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The product may have been altered since this document was published.
We reserve the right to change the technical data, design and scope of supply.
Generally the information provided and agreements made when processing the individual quotations and orders are binding.
The original operating instructions were written in German.
Table of contents

1 Introduction ........................................................................................................................................ 5
  1.1 Validity ........................................................................................................................................ 5
  1.2 Manufacturer ............................................................................................................................ 5
  1.3 Subject to change without notice .............................................................................................. 5
  1.4 Completeness ............................................................................................................................ 5
  1.5 Safekeeping .............................................................................................................................. 6
  1.6 Notation conventions ................................................................................................................... 6
    1.6.1 Symbols .................................................................................................................................... 6
    1.6.2 Hazard communication system .............................................................................................. 7
    1.6.3 Information system ................................................................................................................ 9
2 Safety ............................................................................................................................................. 10
  2.1 General safety information ......................................................................................................... 10
  2.2 Appropriate use .......................................................................................................................... 10
  2.3 Inappropriate use ........................................................................................................................ 10
  2.4 Standards and regulations .......................................................................................................... 11
    2.4.1 Application range of protective relay ...................................................................................... 11
  2.5 Measures for ensuring compliance with explosion protection requirements ................................ 13
    2.5.1 Measures taken by the manufacturer .................................................................................. 13
    2.5.2 Measures to be taken by the transformer manufacturer/operator ........................................ 14
  2.6 Personnel qualification .............................................................................................................. 14
  2.7 Operator's duty of care .............................................................................................................. 15
  2.8 Personal protective equipment .................................................................................................. 15
  2.9 Drying transformer ................................................................................................................... 16
    2.9.1 Drying transformer in furnace ............................................................................................. 16
    2.9.2 Drying the transformer in the transformer tank ................................................................... 17
3 Product description ....................................................................................................................... 18
  3.1 Scope of delivery ........................................................................................................................ 18
  3.2 Function description .................................................................................................................... 18
  3.3 Setup/versions ............................................................................................................................ 19
  3.4 Name plate .................................................................................................................................. 20
4 Packaging, transport and storage ............................................................................................... 21
  4.1 Packaging .................................................................................................................................... 21
## Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.1</td>
<td>Suitability</td>
<td>21</td>
</tr>
<tr>
<td>4.1.2</td>
<td>Markings</td>
<td>21</td>
</tr>
<tr>
<td>4.2</td>
<td>Transportation, receipt and handling of shipments</td>
<td>22</td>
</tr>
<tr>
<td>4.3</td>
<td>Storage of shipments</td>
<td>23</td>
</tr>
<tr>
<td>4.4</td>
<td>Unpacking shipments and checking for transportation damages</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Mounting</td>
<td>25</td>
</tr>
<tr>
<td>5.1</td>
<td>Installing protective relay in piping and connecting</td>
<td>25</td>
</tr>
<tr>
<td>5.1.1</td>
<td>Checking function of protective relay</td>
<td>25</td>
</tr>
<tr>
<td>5.1.2</td>
<td>Installing protective relay in piping</td>
<td>27</td>
</tr>
<tr>
<td>5.1.3</td>
<td>Installing electrics for protective relay</td>
<td>31</td>
</tr>
<tr>
<td>5.2</td>
<td>Checking protective relay</td>
<td>34</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Checking protective relay</td>
<td>34</td>
</tr>
<tr>
<td>6</td>
<td>Commissioning</td>
<td>36</td>
</tr>
<tr>
<td>7</td>
<td>Operation</td>
<td>37</td>
</tr>
<tr>
<td>7.1</td>
<td>Tripping of the protective relay and re-commissioning the transformer</td>
<td>37</td>
</tr>
<tr>
<td>7.1.1</td>
<td>Flap valve in IN SERVICE position</td>
<td>38</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Flap valve in OFF position</td>
<td>38</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Re-commissioning the transformer</td>
<td>38</td>
</tr>
<tr>
<td>8</td>
<td>Inspection and maintenance</td>
<td>39</td>
</tr>
<tr>
<td>8.1</td>
<td>Inspection</td>
<td>39</td>
</tr>
<tr>
<td>9</td>
<td>Technical data for protective relay</td>
<td>40</td>
</tr>
<tr>
<td>9.1</td>
<td>Protective relay with several dry-reed magnetic switches</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Glossary</td>
<td>42</td>
</tr>
</tbody>
</table>
1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Validity

This technical file applies to the following type of protective relay RS:

• RS 2001-Ex

1.2 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH

Falkensteinstraße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.3 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.4 Completeness

This technical file is incomplete without the supporting documentation.

