flushing} = 2.3 \times 50.2 = 115.46 \text{ l/min}$$

$$q \text{ flushing} = 0.61 \times 50.2 = 30.62 \text{ gpm}$$

1) Accumulated energy:  $W$ ,  $W = m \times c \times \Delta T$

Accumulated energy per time unit:  $E$  (Power)  $E = W/t$

$$\begin{aligned} E &= W/t \\ m &= q \times t \times \rho \end{aligned} \quad \left. \vphantom{\begin{aligned} E &= W/t \\ m &= q \times t \times \rho \end{aligned}} \right\} \Rightarrow E = c \times q \times \rho \times \Delta T$$

$E$ : Power [W]

$c$ : Spec. heat capacity oil [kJ/kg K]

$c_{oil} = 2$  kJ/kg K

$q$ : Oil flushing flow [ $\text{m}^3/\text{s}$ ]

$\rho$ : Oil density [ $\text{kg}/\text{m}^3$ ]

$\rho_{oil} = 870$   $\text{kg}/\text{m}^3$

$\Delta T$ : Temperature difference [°C]

$\Delta T = 15$  °C (example)

$$q = (1/(c \times \rho \times \Delta T)) \times E \quad [\text{m}^3/\text{s}]$$

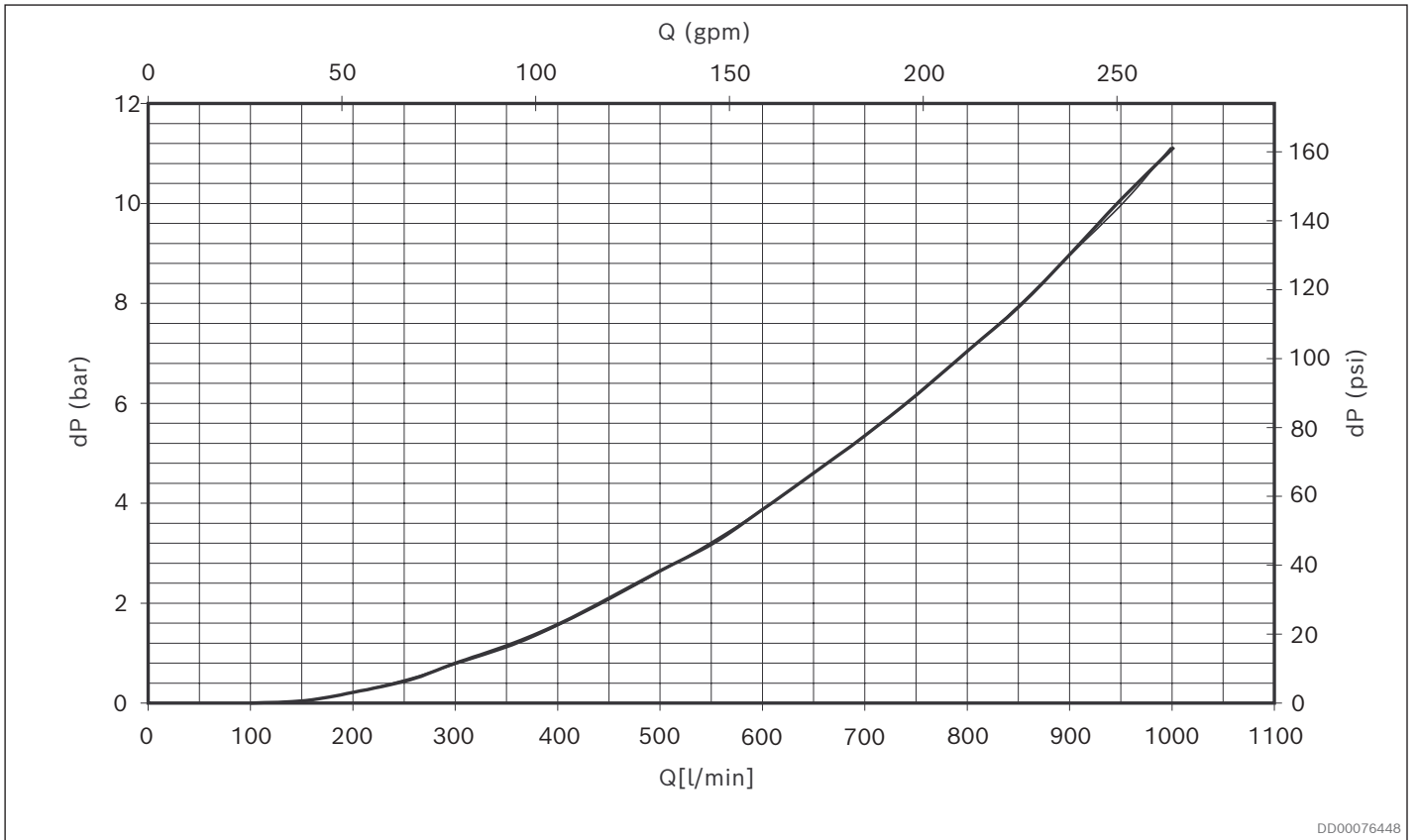
$$q = (60000/(2000 \times 13050)) \times E[\text{W}] \quad [\text{l/min}]$$

