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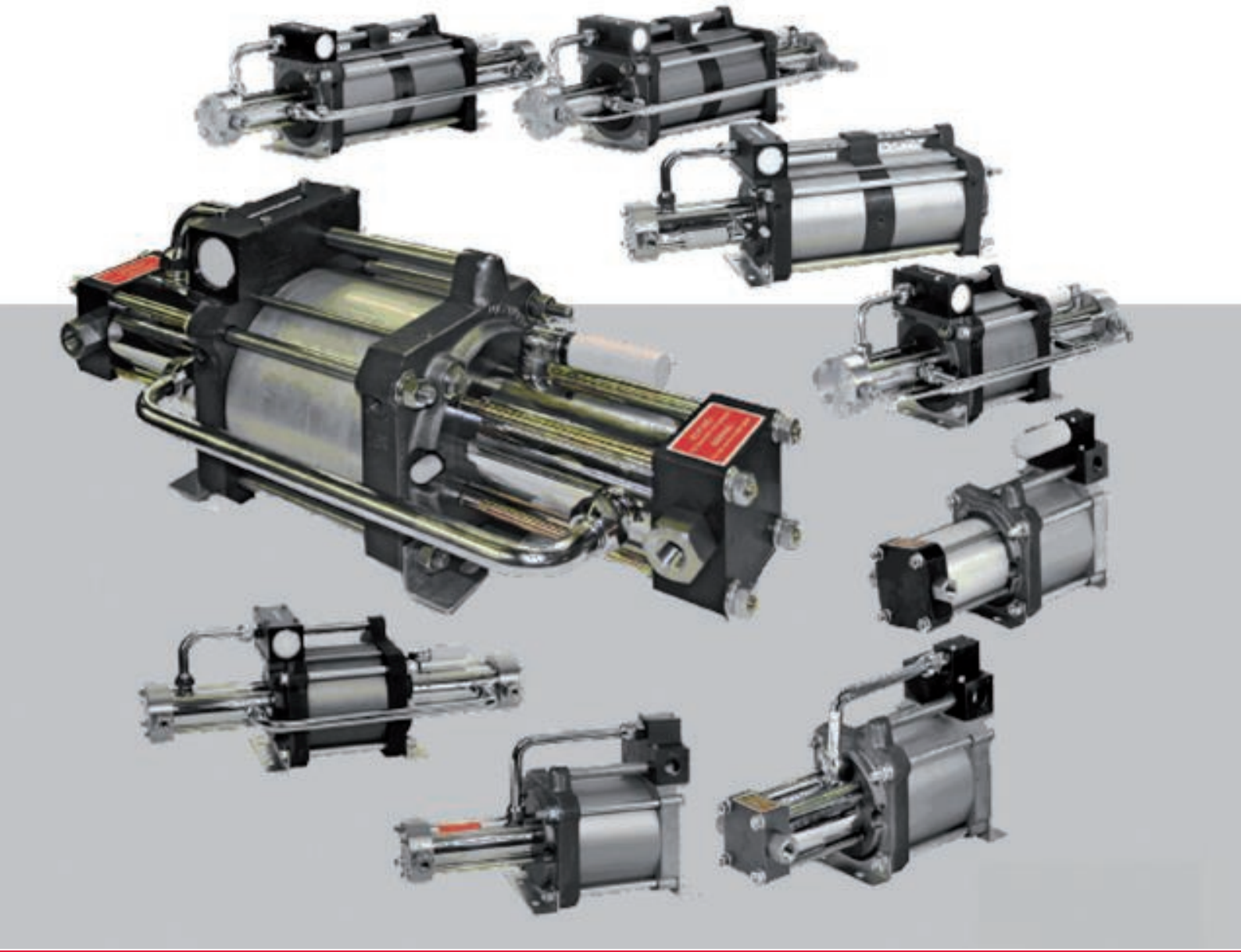

# » Air-Driven Gas Booster

## Assembly Instructions acc. to Machinery Directive & Operating Instructions acc. to ATEX Directive

Read the instructions before commencing any work!

MAXIMATOR GmbH
Lange Strasse 6 · D-99734 Nordhausen
Phone +49 3631/ 953350-0 · Fax 0 3631 / 953350-10

e-mail: info@maximator.de
Internet: http://www.maximator.de

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# Table of Contents

# Table of Contents

# Table of Contents



## Abbreviations and formula symbols used

| | | |
|---|---|---|
| $I, i_1, i_2$ | - | transmission ratio |
| $L_{eq}$ | - | noise emission |
| $P_A$ | - | primary pressure |
| $P_B$ | - | operating pressure |
| $P_L$ | - | drive pressure |
| $P_1, P_2$ | - | pressure |
| $T_1, T_2$ | - | temperature |
| $\chi$ | - | isotropic exponent |

# 1 General Information

## 1.1 Information about these instructions

Maximator's booster can be used in a large number of applications. They are used to convey gases and compress them to high pressures. The boosters are driven by compressed air at a range of 1 to 10 bar.

These instructions enable safe and efficient handling of Maximator's air-driven gas boosters. The instructions are part of the booster and must be kept in the direct vicinity of the booster, accessible to personnel at all times.

Personnel must have carefully read and understood these instructions before commencing work. A basic prerequisite for safe work is compliance with all specified safety information and handling instructions in these operating instructions.

In addition, local occupational safety provisions and general safety regulations apply to the area in which the booster is used.

The purpose of illustrations in these instructions is to aid general understanding and they may differ from the actual implementation. Furthermore, technical data and measurement and weight information apply to the day on which these assembly instructions were printed. They may differ in detail from a particular implementation, without fundamentally changing the objective information and thereby losing validity. Differences in textual and pictorial statements depend on equipment and accessories, which means that no claims arising from this can be asserted.

The documents on fitted components contained in the Annex and all other supplied documents apply in addition to these instructions.

The operating instructions for Maximator products are available as a digital download in many languages at » http://www.maximator.de/Dokumente-Bedienungsanleitungen.

## 1.2 Explanation of symbols

**Safety information**

Safety information in this manual is marked by symbols. The safety information is introduced by signal words that express the extent of the hazard.

**WARNING!**
This combination of symbol and signal word refers to possible hazardous situations that can lead to minor, slight or serious injuries or even death if they are not avoided.

**NOTE**
This combination of symbol and signal word refers to possible hazardous situations that can lead to material and environmental damage if they are not avoided.

### Special safety information

The following symbols are used in safety information to draw attention to particular hazards.


**WARNING!**
This combination of symbol and signal word identifies contents and instructions for intended use in potentially explosive atmospheres.

If a note marked like this is not heeded, there is an increased explosion hazard and serious or even fatal injuries may result.

### Safety information in handling instructions

Safety information may relate to particular individual handling instructions. Such safety information is embedded in the handling instructions so that it does not interrupt reading flow when performing the action. The previously mentioned signal words are used.

Example:

1.► Undo screw

2.►  **WARNING!**
Jamming hazard at lid!

Close the lid carefully.

3.► Tighten screw.

Tips and recommendations

This symbol highlights useful tips, recommendations and information for efficient and trouble-free operation.

### Other marking

To highlight handling instructions, results, lists, references, and other elements, the following marking is used in these instructions.

| Marking | Explanation |
|---|---|
| 1.► | Step-by-step handling instructions |
| ⇨ | Results of handling steps |
| » | References to sections in these instructions and to other applicable documents |
| • | Lists without defined sequence |

## 1.3 Customer service

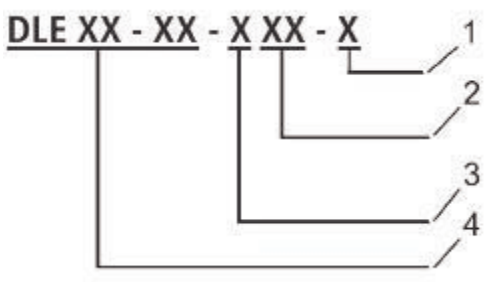
Our customer service is available for technical information and repairs:

| | |
|---|---|
| Address | Maximator GmbH<br>Ullrichstraße 1-2<br>99734 Nordhausen |
| Customer service phone<br>Mon. – Thu.: 7am – 5pm CET;<br>Fri.: 7am – 2pm CET | +49 (0) 3631 9533-5444 |
| Customer hotline telephone (charged)<br>Mon. – Thu.: 5pm – 10pm CET<br>Fri.: 2pm – 10pm CET<br>Saturday, Sunday, and holidays: 8am to 8pm CET | +49 (0) 1805 629 462 867 |
| Fax | +49 (0) 3631 9533-5065 |
| E-mail | service@maximator.de |
| Internet | www.maximator.de/service |

We are always interested in information and application-based experiences, which may be valuable in terms of improving our products.

## 1.4 Type designation code

The structure of the type designation code for the respective booster models is as follows:




1 Code for model, e.g.: C = CO2, O = oxygen

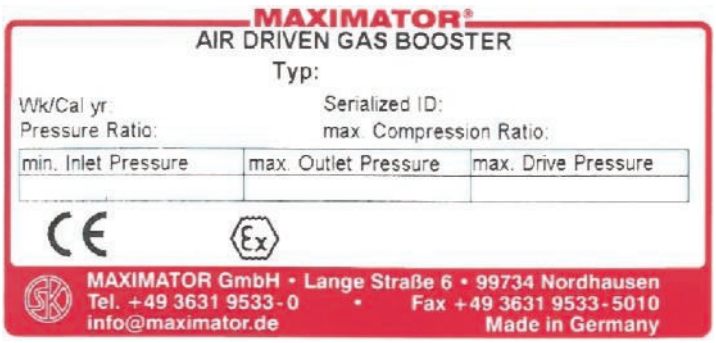
2 Code for thread type of compressed fluid inlet / outlet ports
G = pipe thread (BSP - standard), U = high-pressure port, N = NPT

3 Code for booster type designation 1 = 1 HD piston, 2 = 2 drive pistons

4 Model (e.g. DLE 15-75)

## 1.5 Nameplate

The nameplate is located in the centre of the booster drive unit and contains the following information: :




- Manufacturer
- Type (information from type designation code)
- Calendar week/year of construction
- Serial number
- Transmission ratio
- Maximum compression ratio
- Min. inlet gas pressure
- Max. outlet gas pressure
- Maximum drive air pressure
- ATEX marking

# 2 Safety

This section provides an overview of all important safety aspects for the protection of personnel as well as safe and trouble-free assembly. Further task-related safety information is contained in the sections for the individual service life phases.

## 2.1 Intended use

The compressed air-driven booster described in these assembly instructions (see » chapter 3.5 "Models") are partly completed machinery and are intended to be incorporated into final machinery. The booster are used solely for the oil-free compression of gases within the meaning of the Machinery Directive. Only compressed fluid approved for the booster (chapter 2.5.1 "Approved compressed fluid") may be compressed. The booster are driven, as standard, by means of compressed air or nitrogen at a maximum drive pressure of 10 bar.

If ATEX marking has been affixed to the nameplate and a declaration of conformity has been supplied, the gas booster may be used in potentially explosive atmospheres.

Intended use also includes compliance with all information in these instructions.

Any usage beyond the intended use or other type of use counts as improper use.

## 2.2 Warranty and liability

In principle, the "General Terms and Conditions of Sale and Delivery" issued by the manufacturer of the booster shall apply. The "General Terms and Conditions of Sale and Delivery" can be viewed on Maximator's website » http://www.maximator.de.

Any warranty and liability claims are precluded if they are due to one or more of the causes mentioned in these operating instructions and explicitly identified below:

- Improper use of the booster.
- Improper commissioning, operation or maintenance of the booster.
- Modifications to the booster and improper repair work.
- Operating the booster with defective safety equipment or incorrectly installed safety and protective equipment
- Failure to comply with the information in these operating instructions in respect of commissioning, operation and maintenance.
- Inadequate monitoring of gas booster parts that are subject to wear
- Aging and operational wear of wear parts like seals, guiding elements etc.

## 2.3 Foreseeable misuse

**WARNING!**
Improper use hazard!
Misusing the booster may result in hazardous situations.

- Never use the booster with inappropriate compressed fluid (see » chapter 2.5.1 "Approved compressed fluid").
- In the case of special media, always contact Maximator!
- Never operate the gas booster in enclosed vessels.
- Never perform any unauthorized conversions or technical modifications to the booster.
- Never use the booster in any way other than that described in these operating instructions.
- Never exceed the technical limits or pressures stated in these operating instructions.
- Operate the booster only when in perfect technical condition.
- Always observe all information on installation, maintenance and troubleshooting contained in these operating instructions.
- Gas booster cannot be used for
- producing pharmaceutical products with direct contact
- creating / machining / processing food

## 2.4 General hazards

The following section lists residual risks that may emanate from the booster even if they are used as intended.

In order to reduce the risks of personal injury and material damage and to avoid hazardous situations, all safety information listed here and the safety information in further sections of these instructions must be observed.

## 2.4.1 Pressurized gas hazards

**Pressurized components**

**WARNING!**
Injury hazard due to pressurized components!

Compressed air or gas may escape from pressure lines, screw connections or pressurized components if the booster are used incorrectly. This compressed air or these gases may cause eye injuries, swirl up dust, cause uncontrolled movements in the lines and result in serious injuries.

Defective pressurized components may also case uncontrolled movements that can lead to severe injuries.

- Before assembling or dismantling hoses, lines, screw connections or quick couplings, always make sure that they are depressurized.
- Wear personal protective equipment at all times.

Ensure that defective components to which pressure is applied during operation are immediately replaced by qualified personnel (mechanical or system engineers).

## 2.4.2 Low temperature hazards

**Cold surfaces**

**WARNING!**
Injury hazard due to cold and icy surfaces!

Components such as exhaust air silencers and cooling lines may ice over due to expanding air or gas. Skin contact with cold surfaces may cause skin irritations. Ice particles may be detached and fly around in an uncontrolled manner.

- Always wear protective work clothing, protective goggles and protective gloves when working near to cold or icy surfaces.