The following documents apply:

• Supplements
• Dimensional drawing
• Routine test report
• Conformity certificate
Also observe generally valid legislation, standards, and guidelines as well as specifications on accident prevention and environmental protection in the respective country of use.

1.5 Safekeeping

Keep this technical file and all supporting documents ready at hand and accessible for future use at all times.

1.6 Notation conventions

This section contains an overview of the symbols and textual emphasis used.

1.6.1 Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="symbol1" alt="Wrench size" /></td>
<td>Wrench size</td>
</tr>
<tr>
<td><img src="symbol2" alt="Tightening torque" /></td>
<td>Tightening torque</td>
</tr>
<tr>
<td><img src="symbol3" alt="Number and type of fastening material used" /></td>
<td>Number and type of fastening material used</td>
</tr>
<tr>
<td><img src="symbol4" alt="Fill with oil" /></td>
<td>Fill with oil</td>
</tr>
<tr>
<td><img src="symbol5" alt="Cut open, cut through" /></td>
<td>Cut open, cut through</td>
</tr>
<tr>
<td><img src="symbol6" alt="Clean" /></td>
<td>Clean</td>
</tr>
<tr>
<td><img src="symbol7" alt="Visual inspection" /></td>
<td>Visual inspection</td>
</tr>
<tr>
<td><img src="symbol8" alt="Use your hand" /></td>
<td>Use your hand</td>
</tr>
<tr>
<td><img src="symbol9" alt="Adapter ring" /></td>
<td>Adapter ring</td>
</tr>
<tr>
<td><img src="symbol10" alt="Apply a coat of paint" /></td>
<td>Apply a coat of paint</td>
</tr>
<tr>
<td><img src="symbol11" alt="Use a file" /></td>
<td>Use a file</td>
</tr>
</tbody>
</table>
1 Introduction

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Grease symbol" /></td>
<td>Grease</td>
</tr>
<tr>
<td><img src="image" alt="Coupling bolt symbol" /></td>
<td>Coupling bolt</td>
</tr>
<tr>
<td><img src="image" alt="Use a ruler symbol" /></td>
<td>Use a ruler</td>
</tr>
<tr>
<td><img src="image" alt="Use a saw symbol" /></td>
<td>Use a saw</td>
</tr>
<tr>
<td><img src="image" alt="Hose clip symbol" /></td>
<td>Hose clip</td>
</tr>
<tr>
<td><img src="image" alt="Wire eyelet, safety wire symbol" /></td>
<td>Wire eyelet, safety wire</td>
</tr>
<tr>
<td><img src="image" alt="Use a screwdriver symbol" /></td>
<td>Use a screwdriver</td>
</tr>
<tr>
<td><img src="image" alt="Apply adhesive symbol" /></td>
<td>Apply adhesive</td>
</tr>
<tr>
<td><img src="image" alt="Lock tab symbol" /></td>
<td>Lock tab</td>
</tr>
</tbody>
</table>

Table 1: Symbols

1.6.2 Hazard communication system

Warnings in this technical file are displayed as follows.

1.6.2.1 Warning relating to section

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical file. Warnings relating to sections use the following format:

```
[WARNING]
Type and source of danger
Consequences
   Action
   Action
```
1.6.2.2 Embedded warning information

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

⚠ **DANGER!** Instruction for avoiding a dangerous situation.

1.6.2.3 Signal words and pictograms

The following signal words are used:

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
<td>Indicates a hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
<tr>
<td>WARNING</td>
<td>Indicates a hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Indicates a hazardous situation which, if not avoided, could result in injury.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Indicates measures to be taken to prevent damage to property.</td>
</tr>
</tbody>
</table>

Table 2: Signal words in warning notices

Pictograms warn of dangers:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>Warning of a danger point</td>
</tr>
<tr>
<td>⚡</td>
<td>Warning of dangerous electrical voltage</td>
</tr>
<tr>
<td>🔥</td>
<td>Warning of combustible substances</td>
</tr>
<tr>
<td>⚠</td>
<td>Warning of danger of tipping</td>
</tr>
</tbody>
</table>

Table 3: Pictograms used in warning notices
1 Introduction

1.6.3 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

Important information.
2 Safety

2.1 General safety information

The technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

- Read this technical file through carefully to familiarize yourself with the product.
- Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

The following is considered appropriate use

- Only operate the product in accordance with this technical file and the agreed delivery conditions and technical data
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file
- Use the product only with the transformer specified in the order
- You will find the standard valid for the product and the year of issue on the name plate
- The serial numbers of on-load tap-changers and on-load tap-changer accessories (drive, drive shaft, bevel gear, protective relay etc.) must match if the on-load tap-changers and on-load tap-changer accessories are supplied as a set for one order.