$$q = 0.0023 \times E[\text{W}] \quad [\text{l/min}]$$

$$q = \underline{2.3} \times E[\text{kW}] \quad [\text{l/min}]$$

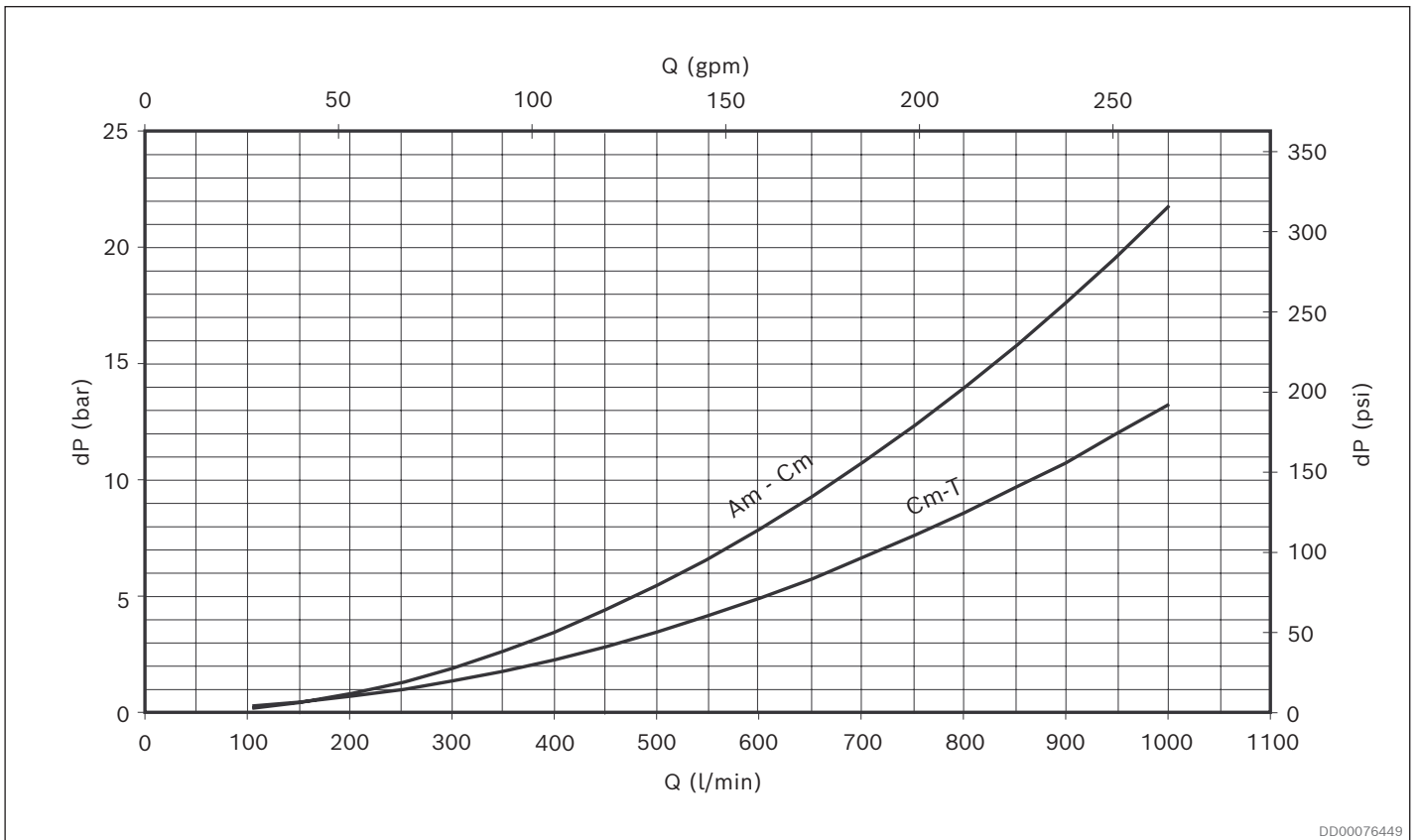
$$q = 2.3/3.79 \times E = \underline{0.61} \times E[\text{kW}] \quad [\text{gpm}]$$

