MAXIMATOR®

Maximum Pressure.

# Air amplifier

## MPLV4, MPLV7, SPLV3, SPLV10, GPLV5

Installation and operating manual

**Key information!**
**Follow the manual for safe and proper use.**
**Keep the manual near the machine for later reference.**

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***Warranty and liability:***

As a general rule, the “General Terms and Conditions” of Maximator GmbH shall apply. These terms and conditions are available at http://www.maximator.de.

Warranty and liability claims shall not be accepted if they can be attributed to one or more of the causes mentioned in this manual or explicitly stipulated below:

– Any use other than the intended use indicated in this manual
– Improper commissioning, operation or maintenance
– Operation with faulty safety equipment or incorrectly installed safety equipment and safeguards
– Failure to observe the commissioning, operation and maintenance instructions in this manual
– Insufficient monitoring of wear parts
– Wear on seals, guiding elements, etc. due to ageing and operation

30.08.2023 Translation

## Contents

# Contents

# 1 General information

## 1.1 Information regarding this manual

The pneumatically driven air amplifier manufactured by MAXIMATOR is a self-controlling, oscillating pressure booster and is used for transporting and compressing pressurised air and nitrogen.
These instructions are applicable for the air amplifier models MPLV4, MPLV7, SPLV3, SPLV10 and GPLV5 (only referred to as “compressor” in other sections and chapters) and with a serial number of greater than 23000001.
The general drawing supplied along the models is an integral component of these instructions and must be kept in safe custody along with them.

## 1.2 Order code

The order code for the air amplifier is structured as follows:


**a** **Model**

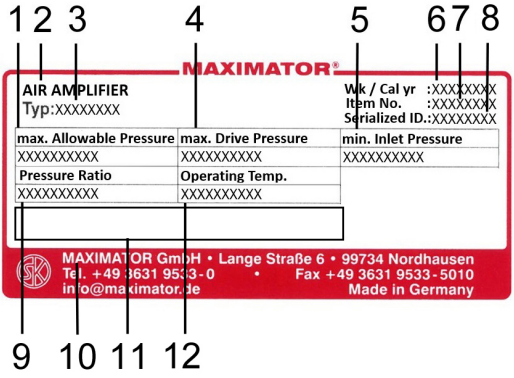
for example: MPLV 4, GPLV 5...

**b** **additional codes for device options and/or variants**

for example: -NPT, -FEC

## 1.3 Rating plate

The rating plate is located on the pneumatic cylinder of the compressor and contains the following information:[1]:




1 Max. permitted operating pressure
2 Air amplifier
3 Type (specifications from the order code)
4 Maximum drive pressure
5 Minimum inlet pressure
6 Calendar week/year of manufacture
7 Article number
8 Serial number
9 Gear ratio
10 Manufacturer contact information
11 Label according to applied guidelines
12 Operating temperature range

[1] Individual compressors may have different rating plates, e.g. metal ones

## 1.4 Explanation of symbols

**DANGER**

This combination of symbol and signal word indicates a hazardous situation which - if not avoided - may lead to severe injuries or death.

**WARNING**

This combination of symbol and signal word indicates a potentially hazardous situation which - if not avoided - may lead to severe injuries or death.

**CAUTION**

This combination of symbol and signal word indicates a potentially hazardous situation which - if not avoided - may lead to light or minor injuries.

***NOTICE***

This combination of symbol and signal word indicates a potentially hazardous situation which - if not avoided - may lead to property damage or damage to the environment.


**WARNING**

This combination of symbol and signal word characterises contents and instructions for the intended use in potentially explosive areas. If failing to comply with instructions marked as such, an increased risk of explosion will be posed and may result in severe or fatal injuries.

## 1.5 List of abbreviations and formula signs used

| Abbreviation | Description |
|---|---|
| A | Gas inlet |
| Fig. | Figure |
| ATEX | EU explosion prevention directive |
| B | Gas outlet |
| E | Exhaust port |
| CET | Central European Time |
| $P_L$ | Drive air inlet |
| PPE | Personal protective equipment |
| Tab. | Table |
| V1 | Spool valve air supply |
| V2 | Air supply to back of piston |
| X | Control air port |
| Y | Pilot valve air supply |

*Tab. 1-1 List of abbreviations*

| Formula symbol | Description |
|---|---|
| i | Gear ratio |
| κ | Isentropic exponent |
| $n_{sp}$ | Strokes under standstill pressure |
| $p_A$ | Primary pressure |
| $p_B$ | Operating pressure |
| $p_L$ | Drive pressure |
| $T_A$ | Input temperature |
| $T_B$ | Output temperature |
| $V_{stroke}$ | Stroke volume |
| $V_{leak}$ | Leakage volume |

*Tab. 1-2 Formula symbol*

## 1.6 Qualification of the personnel

Only qualified personnel who are specialised and have been trained to do so must work on the air amplifier. Allowing unqualified personnel to work on the compressor or enter the danger zone creates hazards which could lead to death, severe injuries and significant property damage.

# 2 Safety and protection measures

The following sections stipulate the residual risks associated with the product, even when used as intended. In order to reduce the risk of personal injuries and material damage, and to prevent hazardous situations, you must observe the safety information listed in this section and the warnings in all other sections of this manual.

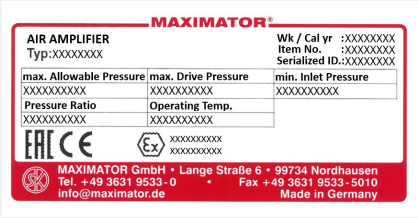
## 2.1 Personal protective equipment

Personal protective equipment (in other sections also referred to as PPE) protects personnel from occupational safety and health hazards while at work.

Wearing personal protective equipment may be required during work on the product. Wherever possible, this personal protective equipment is listed in these instructions for the individual work steps.
However, detailed specifications of the required protective equipment can only be determined with full knowledge of the system. The required personal protective equipment should therefore be determined by the user.

## 2.2 Signs and labels

The following signs are found on the product.
Over time, labels can become unrecognisable due to dirt or other causes. As a result, hazards cannot be identified, or necessary operating indications cannot be followed. Resulting errors can lead to severe injuries or death.
Keep the labels in good, legible condition and replace any damaged labels.

| Signs and labels | Graphic display |
|---|---|
| Rating plate:<br>The rating plate is affixed to the pneumatic cylinder of the air amplifier. The rating plate indicates the operating characteristics of the air amplifier. |  |

*Tab. 2-1 Overview of labels*

## 2.3 Work and danger zone

The danger zone comprises the entire area surrounding the product. The hazards associated with the product and the danger zone depend on the application and the installation location. The danger zone should therefore be determined by the user.