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use section. Please also note the following:

Unauthorized or inappropriate changes to the product may lead to personal injury, material damage, and operational faults. Only modify product following discussion with Maschinenfabrik Reinhausen GmbH.
2 Safety

2.4 Standards and regulations

The standards and regulations which apply to the explosion-protected product are described in the following chapters.

2.4.1 Application range of protective relay

The protective relay is certified for Ex II 2G Ex ia IIC T4 Gb and Ex II 3G Ex nA nC IIC T4 Gc. Refer to the following overview for the resulting application ranges.

Depending on the ignition protection type needed and the resultant zone classification, one of the two ignition protection types should be defined by the customer.

- The intrinsic safety "i" ignition protection type can be used for zone 1 (category 2G) and zone 2 (category 3G).
- The "n" ignition protection type can only be used for zone 2 (category 3G).

<table>
<thead>
<tr>
<th>Number</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sign for explosion protection</td>
</tr>
<tr>
<td>2</td>
<td>Equipment group</td>
</tr>
<tr>
<td>3</td>
<td>Equipment category</td>
</tr>
<tr>
<td>4</td>
<td>Ex: Symbol for explosion-protected equipment</td>
</tr>
<tr>
<td>5</td>
<td>Ignition protection type</td>
</tr>
<tr>
<td>6</td>
<td>Explosion group</td>
</tr>
<tr>
<td>7</td>
<td>Temperature class</td>
</tr>
<tr>
<td>8</td>
<td>EPL (Equipment Protection Level)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protective relay</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>II</td>
<td>2G</td>
<td>Ex</td>
<td>ia</td>
<td>IIC</td>
<td>T4</td>
<td>Gb</td>
<td></td>
</tr>
<tr>
<td>Protective relay</td>
<td>II</td>
<td>3G</td>
<td>Ex</td>
<td>nA</td>
<td>nC</td>
<td>IIC</td>
<td>T4</td>
<td>Gc</td>
</tr>
</tbody>
</table>

Table 4: Example of the application range

<table>
<thead>
<tr>
<th>Equipment groups (number 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>Equipment in this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust.</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>Equipment in this category is intended for use in other areas in which explosive atmospheres may be present.</td>
</tr>
</tbody>
</table>

Table 5: Equipment groups
### Equipment category / zone classification (number 3)

<table>
<thead>
<tr>
<th>Designation for gases</th>
<th>Designation for dusts</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G (0)</td>
<td>1D (20)</td>
<td>Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapors or mists or by air/dust mixtures are present continuously, for long periods or frequently.</td>
</tr>
<tr>
<td>2G (1)</td>
<td>2D (21)</td>
<td>Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapors, mists or air/dust mixtures occur occasionally.</td>
</tr>
<tr>
<td>3G (2)</td>
<td>3D (22)</td>
<td>Equipment in this category is intended for use in areas in which explosive atmospheres caused by gases, vapors, mists, or air/dust mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for a short period only.</td>
</tr>
</tbody>
</table>

Table 6: Equipment category / zone classification

### Ignition protection types (number 5)

- **d**: Pressure-proof enclosure
- **e**: Increased safety
- **l**: Intrinsic safety (ia, ib)
- **m**: Encapsulation
- **o**: Oil immersion
- **p**: Pressurized apparatus
- **q**: Powder filling
- **n**: Ignition protection type "n" (only zone 2)
  - n A: non-sparking equipment
  - n C: sparking equipment with special protection for contacts
  - n R: vapor-protected housing

Table 7: Ignition protection types

### Explosion group (number 6)

<table>
<thead>
<tr>
<th>EN/IEC</th>
<th>Gases, vapors (examples)</th>
<th>Min. ignition energy (mJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIA</td>
<td>Ammonia</td>
<td>-</td>
</tr>
<tr>
<td>IIA</td>
<td>Acetic acid, acetone, benzene, diesel, ethane, ether, fuel oil, hexane, methane, petrol, petroleum, propane</td>
<td>0.18</td>
</tr>
</tbody>
</table>
### 2 Safety

<table>
<thead>
<tr>
<th>EN/IEC</th>
<th>Gases, vapors (examples)</th>
<th>Min. ignition energy (mJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIB</td>
<td>Ethylene, isoprene, town gas</td>
<td>0.06</td>
</tr>
<tr>
<td>IIC</td>
<td>Acetylene, carbon disulfide, hydro</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 8: Explosion groups

### Temperature classes (number 7)

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>Maximum equipment surface temperature</th>
<th>Ignition temperature of the flammable substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>450 °C</td>
<td>&gt; 450 °C</td>
</tr>
<tr>
<td>T2</td>
<td>300 °C</td>
<td>&gt; 300 °C &lt; 450 °C</td>
</tr>
<tr>
<td>T3</td>
<td>200 °C</td>
<td>&gt; 200 °C &lt; 300 °C</td>
</tr>
<tr>
<td>T4</td>
<td>135 °C</td>
<td>&gt; 135 °C &lt; 200 °C</td>
</tr>
<tr>
<td>T5</td>
<td>100 °C</td>
<td>&gt; 100 °C &lt; 135 °C</td>
</tr>
<tr>
<td>T6</td>
<td>85 °C</td>
<td>&gt; 85 °C &lt; 100 °C</td>
</tr>
</tbody>
</table>

Table 9: Temperature classes

### Equipment protection level (EPL) (number 8)

The EPL indicates the level of protection defined for a device based on the level of probability of ignition and taking account of the differences between potentially explosive gas atmospheres, potentially explosive dust atmospheres, and potentially explosive atmospheres in mine workings affected by firedamp.

### 2.5 Measures for ensuring compliance with explosion protection requirements

To comply with explosion protection requirements, measures stipulated by both the manufacturer and transformer manufacturer/operator must be undertaken.

#### 2.5.1 Measures taken by the manufacturer

For correct protective relay operation, the manufacturer has taken the following measures for ensuring compliance with explosion protection requirements.

<table>
<thead>
<tr>
<th>EN 60079-0</th>
<th>General requirements</th>
</tr>
</thead>
</table>

Table 10: Basic standard
Measures for compliance with "General requirements"

The requirements of EN 60079-0 "General requirements" (such as choice of basic material, IP degree of protection, seal integrity and compressive strength of equipment, grounding etc.) were taken into consideration in the protective relay design. The customers does not therefore need to take any special measures in this regard.

2.5.2 Measures to be taken by the transformer manufacturer/operator

For correct protective relay operation, the operator must take the following measures for ensuring compliance with explosion protection requirements.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Protection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 60079-11</td>
<td>Intrinsic safety i</td>
</tr>
<tr>
<td>EN 60079-15</td>
<td>Ignition protection type n</td>
</tr>
</tbody>
</table>

Table 11: Basic standards

Measures for ensuring compliance with intrinsic safety "i"

This ignition protection type is used when the operator wants to operate the electrical supply of the protective relay with an intrinsically safe power circuit. Then the operator has to comply with the limit values described in the electrical data for ignition protection type "i".

In terms of wiring, particular attention should be paid to ensuing that the spacing (air gaps) between shiny parts and cables is at least 3 mm.

Measures for ensuring compliance with ignition protection type "nA nC"

This ignition protection type is used when the operator cannot operate the electrical supply of the protective relay with an intrinsically safe power circuit, i.e. cannot ensure the electrical limit values for intrinsic safety "i".

Then the operator has to comply with the limit values described in the electrical data for ignition protection type "n".

In terms of wiring, particular attention should be paid to ensuing that the spacing (air gaps) between shiny parts and cables is at least 3 mm.

2.6 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.
2.7 Operator’s duty of care

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

- All warning and hazard notices are complied with.
- Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.
- Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.
- The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.
- Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.
- The specified operating conditions and requirements of the installation location are complied with.
- All necessary devices and personal protective equipment for the specific activity are made available.
- The prescribed maintenance intervals and the relevant regulations are complied with.
- Installation, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
- The operator must ensure appropriate use of the product.

2.8 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Follow information about personal protective equipment provided in the work area.
Always wear

<table>
<thead>
<tr>
<th>Protective clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close-fitting work clothing with a low breaking strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts. Do not wear any rings, necklaces or other jewelry.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
</tr>
</tbody>
</table>

Table 12: Personal protective equipment to be worn at all times

<table>
<thead>
<tr>
<th>Wear the following in special environments</th>
<th>Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety glasses</td>
<td>To protect the eyes from flying parts and splashing liquids.</td>
</tr>
<tr>
<td>Hard hat</td>
<td>To protect from falling and flying parts and materials.</td>
</tr>
<tr>
<td>Hearing protection</td>
<td>To protect from hearing damage.</td>
</tr>
</tbody>
</table>

Table 13: Personal protective equipment to be worn in special environments

2.9 Drying transformer

2.9.1 Drying transformer in furnace

Observe the following information when drying the transformer in a furnace.
NOTICE

Damage to protective relay, on-load tap-changer and transformer!

If the protective relay is dried in a furnace, this may cause damage to the protective relay and restrict its correct function.

► Do not dry protective relay in a furnace.

2.9.2 Drying the transformer in the transformer tank

If drying takes place in the transformer tank, the protective relay can remain fitted during the drying process.
3 Product description

This chapter contains an overview of the design and function of the product.

3.1 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Protective relay
- Operating instructions
- Supplements
- Dimensional drawing

Please note the following:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation
- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation

3.2 Function description

The protective relay is used to protect the on-load tap-changer and the transformer when a malfunction occurs in the diverter switch oil compartment or selector switch oil compartment. It is tripped when the specified speed of oil flow from the on-load tap-changer head to the oil conservator is exceeded due to a fault. The flowing oil actuates the flap valve which tips over into position OFF. The contact in the dry-reed magnetic switch is thereby actuated, the circuit breakers are tripped, and the transformer is de-energized.

The protective relay is part of an oil-insulated on-load tap-changer and its properties conform to the applicable valid version of IEC publication 60214-1. Therefore, it is part of the scope of our delivery.

Diverter switch operations at rated switching capacity or at permissible overload will not cause the protective relay to trip.

The protective relay responds to oil flow, not to gas accumulated in the protective relay. It is not necessary to bleed the protective relay when filling the transformer with oil. Gas accumulation in the protective relay is normal.
3.3 Setup/versions

Front view

Figure 1: RS 2001-Ex

1. Inspection window
2. Gore membrane

Rear view

Figure 2: RS 2001-Ex

1. Ground connection
2. Name plate
### 3.4 Name plate

The name plate for the explosion-protected protective relay is on the rear of the product.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gasket</td>
</tr>
<tr>
<td>2</td>
<td>Potential tie-in</td>
</tr>
<tr>
<td>3</td>
<td>Terminal box cover</td>
</tr>
<tr>
<td>4</td>
<td>OPERATION (reset) test button</td>
</tr>
<tr>
<td>5</td>
<td>Slotted head screw for potential tie-in</td>
</tr>
<tr>
<td>6</td>
<td>OFF (test tripping) test button</td>
</tr>
<tr>
<td>7</td>
<td>Protective conductor connection</td>
</tr>
<tr>
<td>8</td>
<td>Protective cover with pictogram for terminal assignment</td>
</tr>
<tr>
<td>9</td>
<td>Cable bushing with dummy plug</td>
</tr>
<tr>
<td>10</td>
<td>Connection terminal</td>
</tr>
</tbody>
</table>

---

**Figure 3: RS 2001-Ex**

**Figure 4: Position of name plate**
4 Packaging, transport and storage

4.1 Packaging

The products are sometimes supplied with a sealed packaging and sometimes also dried depending on what is required.

A sealed packaging surrounds the packaged goods on all sides with plastic foil. Products that have also been dried are identified by a yellow label on the sealed packaging.

The information in the following sections should be applied as appropriate.

4.1.1 Suitability

**NOTICE**

**Property damage due to incorrectly stacked crates!**

Stacking the crates incorrectly can lead to damage to the packaged goods!

► Only stack up to 2 equally sized crates on top of one another.
► Do not stack crates above a height of 1.5 m.

The packaging is suitable for undamaged and fully functional means of transportation in compliance with local transportation laws and regulations.

The packaged goods are packed in a stable crate. This crate ensures that when in the intended transportation position the packaged goods are stabilized to prevent impermissible changes in position, and that none of the parts touch the loading surface of the means of transport or touch the ground after unloading.

4.1.2 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment of non-hazardous goods. Adherence to these symbols is mandatory.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect against moisture</td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td></td>
</tr>
<tr>
<td>Fragile</td>
<td></td>
</tr>
<tr>
<td>Attach lifting gear here</td>
<td></td>
</tr>
<tr>
<td>Center of mass</td>
<td></td>
</tr>
</tbody>
</table>

Table 14: Shipping pictograms
4.2 Transportation, receipt and handling of shipments

**WARNING**

Danger of death and damage to property!

- Transport crate only when closed.
- Do not remove the mounting material used in the crate during transport.
- Only trained and appointed persons may select the sling gear and secure the load.
- Do not walk under the hanging load.
- Use means of transport and lifting gear with a sufficient carrying capacity in accordance with the weight stated on the delivery slip.

In addition to oscillation stress and shock stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a crate tips over, falls from a certain height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

**Visible damage**

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately onsite together with the carrier involved. This is essential for any claim for damages!
- Photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- **NOTICE!** Be absolutely sure to also check the sealed packaging. If the sealed packaging is damaged, do not under any circumstances install or commission the packaged goods. Either dry the dried packaged goods again as per the operating instructions for the relevant on-load tap-
4 Packaging, transport and storage

changer/de-energized tap-changer or contact Maschinenfabrik Reinhausen GmbH to agree on how to proceed with drying. If this is not done, the packaged goods may be damaged.

- Name the damaged parts.

