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# Когтевые компрессоры ММ 1104-1142 ВР



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# Preface

Congratulations on your purchase of the Busch compressor. With watchful observation of the field's requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

These operating instructions contain information for

- product description,
- safety,
- transport,
- storage,
- installation and commissioning,
- maintenance,
- overhaul,
- troubleshooting and
- spare parts

of the compressor.

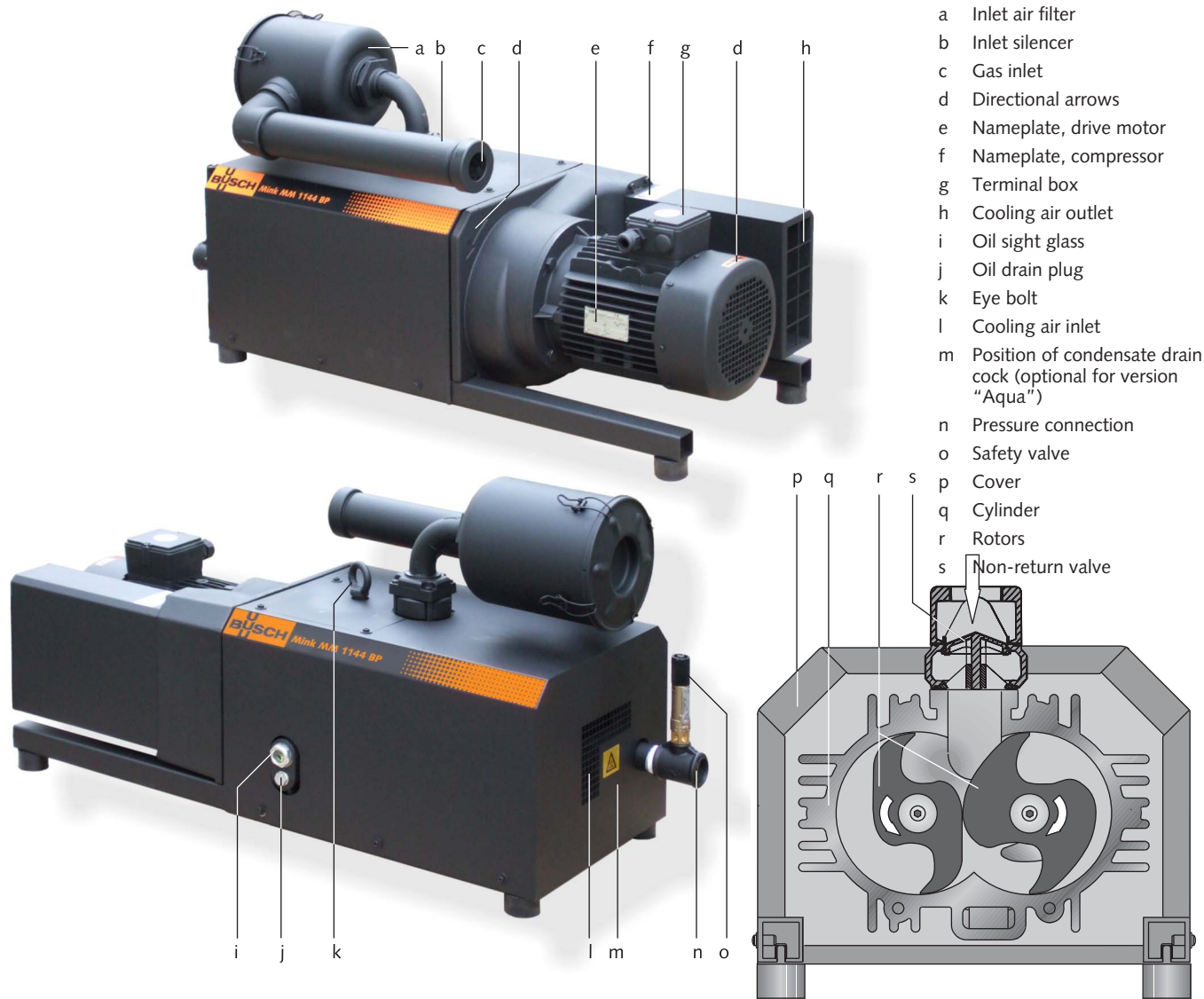
Version drive with integrated frequency inverter:

The drive with integrated frequency inverter is subject to a separate instruction manual.

For the purpose of these instructions, "handling" the compressor means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the compressor.

**Prior to handling the compressor these operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!**

**Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.**



- a Inlet air filter
- b Inlet silencer
- c Gas inlet
- d Directional arrows
- e Nameplate, drive motor
- f Nameplate, compressor
- g Terminal box
- h Cooling air outlet
- i Oil sight glass
- j Oil drain plug
- k Eye bolt
- l Cooling air inlet
- m Position of condensate drain cock (optional for version "Aqua")
- n Pressure connection
- o Safety valve
- p Cover
- q Cylinder
- r Rotors
- s Non-return valve

## Product Description

### Use

The compressor is intended for

- the compression of
- air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the compressor and is permissible only after prior consultation with Busch.

Max. allowed temperature of the inlet gas: 40 °C

Standard-version:

The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the compressor.

Version "Aqua":

The compressor features the corrosion protection coating CPC and is capable of conveying water vapour (→ page 8: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).

The compressor is intended for the placement in a non-potentially explosive environment.

The compressor is thermally suitable for continuous operation (100 percent duty).

