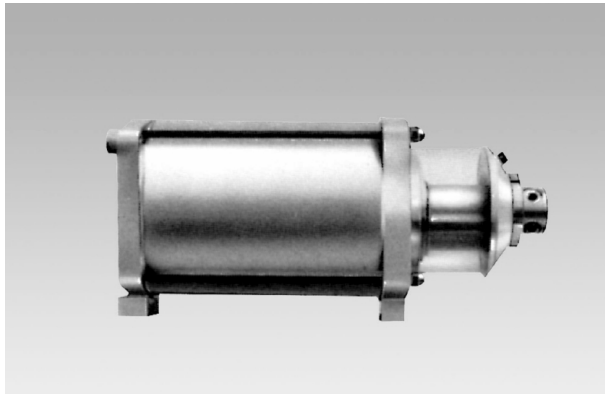




# Intensifiers

4 pressure stages, max. operating pressure 500 bar



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## 1 Description of the product

This pneumatic-hydraulic intensifier can be used as a pressure generator where live cables are not possible or suitable, e.g. in hazardous surroundings.

Only single-acting actuators can be connected. The required oil volume should utilise the working volume only up to 60 to 70% so as to have some reserve left.

### Function

The intensifier generates from a pneumatic pressure a hydraulic pressure as a function of the surface ratio of the piston.

At the low-pressure side the intensifier is pressurised with compressed air. After extending of the cylinders, pressure build-up is relatively slow, according to the nominal bore of the pneumatic piping and air pressure. At a pressure of 6bar the sextuple working volume must be fed. Any minor leak losses are compensated by replenishing out of the oil reservoir. For quick return a high-speed vent valve can be used at the pneumatic port. The hydraulic operating pressure can only be adjusted by means of a pressure reducing valve at the pneumatic side.

The mounting position of the intensifier is vertical or horizontal to the mounting surfaces.

### When designing fixtures, some features of the air intensifier should be taken into account:

- Extend hydraulic actuators  
Air intensifiers are liable to release the effective oil volume very quickly within 1 second. The oil speed depends only on the flow rate of the compressed air. This may cause malfunctions in clamping elements where the maximum flow rate is limited (swing clamps, work supports). In those cases a flow control valve must be provided on the oil side.
- Pressure build-up  
After extending the cylinders, pressure build-up is relatively slow, according to the nominal bore of the pneumatic piping and air pressure. At 6 bar the sextuple working volume must be fed, which takes approx. 3 seconds.
- Unclamping  
For this purpose, the air volume accumulated must first be reduced to a residual pressure below 0.2 bar, before the connected hydraulic actuators retract.  
The high-speed vent valve available as an accessory allows for a pressure release time of approx. 2 seconds at an initial pressure of 6 bar.
- Pressure adjustment  
See section "Adjust operating pressure"
- Replenishment  
See section "Adjust operating pressure"

## 2 Validity of the documentation

Intensifiers of the data sheet D 8.770. The following types or part numbers are concerned:

- 8772-101
- 8773-101
- 8774-101
- 8775-101

## 3 Target group of this document

- Specialists, fitters and set-up men of machines and installations with hydraulic expert knowledge.

### Qualification of the personnel

**Expert knowledge** means that the personnel must

- be in the position to read and completely understand technical specifications such as circuit diagrams and product-specific drawing documents,
- have expert knowledge (electric, hydraulic, pneumatic knowledge, etc.) of function and design of the corresponding components.

An **expert** is somebody who has due to its professional education and experiences sufficient knowledge and is familiar with the relevant regulations so that he

- can judge the entrusted works,
- can recognize the possible dangers,
- can take the required measures to eliminate dangers,
- knows the acknowledged standards, rules and guidelines of the technology.
- has the required knowledge for repair and mounting.

## 4 Safety instructions

### **DANGER**

#### Danger of life / heavy health damages

Stands for an imminent danger.

If it is not avoided, death or very severe injuries will result.

### **WARNING**

#### Person damage

Stands for a possibly dangerous situation.