During assessment, check the following leak points:

| leak point | leak type | leak source | Comment |
|---|---|---|---|
| silencer | normal operating leakage | air drive component | permanent leak of operating fluids |
| bleed port | minor leakage | high-pressure seal, piston seal on drive side | only for SPLV 3/ SPLV 10 and GPLV 5 |
| air supply port | minor leakage | high-pressure seal, piston seal on drive side | only for MPLV 4 and MPLV 7 |
| bleed port | unexpected | faulty high-pressure seal, piston seal on drive side | only for SPLV 3/ SPLV 10 and GPLV 5 |
| air supply port | unexpected | faulty high-pressure seal, piston seal on drive side | only for MPLV 4 and MPLV 7 |
| High-pressure/ drive section | unexpected | Defective high-pressure / drive section or seals on these components | All equipment |
| screw fittings | unexpected | loose screw fitting, faulty screw fitting | All equipment |
| drive connection lines | unexpected | connection line, fitting, O-ring | All equipment |

*Tab. 2-2 leak point danger zone*

The hazards are primarily due to the high pressure and extreme temperatures of the conveyed fluid and/or the hazardous substances used.

The system designer must determine detailed danger zones as part of his job and can use his special knowledge of high-pressure technology and the hazardous substances used in each case.

## 2.4 Non obvious hazards

Using asphyxiant operating fluids can lead to severe injuries or death by asphyxiation. Assess the risk for the equipment in the risk assessment. The following are some potential corrective actions:

- Operate the compressor in an adequately ventilated space.
- Check the compressor for leaks on a regular basis.
- Ensure that lines are connected in such a way as to remain leak-tight for a long time.
- If necessary, use connecting lines to remove the escaping operating fluids.

Assess the risk for the equipment in the risk assessment.

## 2.5 Residual risks

### 2.5.1 Start-up and shut down

There is no command device for safe shut-down (E-stop). This can lead to severe injuries or death.

Assess the risk for the equipment in the risk assessment.

### 2.5.2 Unexpected restart

When restoring the pneumatic energy supply or in case of changes made to the operating parameters, the compressor may start accidentally. This can lead to severe injuries or death.

Assess the risk for the equipment in the risk assessment.

### 2.5.3 Risk of injury posed by noise

The noise level emitted in the work area depends on the mounting and application.

Assess the risk for the equipment in the risk assessment.

### 2.5.4 Risk of injury posed by raised particles or ice crystals.

Escaping gas raises particles or ice crystals and can cause injuries to the eyes.

Assess the risk for the equipment in the risk assessment.

### 2.5.5 Hazardous operating fluids

Improper use of operating fluids can lead to serious accidents resulting in death.

Assess the risk for the equipment in the risk assessment.

Active leaks can lead to serious accidents resulting in death.

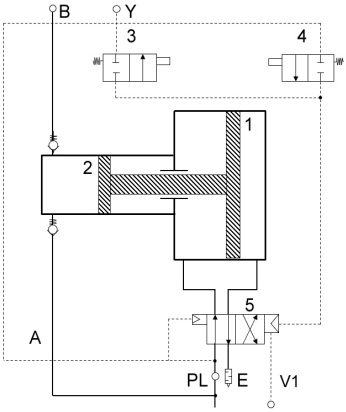
Assess the risk for the equipment in the risk assessment.

# 3 Product description

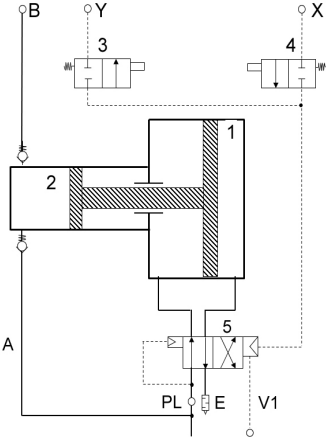
## 3.1 Design and function

***Structure***

Schematic diagram without control air




Schematic diagram with control air




*Tab. 3-1 Schematic diagram*

| | | | |
|---|---|---|---|
| 1 | Air piston | A | Gas inlet to the air amplifier |
| 2 | High-pressure piston | B | Gas outlet from the air amplifier |
| 3 | Pilot valve lower cap | $P_L$ | Drive air inlet |
| 4 | Pilot valve top cap | E | Exhaust port/silencer |
| 5 | Spool valve | V1 | Spool valve air supply |
| | | V2 | Back of piston air supply |
| | | Y | Pilot valve air supply |
| | | X | Pilot supply port |

***Functional description***

The operating principle of an air amplifier is similar to that of a pressure intensifier. As shown in the schematic diagram, drive air inlet $P_L$ and gas inlet A on the air amplifier are supplied by the same supply line. This requires that the device have the same pressure and the same fluid on the drive side and the high pressure side.

Low pressure is applied to the large area of the air piston (1) which applies high-pressure to the small area of the high-pressure piston (2). The piston of the air amplifier performs reciprocating movements until the stall pressure is reached. In so doing, the high pressure piston delivers and compresses the operating fluid by means of the check valves in gas inlet A and gas outlet B. The output pressure results from the set pressure in the supply line, which is applied to ports $P_L$ and A and the fixed pressure ratio.

The continuous operation is achieved by means of an internally controlled directional valve, the spool valve (5). The spool valve alternately guides the operating fluid to the two sides of the air piston. The spool valve is controlled by two directional valves, the pilot valves (3 and 4), which are operated mechanically by the air piston in its stop positions. The pilot valves vent the operating area of the control slide valve.

An equilibrium of forces on the drive and high-pressure side is generated as soon as the stall pressure is reached. The air amplifier stops and no longer consumes drive fluid. If the pressure drops on the high pressure side or increases on the supply side, the air amplifier automatically restarts, while the operating fluid is compressed until an equilibrium of forces is restored.

In air amplifiers equipped with a pilot air port X, the operating area of the spool valve will only be supplied with air if air pressure is present on the pilot port. If no pilot air pressure is present, the amplifier will not cycle.

The GPLV 5 is equipped with a double-acting high pressure unit and exerts compression on both the forward and return stroke.

Air amplifiers types MPLV 2.5/MPLV 4/MPLV 7 operate without a pilot valve in the lower cap (3). The return stroke is performed by the operating fluid entering the high pressure unit. The pneumatic piston return chamber has a vent hole for this purpose.

## 3.2 Intended use

Within their technical limits, air amplifiers are used to deliver and compress compressed air and nitrogen. Other operating fluids must be released by specific clearance issued by Maximator.

If the air amplifier bears an ATEX label and comes with a declaration of conformity, it is designated for use in corresponding potentially explosive areas.

## 3.3 Foreseeable misuse

The product may only be used in accordance with the indications in this manual.

The product cannot be used for:

– sealing containers

## 3.4 Misuse

Unauthorised modifications or technical changes to the product may lead to accidents with serious or fatal injuries.
Never carry out unauthorised modifications or technical changes to the product!

## 3.5 Ports

Comply with the connected load specifications for all interface connections. Refer to the enclosed general drawing for the connection ports available on the air amplifier.

The following interfaces are standard on the air amplifier:

***Drive air inlet "$P_L$"***

Input of drive fluid.

***Gas inlet "A"***

Input of operating fluid.

***Gas outlet "B"***

Output of operating fluid.

***Exhaust port "E"***

Output of expanding drive fluid.

***Pilot air port “X”***

Port for pilot air. The air amplifier will only operate if the pilot air connection is pressurised. The pressure of the pilot air must always be larger or equal to the drive pressure to ensure flawless function. The pilot air is subject to the same fluid quality requirements as the drive fluid/operating fluid.

***Spool valve air supply port "V1"***

Spool valve air supply and ventilation. The port must not be obstructed.