## 5 Pressure loss diagram



DD00076448

Fig. 3: A to Am, C to Cm viscosity 40 cSt



DD00076449

Fig. 4: Am - Cm, Cm to T viscosity 40 cSt

## 6 Dimensions / Interface

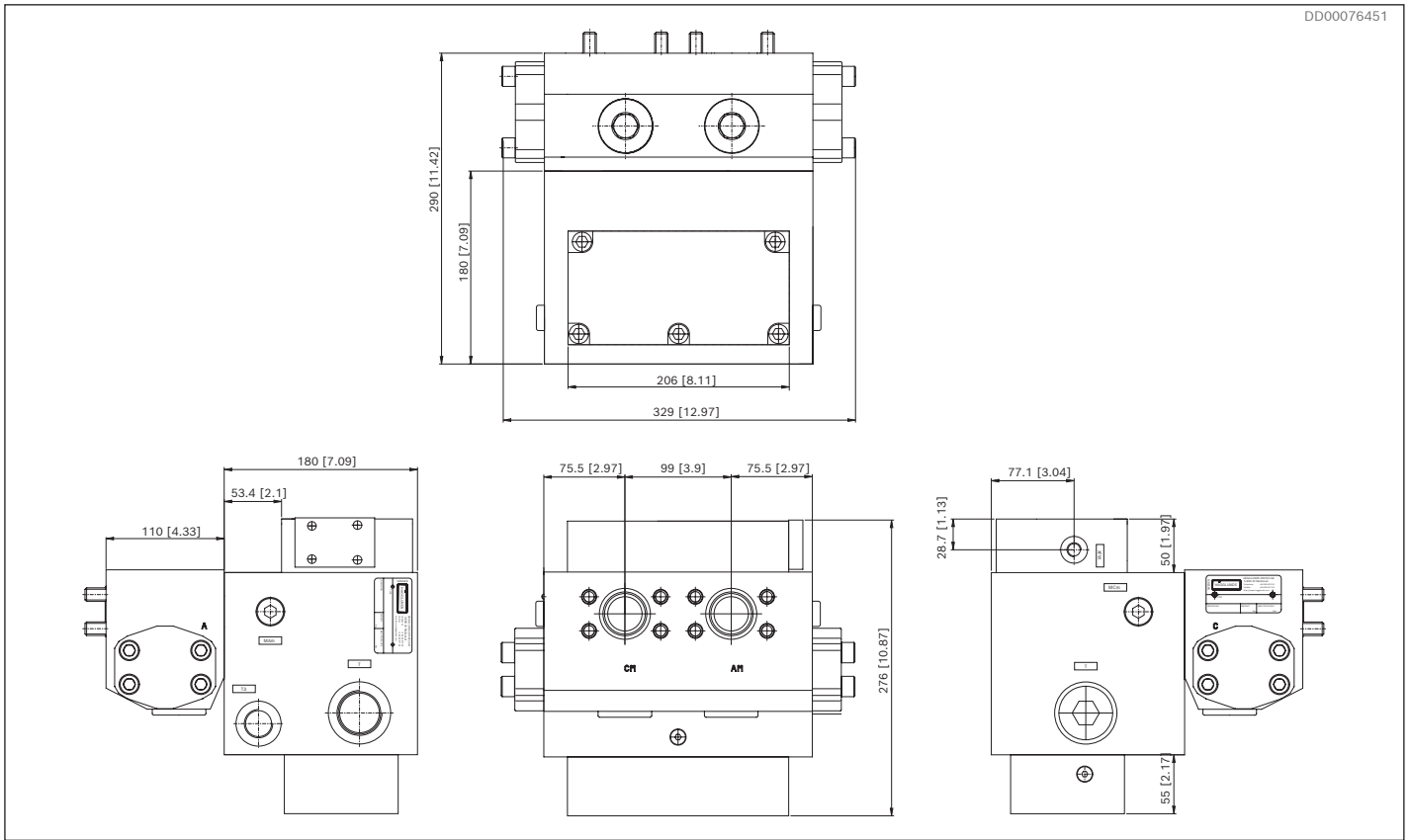


Fig. 5: Dimensions VFCCA 1000 H, VFCCA 1000 H Ex

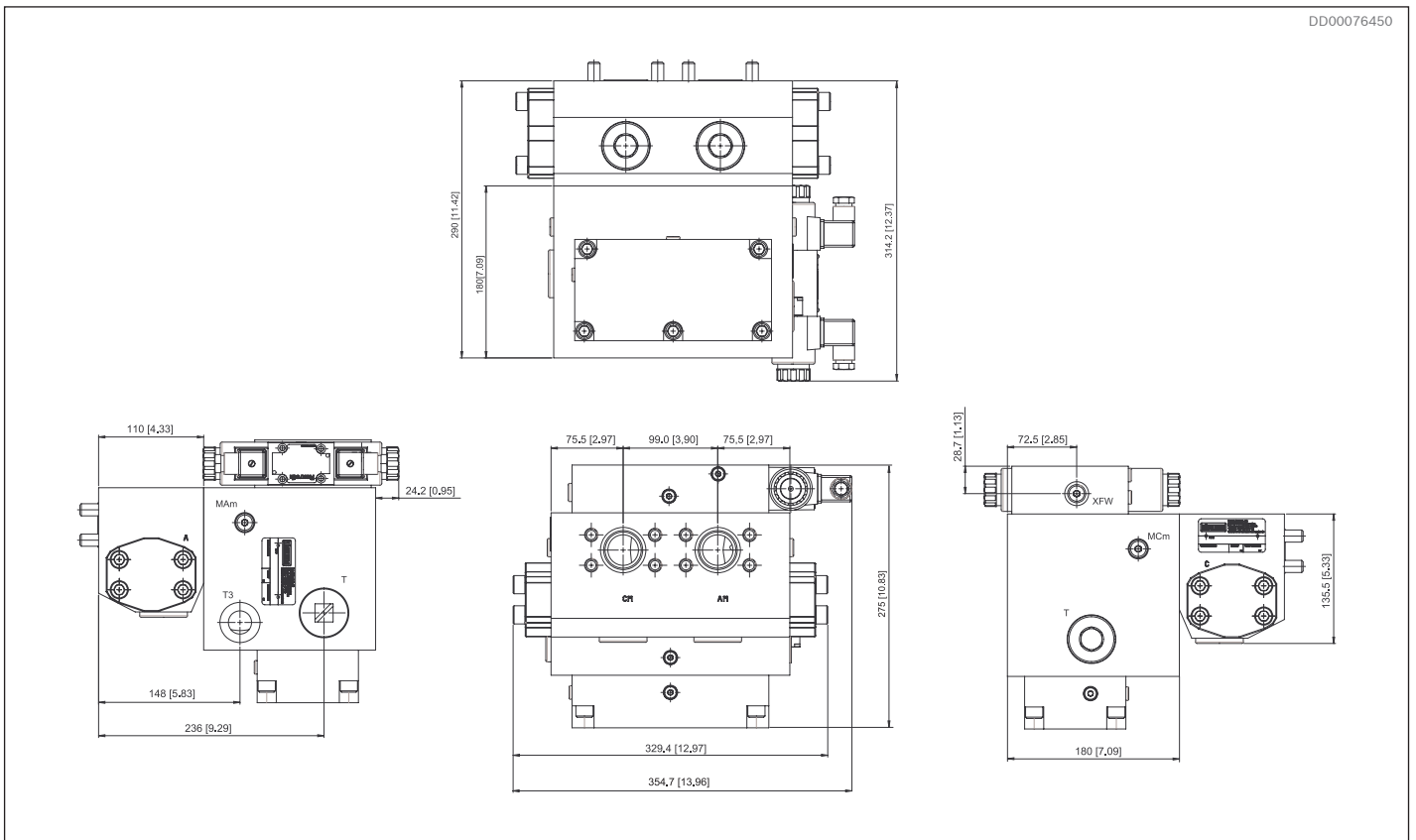


Fig. 6: Dimensions VFCCA 1000 E

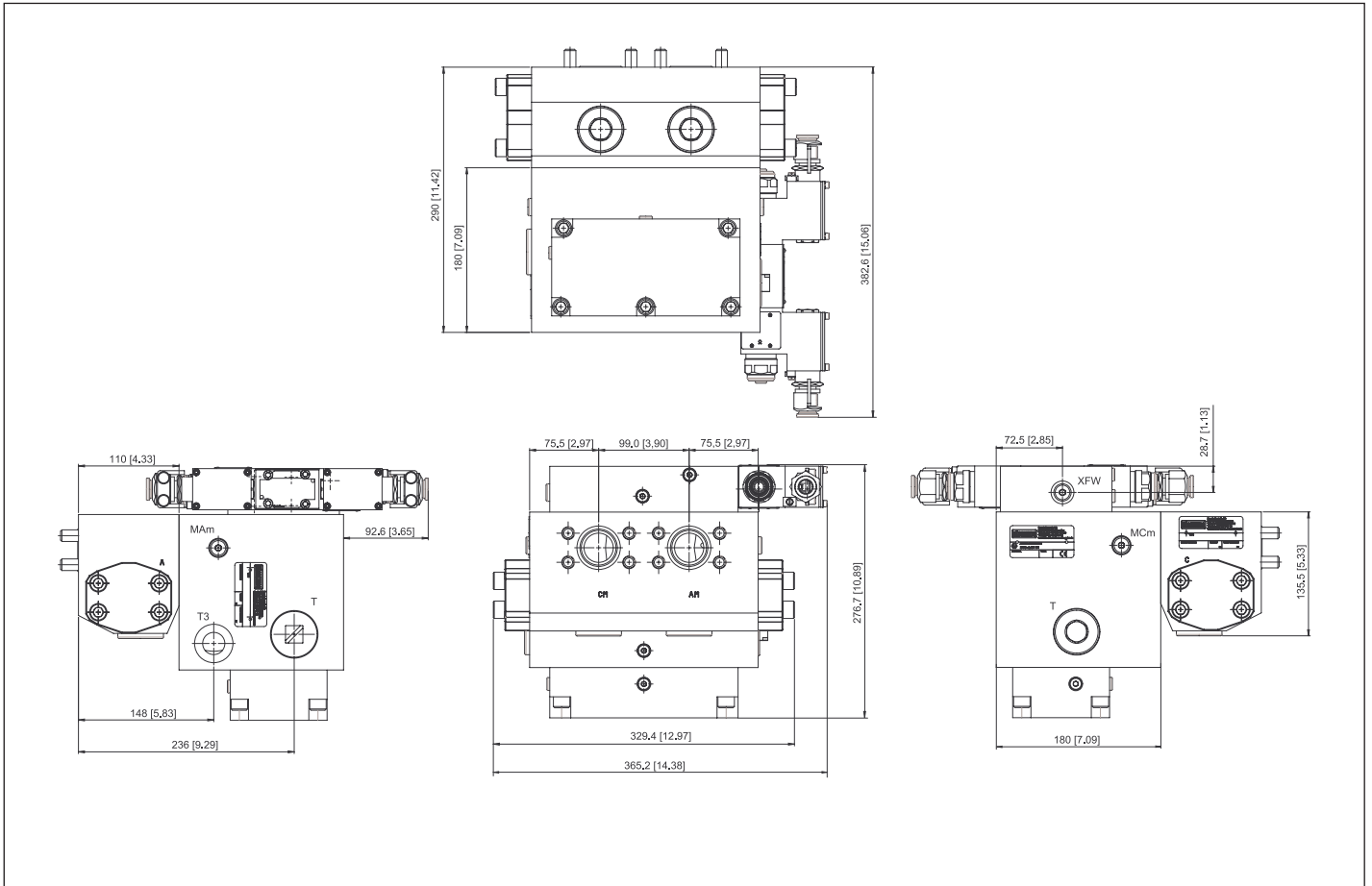


Fig. 7: Dimensions VFCCA 1000 E Ex

## 7 Safety and installation instruction

### 7.1 Safety instructions

#### 7.1.1 General safety instructions

### DANGER

#### **Danger from excessively high pressure!**

Danger to life or risk of injury, damage to equipment!  
Using the valve above the permissible maximum pressure can cause valve burst and hydraulic fluid to escape under high pressure.

- ▶ Use the valve within the permissible maximum pressure

#### **Pressurized valve**

Danger to life risk of injuries when working on valve in system not being depressurized

- ▶ Protect the system against being energized.
- ▶ Make sure that the system is depressurized.
- ▶ Do not disconnect any line connection, ports and components when the system is pressurized

### 7.1.2 Safety instructions for ATEX environment

### DANGER

#### **Unsafe work on the valve**

Danger to life or risk of injury, damage to equipment!

- ▶ Before carrying any work on the valve, firstly make sure that a potentially explosive atmosphere cannot occur during the period of the work

### WARNING

#### **Escaping oil mist!**

Risk of explosion, fire health hazard, environmental pollution.

- ▶ Depressurize the system including valve and repair the leak.
- ▶ Keep open flames an ignition sources from the Häggglunds valve