If it is not avoided, death or very severe injuries will result.

### **CAUTION**

#### Easy injuries / property damage

Stands for a possibly dangerous situation.

If it is not avoided, minor injuries or material damages will result.

#### Hazardous to the environment



The symbol stands for important information for the proper handling with materials that are hazardous to the environment.

Ignoring these notes can lead to heavy damages to the environment.



#### Mandatory sign!

The symbol stands for important information, necessary protection equipment, etc.

### **Note**

This symbol stands for tips for users or especially useful information. This is no signal word for a dangerous or harmful situation.

## 5 For your safety

### 5.1 Basic information

The operating instructions serve to information and avoidance of dangers for transport, operation and maintenance.

Only in strict compliance with these operating instructions, accidents and property damages can be avoided as well as trouble-free operation of the product can be guaranteed.

Furthermore, the consideration of the operating instructions will result in:

- reduced down times and repair costs,
- increased service life of the products.

### 5.2 Safety instructions

#### **WARNING**

##### Injuries caused by missing safety devices!

- To avoid injuries appropriate safety devices must be provided by the customer.

##### Injuries due to non-compliance of the operating instructions!

- The product may only be operated, if the operating instructions - especially the chapter "Safety instructions" have been read and understood.

##### Injuries due to misuse, incorrect operation or abuse!

Injuries can occur if the product is not used within the intended use and the technical performance data.

- Before start up, read the operating instructions!

##### Injury due to overturning product!

- Overturning product due to inappropriate means of transportation.
- Do not stand below the load during lifting and lowering, stay outside the danger zone.
- Use suitable means of transportation.
- Pay attention to the weight of the equipment.
- Pay attention that the product is safely located (centre of gravity see instruction sign).

##### Poisoning due to contact with hydraulic oil!

- For handling with hydraulic oil consider the material safety data sheet.
- Wear protection equipment.

##### Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!

- Improper connection can lead to escapes of oil under high pressure at the connections.
- Mounting or dismounting of the element must only be made in depressurised mode of the hydraulic system.
- Connection of the hydraulic line as per DIN 3852/ISO 1179.
- Unused connections have to be locked professionally.
- Use all mounting holes.

### Burning due to hot oil!

- In operating conditions oil temperatures up to 70 °C can appear due to environment influences.
- All works must only be made in cool mode!

### Burning due to hot surface!

- In operating conditions, surface temperatures of more than 70 °C can appear at the product.
- All maintenance and repair works must only be effected in cooled mode or with safety gloves.

### Injury / burning due to contact with energized parts!

- Before working on electric equipment, the energized parts must be de-energized and secured.
- Do not open protection covers at electric parts.
- All electrical works must only be realised by electricians.

## ⚠ CAUTION

### Work by qualified personnel

- Works only to be effected by authorised personnel.

### Performance of the product!

The admissible performance data of the product, see chapter "Technical characteristics", may not be exceeded.

### Hydraulic power unit can be damaged!

- Stick absolutely to the indicated direction of the rotary field.

### Aggressive cleaning agents

The product must not be cleaned with:

- Corrosive or corroding components or
- Organic solvents as halogen or aromatic hydrocarbons and ketones (cellulose thinner, acetone, etc.), because this can destroy the seals.

## i Note

### Qualification of personnel

All works may only be effected by qualified personnel familiar with the handling of hydraulic components.

### 5.3 Personal protective equipment



**For works at and with the product, wear safety goggles!**



**For works at and with the product, wear protective gloves!**



**For works at and with the product, wear safety shoes!**

For all works at the product, the operator has to make sure that the necessary protection equipment will be worn.

## 6 Application

### 6.1 Intended use

The products are used to generate hydraulic pressure in industrial applications for bending or clamping of workpieces and / or to operate fixtures alternatively hydraulic actuators within closed, low in dust rooms.

Furthermore the following belongs to possible uses:

- Use within the capacity indicated in the technical characteristics (see data sheet).
- Use as per operating instructions.
- Compliance with service intervals.
- Qualified and trained personnel for the corresponding activities.
- Mounting of spare parts only with the same specifications as the original part.