***Air supply port "V2" to back of piston***

Air supply and ventilation of the piston return chamber of the pneumatic drive. The port must not be obstructed.

***Pilot valve "Y" exhaust port***

Bleeding of the spool valve actuator chamber. An air pulse escapes here after each stroke. The port must not be obstructed.

This port can be used to connect a stroke counter.

## 3.6 Technical specifications

### 3.6.1 Operating conditions

***Ambiance***

| Specification | Value | Unit |
|---|---|---|
| Ambient temperature, min. | - 20 | °C |
| Ambient temperature, max. | + 60 | °C |
| Installation area | protected against climatic exposure | |

*Tab. 3-2 Ambient conditions*

***Operating fluids***

| Specification | Value | Unit |
|---|---|---|
| Operating temperature, min.[a] | -20 | °C |
| Operating temperature, max.[b] | +60 | °C |
| Operating fluid | Compressed air or nitrogen[c] | |
| Max. number of particles of 0.1 - 0.5 µm size (class 3)[d] | information not available | units |
| Max. number of particles of 0.5 - 1.0 µm size (class 3)[e] | 90000 | units |
| Max. number of particles of 1.0 - 5.0 µm size (class 3)[f] | 1000 | units |
| Max. solids, particle concentration of particles (class 6)[g] | 5 | mg/m³ |
| Particle size, max. | 10 | µm |

a. Depending on the design of the compressor. See enclosed general drawing.

b. Depending on the design of the compressor. See enclosed general drawing.

c. Certain compressors may be suitable for other operating fluids. A specific clearance from Maximator is necessary.

d. Specifications for purity classification in line with ISO 8573-1 “Compressed air - Part 1: Contaminants and purity classes“

e. Specifications for purity classification in line with ISO 8573-1 “Compressed air - Part 1: Contaminants and purity classes“

f. Specifications for purity classification in line with ISO 8573-1 “Compressed air - Part 1: Contaminants and purity classes“

g. Specifications for purity classification in line with ISO 8573-1 “Compressed air - Part 1: Contaminants and purity classes“

*Tab. 3-3 Operating fluids*

In case of applications with special specifications for the quality of the fluid that go beyond what is usual in high-pressure system designs, the system manufacturer will have to determine whether the compressor is adequate for the application. For example, these applications may include (but are not limited to) the following:

– Compression of breathing air
– Handling of diving gases
– Compression of auxiliary fluids in food production
– Applications within the pharmaceutical industry without direct contact

***Drive fluid (air quality according to ISO 8573-1)***

| Specification | Value | Unit |
|---|---|---|
| Drive pressure $p_L$, min. | 1 | bar |
| Drive pressure $p_L$, max. | 10 | bar |
| Drive fluid[a] | Compressed air or nitrogen | |
| Drive fluid temperature, min.[b] | -20 | °C |
| Operating fluid temperature, max.[c] | +60 | °C |
| Max. compressed air purity class of oil (Class 4) | 5 | mg/m³ |
| Max. particle count at 0.1 - 0.5 µm size (Class 3) | information not available | units |
| Max. particle count at 0.5 - 1.0 µm size (Class 3) | 90000 | units |
| Max. particle count at 1.0 - 5.0 µm size (Class 3) | 1000 | units |
| Max. solids, particle concentration (Class 6) | 5 | mg/m³ |
| Max. pressure dew point for humidity (Class 4) | +3[d] | °C |
| Particle size, max. | 10 | µm |

a. Certain compressors may be suitable for other operating fluids. A specific clearance from Maximator is necessary.

b. Depending on the design of the compressor. See enclosed general drawing.

c. Depending on the design of the compressor. See enclosed general drawing.

d. For fluid temperature of 20 °C; depending on the temperature of the operating fluid, different values may be required.

*Tab. 3-4 Requirements for drive fluids*

***Operation with compressed air***

Maximator air amplifiers generally do not need a compressed air oiler as they are treated with lubricant during installation. However, after the first time an oiler is used, the drive fluid should always be oiled, since the oil washes the lubricant out. In case a compressed air oiler is used, the oil must comply with DIN 51524 - ISO VG 32 specifications.

If dry or very dry compressed air is used, a gas booster with FEC option is recommended.

***Operation with nitrogen***

As standard, all Maximator air amplifiers can be operated with nitrogen. This is equivalent to operation with dry or very dry compressed air.

***Operation with different fluids and/or pressures***

Consult with Maximator before operating the system with different fluids and/or supply pressures in the drive unit and high pressure unit.

### 3.6.2 Dimensions and weight

The dimensions and weight of the air amplifier are indicated in the general drawing.

### 3.6.3 Performance values

The performance values of the air amplifier can be found on the rating plate and general drawing.

For more detailed information on the air amplifier, including characteristic curve, please refer to the corresponding data sheet on the Maximator website at http://www.maximator.de.

***Permissible leakage rate***

For compressors, assessing leakage through the HP seal and the check valves is a complicated process. Refer to the "Maintenance" section for instructions on measuring leakage and detecting wear.

Under the following assumptions, from the strokes at standstill pressure $n_{sp}$ it is possible to roughly estimate the quantity of leakage:

– At standstill pressure and with gas outlet (B) blocked, the number of strokes obtained $n_{sp}$ result solely from the leakage through the piston seal, check valves and the rod seal.
– Leakage at standstill pressure and leakage in the operating point of the compressor are comparable.

The leakage volume can be estimated as follows:

$V_{leak} = V_{stroke} * p_B * n_{sp}$

**MPLV4 / MPLV7 / SPLV3 / SPLV10 / GPLV5**

Permissible number of strokes at standstill pressure at the time of delivery:

| Criterion | Limit value | Unit |
|---|---|---|
| Strokes under standstill pressure $n_{sp}$ | 1 | - |

*Tab. 3-5 Permissible number of strokes at standstill pressure at the time of delivery*

Permissible number of strokes at standstill pressure at the time of delivery for safe function:

| Criterion | Limit value | Unit |
|---|---|---|
| Strokes under standstill pressure $n_{sp}$ | 2 | - |

*Tab. 3-6 Permissible number of strokes at standstill pressure for safe function*

Listing of stroke volumes of the air amplifiers:

| Type | VStroke | Unit |
|---|---|---|
| MPLV4 | 31 | $cm^3$ |
| MPLV7 | 18 | $cm^3$ |
| SPLV3 | 373 | $cm^3$ |
| SPLV10 | 122 | $cm^3$ |
| GPLV5 | 373 | $cm^3$ |

*Tab. 3-7 Listing of stroke volumes of the air amplifiers*

### 3.6.4 Service life

The service life of the product depends on the conditions of use. The service life should therefore be determined and defined by the user.

# 4 Transport, packaging and storage

## 4.1 Dimensions and weight

The dimensions and weight of the air amplifier are indicated in the general drawing.

## 4.2 Delivery

Scope of delivery

| Designation | Quantity |
|---|---|
| Air amplifier | 1 |
| Installation and operating manual including Declaration of Incorporation and EU Declaration of Conformity | 1 |
| General drawing | 1 |

*Tab. 4-1 Scope of delivery*

## 4.3 Packaging

The individual packages are packed according to the conditions expected for transport. Separate packaging should be used for transport and dust protection. The packaging is supposed to protect the individual components against transport damage, corrosion and other damage up to its place of use.