#### **Static discharge**

Cleaning the valve with a dry rug may lead to explosions through electrostatic dis-charge that may cause severe injuries and even death

- ▶ Do not use a dry rug for cleaning

#### **Lack of grounding**

Risk of explosion that may cause severe injuries and even death

- ▶ The valve must always be fitted to the motor or via adapter fitted to the motor. The valve must be electrically conductive and equipotential bonded with the motor which must be grounded to the system.
- ▶ The valve are not allowed to be fitted to any separate bracket without grounding of the valve.

#### **Painting**

Risk of explosion that may cause severe injuries and even death

- ▶ The valve must not be painted or otherwise coated with non-conductive substances!
- ▶ Any change at the surface protection will lead to loss of explosion protection!

## 7.2 Installation

### 7.2.1 Fitting the VFCCA 1000 Valve on Hägglunds CA and CB

Refer also to the Installation and Maintenance Manual for actual motor.

## NOTICE

### Contamination of the system!

Risk of damage components.

► Clean all mounting surfaces before assembly!

- Remove the SAE flanges from motor mounting surface and the plastic plugs from the adapter/valve mounting surfaces .
- Place the O-rings (5) (included in delivery) in their proper position on the adapter (4) mounting surface.
- Use clean grease to keep O-rings fixed during assembly.
- Mount the adapter (4) onto the motor with the ports in their correct position.
- Place the O-rings (5) (included in delivery) in their proper position on the valve (2) mounting surface.
- Use clean grease to keep O-rings fixed during assembly.
- Mount the valve (2) against the adapter (4) with the ports in their correct position.
- Re-instate paint finish and protect exposed surfaces.