**Hidden damage**

When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 **Storage of shipments**

**Packaged goods dried by Maschinenfabrik Reinhausen**

Upon receipt of the shipment, immediately remove the packaged goods dried by Maschinenfabrik Reinhausen from the sealed packaging and store air-tight in dry insulating oil until used if the packaged goods were not supplied in oil.

**Non-dried packaged goods**

Non-dried packaged goods but with a functional sealed packaging can be stored outdoors when the following conditions are complied with.

When selecting and setting up the storage location, ensure the following:

- Protect stored goods against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Ensure sufficient carrying capacity of the ground.
- Keep entrance paths free.
- Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

Protect the packaging foil from direct sunlight so that it does not disintegrate under the influence of UV rays, which would cause the packaging to lose its sealing function.
If the product is installed more than 6 months after delivery, suitable measures must be taken without delay. The following measures can be used:

- Correctly regenerate the drying agent and restore the sealed packaging.
- Unpack the packed goods and store in suitable storage space (well ventilated, as dust-free as possible, humidity < 50 % where possible).

4.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Transport the packaged crate to the place where installation will take place. Do not open the sealed packaging until just before installation. If this is not done, damage to the packaged goods may occur due to ineffectively sealed packaging.

- **WARNING!** When unpacking, check the condition of the packaged goods. Secure packaged goods in an upright crate from tipping out. If this is not done, the packaged goods may be damaged and serious injuries may result.

- Check completeness of supplementary parts on the basis of the delivery slip.
5 Mounting

This chapter describes how to install and connect the protective relay.

5.1 Installing protective relay in piping and connecting

**WARNING**

Danger of death or severe injury!

Danger of death or severe injury from explosive gases in the protective relay, which accumulate during on-load tap-changer operation!

- Wait 15 minutes after switching off the transformer before you begin further work on the protective relay so that the gases have a chance to volatize.
- Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- De-energize all auxiliary circuits before starting the work.
- Do not operate any electrical devices during the work (for example risk of sparks caused by impact wrench).

Always perform all transformer tests with the protective relay attached and connected.

5.1.1 Checking function of protective relay

Check the function of the protective relay before installing in piping between on-load tap-changer head and oil conservator.

1. Open terminal box.

Figure 5: Protective relay with open terminal box
**5 Mounting**

### NOTICE

**Damage to protective relay!**

Damage to protective relay resulting from improper operation!

► Never press both test buttons at the same time.

2. Press OFF test button.
   
   ⇒ Flap valve is inclined. The red indicator is not visible.

![Figure 6: OFF position](image)

3. Press IN SERVICE test button.
   
   ⇒ Flap valve is vertical. The red indicator appears in the viewing window.

![Figure 7: OPERATION position](image)
4. Close terminal box.

The associated contact positions for checking electrical continuity can be seen in the dimensional drawing provided and on the protective cover.

5.1.2 Installing protective relay in piping

The following requirements must be satisfied in order to install the protective relay in the piping:

- The piping must be free of dirt and foreign bodies before the protective relay is installed.
- The pipes from the protective relay to the oil conservator must be routed with an inclination of at least 2% to ensure the switching gases can escape freely.
- The inner piping diameter must be at least 25 mm.
- The magnetic field strength (bushings, busbars etc.) must be < 20 kA/m.
- Install protective relay with good support and free from vibrations.
- The test buttons must be at the top.
- The reference arrow on the terminal box cover must be pointing in the direction in which the insulating oil flows from the on-load tap-changer to the oil conservator.
- Install protective relay such that it can be easily accessed for subsequent maintenance work.
Figure 9: Piping with inclination of at least 2 %
5 Mounting

Figure 10: Protective relay with test button at the top
1. Install the protective relay horizontally in the pipe between on-load tap-changer head and oil conservator as near as possible to the on-load tap-changer head taking the above points into consideration.
2. Provide a stop-cock (nominal width of at least 25 mm) between protective relay and oil conservator.

![Stop-cock Diagram]

**Figure 12: Stop-cock**

5.1.3 **Installing electrics for protective relay**

The protective relay's dry-reed magnetic switch is supplied as either an NC or NO contact in the following variants:

- 2 x NC contact
- 2 x NO contact
- 1 x NC contact and 1x NO contact

When making the electrical connection for the protective relay, proceed as follows.

1. Connect protective conductor with cable cross-section of 1…4 mm² to cylinder head screw.
2. Take off MR dummy plug.

Figure 13: Dummy plug

| 1 | Dummy plug |

3. Insert explosion-certified cable bushing into tapped hole on side of terminal box.

4. Open terminal box.

Figure 14: Terminal box
5. Loosen screw, remove terminal box cover, and take off protective cover.

![Figure 15: Terminal box cover and protective cover](image)

6. Guide explosion-certified cable through cable bushing and into protective relay. Ensure that the cable connection is well secured and sealed.

**WARNING**

Risk of severe injury or death!

Danger of death and severe injury due to unprofessional electrical connection of protective relay.

- Connect the protective relay into the tripping circuit of the circuit breakers of the transformer to be protected so that the transformer is immediately de-energized by the circuit breakers when the protective relay is tripped.

- Systems which only generate an alarm message are not permitted.

7. Connect electric cables with cable cross-section of 1…4 mm² to connection terminals in accordance with connection diagram.

8. Insert protective cover.

10. Close terminal box.

5.2 Checking protective relay

5.2.1 Checking protective relay

- Check that the protective relay is functioning correctly before commissioning the transformer:
  1. Ground the transformer on the high-voltage and low-voltage sides. Ensure that the working ground connection on the transformer is not removed during testing.
  2. Ensure that transformer remains de-energized during testing.
  3. Deactivate the automatic fire extinguishing device.
  4. Open terminal box of protective relay.
5. Press OFF test button.
6. Leave the transformer's danger zone.
7. Ensure that the transformer's circuit breaker cannot be closed.
   • Passive protection test
8. Press IN SERVICE test button.
9. Leave the transformer's danger zone.
10. Close the transformer's circuit breaker with isolating switches open and the transformer grounded on all sides.
11. Press OFF test button.
12. Ensure that the transformer's circuit breaker is open.
   • Active protection test.
13. Press IN SERVICE test button to reset the protective relay.
6 Commissioning

Once you have checked that the protective device is working correctly, you can continue by commissioning the transformer. Follow the description provided in the operating instructions for the on-load tap-changer or de-energized tap-changer.
7 Operation

The following chapter describes how to operate the protective relay.

7.1 Tripping of the protective relay and re-commissioning the transformer

**WARNING**

Danger of death or severe injury!

Danger of death or severe injury from explosive gases in the protective relay, which accumulate during on-load tap-changer operation!

► Wait 15 minutes after switching off the transformer before you begin further work on the protective relay so that the gases have a chance to volatize.

► Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

► De-energize all auxiliary circuits before starting the work.

► Do not operate any electrical devices during the work (for example risk of sparks caused by impact wrench).

**WARNING**

Risk of severe injury or death!

Risk of severe injury or death if on-load tap-changer and transformer are insufficiently tested!

► Be sure to contact Maschinenfabrik Reinhausen to check on-load tap-changer and transformer after the protective relay has been tripped.

► Only use the equipment again when you are sure there is no damage to the on-load tap-changer or transformer.

When the circuit breakers have been tripped by the protective relay, proceed as follows:

1. Establish time of tripping.
2. Determine operating position of on-load tap-changer.
3. As a precaution, block the motor-drive unit by tripping the motor protective switch to prevent the on-load tap-changer from being actuated by remote control.
4. Check the on-load tap-changer head cover. If oil is leaking, shut the oil conservator stop valve immediately.
5. Check whether the flap valve of the protective relay is in the OFF or IN SERVICE position.
7.1.1 Flap valve in IN SERVICE position

If the flap valve is in the IN SERVICE position, there may be a fault in the tripping circuit. Check the tripping circuit in this case. If you are not able to clarify why the protective relay tripped, be sure to contact Maschinenfabrik Reinhausen to check the on-load tap-changer.

7.1.2 Flap valve in OFF position

If the flap valve is in the OFF position, proceed as follows:

1. Ensure that the transformer is not started up under any circumstances.
2. Contact and inform Maschinenfabrik Reinhausen of the following:
   - Serial number of protective relay and on-load tap-changer
   - What was the load of the transformer at the instant of tripping?
   - Was the on-load tap-changer moved immediately before or during tripping?
   - Did any other protective devices of the transformer respond at the instant of tripping?
   - Were switching operations in the network being carried out at the instant of tripping?
   - Were overvoltages registered at the instant of tripping?
3. Take further action in agreement with Maschinenfabrik Reinhausen.

7.1.3 Re-commissioning the transformer

Once the reason for the protective relay tripping has been established and remedied, you can re-commission the transformer:

1. Ensure that the flap valve is in the IN SERVICE position.
2. Commission the transformer.
8 Inspection and maintenance

Risk of life-threatening injury due to electric shock!

Electrical accidents have thermal and muscle-paralyzing effects which may be fatal.

► Work on the device and system peripherals may only be undertaken by qualified specialists, who are also familiar with the safety rules applicable in electrical operating facilities.

Danger of death or severe injury from explosive gases during maintenance work!

Danger of death from flying debris and spraying of hot oil if incorrect action is taken when explosive gases accumulate under the transformer cover, in the piping, in the oil conservator, and at the dehydrating breather opening!

► Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

► Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.

► Use suitable personal protective equipment/clothing.

► Observe applicable fire protection regulations.

► Ensure that the on-load tap-changer is fully submerged in oil again after the maintenance.

► Ensure that all safety equipment is ready for use after the maintenance.

► Make sure that only trained technicians perform work on the transformer.

8.1 Inspection

Monitoring the on-load tap-changer and motor-drive unit is limited to occasional visual checks of on-load tap-changer head, protective relay, and motor-drive unit. For efficiency reasons these visual checks can be combined with the usual checks on the transformer.

Check the following:

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>annually</td>
<td>Check coating of protective relay.</td>
</tr>
<tr>
<td>annually</td>
<td>Check sealing points of protective relay and connected pipes.</td>
</tr>
<tr>
<td>annually</td>
<td>Check correct function of protective relay.</td>
</tr>
</tbody>
</table>

Table 15: Inspection plan
9 Technical data for protective relay

General technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>Outdoor model</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 54</td>
</tr>
<tr>
<td>Relay actuation</td>
<td>Flap valve with aperture</td>
</tr>
<tr>
<td>Vibration immunity</td>
<td>up to max. 3 g</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 3.5 kg</td>
</tr>
<tr>
<td>Oil flow speed of available types when tripping (oil temperature 20°C)</td>
<td>0.65 ± 0.15 m/s</td>
</tr>
<tr>
<td></td>
<td>1.20 ± 0.20 m/s</td>
</tr>
<tr>
<td></td>
<td>3.00 ± 0.40 m/s</td>
</tr>
<tr>
<td></td>
<td>4.80 ± 0.60 m/s</td>
</tr>
</tbody>
</table>

Table 16: General technical data

Tripping switch

The protective relay can be supplied with two independent dry-reed magnetic switches. These can be designed as normally open (NO) or normally closed (NC) contacts (see dimensional drawing supplied).

Additional electrical data for the dry-reed magnetic switches

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum admissible voltage</td>
<td>24 V</td>
</tr>
<tr>
<td>Minimum switching capacity AC/DC</td>
<td>1.2 VA/1.2 W</td>
</tr>
<tr>
<td>Power frequency withstand voltage test (insulation against ground potential)</td>
<td>Between all voltage-carrying connections and the grounded parts: at least 2500 V, 50 Hz, test duration 1 minute</td>
</tr>
</tbody>
</table>

Table 17: Additional electrical data for the dry-reed magnetic switches

Electrical data for connecting to an inherently safe circuit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum input voltage $U_i$</td>
<td>60 V</td>
</tr>
<tr>
<td>Maximum input current $I_i$</td>
<td>2 A</td>
</tr>
<tr>
<td>Minimum switched current at 24 V</td>
<td>50 mA</td>
</tr>
<tr>
<td>Maximum inner capacity $C_i$</td>
<td>negligible</td>
</tr>
<tr>
<td>Maximum inner inductivity $L_i$</td>
<td>negligible</td>
</tr>
</tbody>
</table>

Table 18: Connection to an inherently safe circuit

Electrical data for connecting to a non-inherently safe circuit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage $UC$</td>
<td>250 V</td>
</tr>
<tr>
<td>Rated current level</td>
<td>2 A</td>
</tr>
<tr>
<td>Maximum AC switching capacity</td>
<td>200 VA</td>
</tr>
</tbody>
</table>

Table 18: Connection to a non-inherently safe circuit
Maximum DC switching capacity | 130 W
---|---
Minimum switched current at 24 V | 50 mA
Minimum switched current at 250 V | 4.8 mA

Table 19: Connection to a non-inherently safe circuit

**Thermal data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature $T_a$</td>
<td>-25° C…+50° C</td>
</tr>
<tr>
<td>Oil temperature</td>
<td>&lt; 130° C</td>
</tr>
</tbody>
</table>

Table 20: Thermal data

### 9.1 Protective relay with several dry-reed magnetic switches

The protective relay can be supplied with several independent dry-reed magnetic switches. These can be designed as normally open (NO) or normally closed (NC) contacts and are electrically isolated (see dimensional drawing supplied).

Electrical data for normally open (NO) and normally closed (NC) dry-reed magnetic switch
# Glossary

<table>
<thead>
<tr>
<th>IEC</th>
<th>The International Electrotechnical Commission (IEC for short) is involved in the preparation and publication of international standards for electrical, electronic and related technologies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>Ingress protection</td>
</tr>
<tr>
<td>MR</td>
<td>Maschinenfabrik Reinhausen GmbH</td>
</tr>
<tr>
<td>NC</td>
<td>Normally Closed contact</td>
</tr>
<tr>
<td>NO</td>
<td>Normally Open contact</td>
</tr>
</tbody>
</table>
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