Do not remove the dust protection until shortly before installation.
Dispose of the packaging materials in an environmentally friendly manner.

## 4.4 Storage

Note the following with regard to package storage:

- Do not store the packages out of doors.
- Keep the packages dry and dust-free.
- Do not expose the packages to corrosive fluids.
- Keep the packages protected from sunlight.
- Prevent mechanical vibrations.
- Maintain a storage temperature of -20°C to +60°C.
- The relative humidity should not exceed 60%.

Storage instructions in addition to the specifications mentioned here may be attached to the packages.

# 5 Installation

## 5.1 Prerequisites for installation

Observe the manual and general drawing of the product.
In addition, the following conditions must be met:

- The product must be free of damage.
- The product must be easily accessible from all sides.
- Do not expose the product to any external heat or radiation sources.
- Install the product in a clean environment.

## 5.2 Air amplifier installation

The product is enclosed in dust-protection packaging. Do not remove this packaging until shortly before installation. Dispose of this packaging in an environmentally friendly manner.

Attach the air amplifier to the fastening holes provided using screws or bolts with a strength of at least 4.6. Determine the adequate screw or bolt size using the enclosed general drawing.

The preferred installation position is vertical.

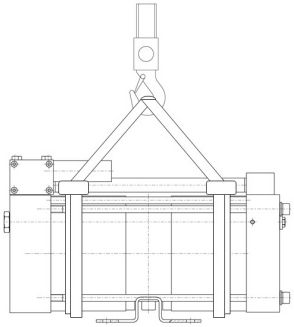


*Fig. 5-1 Lifting points of air amplifier*

## 5.3 Installation of connecting lines

The air amplifier is delivered without any connection screw fittings or connecting lines. For this purpose, observe the specifications in section “Connections” and on the general drawing. To prevent malfunctions, the cross-sections of the connecting lines must be designed for the corresponding volume flows.

### 5.3.1 Connecting the drive air

Connect the connecting line for the drive air to the drive air port ($P_L$). Observe the connection specifications on the general drawing.

### 5.3.2 Control air connection

Connect the connecting line for the control air, if applicable, to the control air port (X) of the air amplifier. Observe the connection specifications on the general drawing.

### 5.3.3 Connecting the inlet line and outlet line

Connect the inlet and outlet lines to the corresponding air amplifier ports (A and B) as appropriate. Observe the connection specifications on the general drawing.

### 5.3.4 Connecting a separate bleed pipe

If a bleed port (Z) is provided, a bleed line can be installed here in an appropriate manner. Observe the connection specifications on the general drawing.

### 5.3.5 Exhaust silencer installation

If the exhaust air connection pipe of the air amplifier is not installed separately, the enclosed exhaust air silencer must be installed at the corresponding port (E).

## 5.4 Commissioning

### 5.4.1 Prerequisites for commissioning

Observe the manual and general drawing of the product.
In addition, the following conditions must be met:

- The product must be free of damage.
- The product must be securely attached.
- The connections must be installed correctly.
- Connecting cables/pipes must be free from damage.

**WARNING**

**Incorrect installation of the air amplifier can result in a risk of injury!**

Incorrect installation of the air amplifier can lead to accidents resulting in severe injuries or death.

► Permissible pressures at the inlet and outlet of the air amplifier must not exceed the maximum permitted operating pressure of the air amplifier.

Prior to commissioning the air amplifier, the system-specific stall pressure must be calculated. The stall pressure of the air amplifier is calculated using the following formula:

$p_B = p_L * i$

**Legend:**

$p_L$ - drive pressure (at drive air inlet $P_L$)
$p_B$ - operating pressure (at gas outlet B)
i - pressure ratio

### 5.4.2 Commissioning

**WARNING**

**Risk of injury due to extreme temperatures!**

The surfaces of the product can be very hot or very cold. This can lead to accidents resulting in severe injuries or death.

► Before working on the product, please ensure that the product is at ambient temperature.

The following section explains how to commission the air amplifier:

1) Check all connections for proper installation.
2) Check all connecting lines for mechanical damage.
3) Slowly open the shared supply line to drive air inlet $P_L$ and gas inlet A.
   – The operating fluid flows in, and the air amplifier automatically starts pumping.

We recommend increasing the pressure of the supply line slowly, in order to keep the stress on the air amplifier components low during commissioning.
This keeps the stroke frequency of the air amplifier low. Otherwise, during the ramp-up phase, until the required operating pressure is reached, operating phases with very high cycle frequencies can occur.

# 6 Operation

## 6.1 Prerequisites for operation

Observe the manual and general drawing of the product.
In addition, the following conditions must be met:

- The product must be free of damage.
- The product must be securely attached.
- The product is not subject to any vibrations greater than those typically occurring in high-pressure systems.
- A risk assessment has been compiled for the system, and all basic health and safety requirements have been met.

## 6.2 Normal, safe operation

**WARNING**

**Risk of injury due to extreme temperatures!**

The surfaces of the product can be very hot or very cold. This can lead to accidents resulting in severe injuries or death.

► Before working on the product, please ensure that the product is at ambient temperature.

Normal, safe air amplifier operation must be defined in the context of overall system.

## 6.3 Abnormal situations during operation

Refer to the general system documentation for measures to consider or implement in case of abnormal operation.

## 6.4 Signs indicating the product is no longer safe to use

The following signs indicate that the compressor is no longer safe to use. In such cases, the compressor must be put into a safe state immediately.

- Leakage through the high-pressure piston seal
- Leakage through the air piston seal
- Leakage on caps and air cylinders
- Leaking connections
- Visible damage

## 6.5 Put the air amplifier in a safe state

In a safe state, the air amplifier is depressurised on the drive and high pressure side. The steps necessary in order to achieve a safe state depend on the installation position in the system. Refer to the general system documentation for the required actions.

# 7 Maintenance

## 7.1 Maintenance intervals

To ensure safe and smooth operation, the compressor must be checked regularly and serviced, cleaned or repaired as necessary. The individual maintenance activities are described in the following section.

Maximator recommends the intervals listed below. These intervals are calculated based on 1,300,000 strokes/year.

The required maintenance intervals depend on the system and application. The intervals must be adjusted based on the given conditions of use. For dry or very dry operating fluids, the maintenance intervals may have to be reduced.

| Activity | before and after each use | daily | weekly | monthly | quarterly | semi-annually | annually | as needed |
|---|---|---|---|---|---|---|---|---|
| System inspection | | | x | | | | | |
| Leak-testing the connections | | | x | | | | | |
| Check screw fittings and connecting lines for damage | | | x | | | | | |
| Clean compressor | | | | | x | | | |
| Check fastening elements and connecting elements | | | | | x | | | |
| Leak detection | | | | | | x | | |
| Repair compressor | | | | | | | | x |

*Tab. 7-1 Maintenance intervals*

## 7.2 Maintenance work

**WARNING**

**Risk of injury due to extreme temperatures!**

The surfaces of the product can be very hot or very cold. This can lead to accidents resulting in severe injuries or death.

► Before working on the product, please ensure that the product is at ambient temperature.

**WARNING**

**Risk of injury due to inappropriate spare parts!**

Making repairs using inappropriate spare parts can lead to accidents resulting in severe injuries or death.