Max. permissible number of startings per hour: 12

**The maximum allowed pressure on the pressure connection (n) is 0.7 ... 2.0 barg (the nameplate of the compressor indicates the valid pressure). By means of process control and/or pressure relief valves it must be made sure that the maximum allowed pressure will not be exceeded.**

As a rule ambient pressure must be present at the gas inlet. Deviations are indicated on the nameplate of the compressor.

The safety valve (o) on the compressor protects the compressor against overload only. It is **no** pressure limiting device in terms of EN 1012-1 for the pressure system. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.

### Principle of Operation

The compressor works on the claw principle.

The components are dimensioned such, that on the one hand there is never contact between the two claws or between a claw and the cylinder, on the other hand the gaps are small enough to keep the clearance loss between the chambers low.

In order to avoid the suction of dust, the compressor is equipped with an air filter (a) on the gas inlet.

In order to avoid the suction of solids, the compressor is equipped with a screen in the gas inlet.

In order to avoid reverse rotation after switching off, the compressor is equipped with a non-return valve (s).

The compressor compresses the inlet gas absolutely oil-free. A lubrication of the pump chamber is neither necessary nor allowed.

## Cooling

The compressor is cooled by

- radiation of heat from the surface of the compressor
- the air flow from the fan wheel of the drive motor
- the process gas
- the air flow from the fan wheel on the shaft of the compressor

## Start Controls

The compressor comes without start controls. The control of the compressor is to be provided in the course of installation.

## Safety

### Intended Use

**Definition:** For the purpose of these instructions, “handling” the compressor means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the compressor.

The compressor is intended for industrial use. It shall be handled only by qualified personnel.

**The allowed media and operational limits (→ page 3: Product Description) and the installation prerequisites (→ page 5: Installation Prerequisites) of the compressor shall be observed both by the manufacturer of the machinery into which the compressor is to be incorporated and by the operator.**

The maintenance instructions shall be observed.

**Prior to handling the compressor these installation and operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!**

### Safety Notes

The compressor has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. These operating instructions highlight potential hazards where appropriate. Safety notes are tagged with one of the keywords DANGER, WARNING and CAUTION as follows:



#### DANGER

Disregard of this safety note will always lead to accidents with fatal or serious injuries.



#### WARNING

Disregard of this safety note may lead to accidents with fatal or serious injuries.



#### CAUTION

Disregard of this safety note may lead to accidents with minor injuries or property damage.

### Noise Emission

For the sound pressure level in free field according to EN ISO 2151 → page 19: Technical Data.



#### CAUTION

The compressor emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

Persons staying in the vicinity of a non noise insulated compressor over extended periods shall wear ear protection.

## Transport

### Transport in Packaging

Packed on a pallet the compressor is to be transported with a forklift.

### Transport without Packaging

In case the compressor is packed in a cardboard box with inflated cushions:

- ◆ Remove the inflated cushions from the box

In case the compressor is in a cardboard box cushioned with rolled corrugated cardboard:

- ◆ Remove the corrugated cardboard from the box

In case the compressor is laid in foam:

- ◆ Remove the foam

In case the compressor is bolted to a pallet or a base plate:

- ◆ Remove the bolting between the compressor and the pallet/base plate

In case the compressor is fastened to the pallet by means of tightening straps:

- ◆ Remove the tightening straps



#### CAUTION

Do not walk, stand or work under suspended loads.

- Make sure that the eyebolts are in faultless condition (replace damaged, e.g. bent eyebolts with a new ones)
- Make sure that the eyebolts are fully screwed in and tightened by hand
- Attach lifting gear securely to the eyebolts on the synchronising gear (k) and on the drive motor

In case the drive motor comes without an eyebolt or the eyebolt on the drive motor is located at an unfavourable position:

- ◆ Loop a belt/rope with suitable length and strength around the flange of the drive motor
- Attach the lifting gear to a crane hook with safety latch
- Lift the compressor with a crane

In case the compressor was bolted to a pallet or a base plate:

- ◆ Remove the stud bolts from the rubber feet

## Storage

### Short-term Storage

- Make sure that the gas inlet and the pressure connection are closed (leave the provided plugs in)
- Store the compressor
  - if possible in original packaging,
  - indoors,
  - dry,
  - dust free and
  - vibration free

## Conservation

In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) conserve the compressor immediately. In case of favourable ambient conditions conserve the compressor if a storage of more than 3 months is scheduled.

- Make sure that all ports are firmly closed; seal all ports that are not sealed with PTFE-tape, gaskets or o-rings with adhesive tape

**Note:** VCI stands for "volatile corrosion inhibitor". VCI-products (film, paper, cardboard, foam) evaporate a substance that condenses in molecular thickness on the packed good and by its electro-chemical properties effectively suppresses corrosion on metallic surfaces. However, VCI-products may attack the surfaces of plastics and elastomers. Seek advice from your local packaging dealer! Busch uses CORTEC VCI 126 R film for the overseas packaging of large equipment.

- Wrap the compressor in VCI film
- Store the compressor
  - if possible in original packing,
  - indoors,
  - dry,
  - dust free and
  - vibration free.

For commissioning after conservation:

- Make sure that all remains of adhesive tape are removed from the ports
- Commission the compressor as described in the chapter Installation and Commissioning (→ page 5)

## Installation and Commissioning

### Installation Prerequisites



CAUTION

In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:

Risk of damage or destruction of the compressor and adjoining plant components!

Risk of injury!

The installation prerequisites must be complied with.