### 6.2 Misapplication

## ⚠ WARNING

### Injuries, material damages or malfunctions!

- Do not modify the product!

The use of these products is not admitted:

- For domestic use.
- On pallets or machine tool tables in primary shaping and metal forming machine tools.
- If due to vibrations or other physical / chemical effects damages of the products or seals can be caused.
- In machines, on pallets or machine tool tables that are used to change the characteristics of the material (magnetise, radiation, photochemical procedures, etc.).
- In areas for which special guidelines apply, especially installations and machines:
  - For the use on fun fairs and in leisure parks.
  - In food processing or in areas with special hygiene regulations.
  - For military purposes.
  - In mines.
  - In explosive and aggressive environments (e.g. ATEX).
  - In medical engineering.
  - In the aerospace industry.
  - For passenger transport.
- For other operating and environmental conditions e.g.:
  - Higher operating pressures than indicated on the data sheet or installation drawing.
  - With hydraulic fluids that do not correspond to the specifications.

## 7 Transport

### Hazardous to the environment

During improper transit, escaping oil residuals can lead to environmental pollutions.

Transport the product only in an upright position! Pay attention to the sign on the packaging: "Top, do not overturn".



**⚠ WARNING**

**Injury due to overturning product!**

- Overturning product due to inappropriate means of transportation.
- Do not stand below the load during lifting and lowering, stay outside the danger zone.
- Use suitable means of transportation.
- Pay attention to the weight of the equipment.
- Pay attention that the product is safely located (centre of gravity see instruction sign).



**For works at and with the product, wear suitable protection equipment!**

The product is delivered in a solid carton box (on a throw-away pallet) and may only be transported to the installation site by means of a corresponding conveyor (pay attention to the min. lifting force).

The product must only be lifted down from the transport pallet by means of a conveyor, the product must centrally rest on the two fork rakes e.g. of the fork-lift truck.

**8 Installation**

**⚠ WARNING**

**Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!**

- Improper connection can lead to escapes of oil under high pressure at the connections.
- Mounting or dismounting of the element must only be made in depressurised mode of the hydraulic system.
- Connection of the hydraulic line as per DIN 3852/ISO 1179.
- Unused connections have to be locked professionally.
- Use all mounting holes.

**Poisoning due to contact with hydraulic oil!**

Wear, damage of the seals, ageing and incorrect mounting of the seal kit by the operator can lead to escapes of oil.

Incorrect connection can lead to escapes of oil at the ports.

- For handling with hydraulic oil consider the material safety data sheet.
- Wear protection equipment.



**For works at and with the product, wear suitable protection equipment!**

**Note**

**Pneumatic supply**

When connecting the product to the pneumatic supply line, the hydro-pneumatic pump unit starts to deliver.

**Note**

We recommend to install a hand-operated shut-off valve just in front of the hydro-pneumatic pump unit. By this valve the hydro-pneumatic pump unit can be quickly switched off in case of emergency or for maintenance works.

**8.1 Overview of components**

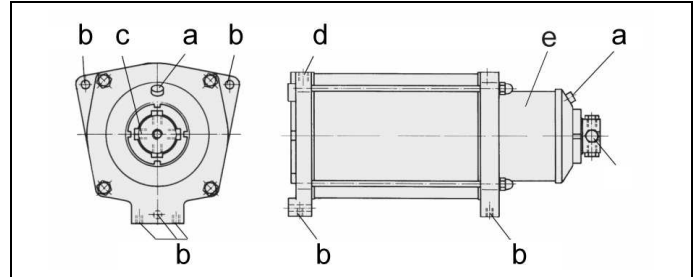


Figure 1: Schematic figure, components according to design

a Oil filling plug / bleeding screw	d Pneumatic port 3/8
b Fixing possibilities	e Perspex pipe for oil level gauge
c Hydraulic ports G1/4, (5 off)	

**8.2 Installation**

**⚠ CAUTION**

**Malfunctions!**

Chips, coolants and cutting fluids can cause malfunctions.

- Protect the power units against penetration of chips, coolants and cutting fluids!

The intensifier has to be mounted in horizontal or vertical position, if possible above the installation or fixture.

If the intensifier will be installed below the fixture, an air bleeding possibility has to be provided at the highest point of the installation.

- Install the intensifier at an appropriate place.
- The intensifier can be screwed on at the provided fixing points (b), if required.

**Note**

For horizontal mounting position, the corresponding fixing points have to be used.

**8.3 Connection of the hydraulic equipment**

1. Connect hydraulic lines to qualifying standards and pay attention to scrupulous cleanness (A = Extend)!

**Note**

**More details**

- See ROEMHELD data sheets A 0.100, F 9.300, F 9.310 and F 9.360.

**Screwed Plug**

- Use only fittings "screwed plug B and E" as per DIN 3852 (ISO 1179).

**hydraulic connection**

- Do not use sealing tape, copper rings or coned fittings.



**For piston pumps**

Use hydraulic oil as per DIN 51524-2 HLP 22.

**Note**

**Connection of the hydraulic**

Further connection data, plans or similar (e. g. hydraulic, electric circuit diagrams or electrical parameters) see enclosures!

**9 Start up**

**9.1 Charging with hydraulic oil**

**WARNING**

**Poisoning due to contact with hydraulic oil!**

- For handling with hydraulic oil consider the material safety data sheet.
- Wear protection equipment.

**CAUTION**

**Component damage or malfunction due to pressure on oil tank!**

Oil reservoir can be damaged!

- Open oil filler / bleeding screw one revolution, so that a pressure compensation takes place.



**For works with operating fluids, pay attention to the safety data sheets!**



**For works at and with the product, wear suitable protection equipment!**

**Note**

**The pressure generator is delivered without oil filling.**

- Filling must only be made when the connected hydraulic actuators and accumulators are in off-position.
- Accumulated oil volume in actuators or accumulators can lead to overflowing of the oil reservoir!

**Hydraulic fluids**

Operation of the products with hydraulic fluids that do not correspond to the specifications is inadmissible. See technical characteristics:

**Impurities in the oil tank to avoid!**

No impurities must enter into the oil reservoir. Use clean filter cloth!

**Filtration and cleanliness level of the hydraulic fluid**

Pay attention to the indication for filtration and purity class of the hydraulic fluid (see technical characteristics).



**For piston pumps**

Use hydraulic oil as per DIN 51524-2 HLP 22.

For oil filling proceed as follows:

- Make sure that all cylinders are retracted in off-position!
- Depressurise pneumatic oil supply.
- Unscrew oil filling plug / bleeding screw.
- Insert clean funnel with filter (mesh aperture max. 0.4 mm) or filter cloth in oil filler port.
- Fill in hydraulic oil, so that the oil reservoir is at least half-full.

- Screw in oil filling plug / bleeding screw and open by one revolution.
- Operate the fixture several times.
- Check oil level and refill hydraulic oil, if necessary.

**9.2 Bleeding of the hydraulic system**

Bleed the hydraulic lines during start-up of the system to guarantee a correct functioning of the intensifier. Insufficient bleeding can lead to troubles of functioning.

For bleeding of the oil reservoir, open the filler screw by one revolution.

**Note**

Insufficient bleeding leads to low pressure in the intensifier, which avoids replenishing of oil, and in addition there is the danger that the perspex pipe for oil level gauge will burst.

**9.3 Adjust operating pressure**

The hydraulic operating pressure can only be adjusted by means of a pressure reducing valve at the pneumatic side. We recommend our service unit (accessory see data sheet).

The operating pressure ( $p_o$ ) is proportional to the adjusted pneumatic operating pressure ( $p_L$ ) and can be seen from the following diagram.

**Note**

The maximum operating pressure on the hydraulic side is determined by the component having the smallest admissible operating pressure.

- The pneumatic adjustment must be checked by a pressure gauge located on the hydraulic side.

**Replenishment**

Any minor leak losses are compensated by replenishing out of the oil tank.

This requires a well vented system and an oil filler screw slightly opened.

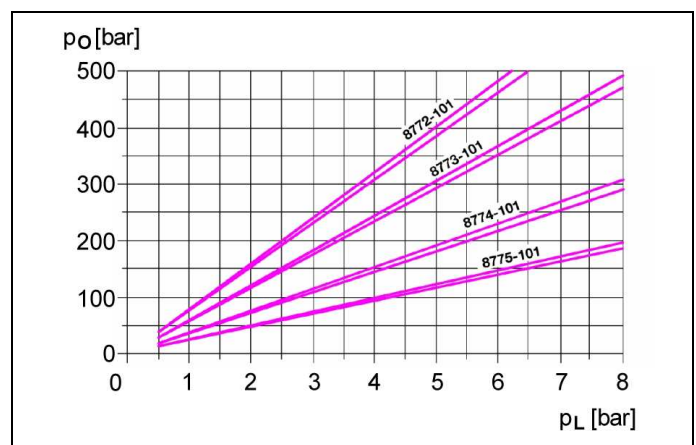


Figure 2: Diagram pressure course

p <sub>o</sub> Operating pressure on the oil side	p <sub>L</sub> pneumatic operating pressure
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## 9.4 Operation

### **WARNING**

#### **Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!**

Improper connection and use can lead to escapes of oil under high pressure at the seals.

- Mounting or dismounting of the element must only be made in depressurised mode.
- Fixing has to be made in an appropriate way.

#### **Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!**

Wear, damage of the seals, ageing and incorrect mounting of the seal kit by the operator can lead to escapes of oil under high pressure.

- Before using them make a visual control.

### **CAUTION**

#### **Component damage or malfunction due to pressure on oil tank!**

Oil reservoir can be damaged!

- Open oil filler / bleeding screw one revolution, so that a pressure compensation takes place.
  - The hydraulic system has to be bled completely!
  - Air supply should be made through a service unit.
  - Compressed air on the low-pressure side, see diagram pressure course or technical characteristics.
  - It is imperative to check the high-pressure range by a pressure gauge!
  - Intensifier is delivered without oil filling. After connecting the cylinder, the oil reservoir can be filled. Swarf or contamination in the hydraulic oil lead to increased wear or damage at the guides, running surfaces and seals.
  - For pressure intensification there is a stroke volume available as per chart (see technical characteristics).  
In order to have a reserve for pressure built up, this volume should only be used up to 60-70%.
- Use hydraulic oil HLP22 as per ROEMHELD data sheet A 0.100.

### **Note**

Procedures, see individual sections.

## 9.5 Instructions for operation

- The intensifier delivers oil into the system, if the hydraulic port is pressurised by compressed air.
- In case of relief of the pneumatic port oil can return. Then missing oil will be replenished.
- Open oil filling plug (a) by one revolution to allow a pressure compensation.
- Check the oil level and refill oil, if necessary. The oil reservoir should be at least half-full. Refill oil only in depressurised mode.

## 10 Maintenance

### **WARNING**

#### **Burning due to hot surface!**

- In operating conditions, surface temperatures of more than 70 °C can appear at the product.
- All maintenance and repair works must only be effected in cooled mode or with safety gloves.



**For works at and with the product, wear suitable protection equipment!**

### **Note**

#### **Operating instructions**

- Further operating instructions for individual components are available in the internet ([www.ROEMHELD.com](http://www.ROEMHELD.com)) or on request!