► Only use spare parts that comply with Maximator specifications.

**WARNING**

**Risk of injury when handling lubricants!**

Handling lubricants can lead to accidents resulting in severe or fatal injuries.

► Use protective gloves and goggles.

► Avoid contact with the skin.

► Observe the safety data sheet of the lubricant accordingly.

### 7.2.1 System inspection

The following section explains how to check the air amplifier for proper function:

| | Description |
|---|---|
| **Qualifications** | Operating the system |
| **Type of maintenance** | Check |
| **Interval** | weekly |
| **PPE** | – Safety goggles<br>– Hearing protection |
| **1.** | Shut off the fluid outlet and adjust $p_B$ to a value that is standard for the system.<br>The air amplifier stops automatically when the final pressure is reached (holding time 60 s). |
| **2.** | Vent $p_L$.<br>$p_B$ does not drop by more than 10% (holding time 30 s). |
| **3.** | Set $p_L$ to approx. 50% of the value from the first step and slowly vent $P_B$.<br>The air amplifier starts up automatically. |
| **4.** | If the inspection does not reveal any abnormalities, it is safe to continue using the air amplifier.<br>In case of abnormalities, consult with the maintenance staff. |

### 7.2.2 Leak-testing the connections

The following section explains how to check the connections for leaks:

| | Description |
|---|---|
| **Qualifications** | Operating the system |
| **Type of maintenance** | Check |
| **Interval** | weekly |
| **Prerequisites** | – The air amplifier is easy to access.<br>– All connections are pressurised. |
| **Tools** | – Torch<br>– Cleaning cloth<br>– Leak detection spray |
| **PPE** | Safety goggles |
| **1.** | Check connections for leaks.<br>Use leak detection spray. |
| **2.** | If the inspection does not reveal any abnormalities, it is safe to continue using the air amplifier.<br>In case of abnormalities, consult with the maintenance staff. |

### 7.2.3 Inspect screws and connecting lines

The following section explains how to inspect the screw fittings and connecting lines:

| | Description |
|---|---|
| **Qualifications** | Operating the system |
| **Type of maintenance** | Check |
| **Interval** | weekly |
| **Prerequisites** | The air amplifier is easy to access. |
| **Tools** | – Torch<br>– Cleaning cloth |
| **1.** | Visual inspection of the screw fittings and connecting lines. Is there any visible damage or other visible signs of wear? |
| **2.** | If the inspection does not reveal any abnormalities, it is safe to continue using the air amplifier.<br>In case of abnormalities, consult with the maintenance staff. |

### 7.2.4 Clean air amplifier

The following section explains how to clean the air amplifier:

| | Description |
|---|---|
| **Qualifications** | Clean air amplifier |
| **Type of maintenance** | Cleaning |
| **Interval** | quarterly |
| **Prerequisites** | – The air amplifier is easy to access.<br>– The air amplifier is depressurised. |
| **Tools** | – Cotton cleaning cloth<br>– Solvent-free cleaning product |
| **1.** | Clean air amplifier. |
| **2.** | The cleaning process has been successful if:<br>– The air amplifier is free of dirt.<br>– ports and silencers are free of dirt. |

### 7.2.5 Check screw fittings on air amplifier and connection ports

The following section explains how to inspect the screw fittings on the air amplifier and the connection ports:

| | Description |
|---|---|
| **Qualifications** | Repair and service the air amplifier |
| **Type of maintenance** | Check |
| **Interval** | quarterly |
| **Prerequisites** | – The air amplifier is easy to access.<br>– The air amplifier is depressurised. |
| **Tools** | Torque spanner |
| **1.** | Check all fasteners and retighten if necessary. |
| **2.** | Check all connection ports and retighten if necessary. |
| **3.** | The inspection has been successful if:<br>– all fasteners are properly tightened.<br>– all connection ports are properly tightened. |

### 7.2.6 Leak detection

The following section explains how to check the air amplifiers for leakage:

| | Description |
|---|---|
| **Qualifications** | Repair and service the air amplifier |
| **Type of maintenance** | Check |
| **Interval** | semi-annually |
| **Prerequisites** | The air amplifier is easy to access. |
| **Tools** | – Torch<br>– Cleaning cloth<br>– Leak detection spray<br>– Leak detection system[a] |
| **PPE** | – Safety goggles<br>– Hearing protection |
| **1.** | Check all connections for leaks.<br>Use leak detection spray on the drive unit. |
| **2.** | Shut off gas outlet (B). |
| **3.** | Approach stall pressure |
| **4.** | Determine how many strokes the air amplifier performs at stall pressure $n_{sp}$ (holding time 60 s). |

| | Description |
|---|---|
| **5.** | Vent $p_L$<br>$p_B$ does not drop by more than 10% (holding time 30 s). |
| **6.** | Set $p_L$ to approx. 50% of the value from the first step and slowly vent $P_B$.<br>The air amplifier will start up automatically. |
| **7.** | – Vent $p_L$<br>– Vent $p_B$<br>– Measure leakage from the check valves |
| **8.** | – Vent $p_L$<br>– Vent $p_B$<br>– Disassemble spool valve<br>– Inspect spool valve<br>– Are the seals worn out?<br>– Is there still enough lubricant? |
| **9.** | The inspection has been successful if:<br>– all measurements are satisfactory.<br>– the spool valve is OK<br>If the air amplifier does not pass the inspection, it must be repaired or replaced. |

a. The simplest way to measure leakage is by means of water displacement in a measuring cup.

### 7.2.7 Repair air amplifier

The following section explains how to repair the compressor:

| | Description |
|---|---|
| **Qualifications** | Repair and service the compressor |
| **Type of maintenance** | Repair |
| **Interval** | as needed |
| **Prerequisites** | Clean, even work area with ample lighting |
| **Tools** | – Cleaning rags<br>– Cleaning product<br>– Torch<br>– Lubricant as per drawing |
| **PPE** | – Safety goggles<br>– Protective gloves |
| **1.** | Disassemble the compressor. |
| **2.** | Clean the inside and outside of the compressor. |
| **3.** | Replace all seals and guide elements. |
| **4.** | Replace damaged compressor components as necessary. |
| **5.** | Assemble compressor. Apply a thin and even layer of lubricant to the following surfaces:<br>– Contact surfaces of seals and guide elements<br>– Seals<br>Specially designated areas must be treated according to drawing indications. |
| **6.** | Check compressor.<br>This includes the following maintenance work:<br>– 7.2.1 - System check<br>– 7.2.6 - Leak test |
| **7.** | If the compressor has passed all tests, the repair is complete. |

Maximator devices can be sent in for repairs to your local Maximator representative. All the necessary details are available on the Maximator website http://www.maximator.de

## 7.3 Spare parts and consumables

**WARNING**

**Risk of injury due to inappropriate spare parts!**

Making repairs using inappropriate spare parts can lead to accidents resulting in severe injuries or death.

► Only use spare parts that comply with Maximator specifications.

A list of the available spare parts, spare part kits and consumables can be found on the general drawing.

## 7.4 Accessories and special tools

A variety of special accessories are available for the air amplifier.
Please consult with our sales department.