- Make sure that the integration of the compressor is carried out such that the essential safety requirements of the Machine Directive 2006/42/EC are complied with (in the responsibility of the designer of the machinery into which the compressor is to be incorporated; → page 15: note in the EC-Declaration of Conformity)

### Mounting Position and Space

- Make sure that the environment of the compressor is not potentially explosive
- Make sure that the following ambient conditions will be complied with:
  - ambient temperature: 0 ... 40 °C
  - ambient pressure: atmospheric
- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- Make sure that the compressor will be placed or mounted horizontally
- Make sure that the base for placement / mounting base is even

- Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 1 m between the compressor and nearby walls
- Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the compressor
- Make sure that the installation space or location is vented such that a sufficient cooling of the compressor is warranted



CAUTION

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

Risk of burns!

- Make sure that the compressor will not be touched inadvertently during operation, provide a guard if appropriate
- Make sure that the sight glass (i, 76) of the synchronising gear will remain accessible

In case the synchronising gear oil change is planned to be carried out on location:

- ◆ Make sure that the drain port (j, 80) and the filling port (72) of the synchronising gear will remain easily accessible

### Gas Inlet



CAUTION

Intruding foreign objects or liquids can destroy the compressor.

In case the inlet gas can contain dust or other foreign solid particles:

- ◆ Make sure that a suitable filter (5 micron or less) is installed upstream the compressor (included in scope of delivery)

The following guidelines for the suction line do not apply, if the air to be compressed is taken in right at the compressor.

- Make sure that the suction line fits to the gas inlet (c) of the compressor
- Make sure that the gas will be sucked through a vacuum-tight flexible hose or a pipe

In case of using a pipe:

- ◆ Make sure that the pipe will cause no stress on the compressor's connection, if necessary use an expansion joint
- Make sure that the line size of the suction line over the entire length is at least as large as the gas inlet (c) of the compressor

In case the length of the suction line exceeds 2 m it is prudent to use larger line sizes in order to avoid a loss of efficiency and an overload of the compressor. Seek advice from your Busch representative!

Version "Aqua", if very humid process gases and/or adverse operating cycles bear the risk, that condensates remain in the compressor:

- ◆ Provide a shut-off valve, a drip-leg and a drain cock in the suction line, so that condensates can be drained from the suction line
- ◆ Provide a valve for the unthrottled suction of ambient air (ambient air valve) between the shut-off valve and the compressor (in order to dry the compressor after process end).
- ◆ Make sure that the anti-pulsation chamber is equipped with a condensate drain cock (m) (optional; if the condensate drain cock is missing contact the Busch service)
- Make sure that the suction line does not contain foreign objects, e.g. welding scales

### Pressure Connection

- Make sure that the pressure line fits to the pressure connection (n) of the compressor
- Make sure that the pressure connection is connected to a pressure-tight flexible hose or a pipe

- Make sure that the pressure line is designed for 2.0 barg and 250 °C

In case of using a pipe:

- ◆ Make sure that the pipe will cause no stress on the compressor's connection, if necessary use an expansion joint
- Make sure that the line size of the pressure line over the entire length is at least as large as the pressure connection (n) of the compressor

In case the length of the pressure line exceeds 2 m it is prudent to use larger line sizes in order to avoid a loss of efficiency and an overload of the compressor. Seek advice from your Busch representative!

- Make sure that the pressure line either slopes away from the compressor or provide a liquid separator or a drip leg with a drain cock, so that no liquids can back up into the compressor

## Electrical Connection / Controls

- Make sure that the stipulations acc. to the EMC-Directive 2004/108/EC and Low-Voltage-Directive 2006/95/EC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is the responsibility of the designer of the machinery into which the compressor is to be incorporated; → page 15: note in the EC-Declaration of Conformity).
- Make sure that the power supply for the drive motor is compatible with the data on the nameplate of the drive motor
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor
- Make sure that the drive of the compressor will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

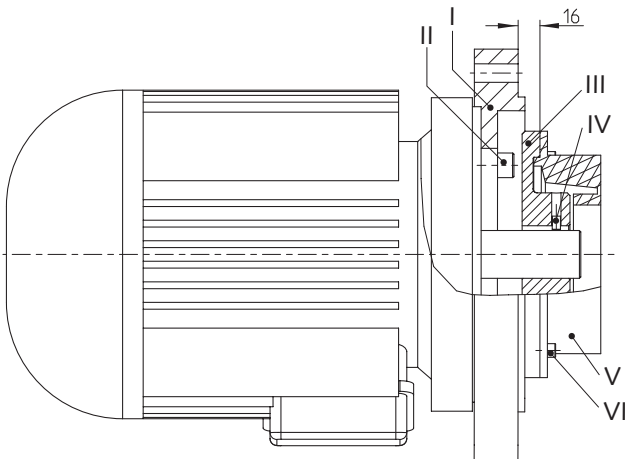
In case of mobile installation:

- ◆ Provide the electrical connection with grommets that serve as strain-relief

## Installation

### Mounting a NEMA-Motor with BoWex-Coupling

For certain markets the compressor is available without motor, but with a NEMA-adaptor flange and a BoWex-coupling.



- Remove the NEMA-adaptor flange (I) from the compressor
- Pull the elastomer part (V) together with the hub (III) off the shaft of the compressor
- Mount the NEMA-adaptor flange (I) on the motor (the bolts (II) are not part of the Busch scope of delivery)
- Undo the cylinder screws (VI) and remove the elastomer part (V) from the hub (III)
- Make sure that the parallel key is inserted into the motor shaft

- Push the hub (III) onto the motor shaft such that the mounting face of the hub (III) will be located  $16 \pm 1$  mm before the mounting face of the NEMA-adaptor flange (I) (→ sketch)
- Fasten the hub (III) on the motor shaft using the set screw (IV)
- Apply thread locking agent on the threads of the cylinder screws (VI)
- Mount the elastomer part (V) on the hub (III) with the cylinder screws (VI) and tighten the cylinder screws with 14 Nm
- Mount the motor on the compressor

## Mounting

- Make sure that the installation prerequisites (→ page 5) are complied with
- Set down or mount the compressor at its location

## Checking Synchronising Gear Oil

The compressor is delivered with oil filled synchronising gear.