Make sure that all surfaces have warmed to ambient temperature before beginning any work.

## 2.4.3 General hazards at the workplace

**Noise**

**WARNING!**
Injury hazard due to noise!

The noise level occurring in the work area may cause serious hearing damage, depending on the installation type and expanding air.

- Always wear personal protective equipment when working on booster in operation.
- Only remain in the danger zone to the extent necessary.

The noise level depends on the installation situation and can be determined only in the installed state.

**Flying ice crystals and accumulations of fluid**

**WARNING!**

Injury hazard due to flying ice crystals and accumulations of fluid!

Components such as exhaust air silencers and cooling lines may ice over due to expanding air or gas. Ice particles may be ejected and tossed around by the expanding exhaust air. The ejected ice crystals may lead to eye injuries and accumulations of fluid on the floor.

- Wear protective goggles at all times during work.
- Immediately use suitable media to absorb accumulations of fluid.
- Wear anti-slip safety footwear at all times.

Attach warning signs and instructions at or near to the area where accumulations of fluid may occur in the floor area or ice crystals may fly around.

### 2.4.4 Explosion hazards

**Explosion protection**

When working in an explosion zone, adhere to the national or international regulations for behaviour in potentially explosive atmospheres.

### 2.4.5 Safety at the installation location

The gas booster must not be operated in enclosed vessels. The escaping drive air may cause the vessel to burst. The screw connections at inlet and outlet glands must not be loosened. The screw connections must be tight to prevent leaks and damage. The booster must be installed in a way that keeps the actuators and screw connections freely accessible at all times

## 2.5 Fluid and substance hazards

**Compressed fluid**

**WARNING!**

Injury hazard due to incorrect handling of compressed fluid!

Incorrect handling of compressed fluid may cause serious poisoning or even fatal injury or illness.

- Always pay attention to the manufacturer's safety data sheet.
- Always ensure that there is sufficient ventilation when working with gases.
- Do not smoke inside the danger zone or its immediate vicinity. Avoid all naked flames, fire and sources of ignition.
- Always keep self-contained breathing apparatus ready for emergencies.
- In the event of signs of asphyxiation, immediately provide the affected person with self-contained breathing apparatus, put him or her in the recovery position in the fresh air and keep him or her warm. Initiate first aid measures involving artificial respiration if the person stops breathing. Seek immediate medical assistance.

### Leaks

**WARNING!**

Injury hazard due to unforeseen leaks of the compressed fluid!

If the compressed fluid escapes at unintended places, this may cause serious injuries, illness or even death. Leaks can be caused by wear and tear, aging of seals or untight connections. These include:

- Leaks in the drive unit (escaping drive fluid)
- Leak at inlet glands and pressure sockets
- Leak at the static seal on the gas booster / high-pressure unit and hence escape of compressed fluid through the exhaust air silencer.

**NOTE**

The fluid is routed to the ambient atmosphere! If necessary, discharge exhaust air safely.

### Leak detection holes

During operation, minor leaks via the booster high-pressure seal system are permitted. This leak escapes via leak detection holes Z1 and Z3. A leak of 60 ml/min (static with helium) is permitted.

**WARNING!**

Injury hazard due to fluid routed to the ambient atmosphere.

During operation with hazardous or flammable gases, a pipe must therefore be fitted to the leakage detection hole (» chapter 6.4.4 "Connect separate leakage pipe").

### Flushing ports

From a technical point of view, the most important aspect when compressing hazardous and flammable gases is to avoid the formation of dangerous and potentially explosive atmospheres. As gas leaks cannot be ruled out, MAXIMATOR booster, depending on construction, must be flushed with inert gas (preferably nitrogen) prior to, during and after use.

If no flushing is carried out, these areas are characterized by zone 0 and a type test is required. In the current implementation, the booster do not meet the requirements of category 1. Therefore, operation without flushing is expressly prohibited. (see » chapter 6.4.5 "Flushing plans for compressing hazardous and flammable gases").

Contact the manufacturer about using other media that involve special instructions.

For hazardous gases: remove plug from the SFP (special flushing port) and fit piping to sufficient dimensions. The special flushing port is marked on the caps of the equipment with the designation "SFP".

**Drive fluids**

Unless special precautions are taken, the drive fluid will escape from the booster in a pulsed manner via the silencer and the relief holes.

**WARNING!**
Injury hazard due to escaping drive fluid!

If nitrogen is used as the drive fluid, an asphyxiation hazard may arise in the vicinity of the booster; the booster must therefore be installed in a well-ventilated location.

The use of other drive fluids must be clarified with Maximator. Further precautions may need to be taken here.

## 2.5.1 Approved compressed fluid

**Compressed fluid**

» Annex II "Approved compressed fluid" lists the most common approved compressed fluid; the use of other compressed fluid must be clarified with Maximator.

**WARNING!**

Accident hazard due to failure to observe appropriate compressed fluid!

A failure to observe the suitability of the compressed fluid may result in an increase of seal wear and tear, seal failure and serious accidents.

- Compress only compressed fluids that have been approved for the respective booster models. With this in mind, compare the type specifications on the nameplate with those in » Annex II "Approved compressing media".
- Operation using other compressed fluid must be clarified with Maximator. Further precautions may need to be taken here.

**WARNING!**
Accident hazard due to failure to comply with necessary precautions!

In the case of hazardous or environmentally harmful operating fluids, it may be necessary to take special precautions, such as fitting exhaust air or leakage piping, in order to prevent serious accidents.

**Compressing hazardous gases!**

To prevent hazardous states, always pay attention to the following:

**WARNING!**
Asphyxiation hazard in enclosed rooms!

- Always install booster in a well-ventilated room.
- Check leaks at regular intervals (on a weekly basis, depending on operating conditions).
- The contents of the leakage pipes must always be discharged correctly without pressure.
- For booster in rooms or buildings, it must be possible to shut off the external gas supply securely and quickly from a safe point.
- Always create pipe connections to booster such that they ensure durable tightness of connections.

### 2.5.2 Oxygen hazards

**WARNING!**
Handling oxygen may result in hazardous situations.

Oxygen is a colourless, odourless, highly reactive gas that supports combustion. There is an increased risk of fire and explosion in oxygen-enriched systems.

Prevention of sources of ignition is particularly important when handling oxygen. Typical sources of ignition are impact sparks (also caused by particles contained in the fluid), friction and adiabatic compression or shock waves.

To use Maximator booster for oxygen safely, the following information, in addition to the locally or internationally applicable standards, regulations and rules, must therefore be observed:

- Only equipment that has been cleaned for use with oxygen and lubricated using grease recommended by Maximator may be used (oxygen cleaning).
- The ports on the equipment must be implemented in a grease-free manner or with the grease recommended by Maximator.
- The maximum permitted residual oil or residual grease content on surfaces must not exceed 200 mg/m² (IGC 33/06/E).
- The drive air must be oil-free and grease-free, max. 0.01 mg/m³ (cf. BGR 500). The maintenance intervals must be adjusted with regard to the increasing surface contamination by substances contained in the drive fluid.
- The pipe flow speeds must not exceed 8 m/s (IGC 33/06/E).
- The maximum compression ratio is 1:4* .
- The maximum operating pressure is 350 bar.
- Only Maximator original spare parts may be used. These spare parts have not been specially cleaned for use with oxygen (oxygen cleaning) and must be specially cleaned before use.

* Taking into account the ignition temperature of greases minus a safety reserve of 80°C


**WARNING!**
Explosion hazard when using oxygen.

Incorrect handling of oxygen equipment will result in loss of explosion protection.

## 2.6 Duties of the manufacturer of complete machinery

### 2.6.1 Safety equipment

Before the booster is commissioned, it needs to be installed and integrated into the safety system.

### 2.6.2 Work and hazard areas

The danger zone is located around the entire booster.

### 2.6.3 Manufacturer

The following section defines a manufacturer as the entity that incorporates the booster into complete machinery.

The manufacturer must observe additional duties arising from the incorporation of the booster into a system:

- The manufacturer must ensure that, when incorporating the booster into a plant/ system, an overall risk assessment is drawn up and the required hazard removal measures are initiated.
- The manufacturer must ensure that the booster are integrated into the emergency-stop concept of the plant/system.
- The manufacturer must ensure that all pressure hoses, pressure lines, couplings and screw connections are designed and dimensioned for the pressure ranges of the booster.

### 2.6.4 Manufacturer's duties

Information that needs to be securely transferred to the operator.

The booster are used in the commercial sphere. The operator of the booster is therefore subject to the statutory obligations regarding occupational safety.

In addition to the safety information contained in these instructions, the safety, work protection and environmental regulations applicable to the deployment area of the booster must be complied with.

The following applies, in particular:

- The operator must find out about the applicable occupational safety regulations and additionally determine, in a risk assessment, risks that may arise due to the special working conditions at the location in which the booster are used. It must implement them in the form of instructions for operating the booster.
- During the entire service life of the booster, the operator must check whether the operating instructions prepared by it comply with the current status of regulations and adapt them if necessary.
- The operator must clearly lay down and define who is responsible for installation, operation, troubleshooting, maintenance and cleaning.
- The operator must ensure that all personnel using the booster have read and understood these instructions. Furthermore, it must train staff, and inform them about hazards, at regular intervals.
- The operator must provide personnel with the necessary protective equipment and give binding instructions on wearing the necessary protective equipment.

The operator is also responsible for ensuring that the booster are always in perfect technical condition. The following therefore applies:

- The operator must ensure that the booster are integrated into the emergency-stop equipment or into the safety chain of the system into which the booster are incorporated.
- The operator must ensure that, when aggressive compressed fluids and/or poisonous gases are used, pipes are fitted to collect any leaks of the aggressive fluids and/or poisonous gases in corresponding containers, and that the aggressive and poisonous fluids are disposed of appropriately.
- The operator must ensure that, in the event of compression of aggressive, flammable, hazardous or poisonous gases, the booster are flushed with nitrogen before commencing fault removal work.

- The operator must ensure that only suitable fluids (see » chapter 2.5.1 "Approved compressed fluids") are compressed using the booster.
- Fluid compatibility must be checked for this.
- The operator must ensure that the operating media (compressed air, gases) are installed and stored in the approved manner.
- The operator must ensure that all pressure hoses, pressure lines, couplings and screw connections are designed and dimensioned for the pressure ranges of the booster.
- The operator must ensure that suitable fluid ports exist and that they can be secured by means of a separate shut-off valve.
- The operator must ensure that the ports for the compressed fluids (compressed air and gases) work properly.
- The operator must ensure that the booster are always kept and operated in perfect technical condition.
- The operator must ensure that sufficient lighting is always available in the booster working area.
- The operator must ensure that all fault removal and repair work is carried out exclusively by personnel trained by Maximator.
- The operator must ensure that all warning, information and safety signs affixed to the booster are kept complete and legible at all times.
- The operator must ensure that the booster are checked in terms of damage and correct condition whenever they are put into service.

**Additional operator duties with regard to explosion protection**

The operator has additional duties arising from the EC Directive on improving the safety and health protection of workers potentially at risk from explosive atmospheres.

This includes the following organizational measures:

- Marking of explosive areas
- Clear signs in relation to all prohibitions
- Preparation of explosion protection documentation for each zone
- Issuing a prohibition on access by unauthorized persons

## 2.6.5 Personnel requirements

**Qualifications**

**WARNING!**
Injury hazard in the event of inadequate personnel qualifications!

There is a risk of serious injury and considerable damage if unqualified personnel carries out work on booster or remains in the danger zone of the booster.

Only let personnel trained by MAXIMATOR carry out activities.

Keep unqualified personnel away from the danger areas. These instructions specify personnel qualifications for the various areas of activity, as stated below:

Mechanical and system engineers shall be capable of carrying out the work assigned to them on account of their professional training, knowledge and experience as well as knowledge of the relevant

regulations. Furthermore, the mechanical and system engineer shall be familiar with the installation, assembly and combination of machinery, able to identify possible hazards independently and know how to avoid them.

Personnel shall consist only of individuals who are expected to perform their work reliably. Individuals whose reactions are affected, e.g. by drugs, alcohol or medication, shall not be permitted to carry out work.

Observe the age and job-specific regulations applicable at the installation location when choosing personnel.

## 2.7 Personal protective equipment

The purpose of personal protective equipment is to protect personnel against safety and health hazards at work.

Personnel must wear personal protective equipment, to which separate reference is made in individual sections of these instructions, during various activities on and with the booster.

**Description of personal protective equipment**

**Protective workwear**

Protective workwear is tight-fitting work clothing with low tear strength, tight sleeves and no protruding parts.

**Protective goggles**

Protective goggles are intended to protect eyes against flying parts and fluid spatter.

**Protective gloves**

Protective gloves are intended to protect the hands against friction, abrasions, punctures, or more severe injuries as well as against contact with hot or cold surfaces.

**Safety footwear**

Safety footwear protects the feet against crushing, falling parts, and slipping on slippery sub-surfaces

**Hearing protection**

Hearing protection is intended to protect against continuous noise that exceeds the permitted noise level and could thereby cause permanent hearing damage.

## 2.8 Signs

The following symbols and information signs are located in the working area. They apply to the direct environment in which they are installed.

**WARNING!**
Illegible sign hazard

Over the course of time, stickers and signs can become dirty or otherwise unrecognizable, thereby preventing hazards from being identified and the necessary operating instructions from being followed. This gives rise to the risk of injury.

- Always keep all safety, warning and operating information in a legible condition.
- Immediately replace any damaged signs or stickers.

**Signs on the booster**

The signs affixed to the booster are shown in the following figure.

<table>
<tr><td rowspan="3">  </td><td>Figure</td><td>Description</td></tr>
<tr><td> 
</td><td>Attention! Not suitable for oxygen.</td></tr>
<tr><td> 
</td><td>Attention! Keep oil-free and grease-free, cleaned for OXYGEN SERVICE.</td></tr>
</table>

Signs may vary, depending on model.