Pos	Description
1	4 pcs M16 x 180 (7") (included in delivery) Tightening torque: 277 Nm (204 lbf-ft)
2	Valve VFCCA 1000
3	8 pcs 1/2 UNC x 102 (4") (included in delivery) Tightening torque: 131 Nm (97 lbf-ft)
4	Adapter VA 1000-10 (Included in delivery)
5	4 pcs o-ring 40.87 x 3.53 NBR90 (included in delivery)

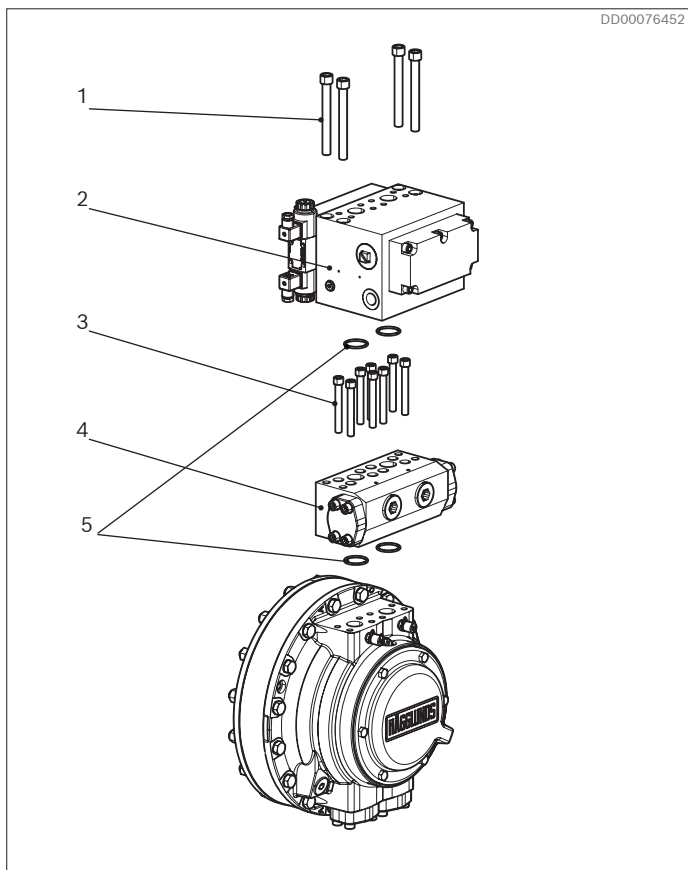


Fig. 8: Hägglunds CA

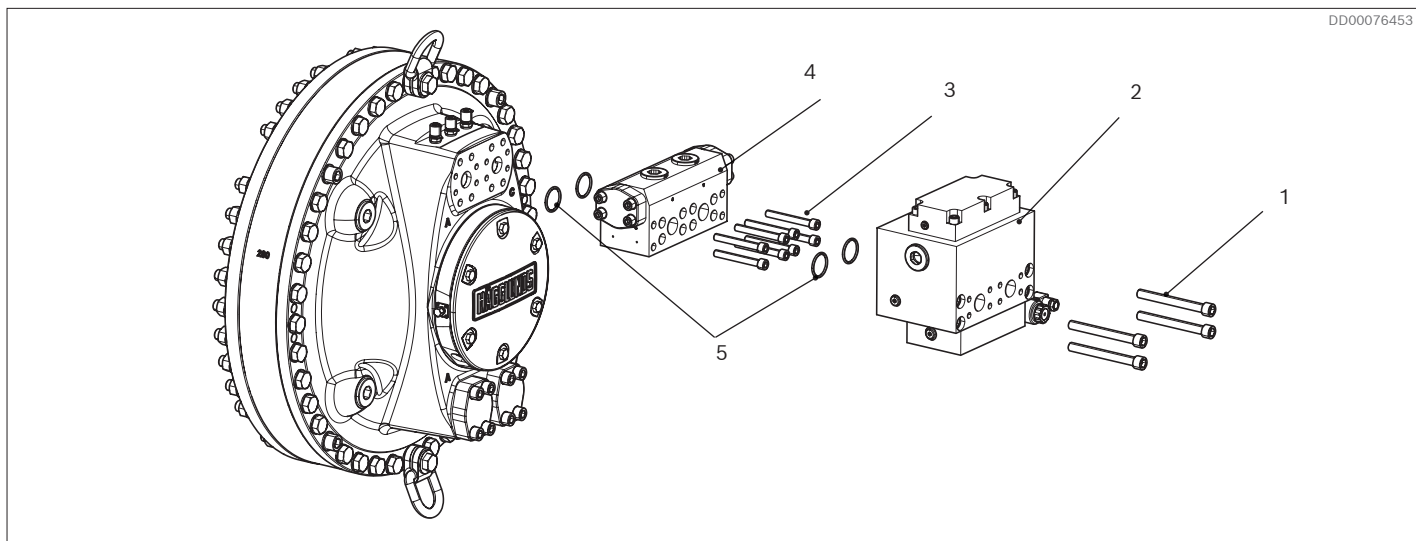


Fig. 9: Hägglunds CB

### 7.2.2 Fitting the VFCCA 1000 valve on Hägglands CBm

Refer also to the Installation and Maintenance Manual for actual motor.

## NOTICE

#### Contamination of the system!

Risk of damage components.

- ▶ Clean all mounting surfaces before assembly!.

- Remove the SAE flanges from motor mounting surface and the plastic plugs from the adapter/valve mounting surfaces.
- Place the O-rings (8) (included in delivery) in their proper position on the adapter (7) mounting surface.
- Use clean grease to keep O-rings fixed during assembly.
- Mount the adapter (7) onto the motor with the ports in their correct position.
- Place the O-rings (5) (included in delivery) in their proper position on the adapter (4) mounting surface.
- Use clean grease to keep O-rings fixed during assembly
- Mount the the adapter (4) onto the adapter (7)with

the ports in their correct position.