The tools used for the products are continuously being updated and supplemented.
An overview of the currently available tools is accessible upon request when contacting the Maximator customer service.

## 7.5 Customer service

Our customer service is also at your disposal for technical details and repairs:

| | |
|---|---|
| Address | Maximator GmbH<br>Ullrichstraße 1-2<br>99734 Nordhausen<br>Germany |
| Customer service phone<br>Mon. – Thurs.: 06:30 – 16:15 CET<br>Fri.: 06:30 – 14:00 CET | +49 3631 9533-5444 |
| Fax | +49 3631 9533-5065 |
| Email | service@maximator.de |
| Website | www.maximator.de/service |

Feedback and experiences resulting from the application of our products and potentially leading to an optimisation of such are appreciated.

# 8 Troubleshooting

The following is a list of typical product faults, their causes and the appropriate solutions.

If you experience any other specific or unexpected faults, please notify us at service@maximator.de

## 8.1 Drive side

| Fault | Cause of fault | Solution |
|---|---|---|
| The air amplifier does not operate at low air pressure | Friction of the O-rings on the spool valve is too high | – Relubricate<br>– Replace the O-rings on the spool valve |
| The air amplifier does not operate at low air pressure | O-rings will swell if the wrong oil or lubricant is used | – Replace the O-rings<br>– Use lubricant specified in drawing |
| The air amplifier does not work | The pilot air is not connected | Pilot air connection |
| The air amplifier does not work or works slowly. | The pilot air is not adequately pressurised | The pilot air must be at minimum $p_L$ |
| The air amplifier does not work or works slowly. | Ice has formed on the silencer or spool valve | Dehumidify the compressed air |
| The air amplifier does not work or works slowly. | Formation of residue in the silencer | Clean the silencer; replace if necessary |
| The air amplifier does not work; air escapes through the silencer | The O-rings on the spool valve are faulty | Replace and lubricate the O-rings |
| The air amplifier does not work; air escapes through the silencer or through air supply port "V2" | The O-ring on the air piston is faulty or worn | Replace and lubricate the O-ring |
| The air amplifier does not work; air flows through air supply port "V1" | The spool valve is jammed. | – Clean the spool valve and sleeve<br>– Check the O-rings and sleeves, and replace them if necessary<br>– Lubricate |
| The air amplifier operates with high frequency and short strokes | The pilot valve in the top or bottom cap is faulty | Clean, lubricate and, if necessary, replace the pilot valve |

*Tab. 8-1 Trouble shooting on the drive side*

## 8.2 High pressure side

| Fault | Cause of fault | Solution |
|---|---|---|
| The air amplifier operates without delivering the gas, or it operates erratically. It does not reach the calculated operating pressure. | Check valve failure | Inspect the check valves and replace if necessary |
| Operating pressure escapes through bleed port "Z" | Worn out HP seal or seal and guide element | Replace seal kits |
| Operating fluid escapes through silencer, air supply port "V2" or other designated leakage point | Worn out HP seal or seal and guide element | Replace seal kit |

*Tab. 8-2 Troubleshooting*

# 9 Removal and disposal

## 9.1 Prerequisites for removal and disposal

Follow the manual and general drawing for the product.
In addition, the following conditions must be met:

– The product must be in a safe state.
– The product must be at ambient temperature.

## 9.2 Removal

**WARNING**

**Risk of injury when handling lubricants!**

Handling lubricants can lead to accidents resulting in severe or fatal injuries.

► Use protective gloves and goggles.
► Avoid contact with the skin.
► Observe the safety data sheet of the lubricant accordingly.

To remove the air amplifier, proceed as follows:

– Shut down the air amplifier.
– Depressurise it.
– Disconnect the connections and remove fastening screws.
– Disassemble the air amplifier.

## 9.3 Disposal

**WARNING**

**Risk of injury when handling lubricants!**

Handling lubricants can lead to accidents resulting in severe or fatal injuries.

► Use protective gloves and goggles.
► Avoid contact with the skin.
► Observe the safety data sheet of the lubricant accordingly.

If the service life has expired: Send the product back to Maximator, postage paid, for proper disposal.

# 10 Use in explosion-prone zones

## 10.1 General information

If the compressors feature an ATEX label and a Declaration of Conformity to 2014/34/EU was provided, it will be intended for the use in areas conforming to the applicable device label. The designation is indicated on the rating plate and on the general drawing.
The individual parts of the label are explained in the example below.

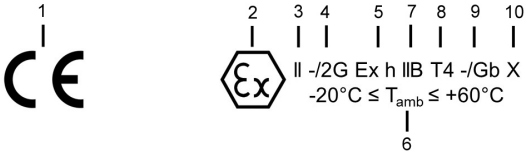



*Fig. 10-1 Exemplary figure - ATEX label*

1 CE symbol
2 Ex-symbol
3 Equipment group II: The air amplifier may be used in potentially explosive atmospheres, except in mining.
4 Equipment category -/2G: The device boasts multiple equipment categories. Admissible zones can be found in figure 10-2 to 10--5 “Display of ATEX zones”.
5 Ex h marking: Designated for use as per DIN EN ISO 80079-36/37.
6 Designation of ambient temperature: Permissible range of ambient temperature.
7 Explosion group: The device is designated for use in potentially explosive gas atmospheres, with gases from Group IIB.
8 Temperature class: Under compliance with the indications in the operating manual, the device can be used in the temperature class indicated.
9 Equipment protection level (EPL) -/Gb: The device boasts multiple equipment protection levels. Admissible zones can be found in figure 10-2 to 10--5 “Display of the ATEX zones”.
10 Additional marking X: Further details with regard to explosion protection that go beyond the content about the ATEX label can be found in the operating instructions.

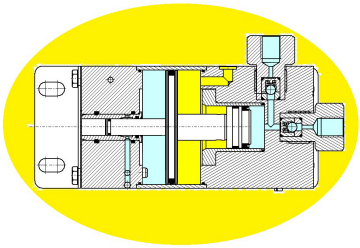


*Fig. 10-2 Display of ATEX zones for MPLV4, MPLV7*

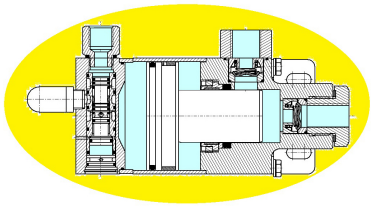


*Fig. 10-3 Display of ATEX zones for MPLV4L*

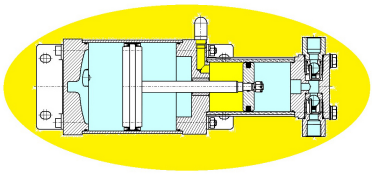


*Fig. 10-4 Display of ATEX zones for SPLV3, SPLV10*

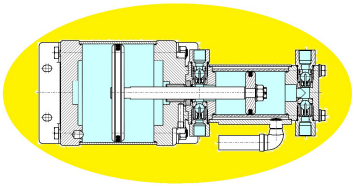


*Fig. 10-5 Display of ATEX zones for GPLV5*

Legend:

No zone:

Zone 0:

Zone 1:

Zone 2:

## 10.2 Temperature class

The temperature of the compressor mainly depends on the temperature of the operating fluid. Refer to the following table for the maximum operating fluid temperature required in order to attain temperature class T4:

| Max. temperature of operating fluid | Temperature class |
|---|---|
| 60°C | T4 |

*Tab. 10-1 Temperature classes*

For the compression of ideal gases, the maximum expected temperature can be calculated using the formula for adiabatic status change:

$$T_B = T_A \left( \frac{p_B}{p_A} \right)^{\frac{\kappa - 1}{\kappa}}$$

Legend:

$T_A$ = input temperature
$T_B$ = output temperature
$p_A$ = inlet pressure
$p_B$ = outlet pressure
$\kappa$ = isentropic exponent

The isentropic exponent κ for compressed air and nitrogen at 20 °C is approx. 1.4.