## 2.9 Spare parts

**WARNING!**
Hazard due to the use of incorrect spare parts!

Use of incorrect or faulty spare parts may cause malfunctions. This may cause severe injuries or even death as well as significant material damage.

Use only Maximator original spare parts or spare parts explicitly approved by Maximator.

Contact Maximator in the event of a lack of clarity.

## 2.9 Environmental protection

**NOTE**

Risk to the environment due to incorrect handling of environmentally hazardous substances!

Incorrect handling, especially incorrect disposal, of environmentally hazardous substances may cause significant environmental damage.

Follow the manufacturer's instructions on handling environmentally hazardous substances and their disposal.

If environmentally hazardous substances accidentally enter the environment, take appropriate measures immediately. If in doubt, inform the responsible local authorities about the damage and ask about suitable measures that can be taken.

# 3 Design and Function

## 3.1 Overview

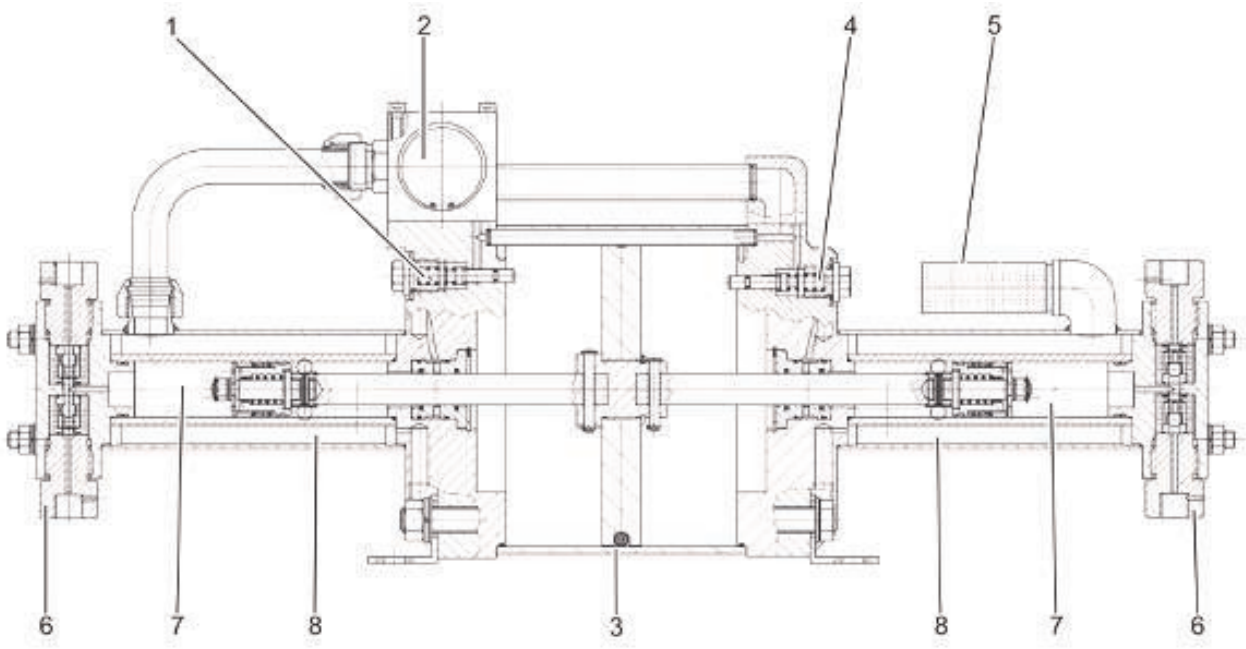



Fig. Maximator booster, type DLE 15

| | | | |
|---|---|---|---|
| 1 | Pilot valve 1 | 5 | Exhaust silencer |
| 2 | Spool valve | 6 | Booster head with inlet and pressure valve |
| 3 | Air cylinder | 7 | Pressure cylinder |
| 4 | Pilot valve 2 | 8 | Cooling cylinder |

## 3.2 Brief description

The booster work on the principle of a pressure intensifier. They are used to compress gases and compressed air to higher pressures and are operated with a drive pressure of up to 10 bar of compressed air. The drive pressure is required to compress the respective fluid to a higher operating pressure. The transmission ratio is derived from the piston area of the large air piston in relation to that of the smaller high-pressure piston. The primary pressure must be selected, depending on booster type (see » Annex III "Performance Values").

## 3.3 Assembly description

**Pilot valve**

The purpose of the pilot valves is to enable the air piston to switch the stop positions over. The pilot valves are actuated in the stop positions by the air piston and transfer air pulses to the spool valve. This enables the pilot valves to ventilate and vent the actuator chamber of the spool valve. This moves the spool valve from one stop position to the other.

**Spool valve**

The spool valve is used to apply compressed air alternately to the top and bottom of the air piston. The spool valve is controlled by means of the pilot valves and ensures that the drive air reaches the opposite side of the air piston.

**Drive unit**

The drive unit is used to take up the drive air (compressed air) and actuate the booster high-pressure piston via a piston rod, thereby compressing the compressed fluid in question to a higher pressure.

**Gas booster with inlet and outlet valve**

The gas booster locks the compression chamber and separates this spatially from the ambient pressure. The  gas booster contains the inlet and outlet valves. The gas to be compressed enters and exits the booster compression chamber through these inlet and outlet valves.

**High-pressure unit**

The booster high-pressure unit is used to compress the respective gas. The booster high-pressure unit consists of the pressure cylinder, gas booster with inlet and outlet valves and the high-pressure piston with seal and guide elements.

**Exhaust air silencer**

The exhaust air silencer serves to reduce noise when expanding drive air is discharged from the booster. On completion of its task, the drive air exits the booster via the exhaust air silencer. The exhaust air silencer may be made of plastic or aluminium, depending on the booster model.

**Cooling cylinder (does not apply to 8 DLE and DLE 2)**

The cooling cylinder serves to insulate and cool the booster high-pressure unit. The cooling cylinder encloses the high-pressure cylinder. The expanding (very cold) drive air is routed into the space between the two cylinders to cool the high-pressure cylinder during operation.

## 3.4 How the booster works

The connection diagram of Maximator booster is represented graphically below.

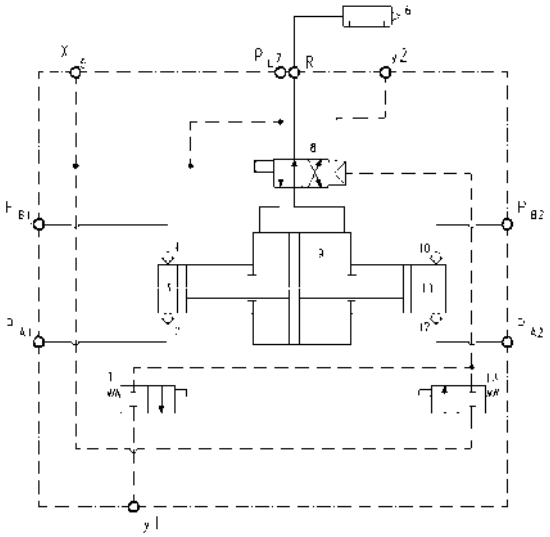


Fig. Connection diagram for double-acting booster

| | | | |
|---|---|---|---|
| 1 | Pilot valve bottom cap | 8 | Spool valve |
| 2 | Inlet valve (A1) | 9 | Air piston |
| 3 | High-pressure piston | 10 | Outlet valve (B2) |
| 4 | Outlet valve (B1) | 11 | High-pressure piston |
| 5 | Pilot valve air port (X) | 12 | Inlet valve (A2) |
| 6 | Exhaust air silencer (R) | 13 | Pilot valve upper cap |
| 7 | Air port (PL) | | |

**Explanation of how the booster works**

The drive air flows from the air port (7) through the spool valve (8) to the bottom of the air piston (9). The air piston moves to the right in the drive unit, thereby causing a suction stroke to be performed on the left-hand side of the high-pressure unit. The inlet valve (2) is opened and the gas to be compressed flows into the high-pressure unit's compression chamber via the port (A). A pressure stroke is performed on the right-hand side of the high-pressure unit.

The pressure stroke closes the inlet valve (12), opens the outlet valve (10) and causes the compressed gas to flow from the port (B). If the air piston (9) has reached the right-hand stop position of the drive unit, it actuates and opens the pilot valve (13). The direct pilot valve air (X-port) from port (5) thereby accesses the large side of the booster spool valve (8) and switches the spool valve to the opposite switch position.

The drive air now flows to the right-hand side of the air piston (9). The air piston moves to the left side of the drive unit. The pressure stroke is now carried out in the left-hand high-pressure unit and a suction stroke on the right-hand side. The now expanding drive air escapes from the working chamber via the exhaust air silencer (6). If the air piston (9) has reached the left-hand stop position of the drive unit, it actuates and opens the pilot valve (1).

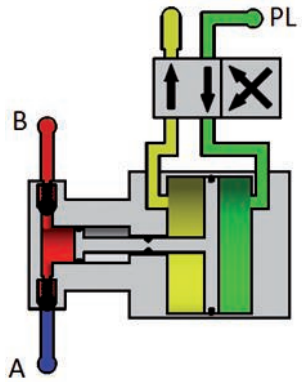
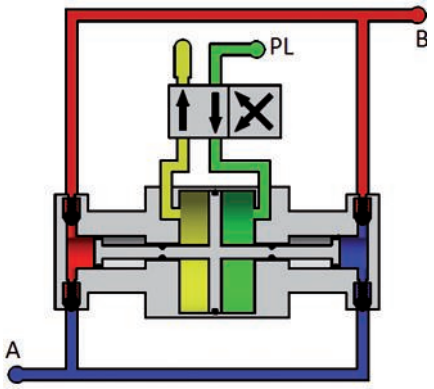
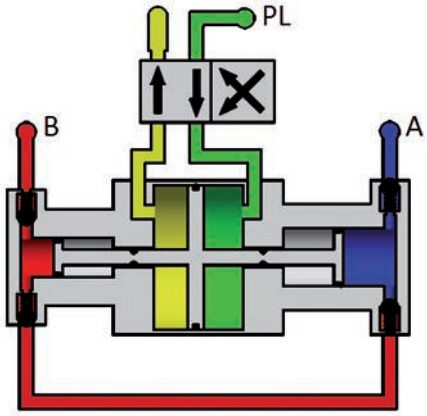
The large side of the spool valve (8) is thereby relieved, and the spool valve switches back to its original position. The cycle begins over again.

In booster models with a transmission ratio > 5, the exhaust air is routed through the cooling cylinders and thereby used to cool the high-pressure units.

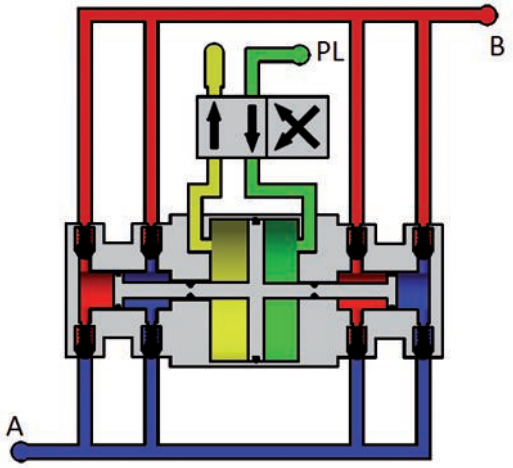
## 3.5 Models

The following section lists the individual booster type models and assigns them to the respective implementation.

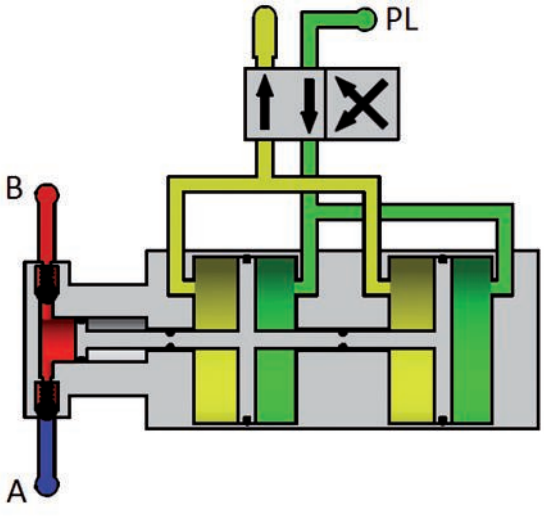
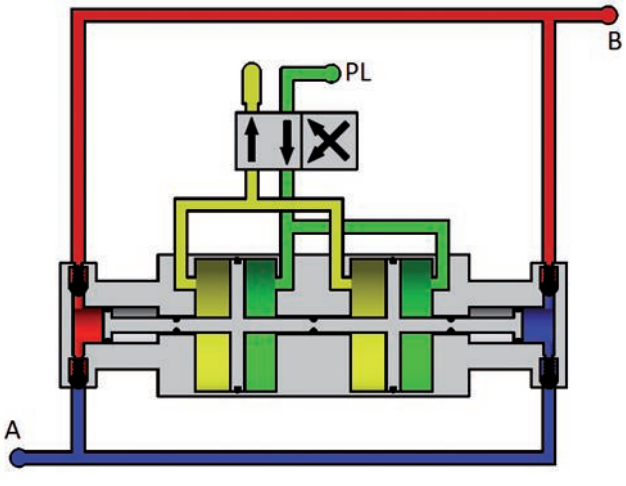
**Booster with one drive unit**

| Model | Graphical representation |
|---|---|
| Single-stage, single-acting:<br>• DLE 2-1<br>• DLE 5-1<br>• DLE 15-1<br>• DLE 30-1<br>• DLE 75-1 |  |
| Single-stage, double-acting:<br>• DLE 2<br>• DLE 5<br>• DLE 15<br>• DLE 30<br>• DLE 75 |  |
| Double-stage, double-acting:<br>• DLE 2-5<br>• DLE 5-15<br>• DLE 5-30<br>• DLE 15-30<br>• DLE 15-75<br>• DLE 30-75 |  |