- Place the O-rings (5) (included in delivery) in their proper position on the valve (2) mounting surface.
- Use clean grease to keep O-rings fixed during assembly.
- Mount the valve (2) against the adapter(4) with the ports in their correct position.
- Re-instate paint finish and protect exposed surfaces

Pos	Description
1	4 pcs M16 x 180 (7") (included in delivery) Tightening torque: 277 Nm (204 lbf-ft)
2	Valve VFCCA 1000
3	8 pcs 1/2 UNC x 102 (4") (Included in delivery) Tightening torque 131 Nm (97 lbf ft)
4	Adapter VA 1000 10 (Included in delivery)
5	4 pcs O-ring 40.87 x 3,53 NBR 90 (Included in delivery)
6	8 pcs 3/4 UNC X178 (7") (Included in VA 1000 15) Tightening torque 568 Nm (419 lbf ft)
7	Adapter VA 1000 15 not included in delivery (see Data sheet RE 15383 Hägglands valve adapters)
8	2 pcs O-ring 56,74x3,53 NBR 90 (Included in VA 1000 15)

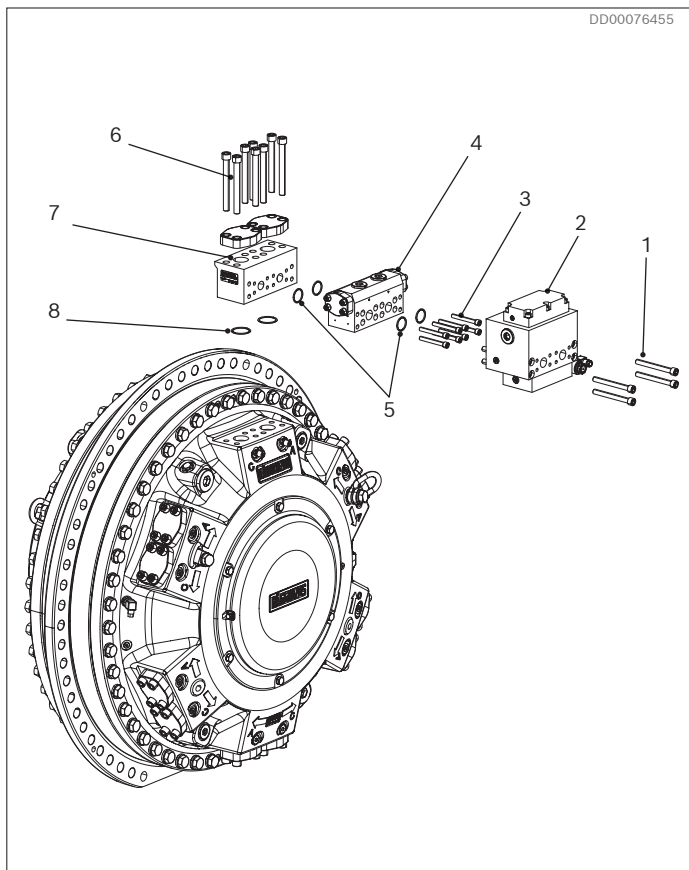


Fig. 10: Hägglands CBm