Since the compression takes place as part of the heat exchange with the environment, the actual temperature will always be below the calculated temperature.

The air amplifier should not be insulated. If it is nonetheless insulated, the equipment manufacturer must determine the temperature class of the equipment accordingly.

## 10.3 Operation and maintenance

Static electricity on the product can lead to explosions. This may result in severe or fatal injuries.

Never use high-power mechanisms for charge generation on or near the product.

The possibility of an explosive atmosphere must be excluded before undertaking any and all work on the product – maintenance, cleaning or any other activity.

In order to ensure adequate safety during regular operation, the function of the air amplifier and compliance with the thresholds specified in these instructions must be monitored accordingly.

In doing so, the maintenance activities must be carried out at intervals that are appropriate for the application.

For safe operation, the devices may no longer be used after the leakage thresholds have been exceeded.

# 11 Summary of ignition hazards

| Ignition hazard<br>Source of ignition | Cause | Protective measure implemented |
|---|---|---|
| Hot surfaces | Heating by the operating fluid and compression | – Temperature class definition<br>– Insulation prohibited |
| Hot surfaces | Friction | – Operating fluid quality specification<br>– Specification of maintenance activities and intervals |
| Mechanically generated sparks | Ignition due to external impact on the device | Impact resistance tests performed |
| Mechanically generated sparks | Ingression of foreign particles | Required IP protection rating ensured |
| Mechanically generated sparks | Ignition of dust in the equipment | Specification of maintenance activities and intervals |
| Mechanically generated sparks | Metallic friction due to wear | Specification of maintenance activities and intervals |
| Mechanically generated sparks | Impact sparks – housing or internal components | – Appropriate housing materials<br>– Ignition protection type c “constructional safety”<br>– Design in accordance with impact energy specifications |
| Flames and hot gases | Ignition of lubricants and operating fluids | – Appropriate selection of lubricants<br>– Temperature class definition<br>– Ignition protection type c “constructional safety” |
| Static electricity | Charging of insulated components | All parts are conductively interconnected |
| Static electricity | Charging of non-conductive device parts or layers | Design in accordance with layer thickness specifications |
| Static electricity | Charging due to high-power mechanisms | Exclusion of powerful charge generating mechanisms |
| Chemical reaction | Reaction of the operating fluids and parts of the device | Adequate selection of materials |

*Tab. 11-1 Summary of the applicable ignition hazards identified and the protective measures implemented*

## Appendix

The appendix comprises the following documents:

- EU Declaration of Conformity for air amplifier MPLV4, MPLV7, SPLV3, SPLV10 and GPLV5
- Declaration of incorporation of air amplifier MPLV4, MPLV7, SPLV3, SPLV10 and GPLV5
- Description of the basic safety and occupational health and safety requirements

MAXIMATOR®
Maximum Pressure.

**EU-Konformitätserklärung**
Hiermit erklären wir, dass die Bauart von pneumatisch angetriebenen Druckluftnachverdichtern der Baureihen:
**MPLV4, MPLV7, SPLV3, SPLV10, GPLV5**
mit einer Seriennummer von **23000001** und höher
in der gelieferten Ausführung folgenden einschlägige Harmonisierungsrechtsvorschriften der Union erfüllt:

**EU-Richtlinie Explosionsschutz 2014/34/EU**
Angewendete harmonisierte Normen und technische Spezifikationen:
DIN EN ISO 12100:2011-03
DIN EN ISO 80079-36:2016-12
DIN EN ISO 80079-37:2016-12

Notifizierte Stelle eingeschaltet zur Aufbewahrung der Unterlagen nach 2014/34/EU:
**0102 PTB - Braunschweig, (Bundesallee 100, 38116 Braunschweig)**

Weitere einschlägige Bestimmungen: EG Maschinenrichtlinie (2006/42/EG) (Unvollständige Maschine)

Anschrift Hersteller: **MAXIMATOR GmbH, Lange Straße 6, 99734 Nordhausen / Deutschland**
Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.

(Original)

**EU Declaration of Conformity**
Herewith, we declare that the model of pneumatic driven air amplifier type:
**MPLV4, MPLV7, SPLV3, SPLV10, GPLV5**
with a serialized ID of **23000001** and above
as supplied are in conformity with the relevant Union harmonisation regulations:

**EU Explosion Protection Directive 2014/34/EU**
Harmonised standards and technical specifications applied:
DIN EN ISO 12100:2011-03
DIN EN ISO 80079-36:2016-12
DIN EN ISO 80079-37:2016-12

Notified body involved for preserving the documents in compliance with 2014/34/EU:
**0102 PTB - Braunschweig (Bundesallee 100, 38116 Braunschweig)**

Further likewise applicable directives: Machinery directive (2006/42/EC) (partly completed machinery)

Name and address of manufacturer: **MAXIMATOR GmbH, Lange Straße 6, 99734 Nordhausen / Germany**
This declaration of conformity is issued under the sole responsibility of the manufacturer.

(Translation)

Nordhausen, den 31.08.2023 (Nordhausen, 31.08.2023)

.....
Steffen Roloff (Divisionsleitung Components) (Division Manager Components)

**MAXIMATOR GmbH**, Lange Straße 6, 99734 Nordhausen, Telefon +49 (0) 3631 9533–0, Telefax +49 (0) 3631 9533–5010, www.maximator.de, info@maximator.de

**MAXIMATOR**
**Maximum Pressure.**

**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.: 03631-9533-0
Die Bauart von pneumatisch angetriebenen Druckluftnachverdichtern der Baureihe:
**MPLV4, MPLV7, SPLV3, SPLV10, GPLV5**
mit einer Seriennummer von **23000001** und höher
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 welche 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)3631-9533-0
The model of pneumatic driven air amplifier type:
**MPLV4, MPLV7, SPLV3, SPLV10, GPLV5**
with a serialized ID of **23000001** and above
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.