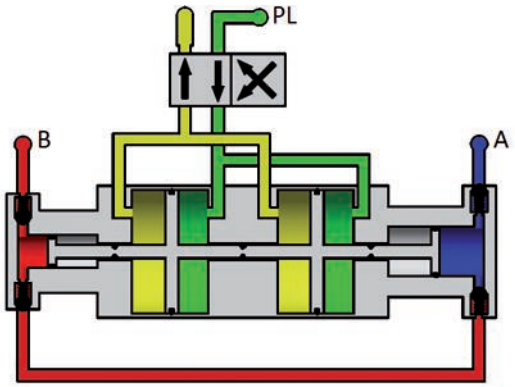
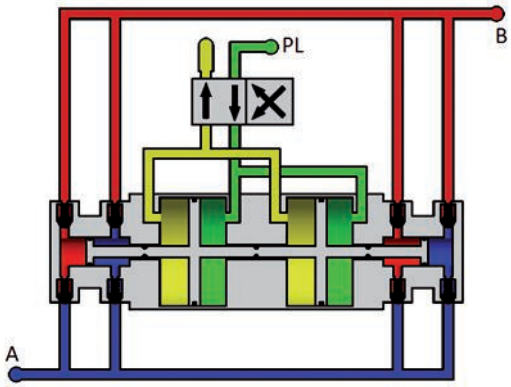
**Booster with one drive unit**

| Model | Graphical representation |
|---|---|
| Single-stage, quadruple-acting:<br>• 8 DLE 1,65 |  |

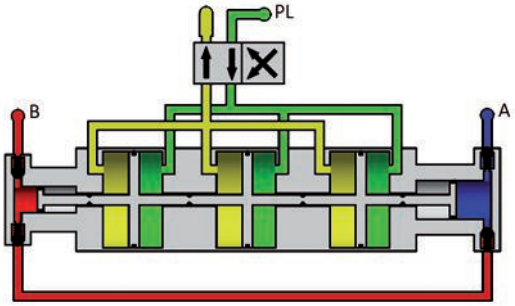
**Booster with two drive units**

| Model | Graphical representation |
|---|---|
| Single-stage, single-acting with two drive units:<br>• DLE 2-1-2<br>• DLE 5-1-2<br>• DLE 15-1-2<br>• DLE 30-1-2<br>• DLE 75-1-2 |  |
| Single-stage, double-acting with two drive units:<br>• DLE 2-2<br>• DLE 5-2<br>• DLE 15-2<br>• DLE 30-2<br>• DLE 75-2<br>• 8 DLE 6 |  |

**Booster with two drive units**

| Model | Graphical representation |
|---|---|
| Double-stage, double-acting with two drive units:<br>• DLE 2-5-2<br>• DLE 5-15-2<br>• DLE 5-30-2<br>• DLE 15-30-2<br>• DLE 15-75-2<br>• DLE 30-75-2 |  |
| Single-stage, quadruple-acting with two drive units:<br>• 8 DLE 3 |  |

**Booster with three drive units**

| Model | Graphical representation |
|---|---|
| Double-stage, double-acting with three drive units:<br>• DLE 30-75-3 |  |

Key

PL = Air drive

A = Inlet port

B = Outlet port

= Exhaust air

## 3.6 Delivery

Scope of delivery:

| Designation | Quantity |
|---|---|
| Booster | 1 |
| Assembly and operating instructions for booster | 1 |
| Set of drawings (sectional drawing, parts list, port/ sectional drawing) | 1 |
| Declaration of incorporation in accordance with the Machinery Directive | 1 |
| Declaration of conformity in accordance with ATEX 2014/34/EU | 1 |

## 3.7 Ports

The information about port values must be observed for all interface connections. Annex V "Overview of Ports" contains an overview of the inlet and outlet ports that are installed as standard, the recommended pipe inner diameters and other port options. A drawing for all ports that need to be fitted is always enclosed with the booster.

The booster have the following interfaces:

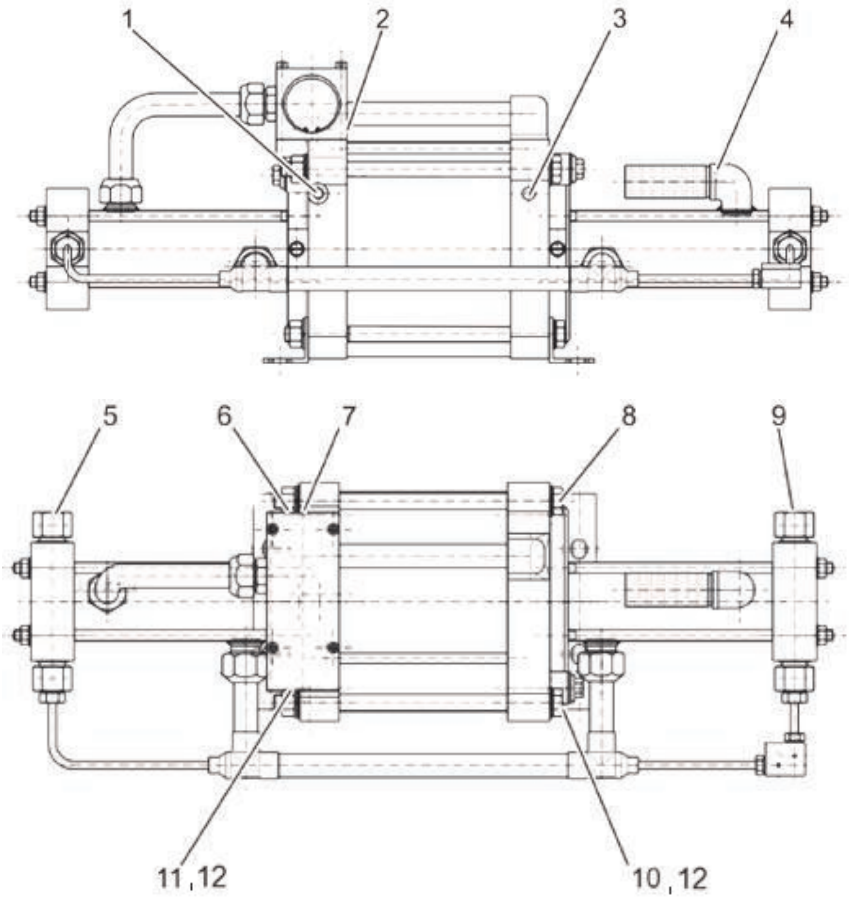



Fig. Ports for combined booster

| Item no. | Designation | Port | Function |
|---|---|---|---|
| 1 | Pilot port "X" | G 1/8“ | Port for direct pilot valve (uncontrolled and filtered)<br>Control air ≥ drive air (max. 10 bar) |
| 2 | Spool valve "Y" ventilator port | Hole | Ventilation and bleeding of the spool valve (pulse-shaped air escape) |
| 3 | Pilot valve exhaust air port | M5 | Bleeding of the pilot valve.<br>This port can be used as a port for a stroke counter. The air exits in a pulsed manner here. The port must not be sealed. |
| 4 | Exhaust air silencer port | G1/2“ | Output of expanding drive air |
| 5 | Outlet port "B" | depending on model | Output of operating pressure |
| 6 | High-pressure side "Z3" leakage port | G1/8“ | Ventilation of the high-pressure cylinder behind the piston. Alternate suction and ejection (alternately assigned a silencer). |
| 7 | Operation port "PL" | G3/4“ | Input of compressed drive air (max. 10 bar) |
| 8 | High-pressure side "Z1" leakage port | G1/8“ | Ventilation of the high-pressure cylinder behind the piston. Alternate suction and ejection (alternately assigned a silencer). |
| 9 | Inlet port "A" | depending on model | Input of primary pressure |
| 10 | Air-side "Z2" leakage port | G1/8“ | Diverting the leak from the drive unit |
| 11 | Air-side "Z4" leakage port | G1/8“ | Diverting the leak from the drive unit |
| 12 | Flushing port "SFP" | G1/8“ | Port for flushing the rear piston chamber |

The port sizes specified here apply to standard implementations of the DLE model range. The ports may differ for the 8 DLE model range and for variants (» observe the "port drawing").

## 3.8 Calculating the operating pressure

Before the booster is commissioned, the operating pressure needs to be calculated. The booster static final pressure is calculated for the corresponding type using the following formulas:

| Booster type | Calculating the static operating pressure |
|---|---|
| Single-stage, single-acting | $P_B = P_L * i$ |
| Single-stage, double-acting / quadruple-acting | $P_B = i * P_L + P_A$ |
| Two-stage | $P_B = i_2 * P_L + i_2 / i_1 * P_A$ |
| Single-stage, single-acting with two drive units | $P_B = P_L * i$ |
| Single-stage, double-acting / quadruple-acting with two drive units | $P_B = i * P_L + P_A$ |
| Two-stage with two / three drive units | $P_B = i_2 * P_L + i_2 / i_1 * P_A$ |

**Key:**

$P_L$ = drive pressure
$P_B$ = operating pressure
$P_A$ = gas primary pressure
i = transmission ratio
$i_1$ = transmission ration stage 1
$i_2$ = transmission ration stage 1

» Chapter 3.5 "Models" contains a list of booster types.

## 3.9 Accessories

With regard to the installation of the booster, we also stock an extensive range of valves, fittings and pipes as well as other components.

Furthermore, it is possible to purchase booster units that are ready for connection. You can obtain an overview of Maximator's product range on Maximator's website » http://www.maximator.de.

The following accessories are available for booster.

**Air control unit**

Using the Maximator air control unit makes it easy to operate the booster. The air control unit consists of a pressure filter, water separator, shut-off valve, pressure governor, pressure gauge and, where applicable, a safety valve.

**Seal sets**

The individual seal sets of the booster components are available from Maximator as complete seal kits. These seal kits are required whenever faults are remedied. See sectional drawings and parts lists of the booster.

**WARNING!**
Handling oxygen may result in hazardous situations.

The seal sets have not been specially cleaned for use with oxygen (oxygen cleaning) and must be specially cleaned before use.

# 4 Technical Data

## 4.1 Operating conditions

### Ambient conditions

| Specification | Value | Unit |
|---|---|---|
| Temperature range | -20 … + 60* | °C |

* Temperature range taking compressed air quality into account.

### Operating fluid

| Specification | Value | Unit |
|---|---|---|
| Operating temperature, max.* | +60…+100 | °C |
| Particle size, max. | 10 | µm |

* Depending on the booster type (see » Annex III "Performance Values" or data sheet).

### Pneumatic (air quality in accordance with ISO 8573-1)

| Specification | Value | Unit |
|---|---|---|
| Oil-free compressed air | *possible | |
| Max. compressed air cleanliness factor of oil (class 4) | 5 | mg/m³ |
| Max. number of particles in the case of 0.1 – 0.5 µm size (class 3) | not specified | Stk |
| Max. number of particles in the case of 0.5 – 1.0 µm size (class 3) | 90.000 | Stk |
| Max. number of particles in the case of 1.0 – 5.0 µm size (class 3) | 1.000 | Stk |
| Max. solids, particle concentration (class 6) | 5 | mg/m³ |
| Max. pressure dew-point in the event of humidity (class 4) | +3 | °C |

* Maximator booster do not generally require a compressed air oiler, as they are treated with special grease during assembly. After an oiler has been used for the first time, however, the drive fluid always needs to be oiled, as the oil washes out the special grease.

To avoid damage to seals and their counter surface, a filter with a fineness of max. 10µm must be installed.

Oil in the oiler must comply with DIN 51524 – ISO VG 32.

**WARNING!**
Handling oxygen may result in hazardous situations.

With regard to requirements on compressed air quality for oxygen equipment, see » chapter 2.5.2 "Oxygen hazards".

**Air Drive pressure**

The booster can be operated with the drive pressures contained in the table opposite.

| | |
|---|---|
| Min. $P_L$ | 1 bar |
| Max. $P_L$ | 10 bar |

**Noise emission**

Example: DLE on base plate at 10 bar drive pressure.

| Specification | Value | Einheit |
|---|---|---|
| Noise emission (Leq) | 81 | dB(A) |

Leq = equivalent continuous sound level (averaged over 30 seconds)

The noise emission measurement was performed at a height of 1.6 metres and at a distance of 1 metre from the test stand. The determined noise emission was measured without counter-pressure at full -load operation and may vary, depending on use and the installation situation.

## 4.2 Dimensions, weights and performance values

» Annex I "Dimensions and Weights" contains a list of the dimensions and weights of all booster types. The list involves approximate specifications, which may vary slightly.

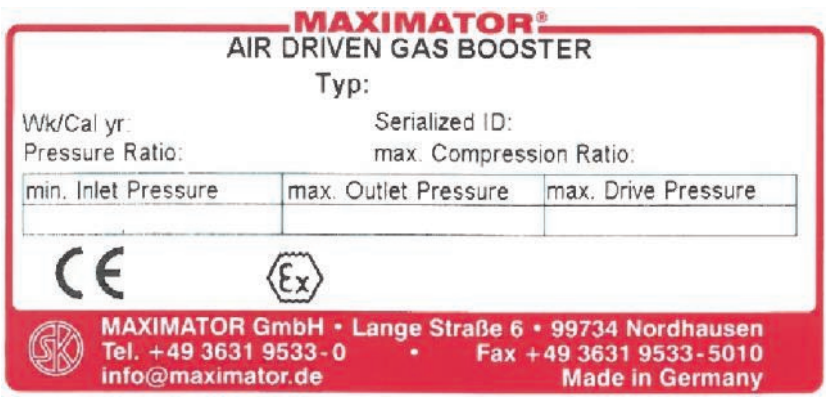
Annex III "Performance values" contains an overview of the performance values of all booster types.

For more detailed information about the respective booster, including characteristic curve and port drawing, please consult the respective data sheet on Maximator's website » http://www.maximator.de.