The level shall be slightly above the middle of the sight glass (i, 76).

- Check on the sight glass (i, 76) that the proper amount of oil is filled

## Connecting Electrically



Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:

- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.



The connection schemes given below are typical. Depending on the specific order or for certain markets deviating connection schemes may apply.

Risk of damage to the drive motor!

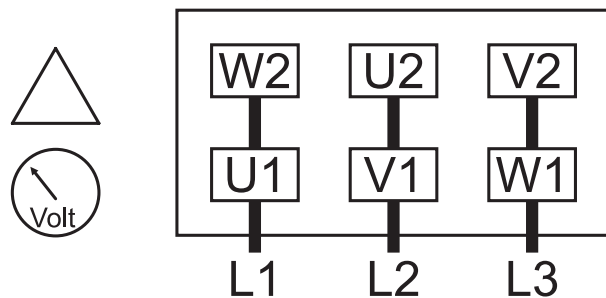
The inside of the terminal box shall be checked for drive motor connection instructions/schemes.

**Note:** For the connection of a drive with integrated frequency inverter see the separate operating instructions!

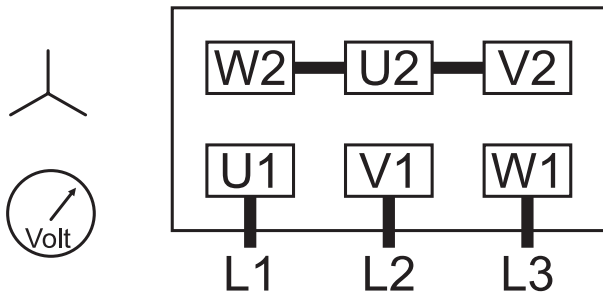
- Electrically connect the drive motor
- Connect the protective earth conductor

### Connection Scheme Three-Phase Motor

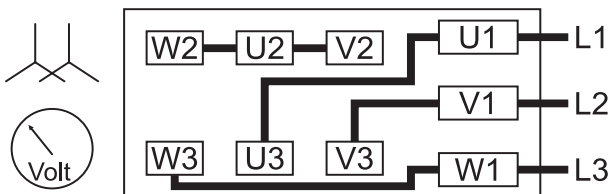
Delta connection (low voltage):



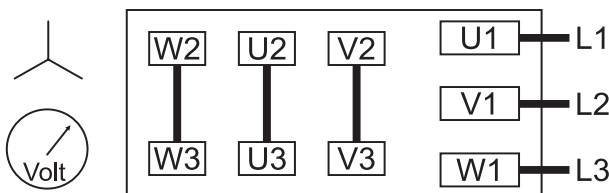
Star connection (high voltage):



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



Star connection, multi-voltage motor (high voltage):



#### CAUTION

Operation in the wrong direction of rotation can destroy the compressor in short time.

Prior to starting-up it must be made sure that the compressor is operated in the proper direction (clockwise rotating field).

Version with three-phase motor:

- ◆ Determine the intended direction of rotation with the arrow (stuck on or cast)
- ◆ "Bump" the drive motor
- ◆ Watch the fan wheel of the drive motor and determine the direction of rotation just before the fan wheel stops

If the rotation must be changed:

- ◆ Switch any two of the drive motor wires (three-phase motor)

## Connecting Lines/Pipes

- Connect the suction line

Installation without suction line:

- ◆ Make sure that the gas inlet (c) is open
- Connect the pressure line
- Make sure that all provided covers, guards, hoods etc. are mounted
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way

## Recording of Operational Parameters

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

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

## Operation Notes

### Use



#### CAUTION

The compressor is designed for operation under the conditions described below.

In case of disregard risk of damage or destruction of the compressor and adjoining plant components!

Risk of injury!

The compressor must only be operated under the conditions described below.

The compressor is intended for

- the compression

of

- air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the compressor and is permissible only after prior consultation with Busch.

Max. allowed temperature of the inlet gas: 40 °C

Standard-version:

The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the compressor.

Version "Aqua":

The compressor features the corrosion protection coating CPC and is capable of conveying water vapour (→ page 8: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).

The compressor is intended for the placement in a non-potentially explosive environment.

The compressor is thermally suitable for continuous operation (100 percent duty).

Max. permissible number of startings per hour: 12

**The maximum allowed pressure on the pressure connection (n) is 0.7 ... 2.0 barg (the nameplate of the compressor indicates the valid pressure). By means of process control and/or pressure relief valves it must be made sure that the maximum allowed pressure will not be exceeded.**

As a rule ambient pressure must be present at the gas inlet. Deviations are indicated on the nameplate of the compressor.

The safety valve (o) on the compressor protects the compressor against overload only. It is **no** pressure limiting device in terms of EN 1012-1 for the pressure system. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.



#### CAUTION

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

Risk of burns!

The compressor shall be protected against contact during operation, it shall cool down prior to a required contact or heat protection gloves shall be worn.



CAUTION

The compressor emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

Persons staying in the vicinity of a non noise insulated compressor over extended periods shall wear ear protection.

- Make sure that all provided covers, guards, hoods etc. remain mounted
- Make sure that protective devices will not be disabled
- Make sure that cooling air inlets and outlets will not be covered or obstructed and that the cooling air flow will not be affected adversely in any other way
- Make sure that the installation prerequisites (→ page 5: Installation Prerequisites) are complied with and will remain complied with, particularly that a sufficient cooling will be ensured

## Conveying Condensable Vapours

Version "Aqua":



CAUTION

Due to the corrosion protection coating CPC the compressor is capable of conveying water vapour.