## 10.1 Plan for maintenance

Maintenance works	Interval	Realisation
Cleaning	As required	Operator
Check	daily	Operator
Checking of hydraulic system and components	yearly	Qualified personnel
Check the hydraulic fluid	after 1250 operating hours or 6 months	Qualified personnel
Exchange of hydraulic fluids	in case of damages	Qualified personnel
Repair		ROEMHELD service staff

## 10.2 Regular checks

Checks by the operator have to be effected as follows:

### 10.2.1 Daily checks

- Check all fixing screws, retighten if required.
- Check all cable fixings and fittings, retighten if required.
- Check if hydraulic hoses, pipes and cables are damaged, or have chafe marks, etc.).
- Check hydraulic components for external leakage - retighten fittings, if required.
- Hydraulic hoses must not get in contact with substances which can cause a damage (acids, lys, solvents, ....).
- Check the oil level of the hydraulic power unit (see chapter Charging of the hydraulic power unit with oil) - if required refill oil (specifications see chapter Technical characteristics).
- Check safety devices as per chapter Safety devices.

### 10.3 Cleaning

#### **WARNING**

##### Injury by flying out components or oil!

- For cleaning works always wear safety goggles, protective shoes and safety gloves.

#### **CAUTION**

##### Aggressive cleaning agents


The product must not be cleaned with:

- Corrosive or corroding components or
- Organic solvents as halogen or aromatic hydrocarbons and ketones (cellulose thinner, acetone, etc.), because this can destroy the seals.

The following cleaning works have to be effected daily at the mechanical components:

- Clean the product only with cleaning clothes.
- Afterwards lubricate slightly movable components (piston rods, guides etc.) and not coated steel components.

## 11 Trouble shooting

Trouble	Cause	Remedy
Pressure will not be built up	Oil volume is not sufficient.	Check oil volume and refill oil, if necessary
	Internal seal damaged.	 <b>Caution !</b> Repair only by ROEMHELD service personnel. Return for repair.
	Replenishing of oil is not possible.	Open oil filling screw (a) by one revolution
	Air in the hydraulic system	Bleeding

## 12 Technical characteristics

### General characteristics

Max. air consumption per stroke at 6 bar	approx. 28.3 l
Viscosity range	(4 ... 1000) 10 <sup>-6</sup> m <sup>2</sup> /s
Recommended viscosity class	ISO VG 22 as per DIN 51519
Recommended hydraulic oil	HLP 22 as per DIN 51524
Mounting position	vertical or horizontal, on the mounting surface

Part-no.	Intensification ratio	Max. air pressure [bar]
8772 101	82.64 : 1	6.3
8773 101	64.00 : 1	8.0
8774 101	39.06 : 1	8.0
8775 101	25.00 : 1	8.0

Part-no.	Max. oil pressure [bar]	Stroke volume [cm <sup>3</sup> ]
8772 101	505	57
8773 101	500	73
8774 101	305	120
8775 101	195	188

### Hydraulic fluids

Details of the hydraulic fluids to be used are attached to the oil filler neck.

#### **Note**



##### For piston pumps

Use hydraulic oil as per DIN 51524-2 HLP 22.

### Purity of the hydraulic fluids

The admissible contamination (unsolved impurities in the hydraulic fluid) depends on the component of the hydraulic system that is most sensitive to dirt. The indicated purity class is the maximally admissible value that should not be exceeded, with regard to the operating safety (clogging of gaps, orifices as well as the locking of the control piston) and the service life (wear reduction).

Application	Minimum purity as per NAS 1638	Minimum purity as per ISO 4406	attainable with filter fineness *
Radial piston and gear pumps, valves and cylinders	8 (recommended: 5 up to 7)	20 / 17 / 13	≤ 20 μm
Proportional pressure and flow control valves	7 (recommended: 5 up to 6)	18 / 16 / 13	≤ 10 μm

\* Important influential factors see chapter: "Maintenance and check of the hydraulic fluid"

Especially with proportional valves, the repetitive accuracy depends especially on the purity degree of the hydraulic fluid.

#### **Note**

##### New hydraulic fluid

- Please note that a new hydraulic fluid "on tap" does not meet the requirements of cleanliness. If necessary, use cleaned oil.

##### Mixing of different types of hydraulic fluid

- Mixing of different types of hydraulic fluid can lead to unintended chemical reactions with mud formation resinification or similar.
- Therefore, the respective manufacturers should be consulted for a change between different hydraulic fluids.
- In any case, the entire hydraulic system is to be rinsed thoroughly.

## 13 Disposal

### DANGER



#### Hazardous to the environment

Due to possible environmental pollution, the individual components must be disposed only by an authorised expert company.

The individual materials have to be disposed as per the existing regulations and directives as well as the environmental conditions.

Special attention has to be drawn to the disposal of components with residual portions of hydraulic fluids. The instructions for the disposal at the material safety data sheet have to be considered.

For the disposal of electrical and electronic components (e.g. stroke measuring systems, proximity switches, etc.) country-specific legal regulations and specifications have to be kept.

## 14 Declaration of manufacture

### Manufacturer

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 Römheldstraße 1-5  
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### Declaration of manufacture of the products

Intensifiers of the data sheet D 8.770. The following types or part numbers are concerned:

- 8772-101
- 8773-101
- 8774-101
- 8775-101

They are designed and manufactured in line with the relevant versions of the directives **2006/42/EC** (EC MSRL) and in compliance with the valid technical rules and standards.

In accordance with EC-MSRL and EN 982, these products are components that are not yet ready for use and are exclusively designed for the installation in a machine, a fixture or a plant.

According to the pressure equipment directives the products are not to be classified as pressure reservoirs but as hydraulic placing devices, since pressure is not the essential factor for the design, but the strength, the inherent stability and solidity with regard to static or dynamic operating stress.

The products may only be put into operation after it was assessed that the incomplete machine/machine, in which the product shall be installed, corresponds to the machinery directives (2006/42/EC).

The manufacturer commits to transmit the special documents of the products to state authorities on request. The technical documentation as per appendix VII part B was prepared for the products.

### 14.1 List of the applied standards

**2006/42/EC** Machinery Directive

**2001/95/EC**, General product safety

**92/58/EEC**, Minimum requirements for the provision of safety and/or health signs at work

**89/391/EEC**, Introduction of measures to encourage improvements in the safety and health of workers at work

**89/655/EEC**, Minimum safety and health requirements for the use by workers of personal protective equipment at the workplace

**2002/95/EC**, Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

**Operating safety regulations (BetrSichV)** for the transposal of the directive on the introduction of measures to encourage improvements in the safety and health of workers at work. (German implementation of the Work Equipment Directive 89/655/EEC)

**Product Safety Act - PSG**; November 2011

**DIN EN ISO 12100**, 2011-03, Safety of machinery; Basic concepts, General principles for design (replacement for part 1 and 2)

**DIN EN ISO 12100-2**, 2004-04, Safety of machinery - Basic concepts, General principles for design - Part 2: Technical principles

**DIN EN ISO 14121-1**, 2007-12, Safety of machinery- Risk assessment- Part 1: Principles

**DIN EN ISO 13732-1**, 2008-12, Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces

**DIN EN 614-1 a. 2**, 2009-06, Safety of machinery - Ergonomic design principles

**DIN EN 626-1**, 2008-09, Safety of machinery - Reduction of risks to health from hazardous substances emitted by machinery

**DIN EN ISO 13849-1**, 2008-12, Safety of machinery - Safety-related parts of control systems - General principles for design

**DIN EN ISO 13849-2**, 2008-09, Safety of machinery - Safety-related parts of control systems - Validation

**DIN EN ISO 4413**, 2011-04, Hydraulic fluid power - General rules and safety requirements for systems and their components

**DIN EN ISO 11201**, 2009-11, Acoustics - Noise emitted by machinery and equipment - Measurement of emission sound pressure levels at a work station

**DIN EN 60073**; 2003-05, Basic and safety principles for man-machine interface

**DIN EN 61310-1**; 2008-09, Safety of machinery - Indication, marking and actuation. Requirements on signals

**DIN EN 81714-2**, 2007-08, Design of graphical symbols for use in the technical documentation of products

Responsible person for the documentation:  
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**Römheld GmbH**  
**Friedrichshütte**  
 Laubach, 18.07.2013



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