## 4.3 Explosion protection

**Ex marking**

The Ex marking is located on the nameplate of the booster's drive unit.



| Marking | Designation | Meaning |
|---|---|---|
| CE Ex | CE mark,<br>Ex mark | Conformity marking in accordance with Annex III of Directive 2004/42/EC and Article 16(4) of Directive 2014/34/EU. |
| II | Equipment group | The boostermay be used in potentially explosive atmospheres, except in mining. |
| 2D/2G | Equipment category | In the case of equipment categories 2G/2D, a potentially explosive atmosphere involving gases (G) and dust (D) may occasionally occur. The equipment guarantees a high level of safety and can be used in zone 1 and zone 2 / 21 and 22. |
| IIB | Explosion group | For use with substances from group IIB, e.g. propane |
| IIC | Explosion group | For use with substances from group IIC, e.g. hydrogen |
| C | Ignition protection type | Constructional safety for non-electrical equipment intended for use in potentially explosive atmospheres according to |
| TX | Additional marking | The temperature depends on the operating parameters. |

## 4.4 Operating instructions in accordance with the Explosion Protection Directive

If the booster bear an Ex symbol and come with a declaration of conformity in compliance with 2014/34/EC, they can be used in potentially explosive atmospheres. They correspond to Group II Category 2G/2D Explosion Group IIB or IIC constructional safety. The respective nameplate shows the group to which your Maximator booster can be assigned.

A prerequisite for safe operation is that the booster is correctly connected to the earth potential.

Booster temperature depends on the temperature of the fluid, the compression and other operating conditions.

The temperature that arises during compression must not exceed the maximum permitted temperature.

The maximum expected temperature can be calculated for ideal gases using the formula for adiabatic change:

$$T_2 = \left( \frac{P_2}{P_1} \right)^{\frac{\chi-1}{\chi}} \cdot T_1$$

where

$T_2$ → Temperature after compression (in K)

$T_1$ → Temperature prior to compression (in K)

$P_2$ → Pressure after compression (in bar)

$P_1$ → Pressure prior to compression (in bar)

$\chi$ → Isentropic exponent

The isentropic exponent  for standard gases can be derived from the following table or corresponding tables.

| Gas | χ | Gas | χ |
|---|---|---|---|
| Argon | 1,66 | Helium | 1,66 |
| Carbon dioxide | 1,3 | Air | 1,4 |
| Nitrogen | 1,4 | Xenon | 1,67 |

Isentropic exponent table

Due to the fact that the compression occurs in a heat exchange with the environment, the actual temperature will always remain below the calculated adiabatic temperature.
If the temperature of the compressed gas is below the maximum permitted temperature, care must be taken, depending on explosion zone, to ensure that these operating conditions do not change.
A slight difference in pressure in both primary pressure and drive pressure would result in a higher temperature!
Please note the following:

- Primary pressures on the booster must be monitored
- Permitted compression ratios must not be exceeded

Prior to commissioning, air must be removed from the systems, e.g. by evacuation or flushing. The safest method is flushing with nitrogen if an oxygen content of below 1 vol% is achieved in the system.

It is also necessary to render a system "free of gas" by means of evacuation or flushing when taking it out of service.

Please note that, in all flushing procedures, the flushing gas always takes "the path of lowest resistance". Therefore, the flushing gas flow must be channelled so as to prevent "dead pockets" as far as possible.

If the temperature of the compressed gas exceeds the maximum permitted temperature, the compression needs to run through several stages and be cooled between the individual compression stages. Sensor monitoring is necessary here.

Equipment must not be cleaned or maintained in the presence of a potentially explosive atmosphere. Take care, when cleaning, to ensure that the plastic surfaces and electrically non-conductive surfaces do not build up an electrostatic charge (use a moist cotton cloth).

No ignitable mixtures may be used as drive gas.

The assembly instructions pursuant to the Machinery Directive (2006/42/EC) are an integral part of these operating instructions.

# 5 Transportation, Packaging and Storage

## 5.1 Transportation safety information

**Incorrect transportation**

Material damage due to incorrect transportation!

Incorrect transportation may cause significant damage.

- Proceed with caution when unloading transport items on delivery and in the case of transportation within the company and pay attention to the symbols and information on the packaging.
- Do not remove any packaging until shortly before assembly.

## 5.2 Packaging

The individual packages have been packed in accordance with the expected transportation conditions. Only environmentally friendly materials have been used for the packaging.

The packaging should protect the individual components against transportation damage, corrosion and other damage until they are assembled. Therefore, do not destroy the packaging and do not remove it until shortly before assembly.

Dispose of packaging material in accordance with the currently applicable statutory provisions and local regulations.

## 5.3 Storage

Store packages under the following conditions:

- Do not store outdoors.
- Store in a dry and dust-free environment.
- Do not expose to aggressive fluids.
- Protect against sunlight.
- Avoid mechanical shocks.
- Storage temperature: -20 to 60°C
- Relative air humidity: max. 60%
- If the equipment is stored longer than 3 months, inspect the general condition of all parts and the packaging on a regular basis. Repair the parts, where necessary.

The packages may contain storage information that goes beyond the requirements stated here. This information must be complied with accordingly.

# 6 Installation and Commissioning

## 6.1 Installation and commissioning safety information

**Incorrect installation and commissioning**

**WARNING!**
Injury hazard due to incorrect installation and commissioning!

Incorrect installation or commissioning may cause serious injuries and considerable damage.

- Ensure that all installation work is carried out and completed in accordance with the specifications and information contained in these instructions.

**Explosion protection**


**WARNING!**
Explosion hazard during assembly!

Assemble only when no potentially explosive atmosphere is present.

Appropriate measures must be taken to ensure static discharge capability at all times. Failure to observe these instructions will result in loss of explosion protection.

Safety when compressing potentially explosive substances
Avoid potentially explosive atmospheres in rooms and in the open air

The following conditions will prevent the formation of an explosive atmosphere in areas of systems at risk:

- Systems must be set up in well-ventilated areas (if possible, outdoors).
- Systems must be and remain airtight.
- Blow-out circuits of safety valves, leakage pipes etc. must be routed to the open air.
- For systems in rooms, it must be possible to shut off the gas supply coming from outside securely from a safe point.

Establish pipe connections to systems such that they ensure durable tightness of the connection.

## 6.2 Installation prerequisites

Install the booster in a way that meets the following conditions:

- The assembly location must be level. Flatness less than 1 mm.
- The booster must have a safe and fixed stand or seat.
- The booster must not be exposed to any oscillations or vibrations.
- The booster must be easily accessible on all sides.
- The booster must be installed in a way that does not expose it to any external sources of heat.
- We recommend that the booster be assembled in a dust-free environment.

## 6.3 Assembling the booster

Make sure you observe the safety information from » chapter 2 "Safety".

The booster must be fixed to the designated mounting holes using at least 4.6 grade screws or bolts. The appropriate screw or bolt size must be determined from the set of drawings supplied.

The preferred installation position is vertical.

**Lifting points**

The booster 8 DLE 1.65,8 DLE 3 and 8 DLE 6 can be attached by means of two belt straps, as shown in the graphic opposite.

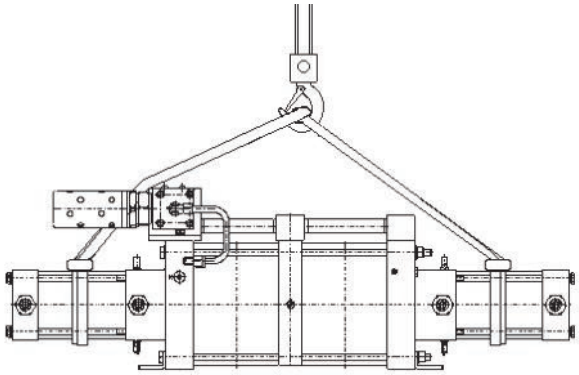


Fig. 8 DLE lifting points

## 6.4 Mounting connection lines

The booster is supplied without any screw connections or pipelines that are necessary for connection. Observe the specifications in » chapter 6.4.1 "Ports" and the port drawing supplied.

**Unpredictable movements**

**WARNING!**
Injury hazard due to unpredictable movements of compressed air lines!

Lines in the internal compressed air network can move unpredictably in the event of a load change (hose rupture) and thereby cause injuries.

- Depressurize the connecting cable before commencing any assembly work.
- All piping must be safely anchored to the floor or walls.
- All piping must be laid so as to avoid any trip hazard.
- Wear personal protective equipment at all times.

**Using incorrect connecting lines**

**WARNING!**
Risk of material damage due to the use of incorrect connecting cables!

Use of incorrectly dimensioned piping or screw connections can lead to malfunctions and material damage to the booster.

- The piping and lines must be adjusted to the booster maximum outlet pressure.
- The respective screw connections must be fitted professionally.

The cross-section of the high-pressure pipes and lines must not be smaller than the cross-section of the ports.

A prerequisite for correct installation is the existence of a professionally planned, installed and maintained compressed air network and a shut-off valve additionally installed at the compressed air network inlet.

### 6.4.1 Connecting the drive air

Depending on the model, the drive air port on the booster either needs to be fitted to the air drive port (PL) of the spool valve housing or to the compressed air control unit (accessories), if available. Observe the information on how to use drive air lines, hose connections or screw connections contained in
chapter 3.7 "Ports" and the port drawing supplied.

The following section describes how to fit the drive air.

**WARNING!**

Injury hazard due to pressurized components!

1.► Unscrew the sealing plug on the drive air port (PL) of the spool valve housing or on the compressed air control unit.

2.► Suitably connect the air control unit's controlled compressed air outlet to the drive air port (PL) of the spool valve housing. *

3.► Suitably connect the drive air to the drive air port (PL) of the spool valve housing or to the compressed air control unit, if available, using a hose or pipe.

* If an air control unit exists (air control unit available as an option).

### 6.4.2 Control air

In the case of booster with a port for control air (direct pilot valve air) - the port is marked by "X" -,

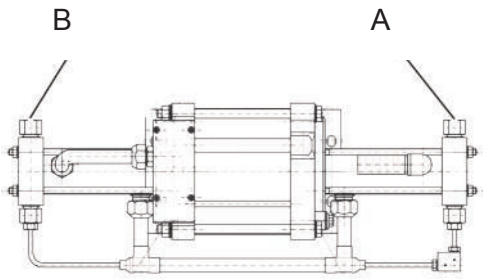
the control air must be connected before the pressure governor (or at the pressure governor's uncontrolled outlet). This enables the booster to work better even at low drive pressures. If the control air is not connected, the booster does not work. The same requirements on compressed air quality apply to the control air as to the drive air (see » chapter 4.1 "Operating conditions").

## 6.4.3 Connecting inlet and outlet pipes

| | |
|---|---|
| Personnel: | Mechanical and system engineers |
| Protective equipment: | Personal protective equipment |

1.► Remove sealing plug from the inlet and outlet ports (A and B).

2.► Fit piping for inlet and outlet lines in accordance with the port drawing.

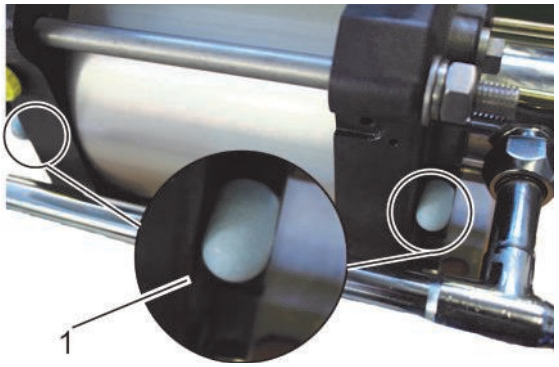



## 6.4.4 Connecting separate leakage pipe

When compressing flammable or hazardous gases, an additional leakage pipe needs to be fitted to the booster.

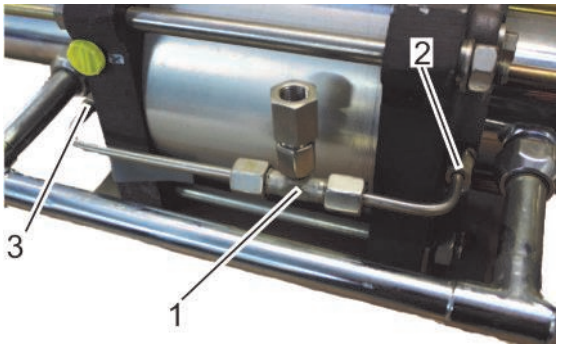
| | |
|---|---|
| Personnel: | Mechanical and system engineers |
| Protective equipment: | Personal protective equipment |

1.► Unscrew the ventilation silencer (1) from the leakage ports Z1 and Z3.




2.► Connect leakage piping (1) to the leakage ports Z1 (2) and Z3 (3).

3.► Fit separate leakage pipe to the leakage piping.



### 6.4.5 Flushing plans for compressing hazardous and flammable gases

| Flushing plans for MAXIMATOR booster | | |
|---|---|---|
| Flushing plan for single-stage, single-acting booster: | Flushing plan for single-stage, double-acting booster: | Flushing plan for double-stage booster: |
| (With SFP flushing port and Z1 leakage port on the high-pressure side).<br>Flushing procedure:<br>1.► Prior to commissioning the booster, nitrogen must be connected to the primary pressure port (A) and to the flushing port (SFP).<br>2.► Switch on the booster for approx. 1 min. (depending on the volume to be flushed).<br>3.► After the flushing operation, switch off the booster.<br>4.► The primary pressure line (A) can then be connected to the gas supply. During compression, continually flush the flushing port with nitrogen.<br>5.► Nach Abschluss der Verdichtung ist der Verdichtungsraum wie im Punkt 2 beschrieben erneut zu spülen. | (With SFP flushing port and Z1 and Z3 leakage port on the high-pressure side).<br>Flushing procedure:<br>1.► Prior to commissioning the booster, nitrogen must be connected to the primary pressure port (A) and to the flushing port (SFP). (A)<br>2.► Switch on the booster for approx. 1 min. (depending on the volume to be flushed).<br>3.► After the flushing operation, switch off the booster.<br>4.► The primary pressure line (A) can then be connected to the gas supply.. During compression, it is not necessary to flush the flushing port continuously with nitrogen, as single-stage, double-acting booster do not draw in any breathing air from the environment via the leakage ports.<br>5.► After completion of the compression, flush the compression chamber again as described in point 2. | (With SFP flushing port and Z1 and Z3 leakage port on the high-pressure side).<br>Flushing procedure:<br>1.► Prior to commissioning the booster, nitrogen must be connected to the primary pressure port (A) and to the flushing ports (SFP).<br>2.► Switch on the booster for approx. 1 min. (depending on the volume to be flushed).<br>3.► After the flushing operation, switch off the booster.<br>4.► The primary pressure line (A) can then be connected to the gas supply. During compression, continually flush the flushing port with nitrogen.<br>5.► The primary pressure line (A) can then be connected to the gas supply. During compression, continually flush the flushing port with nitrogen. |

**Flow rate for gas flushing operations:**

To ensure adequate flushing, different flow rates must be guaranteed, depending on booster. The following table shows the minimum required flow rate.

Apart from the flushing gas flow rate, the cross-sections of the flushing line are also crucial. We recommend that the cross-sections do not fall below an inner diameter of 4 mm. If the diameter is smaller, there is a risk of gas pressure being generated in the flushing line. This might damage the booster high-pressure unit under certain circumstances.

Also make sure that the flushing line outlet remains unobstructed.

| Type | Flow rate IN/min | Type | Flow rate IN/min |
|---|---|---|---|
| DLE 2-1 | 190 | DLE 15-1-2 | 30 |
| DLE 5-1 | 90 | DLE 30-1-2 | 20 |
| DLE 15-1 | 40 | DLE 75-1-2 | 10 |
| DLE 30-1 | 20 | DLE 2-2 * | 170 |
| DLE 75-1 | 10 | DLE 5-2 * | 80 |
| DLE 2 * | 170 | DLE 15-2 * | 30 |
| DLE 5 * | 90 | DLE 30-2 * | 20 |
| DLE 15 * | 30 | DLE 75-2 * | 10 |
| DLE 30 * | 20 | DLE 2-5-2 | 100 |
| DLE 75 * | 10 | DLE 5-15-2 | 60 |
| DLE 2-5 | 110 | DLE 5-30-2 | 70 |
| DLE 5-15 | 60 | DLE 15-30-2 | 20 |
| DLE 5-30 | 70 | DLE 15-75-2 | 20 |
| DLE 15-30 | 20 | DLE 30-75-2 | 10 |
| DLE 15-75 | 30 | DLE 30-75-3 | 10 |
| DLE 30-75 | 10 | 8 DLE 1,65 | - ** |
| DLE 2-1-2 | 190 | 8 DLE 3 | - ** |
| DLE 5-1-2 | 90 | 8 DLE 6 | - ** |

* The flow rates are required only during commissioning and decommissioning in the case of these booster. No flow rate is required during operation.

** Flushing is not possible with these booster.

## 6.5 Fitting the exhaust air silencer

The following section describes how to fit the exhaust air silencer.

The exhaust air silencer may be made of plastic or aluminium, depending on the booster model. The exhaust air silencer is always fitted in the same way.

1.► Keep the exhaust air silencer ready.

2.► Unscrew the sealing plug from the exhaust air port.

3.► Place the exhaust air silencer on the exhaust air port and hand-tighten it.

## 6.6 Commissioning

The following section describes how to commission the booster.

In order to keep the load on the booster components low during commissioning, we recommend that the drive air pressure be increased slowly.

This keeps the booster stroke frequency low. Otherwise, operating phases with very high clock frequencies may occur during the startup phase until the desired operating pressure has been reached.

It is, for example, possible to use the optionally available air control unit to control the drive air pressure.

| | | |
|---|---|---|
| Personnel: | Mechanical and system engineers | |
| Protective equipment: | Protective workwear |  |
| | Protective goggles |  |
| | Safety footwear |  |
| Special tool: | Leak detector spray | |

1.► Check all ports to make sure that they have been installed correctly

2.► Check all piping for mechanical damage.

3.► Open intake line

⇨ The compressed fluid will flow in.

4.► Controller button on air control unit is set to closed (0 bar). *

5.► Open the compressed air line of the compressed air network to the booster.

6.► Pull controller button of the compressed air control unit upwards.*

⇨ The controller button audibly clicks out of the lock.

7.► Set the drive pressure you require on the controller button.*

⇨ The booster will automatically start compressing.

8.► 

**WARNING!**
Injury hazard due to escaping compressed fluid

Carry out leak test on all ports.

* If an air control unit exists (air control unit available as an option).

# 7. Operation

## 7.1 Operation safety information

### 7.1.1 General hazards at the workplace

**Noise**

**WARNING!**
Injury hazard due to noise!

The noise level occurring in the work area can cause major hearing damage, depending on the installation type and expanding air.

- Always wear personal protective equipment when working on booster in operation.
- Only remain in the danger zone to the extent necessary.

The noise level depends on the installation situation and can be determined only in the installed state.

**Flying ice crystals and accumulations of fluid**

**WARNING!**
Injury hazard due to flying ice crystals and accumulations of fluid!

Ice ejected and tossed around by the expanding air may form on the booster exhaust air silencer during operation. The ejected ice crystals may cause eye injuries and accumulations of fluid on the floor.

- Wear protective goggles at all times during work.
- Immediately use suitable media to absorb accumulations of fluid.
- Wear anti-slip safety footwear at all times.

Attach warning signs and instructions at or near to the area where accumulations of fluid may occur on the floor or ice crystals may fly around.

**Incorrect operation**

**WARNING!**
Injury hazard due to incorrect operation!

Incorrect operation may cause serious injuries and significant material damage.

- Observe all information in accordance with these instructions.

## 7.2 Cleaning

Personnel: To be defined by the system engineer

**Pressurized components**

**WARNING!**
Injury hazard due to pressurized components!

Before commencing any cleaning work, shut down and depressurize the booster

**Operating fluids**

**WARNING!**
Injury hazard due to operating fluid residues

If the booster is operated by means of hazardous or environmentally harmful fluids, fluid residues may be present in the direct vicinity of the booster. Relevant precautions (PPE, collecting vessel, etc.) must then be taken when cleaning.

**Explosion protection**


**WARNING!**
Explosion hazard during cleaning

Perform cleaning only when no potentially explosive atmosphere is present.

Appropriate measures must be taken to ensure static discharge capability at all times. Take care, when cleaning, to ensure that the plastic surfaces and electrically non-conductive surfaces do not build up an electrostatic charge (use a moist cotton cloth).

Failure to observe these instructions will result in loss of explosion protection.

## 7.3 Inspection and maintenance intervals

| | |
|---|---|
| Personnel: | to be defined by the system engineer |
| Protective equipment: | Protective equipment: |

Maximator recommends the following inspection and maintenance intervals.

| Maintenance interval | Maintenance | |
|---|---|---|
| Before and after every use | 1.► | Check system to ensure that it is functioning safely |
| | 2.► | Dehumidify the air system. |
| | 3.► | Check ports for leaks. |
| | 4.► | Check all screw connections and piping for damage. |
| Every 3-6 months or every 20,000 | 1.► | Inspect and lubricate spool valve, pilot valve or o-rings in the drive unit. Replace if necessary.* |
| | 2.► | Check booster for leaks. |
| | 3.► | Check and, if necessary, tighten bolts, check valves and screw connections. |
| Every 6 months | 1.► | Replace air filters. |
| Every 12 months | 1.► | Carry out pressure test on the booster piping. (Leak detector spray) |
| | 2.► | Inspect and, if necessary, replace check valves. |
| | 3.► | Clean the booster. ** |
| As required or following wear and tear | 1.► | Replace all seal and guide elements. |

* Maximator special grease (3620.2725) is contained in some seal sets or available separately.

** (over 500-1000 operating hours, 2,000,000 strokes or every 18 months)

**WARNING!**

Handling oxygen may result in hazardous situations.

The maximum permitted residual oil or residual grease content on surfaces must not exceed 200 mg/m² (IGC 33/06/E).

The drive air must be oil-free and grease-free, max. 0.01 mg/m³ (cf. Berufsgenossenschaftliche Regeln (Regulations of Employers' Liability Insurance Association - BGR) 500. The maintenance intervals must be adjusted with regard to the increasing surface contamination by substances contained in the drive fluid.

Only MAXIMATOR personnel may carry out maintenance on oxygen equipment, after 12 months!

Further information about the operation of oxygen compressors is contained in » chapter 2.5.2" Oxygen hazards".

## 7.4 Fault analysis

### 7.4.1 Drive side

| Possible fault | Cause of fault | Fault removal |
|---|---|---|
| Booster fails to operate at low air pressure. | Friction of o-rings on spool valve is too high. | • Re-lubricate.<br>• Replace o-rings on the spool valve. |
| | O-rings swell due to use of wrong oil or lubricant. | • Change o-rings.<br>• Use acid-free and silicon-free lubricants. |
| Booster fails to operate or operates only slowly. | Direct pilot valve air not connected. | • Connect control air |
| | Direct pilot valve air not sufficiently pressurized. | • Control air pressure must be at least the same as the drive pressure. |
| | Silencer or spool valve iced up. | • Use water separator to dewater compressed air. |
| | Formation of residue in the silencer. | • Clean the silencer. Replace, where applicable. |
| Booster fails to operate.<br>Air escapes through the silencer. | O-rings on the spool valve defective. | • Change and grease o-rings. |
| | O-ring on air piston defective or worn out. | • Change and grease o-ring. |
| Booster fails to operate. Air flows through small hole on spool valve housing. | Spool valve hangs. | • Clean spool valve and sleeve.<br>• Check and, if necessary, replace o-rings and sleeve.<br>• Lubricate. |
| Booster operates with high frequency and short strokes. | Pilot valve in top or bottom flap defective. | • Clean, grease and, if necessary, replace pilot valve. |

### 7.4.2 High-pressure side

| Possible fault | Cause of fault | Fault removal |
|---|---|---|
| Booster operates without compressing or operates irregularly.<br>It does not achieve the calculated final pressure. | Failure of the check valves. | • Check, clean and, if necessary, replace check valves. |
| Fluid escapes via leakage port "Z1" and "Z3" | Worn packing ring or HP seal. | • Replace seal sets. |

## 7.5 Repair

Maximator devices should be sent to your local Maximator representative for repairs. All information regarding this is available on the Maximator website » http://www.maximator.de/Inhouse+Reparaturen.

**WARNING!**

Injury hazard due to incorrect handling of compressed fluid!

If the Maximator booster has come into contact with dangerous or environmentally hazardous compressed fluid, care must be taken to ensure that, prior to repair, all measures are taken to be able to handle the booster safely.

The safety data sheet of the compressed fluid and a clearance certificate must be enclosed.

# 8 Dismantling and Disposal

**Safety information**

After the end of the booster service life, it must be dismantled and disposed of in an environmentally friendly manner.

**Explosion protection**


**WARNING!**

Explosion protection during dismantling!

Introducing sources of ignition such as sparks, naked flames and hot surfaces can lead to explosions in the explosion zone.

- Obtain written approval for work before beginning the dismantling operation.
- Flush the booster through with nitrogen before starting the dismantling operation so as to rinse out any residues of poisonous and flammable gases.
- Dismantle only when no potentially explosive atmosphere is present.
- Use only tools that have been approved for use in explosion protection. Failure

to observe these instructions will result in loss of explosion protection.

**Incorrect dismantling**

**WARNING!**

Injury hazard due to incorrect dismantling!

Residual risks such as sharp components, tips and corners on or in the booster or on the required tools may cause injuries.

- Ensure that there is sufficient space before starting work.
- Shut off all operating fluid to the booster.
- Make sure that the workplace is clean and tidy. Components and tools lying loosely on top of another or lying about are hazard sources.

Consult the manufacturer in the event of any uncertainty.

# Dismantling and Disposal

## Dismantling

1.► Shut the booster down, depressurize it and fully release any stored pressure.

2.► 

**WARNING!**
Injury hazard due to incorrect handling of compressed fluid!

In the event of the use of poisonous or environmentally hazardous compressed fluid, flush the booster.
Observe the safety data sheet of the compressed fluid.

3.► Undo fastening screws.

4.► Clean assemblies and components professionally.

5.► Dismantle assemblies and components in accordance with applicable occupational safety and environmental protection regulations.

## Disposal

If no return or disposal agreement has been entered into, recycle the disassembled components in an appropriate manner.

## Annex I: Dimensions and Weight

| Type | Width mm | Height mm | Depth mm | Weight kg |
|---|---|---|---|---|
| DLE 2-1 | 440 | 275 | 180 | 15 |
| DLE 5-1 | 440 | 275 | 180 | 15 |
| DLE 15-1 | 450 | 275 | 180 | 13 |
| DLE 30-1 | 450 | 275 | 180 | 13 |
| DLE 75-1 | 450 | 275 | 180 | 13 |
| DLE 2 | 600 | 275 | 180 | 20 |
| DLE 5 | 600 | 235 | 180 | 20 |
| DLE 15 | 620 | 235 | 180 | 18 |
| DLE 30 | 620 | 235 | 180 | 18 |
| DLE 75 | 620 | 235 | 180 | 18 |
| DLE 2-5 | 600 | 235 | 180 | 20 |
| DLE 5-15 | 610 | 235 | 180 | 19 |
| DLE 5-30 | 610 | 235 | 180 | 19 |
| DLE 15-30 | 620 | 235 | 180 | 19 |
| DLE 15-75 | 620 | 235 | 180 | 19 |
| DLE 30-75 | 620 | 235 | 180 | 19 |
| DLE 2-1-2 | 610 | 275 | 180 | 22 |
| DLE 5-1-2 | 610 | 235 | 180 | 22 |

| Type | Width mm | height mm | Depth mm | Weight kg |
|---|---|---|---|---|
| DLE 15-1-2 | 615 | 235 | 180 | 20 |
| DLE 30-1-2 | 615 | 235 | 180 | 20 |
| DLE 75-1-2 | 615 | 235 | 180 | 20 |
| DLE 2-2 | 780 | 275 | 180 | 25 |
| DLE 5-2 | 780 | 235 | 180 | 25 |
| DLE 15-2 | 800 | 235 | 180 | 23 |
| DLE 30-2 | 800 | 235 | 180 | 23 |
| DLE 75-2 | 800 | 235 | 180 | 23 |
| DLE 2-5-2 | 780 | 235 | 180 | 25 |
| DLE 5-15-2 | 790 | 235 | 180 | 24 |
| DLE 5-30-2 | 790 | 235 | 180 | 24 |
| DLE 15-30-2 | 800 | 235 | 180 | 24 |
| DLE 15-75-2 | 800 | 235 | 180 | 24 |
| DLE 30-75-2 | 800 | 235 | 180 | 24 |
| DLE 30-75-3 | 997 | 235 | 210 | 24 |
| 8 DLE 1,65 | 810 | 350 | 220 | 40 |
| 8 DLE 3 | 990 | 350 | 220 | 55 |
| 8 DLE 6 | 990 | 350 | 220 | 55 |

# Annex II: Approved Compressed Fluids

Maximator booster are suitable for operation using a wide variety of fluids. Special models that enable the booster to be configured for special fluids are available. The most common compressed fluids and booster models are listed in the following table. It generally holds that the operating fluids must not attack the booster materials chemically or physically; if you are unclear about the use of a special fluid, Maximator will be pleased to advise you.

| Compressed fluid (gases) | Formula symbols | Booster types | Special information about compressing the compressed fluid |
|---|---|---|---|
| Argon | Ar | all models | Well-ventilated room |
| N-Butan | $C_4H_{10}$ | all models | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |
| Compressed air | | all models | Well-ventilated room |
| Carbon monoxide | CO | DLE xxx-C | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |
| Carbon dioxide | $CO_2$ | DLE xxx-C | Well-ventilated room |
| Ethane | $C_2H_6$ | all models | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |
| Ethylene | $C_2H_4$ | all models | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |
| Freon (F-12) | $CCL_2F_2$ | DLE xxx-CR | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |
| Helium | He | all models | Well-ventilated room |
| Hydrogen | $H_2$ | DLE xxx-H2 | Fit piping to and flush SFP* (special flushing port) and leak detection holes; high-pressure seal not 100% gas-tight. |

# Approved Compressed Fluids

| Compressed fluid (gases) | **Formula symbols** | **Booster types** | **Special information about compressing the compressed fluid** |
|---|---|---|---|
| Methane | $CH_4$ | all models | Fit piping to and flush SFP (special flushing port) and leak detection holes, high-pressure seal not 100% gas-tight. |
| Sour gas (natural gas with proportion of hydrogen sulphide) | | DLE xxx-HMR | Fit piping to and flush SFP (special flushing port) and leak detection holes, high-pressure seal not 100% gas-tight. |
| Propane | $C_3H_8$ | all models | Fit piping to and flush SFP (special flushing port) and leak detection holes, high-pressure seal not 100% gas-tight. |
| Nitrogen | $N_2$ | all models | Well-ventilated room |
| Laughing gas | $N_2O$ | all models | Fit piping to and flush SFP (special flushing port) and leak detection holes, high-pressure seal not 100% gas-tight. |
| Oxygen | $O_2$ | DLE xxx-S | Fit piping to leak detection holes, lubricate with a grease suitable for oxygen (oxygen cleaning) recommended by Maximator, max. compression ratio 1:4**<br>Observe oil-free and grease-free drive air, BGR 500<br>Max. operating pressure 350 bar |
| Sulphur hexafluorine | $SF_6$ | DLE xxx-CR | Fit piping to and flush SFP (special flushing port) and leak detection holes, high-pressure seal not 100% gas-tight. |
| Xenon | XE | all models | Well-ventilated room |

*Flushing port for any high-pressure leaks occurring

**taking into account the ignition temperature of greases minus a safety reserve of 80°C

Approval of individual components of gas mixtures does not imply approval of the gas mixture as a whole. Maximator will be pleased to advise you regarding the use of gas mixtures.

## Annex III: Performance Values

| Type | Stroke capacity | Max. operating pressure PB | Max. compression ratio * | Transmission ratio | Max. operating temperature °C | Primary pressure min. $P_A$ bar | Primary pressure max. $P_A$ bar |
|---|---|---|---|---|---|---|---|
| DLE 2-1 | 922 | 20 | 1:10 | 1:2 | 60 | 0 | 20 |
| DLE 5-1 | 373 | 50 | 1:15 | 1:5 | 60 | 2 | 50 |
| DLE 15-1 | 122 | 150 | 1:20 | 1:15 | 100 | 7 | 150 |
| DLE 30-1 | 60 | 300 | 1:20 | 1:30 | 100 | 15 | 300 |
| DLE 75-1 | 25 | 750 | 1:20 | 1:75 | 100 | 35 | 750 |
| DLE 2 | 1844 | 40 | 1:10 | 1:2 | 60 | 0 | 40 |
| DLE 5 | 746 | 100 | 1:15 | 1:5 | 60 | 2 | 100 |
| DLE 15 | 244 | 300 | 1:20 | 1:15 | 100 | 7 | 300 |
| DLE 30 | 120 | 600 | 1:20 | 1:30 | 100 | 15 | 600 |
| DLE 75 ! | 50 | 1500 | 1:20 | 1:75 | 100 | 35 | 1500 |
| DLE 2-5 | 922 | 70 | 1:25 | 1:2/1:5 | 60 | 0 | 0,8 x PL |
| DLE 5-15 | 373 | 198 | 1:45 | 1:5/1:15 | 100 | 2 | 1,6 x PL |
| DLE 5-30 | 373 | 330 | 1:90 | 1:5/1:30 | 100 | 2 | 0,5 x PL |
| DLE 15-30 | 122 | 450 | 1:40 | 1:15/1:30 | 100 | 7 | 7,5 x PL |
| DLE 15-75 ! | 122 | 875 | 1:100 | 1:15/1:75 | 100 | 7 | 2,5 x PL |
| DLE 30-75 ! | 60 | 1050 | 1:50 | 1:30/1:75 | 100 | 15 | 12 x PL |
| DLE 2-1-2 | 922 | 40 | 1:10 | 1:4 | 60 | 0 | 40 |
| DLE 5-1-2 | 373 | 100 | 1:15 | 1:10 | 60 | 4 | 100 |
| DLE 15-1-2 | 122 | 300 | 1:20 | 1:30 | 100 | 10 | 300 |
| DLE 30-1-2 | 60 | 600 | 1:20 | 1:60 | 100 | 20 | 600 |
| DLE 75-1-2 ! | 25 | 1500 | 1:20 | 1:150 | 100 | 45 | 1500 |

# Performance Values

| Type | Stroke capacity cm³ | Max. operating pressure PB | Max. compression ratio * | Transmission ratio | Max. operating temperature °C | Primary pressure min. $P_A$ bar | max. $P_A$ bar |
|---|---|---|---|---|---|---|---|
| DLE 2-2 | 1844 | 40 | 1:10 | 1:4 | 60 | 0 | 40 |
| DLE 5-2 | 746 | 100 | 1:15 | 1:10 | 60 | 4 | 100 |
| DLE 15-2 | 244 | 300 | 1:20 | 1:30 | 100 | 10 | 300 |
| DLE 30-2 | 120 | 600 | 1:20 | 1:60 | 100 | 20 | 600 |
| DLE 75-2 ! | 50 | 1500 | 1:20 | 1:150 | 100 | 45 | 1500 |
| DLE 2-5-2 | 922 | 100 | 1:25 | 1:4/1:10 | 60 | 0 | 1,6 x PL |
| DLE 5-15-2 | 373 | 300 | 1:45 | 1:10/1:30 | 100 | 2 | 3,2 x PL |
| DLE 5-30-2 | 373 | 600 | 1:90 | 1:10/1:60 | 100 | 2 | 1 x PL |
| DLE 15-30-2 | 122 | 600 | 1:40 | 1:30/1:60 | 100 | 7 | 15 x PL |
| DLE 15-75-2 ! | 122 | 1500 | 1:100 | 1:30/1:150 | 100 | 7 | 5 x PL |
| DLE 30-75-2 ! | 60 | 1500 | 1:50 | 1:60/1:150 | 100 | 15 | 24 x PL |
| DLE 30-75-3 ! | 60 | 2400 | 1:50 | 1:90/1:225 | 100 | 30 | 30 x PL |
| 8 DLE 1,65 | 4100 | 100 | 1:10 | 1:1,65 | 100 | 0 | 100 |
| 8 DLE 3 | 4100 | 40 | 1:15 | 1:3,3 | 60 | 0 | 40 |
| 8DLE 6 | 2050 | 40 | 1:15 | 1:6,6 | 60 | 0 | 40 |

* = compression ratio = operating pressure/primary pressure

! At operating pressures in excess of 1050 bar, the MAXIMATOR high-pressure port and the corresponding MAXIMATOR screw connections must be used.

# Annex IV: Overview of Ports

The following table lists the inlet ports "A", outlet ports "B" that are installed as standard and the corresponding recommended pipe internal diameters.

For more detailed information about the respective booster, including characteristic curve and port drawing, please consult the respective data sheet on Maximator's website » http://www.maximator.de .

| Type | Port Inlet A* | Port Outlet B * | Recommended pipe internal diameter | | |
|---|---|---|---|---|---|
| | | | Drive air | Primary pressure | Operating pressure |
| DLE 2-1 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5-1 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 15-1 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-1 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 75-1 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 15 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 75 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 2-5 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5-15 | G ½ | G ¼ | 19 | 13 | 4 |
| DLE 5-30 | G ½ | G ¼ | 19 | 13 | 4 |
| DLE 15-30 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 15-75 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-75 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 2-1-2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5-1-2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 15-1-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-1-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 75-1-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 2-2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5-2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 15-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 75-2 | G ¼ | G ¼ | 19 | 6 | 4 |

# Overview of Ports

| Type | Port Inlet A* | Port Outlet B* | Recommended pipe internal diameter | | |
|---|---|---|---|---|---|
| | | | Drive air | Primary pressure | Operating pressure |
| DLE 2-5-2 | G ½ | G ½ | 19 | 13 | 13 |
| DLE 5-15-2 | G ½ | G ¼ | 19 | 13 | 4 |
| DLE 5-30-2 | G ½ | G ¼ | 19 | 13 | 4 |
| DLE 15-30-2 | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 15-75-2 ! | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-75-2 ! | G ¼ | G ¼ | 19 | 6 | 4 |
| DLE 30-75-3 ! | G ¼ | 4H | 19 | 6 | 4 |
| 8 DLE 3 | G ½ | G ½ | 19 | 13 | 13 |
| 8 DLE 6 | G ½ | G ½ | 19 | 13 | 13 |
| 8 DLE 1,65 | G ½ | G ½ | 19 | 13 | 13 |

* see » Other ports

! At operating pressures in excess of 1050 bar, the MAXIMATOR high-pressure port and the corresponding MAXIMATOR screw connections must be used.

**Other ports**

The inlet and outlet ports listed in these instructions are standard ports. The following section lists other possible inlet and outlet ports. These other possible ports must comply with the specifications contained in the type designation code. See » chapter 1.5 "Nameplate" in these operating instructions.

**Inlet port A**

| Port designation | Dimensions | Booster types |
|---|---|---|
| N* | NPT ½“ | DLE 2, DLE 5, 8 DLE |
| | NPT ¼“ | DLE 15 bis DLE 75 |
| U** | 4H | DLE 15 bis DLE 75 |

**Anschluss Auslass B**

| Port designation | Dimensions | Booster types |
|---|---|---|
| N* | NPT ½“ | DLE 2, DLE 5, 8DLE |
| | NPT ¼“ | DLE 15 bis DLE 75 |
| U** | 4H | DLE 15 bis DLE 75 |

* At operating pressures in excess of 1050 bar, the MAXIMATOR high-pressure port and the corresponding MAXIMATOR screw connections must be used.

** At operating pressures in excess of 1050 bar, the MAXIMATOR high-pressure port and the corresponding MAXIMATOR screw connections must be used.

The following combinations of inlet and outlet screw connections are possible: GG, GU, UU, NU and NN

## Annex V: Declaration of Incorporation

**Einbauerklärung** nach 2006/42/EG, Anhang II, Nr.1 B
Inhalt gemäß 2006/42/EG, Anhang II, Nr.1 B.
Anschrift Hersteller: MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Deutschland
Der Dokumentationsbeauftragte ist bevollmächtigt, die speziellen technischen Unterlagen nach Anhang VII B zusammenzustellen: dokumentationsbeauftragter@maximator.de / Tel.: 03631-9533-5109
Die Bauart von druckluftbetriebenen Kompressoren der Baureihe:

**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**

ist eine unvollständige Maschine nach Artikel 2g und ausschließlich zum Einbau in oder zum Zusammenbau mit einer anderen Maschine oder Ausrüstung vorgesehen.
Grundlegende Sicherheits- und Gesundheitsschutzanforderung gemäß Anhang I dieser Richtlinie kommen zur Anwendung und wurden eingehalten :
Auflistung siehe separate Anlage
Die speziellen technischen Unterlagen gemäß Anhang VII B wurden erstellt und sie werden der zuständigen nationalen Behörde auf Verlangen in elektronischer Form übermittelt.
Diese unvollständige Maschine darf erst dann in Betrieb genommen werden, wenn festgestellt wurde, dass die Maschine, in die unvollständige Maschine eingebaut werden soll, den Bestimmungen der Maschinenrichtlinie entspricht.

**Declaration of Incorporation** acc. to 2006/42/EC, Annex II, Nr.1 B
Contents acc. to 2006/42/EC, Annex II, Nr.1 B.
Name and address of manufacturer: MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Germany
The documentation officer is authorised to compile the relevant technical documentation as set forth in Annex VII B:
dokumentationsbeauftragter@maximator.de / Tel.: +49(0)3631-9533-5109
The model of air driven gas booster type:

**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**

is a partly completed machinery as defined in Article 2g and exclusively envisaged for installation into or assembly with other machinery or equipment.
Essential health and safety requirements (EHSR) acc. to Annex I to this directive have been applied and complied with:
See separate Appendix
The relevant technical documentation according to Annex VII B was compiled and will be forwarded to the competent national authority in electronic format upon request.
The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive on Machinery.

**Déclaration d'incorporation de quasi-machines conformément** à la Directive 2006/42/CE, Annexe II, Nr.1 B
Contenu conforme à la Directive 2006/42/CE, Annexe II, Nr.1 B.
Adresse du fabricant : MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Allemagne
La personne en charge de la documentation a procuration pour établir la documentation technique spéciale conformément à l'Annexe VII B : dokumentationsbeauftragter@maximator.de / Tél. : 03631-9533-5109
Le modèle de surpresseurs de gaz type:

**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**

est une quasi-machine conformément à l'Article 2g et elle est destinée uniquement à être intégrée ou dans une autre machine ou un autre équipement ou à réaliser avec ceux-ci un ensemble cohérent.
Les exigences essentielles de santé et de sécurité conformément à l'Annexe I de la Directive ont été appliquées et respectées :
Voir la liste en Annexe
La documentation technique spéciale conformément à l'Annexe VII B a été établie et sera transmise sous forme électronique, sur réquisition, aux services nationaux compétents.
Cette quasi-machine ne pourra être mise en service qu'après avoir constaté que la machine dans laquelle la quasi-machine est intégrée, satisfait aux prescriptions de la Directive sur les machines.

Nordhausen, den 20.04.2016 (Nordhausen, 20.04.2016) [Nordhausen, le 20.04.2016]

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Steffen Roloff (Technischer Leiter) (Technical Director) [Directeur technique]

# Declaration of Incorporation

Appendix to Declaration of Incorporation according to 2006/42/EC Annex II, No.1 B
Description of essential health and safety requirements as defined in 2006/42/EC, Annex I, which were applied and complied with:

| No. | Essential requirements | Applicable | Complied |
|---|---|---|---|
| 1.1.1. | Definitions | Yes | Yes |
| 1.1.2. | Principles of safety integration | Yes | Yes |
| 1.1.3. | Materials and products | Yes | Yes |
| 1.1.4. | Lighting | No | |
| 1.1.5. | Design of machinery to facilitate its handling | Yes | Yes |
| 1.1.6. | Ergonomics | No | |
| 1.1.7. | Operating positions | No | |
| 1.1.8. | Seating | No | |
| 1.2. | Control systems | | |
| 1.2.1. | Safety and reliability of control systems | Yes | No |
| 1.2.2. | Control devices | No | |
| 1.2.3. | Starting | Yes | No |
| 1.2.4. | Stopping | Yes | No |
| 1.2.4.1 | Normal stop | Yes | No |
| 1.2.4.2 | Operational stop | No | |
| 1.2.4.3 | Emergency stop | Yes | No |
| 1.2.4.4 | Assembly of machinery | No | |
| 1.2.5. | Selection of control or operating modes | No | |
| 1.2.6. | Failure of the power supply | Yes | No |
| 1.3. | Protection against mechanical hazards | | |
| 1.3.1. | Risk of loss of stability | Yes | No |
| 1.3.2. | Risk of break-up during operation | Yes | Yes |
| 1.3.3. | Risk due to falling or ejected objects | Yes | Yes |
| 1.3.4. | Risks due to surface, edges or angles | Yes | Yes |
| 1.3.5. | Risks related to combined machinery | No | |
| 1.3.6. | Risks related to variations in operating conditions | No | |
| 1.3.7. | Risks related to moving parts | Yes | Yes |
| 1.3.8. | Choice of protection against risks arising from moving parts | No | |
| 1.3.8.1 | Moving transmission parts | No | |
| 1.3.8.2 | Moving parts involved in the process | No | |
| 1.3.9. | Risks of uncontrolled movements | No | |
| 1.4. | Required characteristics of guards and protective devices | | |
| 1.4.1. | General requirements | No | |
| 1.4.2. | Special requirements for guards | No | |
| 1.4.2.1 | Fixed guards | No | |
| 1.4.2.2 | Interlocking movable guards | No | |
| 1.4.2.3 | Adjustable guards restricting acces | No | |
| 1.4.3. | Special requirements for protective devices | No | |
| 1.5. | Risks due to other hazards | | |
| 1.5.1. | Electricity supply | No | |
| 1.5.2. | Static electricity | Yes | Yes |
| 1.5.3. | Energy supply other than electricity | Yes | No |
| 1.5.4. | Errors of fitting | Yes | Yes |
| 1.5.5. | Extreme temperatures | No | |
| 1.5.6. | Fire | Yes | Yes |
| 1.5.7. | Explosion | Not applicable or certified separately | |

# Declaration of Incorporation

| No. | Essential requirements | Applicable | Complied |
|---|---|---|---|
| 1.5.8. | Noise | Yes | No |
| 1.5.9. | Vibrations | No | |
| 1.5.10. | Radiation | No | |
| 1.5.11. | External radiation | Yes | Yes |
| 1.5.12. | Laser radiation | No | |
| 1.5.13. | Emissions of hazardous materials and substances | Yes | No |
| 1.5.14. | Risk of being trapped in a machine | No | |
| 1.5.15. | Risk of slipping, tripping or falling | Yes | No |
| 1.5.16. | Lightning | No | |
| 1.6. | Maintenance | | |
| 1.6.1. | Machinery maintenance | Yes | No |
| 1.6.2. | Access to operating positions and servicing points | No | |
| 1.6.3. | Isolation of energy sources | Yes | No |
| 1.6.4. | Operator intervention | Yes | Yes |
| 1.6.5. | Cleaning of internal parts | No | |
| 1.7. | Information | | |
| 1.7.1. | Information and warnings on the machinery | No | |
| 1.7.1.1 | Information and information devices | No | |
| 1.7.1.2 | Warning devices | No | |
| 1.7.2. | Warning of residual risks | No | |
| 1.7.3. | Marking of machinery | Yes | Yes |
| 1.7.4. | Instructions | No | |
| 1.7.4.1 | General principles for the drafting of instructions | No | |
| 1.7.4.2 | Contents of the instructions | No | |
| 1.7.4.3 | Sales literature | No | |
| 2. | Supplementary essential health and safety requirements for certain categories of machinery | No | |
| 2.1. | Foodstuffs machinery and machinery for cosmetics or pharmaceutical products | No | |
| 2.2 | Portable hand-held and/or hand-guided machinery | No | |
| 2.2.1. | General | | |
| 2.2.2. | Portable fixing and other impact machinery | No | |
| 2.3. | Machinery for working wood and material with similar physical characteristics | No | |
| 3. | Supplementary essential health and safety requirements to offset hazards due to the mobility of machinery | No | |
| 4. | Supplementary essential health and safety requirements to offset hazards due to lifting operations | No | |
| 5. | Supplementary essential health and safety requirements for underground work | No | |
| 6. | Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of person | No | |

## Annex VI: EU Declaration of Conformity

**EU-Konformitätserklärung**
Im Sinne der EU-Richtlinie Explosionsschutz 2014/34/EU.
Anschrift Hersteller: MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Deutschland
Hiermit erklären wir, dass die Bauart von druckluftbetriebenen Kompressoren der Baureihe:
**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**
in der gelieferten Ausführung folgenden einschlägigen Bestimmungen entspricht:
**EU-Richtlinie Explosionsschutz 2014/34/EU**
Angewendete harmonisierte Normen und technische Spezifikationen:
DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
Notifizierte Stelle: **0102 PTB - Braunschweig, (Bundesallee 100, 38116 Braunschweig)**
Eingeschaltet zur Aufbewahrung der Unterlagen nach 2014/34/EU
Weitere einschlägige Bestimmungen: EG Maschinenrichtlinie (2006/42/EG) (Unvollständige Maschine)

**EU Declaration of Conformity**
As defined by the regulations of the EU Explosion Protection Directive 2014/34/EU
Name and address of manufacturer: MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Germany
Herewith, we declare that the model of air driven gas booster type:
**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**
as supplied are in conformity with the following relevant regulations:
**EU Explosion Protection Directive 2014/34/EU**
Harmonised standards and technical specifications applied:
DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
Notified bodies: **0102 PTB - Braunschweig (Bundesallee 100, 38116 Braunschweig)**
Involved for preserving the documents in compliance with 2014/34/EU
Further likewise applicable directives: Machinery directive (2006/42/EC) (partly completed machinery)

**Déclaration de conformité UE**
Au sens de la directive UE atmosphères explosives 2014/34/UE
Adresse du fabricant : MAXIMATOR GmbH
Lange Straße 6
99734 Nordhausen / Allemagne
Nous certifions que le modèle de surpresseurs de gaz type:
**DLE X, DLE X-X, DLE X-1, DLE X-2, DLE X-1-2, DLE X-X-2, 8 DLE X**
est conforme, à sa livraison, aux spécifications applicables suivantes:
**Directive UE atmosphères explosives 2014/34/UE**
Normes harmonisées appliquées et prescriptions techniques:
DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
Services notifiés: **0102 PTB - Braunschweig (Bundesallee 100, 38116 Braunschweig)**
Chargé de conserver les dossiers conformément à 2014/34/UE
D'autres directives également applicables: Directive machines (2006/42/CE) (quasi-machine)

Nordhausen, den 08.09.2016 (Nordhausen, 08.09.2016) [Nordhausen, le 08.09.2016]

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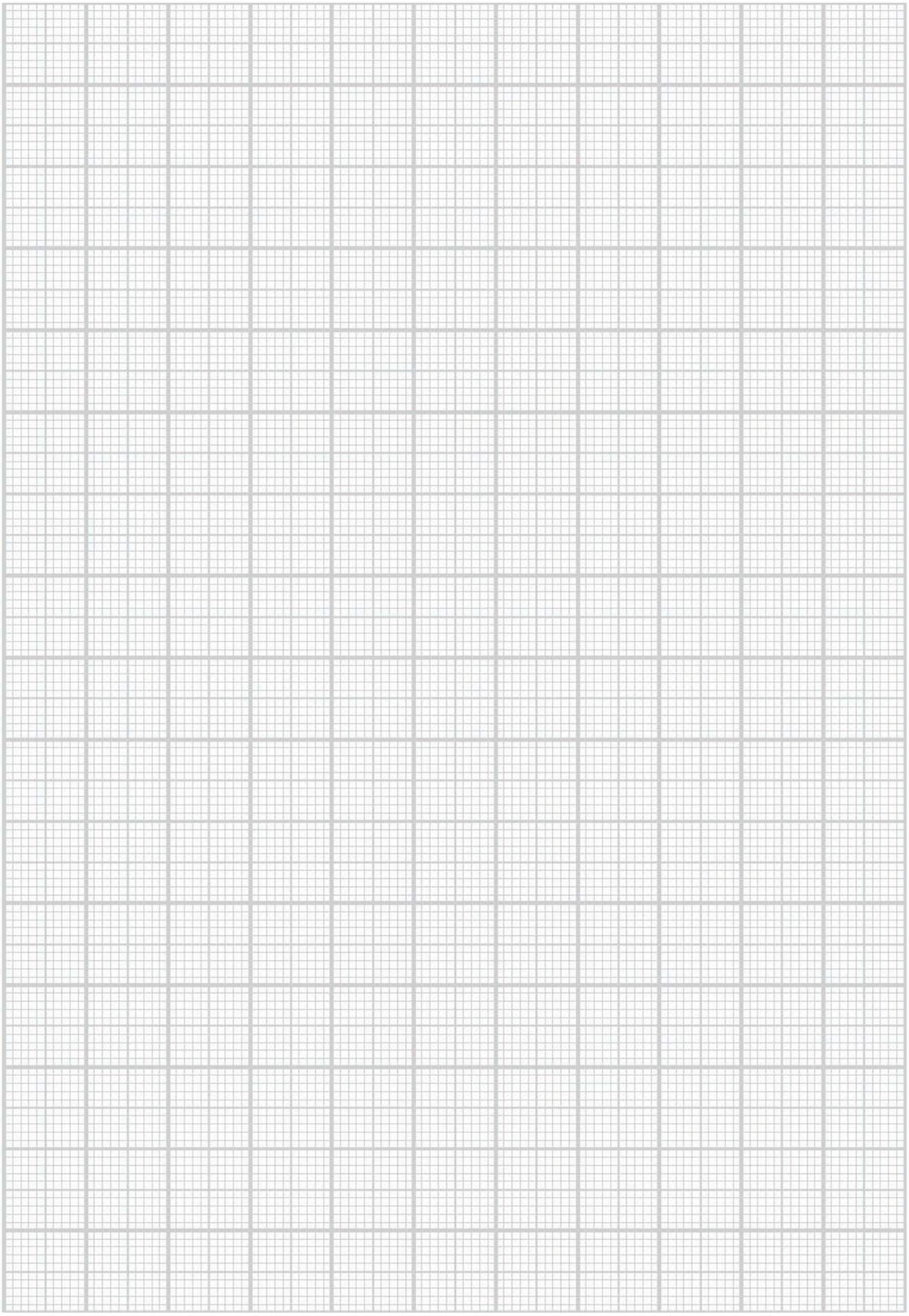
Steffen Roloff (Divisionsleitung Components) (Division Manager Components) [Chef de division Components]

# Notes

# Notes



At your side, everywhere:

With our international partner companies, experienced specialists in high-pressure technology are always available to assist you.

We have compiled detailed information about our international partners for you on our website at www.maximator.de/vertrieb+weltweit.

**MAXIMATOR GmbH**
Lange Straße 6, 99743 Nordhausen
Phone +49 (0) 3631 9533-0
Fax +49 (0) 3631 9533–5010
info@maximator.de

3999.3185 - 2016/09

» Also visit our website: www.maximator.de