#### Note!

**Mounting the valve on Hägglands CBm , adapter R939011952, VA 1000 15 must be ordered separately!**

### 7.3 Installation drawing

#### 7.3.1 VFCCA 1000 H, VFCCA 1000 H Ex

Refer to dimensional drawing: 141 0407

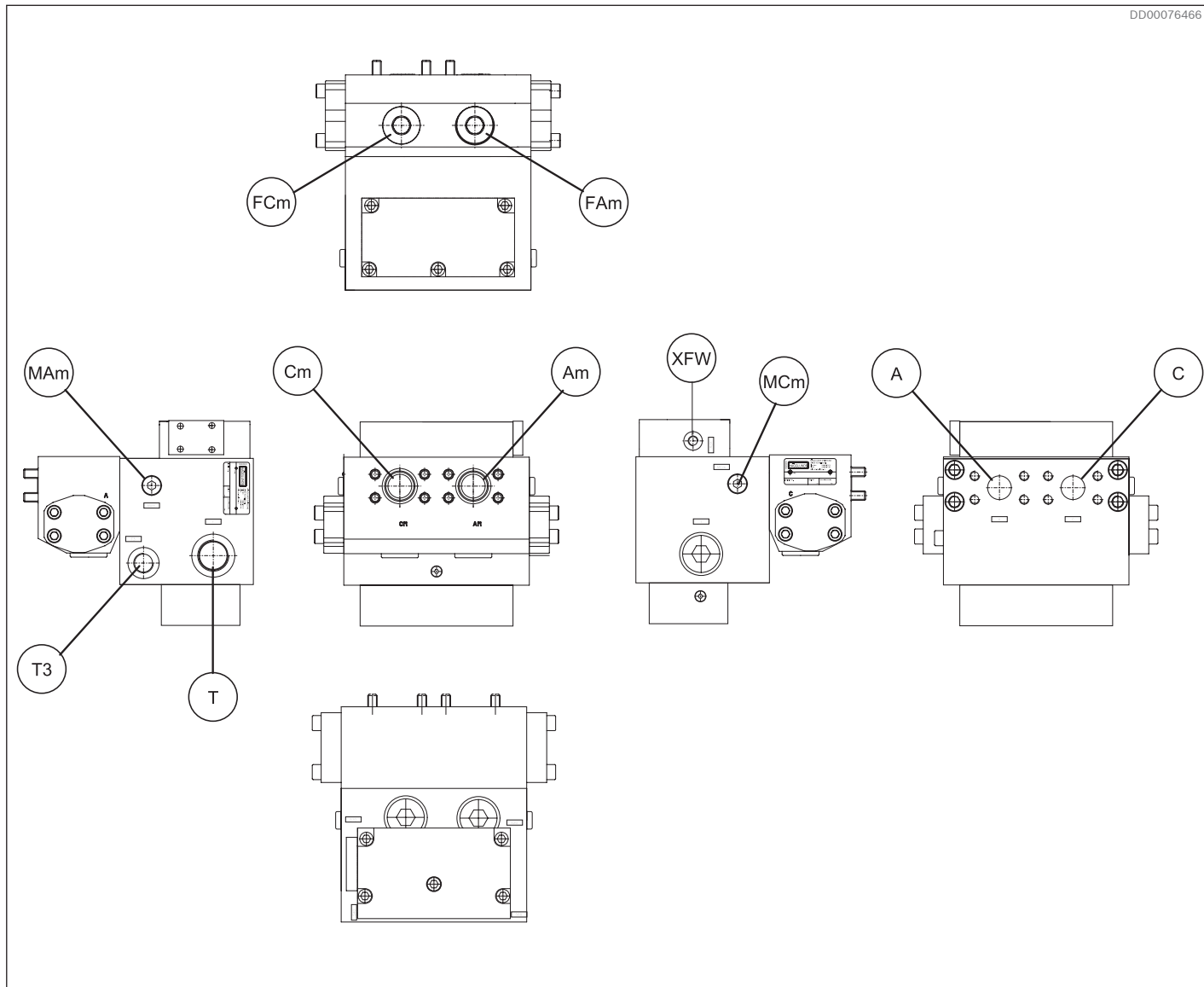


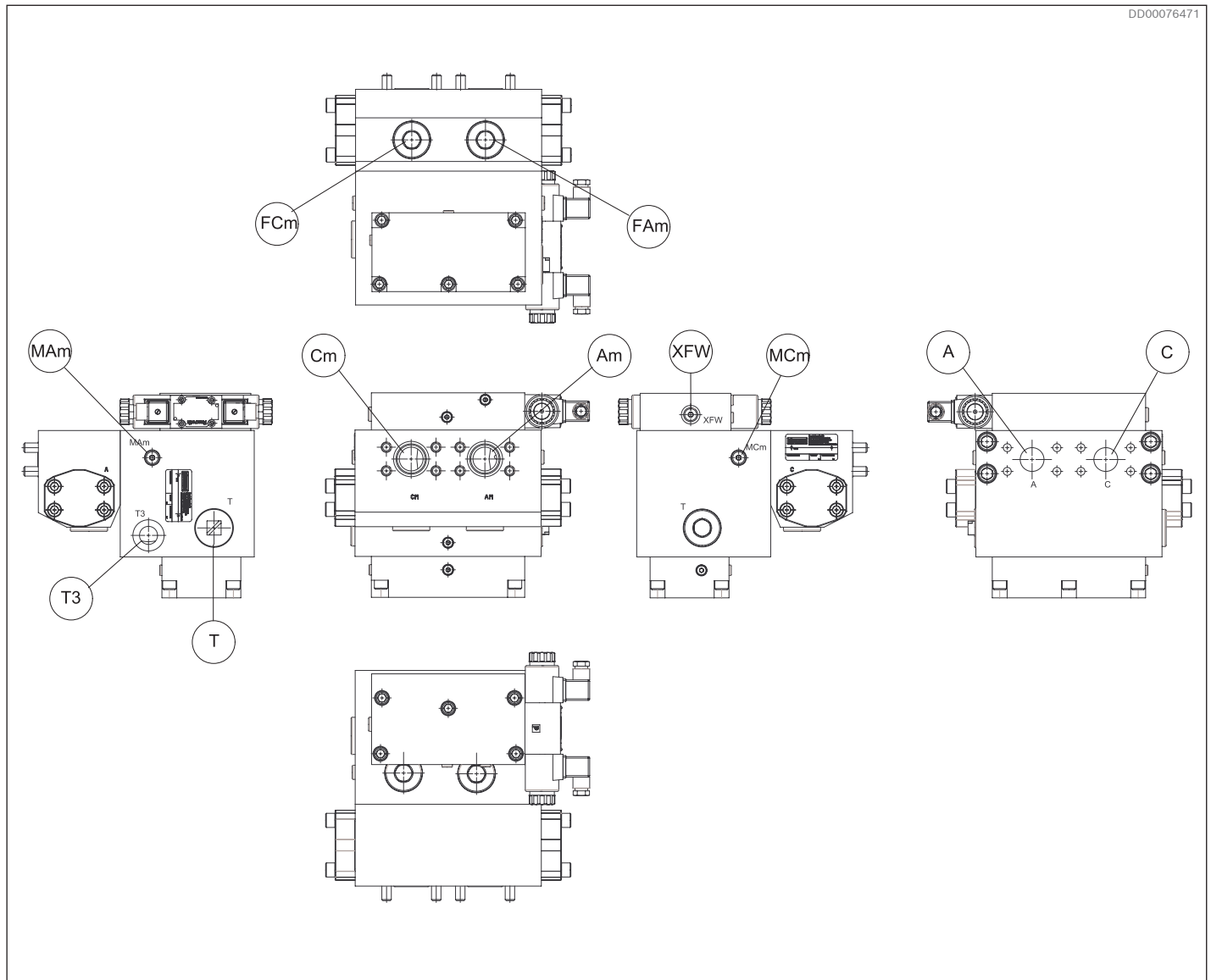
Fig. 11: Installation drawing VFCCA 1000 H, VFCCA 1000 H Ex

Connection	Description	Port Connection
A, C	Main connection	SAE 1 1/4 *
Am, Cm	Main connection	SAE 1 1/4 *
T	Drain Connection	G 1 1/4
T3	Drain Connection	G 3/4
XFW	Pilot Connection	G 1/4
MCm, MAm	Measure connection	G 1/4
FCm FAm	Oil exchange connection	G 1 1/4

\* J815C, Code 62, 414 Bar (6000 psi)

**7.3.2 VFCCA 1000 E, VFCCA 1000 E Ex**

Refer to dimensional drawing: 141 0408, 078 4425



**Fig. 12: Installation drawing VFCCA 1000 E, VFCCA 1000 E Ex**

Connection	Description	Port Connection
A, C	Main connection	SAE 1 1/4 *
Am, Cm	Main connection	SAE 1 1/4 *
T	Drain connection	G 1 1/4
T3	Drain onnection	G 3/4
XFW	Plugged	G 1/4
MCm, MAm	Measure connection	G 1/4
FCm FAm	Oil exchange connection	G 1 1/4

\* J815C, Code 62, 414 Bar (6000 psi)