Nordhausen, den 31.08.2023 (Nordhausen, 31.08.2023)

.....
Steffen Roloff (Divisionsleitung Components) (Division Manager Components)

**MAXIMATOR GmbH**, Lange Straße 6, 99734 Nordhausen, Telefon +49 (0) 3631 9533 – 0, Telefax +49 (0) 3631 9533 – 5010, www.maximator.de, info@maximator.de

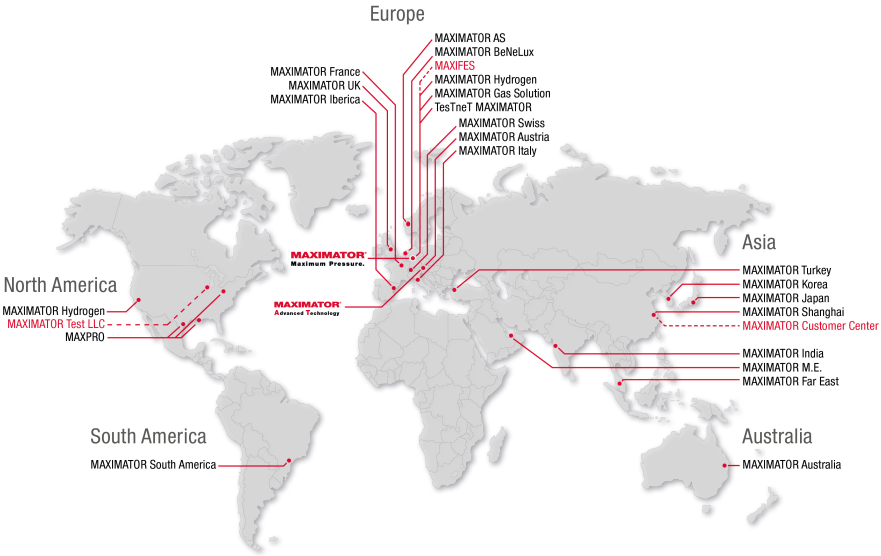
***Description of the basic safety and occupational health and safety requirements (MRL 2006/42/EC, Appendix I)***

| No. | Basic requirement | Applicable | Met | Comment |
|---|---|---|---|---|
| 1. | BASIC SAFETY AND OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS | | | |
| 1.1 | GENERAL INFORMATION | | | |
| 1.1.1 | Terminology | Yes | Yes | |
| 1.1.2 | Safety integration principles | Yes | Yes | |
| 1.1.3 | Materials and products | Yes | Yes | |
| 1.1.4 | Lighting | No | | |
| 1.1.5 | Machine design regarding handling | Yes | Yes | Device corresponds to the design common for the market |
| 1.1.6 | Ergonomics | No | | |
| 1.1.7 | Operator's console | No | | |
| 1.1.8 | Seats | No | | |
| 1.2 | CONTROLS AND CONTROL DEVICES | | | |
| 1.2.1 | Control safety and reliability | Yes | No | Unintended start-up, changing the parameters |
| 1.2.2 | Actuators | No | | |
| 1.2.3 | Starting the system | Yes | No | Unintended start-up, changing the operating state |
| 1.2.4 | Shut-down | | | |
| 1.2.4.1 | Normal shut-down | Yes | No | No control device for shut-down |
| 1.2.4.2 | Operational shut-down | No | | |
| 1.2.4.3 | Emergency shut-down | Yes | No | No emergency stop |
| 1.2.4.4 | Completeness of machines | No | | |
| 1.2.5 | Selection of control or operating modes | No | | |
| 1.2.6 | Fault in the energy supply | Yes | No | Unintended start-up |
| 1.3 | PROTECTIVE MEASURES AGAINST MECHANICAL HAZARDS | | | |
| 1.3.1 | Risk of stability loss | Yes | Yes | Design is non-critical |

| No. | Basic requirement | Applicable | Met | Comment |
|---|---|---|---|---|
| 1.3.2 | Risk of breakage during operation | Yes | Yes | |
| 1.3.3 | Risks posed by dropping or ejected objects | No | | |
| 1.3.4 | Risks posed by surfaces, edges and corners | Yes | Yes | Deburring generally required |
| 1.3.5 | Risks posed by multiple machines combined | No | | |
| 1.3.6 | Risks posed by changed usage conditions | Yes | No | |
| 1.3.7 | Risks posed by movable parts | Yes | Yes | No moving parts that can be accessed from the outside |
| 1.3.8 | Selection of protective equipment against risks posed by movable parts | No | | |
| 1.3.8.1 | Moving parts of the power transmission | No | | |
| 1.3.8.2 | Moving parts that are involved in the work process | No | | |
| 1.3.9 | Risk of uncontrolled movements | No | | |
| 1.4 | PROTECTIVE EQUIPMENT REQUIREMENTS | | | |
| 1.4.1 | General requirements | No | | |
| 1.4.2 | Special specifications for guards | | | |
| 1.4.2.1 | Fixed guards | No | | |
| 1.4.2.2 | Movable guards with guard locking | No | | |
| 1.4.2.3 | Access-restricting adjustable guards | No | | |
| 1.4.3 | Special specifications for protective devices | No | | |
| 1.5 | RISKS POSED BY OTHER HAZARDS | | | |
| 1.5.1 | Electrical energy supply | No | | |
| 1.5.2 | Static electricity | Yes | Yes | See ATEX |
| 1.5.3 | Non-electrical energy supply | Yes | No | Ice formation, flying ice, raised particles, suffocation, noise |

| No. | Basic requirement | Applicable | Met | Comment |
|---|---|---|---|---|
| 1.5.4 | Assembly fault | Yes | Yes | Connection labels |
| 1.5.5 | Extreme temperatures | Yes | No | Machine may heat up or cool down |
| 1.5.6 | Fire | Yes | No | |
| 1.5.7 | Explosion | Yes | | Considered separately |
| 1.5.8 | Noise | Yes | No | Depending on installation and application |
| 1.5.9 | Vibrations | Yes | Yes | Vibrations within the range common for the market |
| 01/05/2010 | Radiation | No | | |
| 01/05/2011 | Radiation from the outside | No | | |
| 01/05/2012 | Laser radiation | No | | |
| 01/05/2013 | Emission of hazardous materials and substances | Yes | No | Exposition and leakage of operating fluids |
| 01/05/2014 | Risk of being locked into the machine | No | | |
| 01/05/2015 | Risk of slipping, tripping or falling | No | | |
| 01/05/2016 | Lightning strike | No | | |
| 1.6 | MAINTENANCE | | | |
| 1.6.1 | Machine maintenance | Yes | No | In context of the overall system |
| 1.6.2 | Access to the operator stations and access points for maintenance | Yes | Yes | Design common for the market |
| 1.6.3 | Disconnection of energy sources | Yes | No | Unavailable |
| 1.6.4 | Operating personnel interventions | Yes | Yes | Design common for the market |

| No. | Basic requirement | Applicable | Met | Comment |
|---|---|---|---|---|
| 1.6.5 | Cleaning of machine parts in the interior | Yes | Yes | The capacity of the internal volume in question is not sufficient to pose a risk to the maintenance personnel due to residues of the permissible operating fluids when the compressor is at a standstill. |
| 1.7 | INFORMATION | | | |
| 1.7.1 | Information and warnings on the machine | No | | |
| 1.7.1.1 | Information and information equipment | No | | |
| 1.7.1.2 | Warning equipment | No | | |
| 1.7.2 | Warning of residual risks | Yes | No | In context of the overall system |
| 1.7.3 | Machine labels | Yes | Yes | |
| 1.7.4 | Operating manual | Yes | Yes | Installation manual |
| 1.7.4.1 | General principles for drafting the operating instructions | Yes | Yes | |
| 1.7.4.2 | Operating manual contents | Yes | Yes | |
| 1.7.4.3 | Sales brochures | Yes | Yes | |
| 2-6 | Not applicable | | | |

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