Very humid process gases and/or adverse operating cycles can lead to residual condensates, though, which cause corrosion.

If this is the case, it is necessary to counteract residual condensates by warming up the compressor, conveyance of ambient air after process end and regular draining of the anti-pulsation chamber (m).

- ◆ Close the shut-off valve in the suction line
- ◆ Warm up the compressor for approx. 10 minutes

At process start:

- ◆ Open the shut-off valve in the suction line

At the process end:

- ◆ Close the shut-off valve in the suction line
- ◆ Open the ambient air valve
- ◆ Operate the compressor for another approx. 10 minutes
- ◆ Close the ambient air valve



CAUTION

During operation of the compressor the anti-pulsation chamber is under pressure.

Risk of injury when the condensate drain cock is opened!

Drain condensate only when the compressor is shut down and the pressure connection (n) is vented to atmospheric pressure.

- ◆ Regularly drain condensate from the anti-pulsation chamber (m)

## Maintenance



DANGER

In case the compressor conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in filters.

**Danger to health during inspection, cleaning or replacement of filters.**

**Danger to the environment.**

**Personal protective equipment must be worn during the handling of contaminated filters.**

**Contaminated filters are special waste and must be disposed of separately in compliance with applicable regulations.**



CAUTION

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

Risk of burns!

- Prior to disconnecting connections make sure that the connected pipes/lines are vented to atmospheric pressure

## Maintenance Schedule

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

### Monthly:

- Make sure that the compressor is shut down and locked against inadvertent start up

- Check the inlet air filter (a), if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 8: Every 6 Months:

### Every 3 Months:

- Make sure that the compressor is shut down
- Check the level of the synchronising gear oil

The level shall be slightly above the middle of the sight glass (i, 76).

The level of the synchronising gear should stay constant over the lifetime of the oil. If the level does fall, the gear is leaky and the compressor requires repair (Busch service).

### Every 6 Months:

- Make sure that the housing is free from dust and dirt, clean if necessary
- Make sure that the compressor is shut down and locked against inadvertent start up
- Remove the acoustic enclosure

**Note:** Make sure that the foam mats do **not** get soaked with water

- Clean the fan cowlings, fan wheels, the ventilation grilles and cooling fins
- Mount the acoustic enclosure

### Every Year:

- Make sure that the compressor is shut down and locked against inadvertent start up
- Replace the inlet air filter (a)



- Check the inlet screen, clean if necessary

**Note:** As there is an inlet air filter upstream the inlet screen, the inlet screen should not show soiling. A soiled inlet screen indicates that the filter is either broken through or improperly inserted.

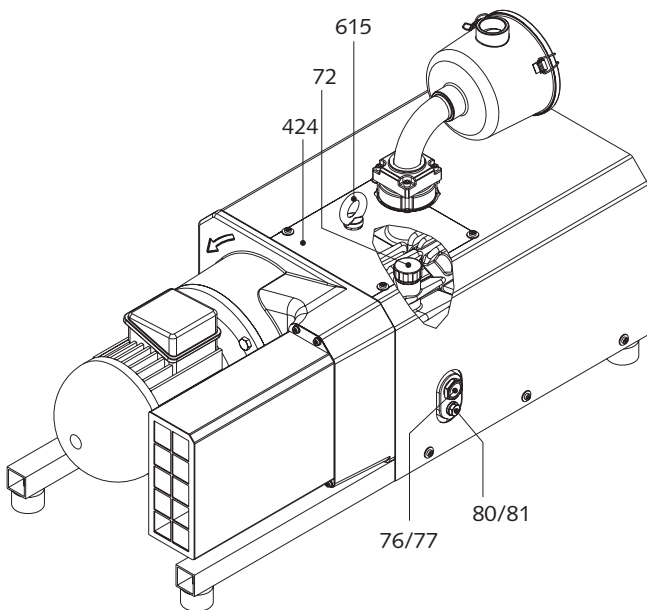
### Every 20000 Operating Hours, At the Latest after 6 Years:

**Note:** The change interval of 20000 operating hours is valid for the gear oil Busch VS 150 only. Other gear oils reduce the change interval.

- Change the synchronising gear oil

## Changing Synchronising Gear Oil

- Make sure that the compressor is shut down and locked against in-advertent start up



- Remove the eyebolt (k)
- Remove the lid (424)
- Undo the venting valve (72) for venting
- Place a drain tray underneath the drain plug (j, 80)
- Open the drain plug (j, 80) and drain the oil
- Make sure that the seal ring on the drain plug (j, 80) is serviceable, replace if necessary
- Firmly reinsert the drain plug (j, 80) together with the seal ring
- Remove the venting valve (72) completely
- Fill in new gear oil until the level is slightly above the middle of the sight glass (i, 76)
- Make sure that the seal ring on the venting valve (72) is undamaged, if necessary replace the venting valve (72)
- Firmly reinsert the venting valve (72) together with the seal ring
- Mount the lid (424)
- Reinsert the eyebolt (k)
- Dispose of the used oil in compliance with applicable regulations

## Overhaul



CAUTION

In order to achieve best efficiency and a long life the compressor was assembled and adjusted with precisely defined tolerances.

This adjustment will be lost during dismantling of the compressor.

It is therefore strictly recommended that any dismantling of the compressor that is beyond of what is described in this manual shall be done by Busch service.



DANGER

In case the compressor conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the compressor.

Danger to health during dismantling of the compressor.

Danger to the environment.

Prior to shipping the compressor shall be decontaminated as good as possible and the contamination status shall be stated in a "Declaration of Contamination" (form downloadable from [www.busch-vacuum.com](http://www.busch-vacuum.com)).

Busch service will only accept compressors that come with a completely filled in and legally binding signed "Declaration of Contamination" (form downloadable from [www.busch-vacuum.com](http://www.busch-vacuum.com)).

## Removal from Service

### Temporary Removal from Service

- Prior to disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

### Recommissioning

- Observe the chapter Installation and Commissioning ( page 5)

### Dismantling and Disposal



DANGER

In case the compressor conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the compressor.

Danger to health during dismantling of the compressor.

Danger to the environment.

During dismantling of the compressor personal protective equipment must be worn.

The compressor must be decontaminated prior to disposal.

- Drain the oil
- Make sure that materials and components to be treated as special waste have been separated from the compressor
- Make sure that the compressor is not contaminated with harmful foreign material

According to the best knowledge at the time of printing of this manual the materials used for the manufacture of the compressor involve no risk.

- Dispose of the used oil in compliance with applicable regulations
- Dispose of the compressor as scrap metal

# Troubleshooting



## WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:

- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or equivalent national accident prevention regulation.



## CAUTION

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

Risk of burns!

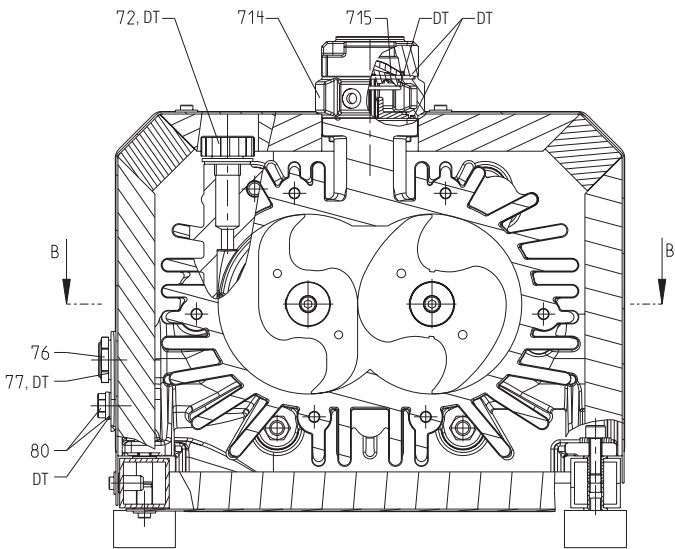
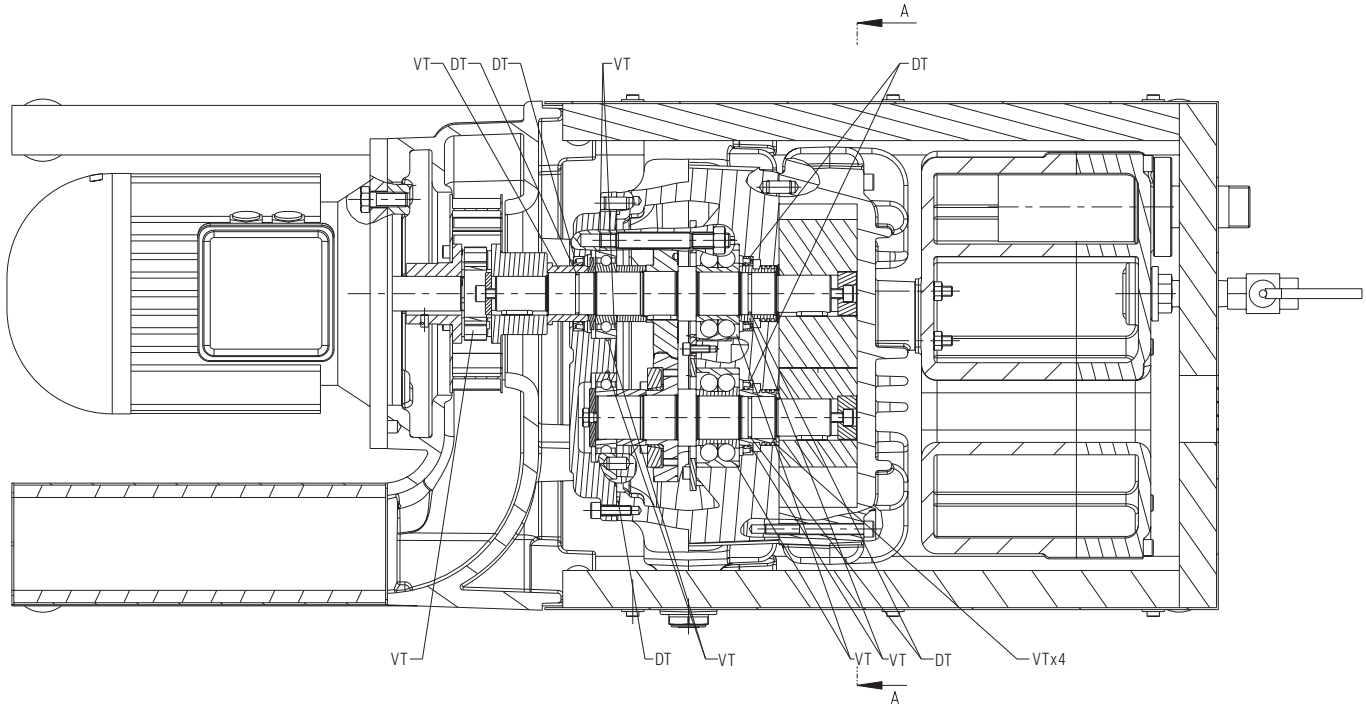
Let the compressor cool down prior to a required contact or wear heat protection gloves.

Problem	Possible Cause	Remedy
The compressor does not reach the usual pressure The drive motor draws a too high current (compare with initial value after commissioning) Filling the system takes too long Building up pressure in the system takes too long	The pressure system or pressure line is not leak-tight	Check the hose or pipe connections for possible leak
	The pressure relief valve/regulating system is misadjusted or defective	Adjust, repair or replace, respectively
	The screen in the gas inlet (c) is partially clogged	Clean the screen If cleaning is required too frequently install a filter upstream
	The filter (a) on the gas inlet (c) is partially clogged	Clean or replace the inlet air filter (a), respectively
	Partial clogging in the suction, discharge or pressure line	Remove the clogging
	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The valve disk of the inlet non-return valve is stuck in closed or partially open position	Disassemble the inlet, clean the screen and the valve (s) as required and reassemble
	Internal parts are worn or damaged	Repair the compressor (Busch service)
The compressor does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary  In case of high ambient temperature: set the trip level of the drive motor starter overload protection 5 percent above the nominal drive motor current
	One of the fuses has blown	Check the fuses
	The connection cable is too small or too long causing a voltage drop at the compressor	Use sufficiently dimensioned cable

	The compressor or the drive motor is blocked	<p>Make sure the drive motor is disconnected from the power supply</p> <p>Remove the fan cover</p> <p>Try to turn the drive motor with the compressor by hand</p> <p>If the unit is still frozen: remove the drive motor and check the drive motor and the compressor separately</p> <p>If the compressor is blocked: Repair the compressor (Busch service)</p>
	The drive motor is defective	<p>Replace the drive motor (Busch service)</p> <p>(the proper function of the fan wheel requires the precise adjustment of the coupling on the motor shaft and on the pump shaft; therefore the motor can be mounted by the Busch service only)</p>
The compressor is blocked	Solid foreign matter has entered the compressor	<p>Repair the compressor (Busch service)</p> <p>Make sure the suction line is equipped with a screen</p> <p>If necessary additionally provide a filter</p>
	Corrosion in the compressor from remaining condensate	<p>Repair the compressor (Busch service)</p> <p>Check the process</p> <p>Observe the chapter Conveying Condensable Vapours (→ page 8)</p>
	Version with three-phase motor: The compressor was run in the wrong direction	<p>Repair the compressor (Busch service)</p> <p>When connecting the compressor make sure the compressor will run in the correct direction (→ page 6: Installation)</p>
The drive motor is running, but the compressor stands still	The coupling between the drive motor and the compressor is defective	<p>Replace the coupling element</p> <p>(the proper function of the fan wheel requires the precise adjustment of the coupling on the motor shaft and on the pump shaft; therefore the coupling element can be replaced by the Busch service only)</p>
The compressor starts, but labours or runs noisily or rattles  The drive motor draws a too high current (compare with initial value after commissioning)	Loose connection(s) in the drive motor terminal box	<p>Check the proper connection of the wires against the connection diagram</p> <p>(particularly on motors with six coils)</p> <p>Tighten or replace loose connections</p>
	Version with three-phase motor: The compressor runs in the wrong direction	Verification and rectification → page 5: Installation and Commissioning
	Foreign objects in the compressor Stuck bearings	Repair the compressor (Busch service)
The compressor runs very noisily	Defective bearings	Repair the compressor (Busch service)
	Worn coupling element	Replace the coupling element
	Low oil level in the synchronising gear	The synchronising gear is leaky Repair the compressor (Busch service)
	Synchronising gear damaged due to operation with low oil level	Repair the compressor (Busch service)
The compressor runs very hot	Insufficient air ventilation	<p>Make sure that the cooling of the compressor is not impeded by dust/dirt</p> <p>Clean the fan cowlings, the fan wheels, the ventilation grilles and the cooling fins</p> <p>Install the compressor in a narrow space only if sufficient ventilation is ensured</p>

Ambient temperature too high	Observe the permitted ambient temperatures
Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
Insufficient gas transfer	Provide a pressure relief valve
Mains frequency or voltage outside tolerance range	Provide a more stable power supply
In case a pressure relief valve/regulating system is installed: The pressure relief valve/regulating system is misadjusted or defective	Adjust, repair or replace, respectively
Partial clogging of filters or screens Partial clogging in the suction, discharge or pressure line	Remove the clogging
Long suction, discharge or pressure line with too small diameter	Use larger diameter

# Sectional Drawing



## Spare Parts

**Note:** When ordering spare parts or accessories acc. to the table below please always quote the type ("Type") and the serial no. ("No") of the compressor. This will allow Busch service to check if the compressor is compatible with a modified or improved part.

**The exclusive use of genuine spare parts and consumables is a prerequisite for the proper function of the compressor and for the granting of warranty, guarantee or goodwill.**

Your point of contact for service and spare parts in the United Kingdom:

Busch (UK) Ltd.  
Hortonwood 30-35  
Telford  
Shropshire  
TF1 7YB

Tel: 01952 677 432  
Fax: 01952 677 423

Your point of contact for service and spare parts in Ireland:

Busch Ireland Ltd.  
A10-11 Howth Junction Business Centre  
Kilbarrack, Dublin 5  
Tel: +353 (0)1 8321466  
Fax: +353 (0)1 8321470

Your point of contact for service and spare parts in the USA:

Busch Inc.  
516-B Viking Drive  
Virginia Beach, VA 23452  
Tel: 1-800-USA-PUMP (872-7867)

Your point of contact for service and spare parts in Canada:

Busch Vacuum Technics Inc.  
1740, Boulevard Lionel Bertrand  
Boisbriand (Montréal)  
Québec J7H 1N7  
Tel: 450 435 6899  
Fax: 450 430 5132

Your point of contact for service and spare parts in Australia:

Busch Australia Pty. Ltd.  
30 Lakeside Drive  
Broadmeadows, Vic. 3047  
Tel: (03) 93 55 06 00  
Fax: (03) 93 55 06 99

Your point of contact for service and spare parts in New Zealand:

Busch New Zealand Ltd.  
Unit D, Arrenway Drive  
Albany, Auckland 1311  
P O Box 302696  
North Harbour, Auckland 1330  
Tel: 0-9-414 7782  
Fax: 0-9-414 7783

Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on page 20 (rear cover page).

Find the up-to-date list of Busch companies and agencies all over the world on the internet at [www.busch-vacuum.com](http://www.busch-vacuum.com).

Pos.	Part	Qty	Part no.
72	Venting valve (=oil fill plug) with seal ring	1	0543 138 026
76	Sight glass	1	0583 000 001
77	Seal ring for sight glass	1	0480 000 271
80	Plug with magnet and seal ring	1	0415 134 870
81	Seal ring for plug with magnet	1	0482 137 352
714	Inlet flange, lower part, with non-return valve	1	0916 102 518

715	Screen	1	0534 000 018
—	Filter cartridge, paper, for inlet filter	1	0532 000 004
—	Safety valve (quote in your order also the ultimate working pressure of the compressor)	1	on request

## Spare Parts Kits

Spare parts kit	Part no.
Overhaul kit (incl. set of seals, marking "VT" and "DT")	0993 138 031
Set of seals (marking "DT")	0990 138 032

## Oil

Denomination	Busch VS 150
ISO-VG	150
Base	PAO
Density [g/cm <sup>3</sup> ]	0.846
Kinematic viscosity at 40°C [mm <sup>2</sup> /s]	150
Kinematic viscosity at 100°C [mm <sup>2</sup> /s]	19.8
Flashpoint [°C]	236
Pourpoint [°C]	-54
Part no. 1l packaging	0831 164 883
Part no. 5 l packaging	0831 164 884
Filling quantity, approx. [l]	0.85

# EC-Declaration of Conformity

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

We

**Busch Produktions GmbH**  
**Schauinslandstr. 1**  
**79689 Maulburg**  
**Germany**

Declare that the vacuum pumps **MM 1104, 1144, 1102, 1142 BP**

with a serial number from **D1601...** to **D1752...**

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

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' 2014/30/EU
- 'RoHS' 2011/65/EU, restriction of the use of certain hazardous substances in electrical and electronic equipment

and following the standards.

Standard	Title of the Standard
EN ISO 12100: 2010	Safety of machinery –General principles for design –Risk assessment and risk reduction
EN ISO 13857: 2008	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-1: 2010 EN 1012-2: 1996 + A1: 2009	Compressors and vacuum pumps - Safety requirements - Part 1 and Part 2
EN ISO 2151: 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1: 2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-2: 2005	Electromagnetic compatibility (EMC) - Generic immunity standards. Immunity for industrial environments
EN 61000-6-4: 2007 + A1: 2011	Electromagnetic compatibility (EMC) - Generic immunity standards. Emission standard for industrial environments
EN ISO 13849-1:2015 <sup>(1)</sup>	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design

<p>Manufacturer</p>  <p><b>Dr.-Ing. Karl Busch</b> General Director</p>	<p>Person authorized to compile the technical file</p> <p><b>Andrej Riwe</b> Technical writer</p>
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Maulburg, 04.04.2016

# Technical Data

For motor connection parameters see nameplate

Type	Frequency [Hz]	Ultimate working pressure* [bar (g)]		Nominal motor rating [kW]	Nominal speed [min <sup>-1</sup> ]	Volume flow [m <sup>3</sup> /h]	Sound pressure level (EN ISO 2151) with silencer, measured at +1.0 bar g [db(A)]	Weight [kg]	Ambient temperature range [°C]	Ambient pressure	Synchronising oil qty [l]	Synchronising gear oil filled ex-works
MM 1104 BP	50	1.2	2.2	1500	62	71	~185	0 ... 40	atmospheric	0.85	see nameplate	
			2.5				~190					
		1.8	3.0				~185					
			3.4				~195					
	2.0	4.0	~190 ... 195									
		60	0.8	2.2	1800	75	73					~185
1.4	3.0		~190									
2.0	4.0		~195									
MM 1144 BP	50	0.8	2.2	1500	78	71	~185					
			2.5				~190					
		1.4	3.0				~185					
			3.4				~195					
		2.0	4.0				~190					
	4.5	~210										
	60	0.8	3.0	1800	96	73	~190					
		1.4	4.0				~195					
		2.0	5.5				~210					
	MM 1102 BP	50	0.7	4.0	3000	105	78	~190				
4.5				~210								
1.4			5.5	~215								
			6.3	~240								
2.0		7.5	~215 ... ~240									
		60	0.8	5.5	3600	135	81	~210				
1.5			7.5	~240								
2.0			8.6									
MM 1142 BP	50	0.8	5.5	3000	140	78	~220					
			6.3				~235					
		1.5	7.5				~215 ... ~235					
	2.0	11.0	~235 ... ~245									
	60	0.8	7.5	3600	175	81	~235					
		1.2	8.6									
		2.0	12.6									

\*valid ultimate working pressure see nameplate