## 7.4 Electrical installation

### 7.4.1 Electrical circuit connection, standard.

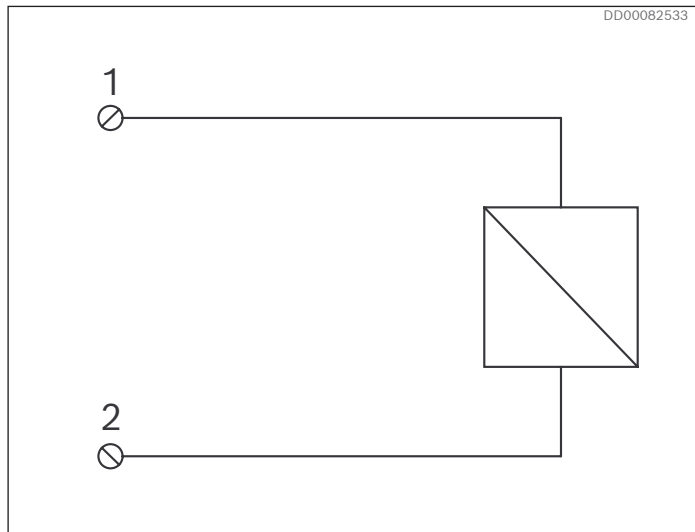


Fig. 13: Circuit diagram standard terminal box

### 7.4.2 Electrical circuit connection, Ex.

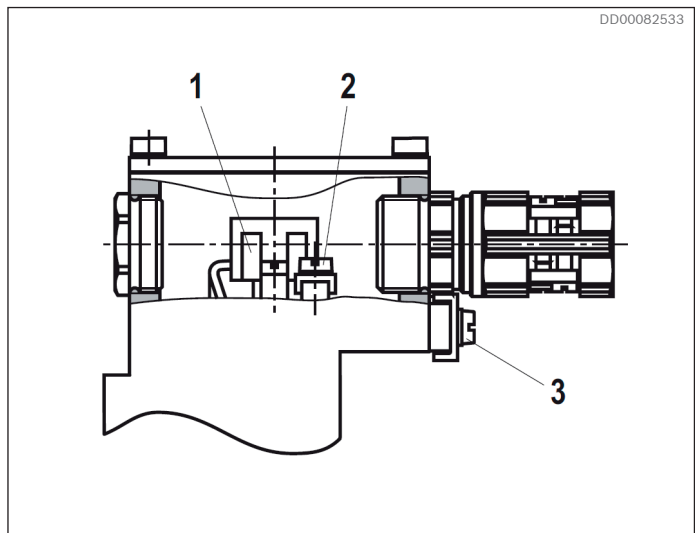


Fig. 14: Electrical connection, Ex terminal box

**Table 5: Properties of the connection terminals and mounting elements**

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 ... 2.5 mm <sup>2</sup> Finely stranded 0.75 ... 1.5 mm <sup>2</sup>
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm <sup>2</sup> Finely stranded max. 1.5 mm <sup>2</sup>
3	Connection for potential equalization conductor	Single-wire 4 ... 6 mm <sup>2</sup> Finely stranded min. 4 mm <sup>2</sup>

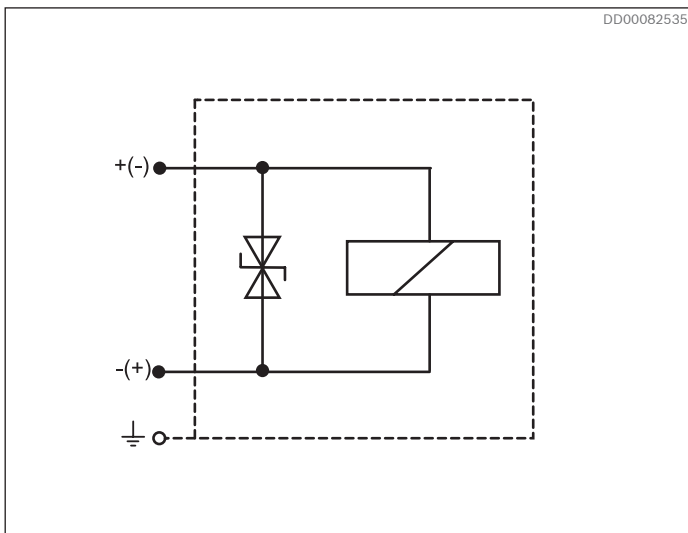


Fig. 15: Circuit diagram Ex terminal box








**Table 6: Cable gland**

Type approval	II 2G Ex e IIC Gb
Threaded connection	M20 x 1.5
Protection class according to EN 60529	IP66 (with correctly installed electrical connection)
Line diameter	7 ... 10.5 mm (0.28 ... 0.41 in)
Sealing	Outer sheath sealing

**Table 7: Connection line**

Line type	Non-armored cables and lines (outer sheath sealing)
Temperature range	-30 ... > +110 °C ( -22...>+230 °F)

## 8 Required and additional documents

Title	Document no	Document type
 Hydraulic fluid quick reference	<a href="#">RE 15414</a>	Data sheet
 Häggglunds valve adapters	<a href="#">RE 15383</a>	Data sheet
 Directional spool valves, direct operated, with solenoid actuation Type WE	<a href="#">RE 23178</a>	Data sheet
 Directional spool valves, direct operated, with solenoid actuation Type WE....XE	<a href="#">RE 23178-XE</a>	Data sheet
 VFCCA 1000 H, VFCCA 1000 H Ex	<a href="#">141 0407</a> *)	Dimension drawing
 VFCCA 1000 E	<a href="#">141 0408</a> *)	Dimension drawing
 VFCCA 1000 E Ex	<a href="#">078 4425</a> *)	Dimension drawing

\*) Documents only available at MyRexroth. Contact your Bosch Rexroth representative for information.

**Bosch Rexroth AB**

895 80 Mellanslät, Sweden  
Tel: +46 (0) 660 870 00  
Fax: +46 (0) 660 871 60  
hagglunds@boschrexroth.com  
www.boschrexroth.com

The data specified above only serve to describe the product.

As our products are constantly being further developed, no statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging