

# MR Safety Devices for On-Load Tap-Changers



## 1. General

Maschinenfabrik Reinhausen (MR) has more than 70 years of experience with on-load tap-changers. Based on this extensive know-how the company has developed a system consisting of carefully matched safety devices.

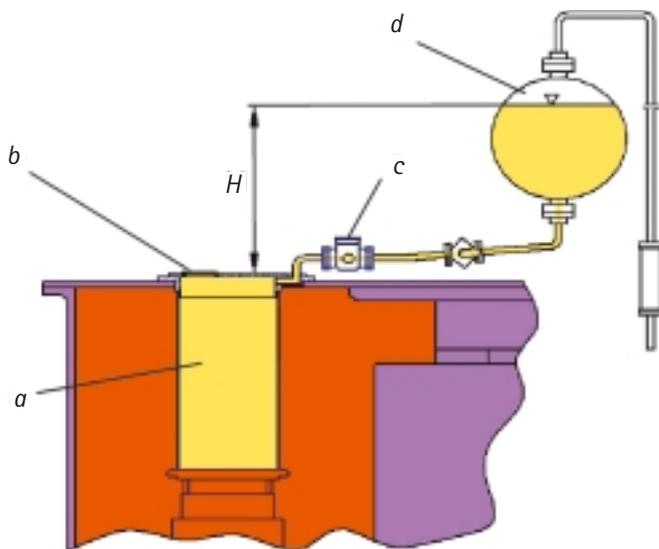


Fig. 1: On-load tap-changer arrangement in the transformer tank

- a Diverter switch oil compartment
- b Rupture disk
- c Protective relay RS2001
- d Oil conservator
- H Oil conservator level

The diverter switch is installed in a pressure-tight oil compartment, which separates the insulating oil of the diverter switch from the insulating oil of the transformer (see Fig. 1). Gases generated during diverter switch operation escape via the oil conservator.

Any faults in the diverter switch oil compartment usually manifest themselves through conversion of electrical energy into heat with associated arcing. The amount of energy released depends on a range of influence factors such as operating voltage, through-current of the on-load tap-changer, short circuit capacity of the grid, etc.

The MR safety devices for on-load tap-changers can deal with all eventualities ranging from low-energy processes to processes with steep pressure increase. They have to be connected in such a way that they switch off the transformer immediately in order to reduce risks for persons and limit consequential damage.

## 2. The standard MR safety system

The protective relay and the rupture disk form the standard MR safety system for oil-insulated on-load tap-changers of type OILTAP® or VACUTAP®, which are equipped with this system as standard.

The standard MR safety system can be used up to an oil conservator level  $H$  of 10 m (Fig. 1). The properties of the protective relay RS2001 and the rupture disk match the current version of IEC 60214-1.

The purpose of the standard MR safety system is to disconnect the transformer from the grid immediately in the event of a fault in the diverter switch oil compartment. The protective relay can switch off the transformer both for low-energy processes and in the event of faults with steep pressure increase. It should be connected into the tripping circuit of the transformer circuit breaker. In the event of a fault with steep pressure increase in the oil compartment, the rupture disk also ensures immediate pressure-relief (see Fig. 2).

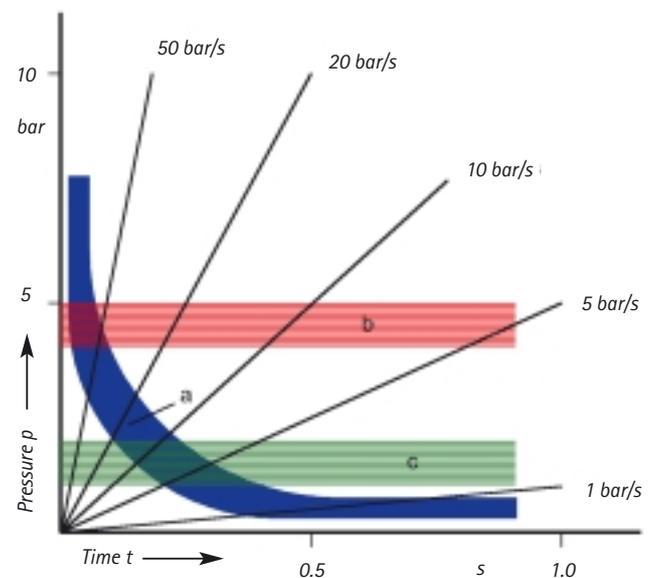


Fig. 2: Response characteristics of MR safety devices

- a Protective relay RS2001
- b Rupture disk
- c Pressure-relief device type MPreC®

### 2.1 Protective relay RS2001

The protective relay RS2001 is an oil-flow controlled relay according to IEC 60214-1. It is installed between the on-load tap-changer head and the oil conservator (see Fig. 3) and shall respond at a pre-determined oil flow between the diverter switch oil compartment and the oil conservator. Even low-energy faults can lead to oil flow in the diverter switch oil compartment.

### 3. Pressure-relief device as optional protective device

The protective relay RS2001 operates according to the principle of a movable flap valve. It features a precisely defined opening, so that any gases generated during diverter switch operation can escape unobstructed via the oil conservator. When triggered, the flap valve operates a reed switch and makes a signal available. Once it has been triggered, the flap valve remains in its position and has to be reset manually.

The response sensitivity of the protective relay is set to match the rated switching capacity of the on-load tap-changer. Further information can be found in section "Assignment of response values to the relevant on-load tap-changer types" in the operating instructions for protective relay RS2001 (BA59).

#### 2.2 Rupture disk (pressure-relief diaphragm)

The rupture disk is a pressure-relief device without signalling contact according to IEC 60214-1. It is used in conjunction with a protective relay and is located in the on-load tap-changer cover (see Fig. 3). It is set to a certain pressure value.

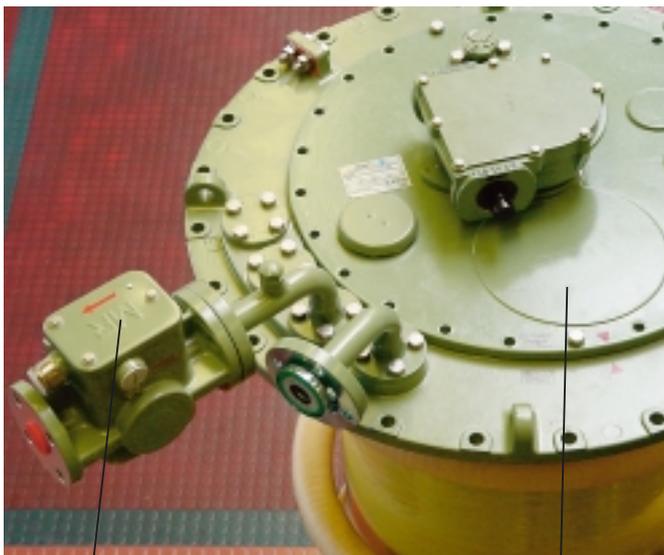


Fig. 3

Protective relay RS2001

Rupture disk

Faults with large energy release can lead to strong pressure waves with high pressure peaks, which can damage the on-load tap-changer oil compartment. The MR on-load tap-changer is equipped with a rupture disk as standard in order to limit such damage. When triggered, the rupture disk opens and enables the pressure to relieve immediately.

#### 3.1 Pressure-relief device type MPreC®

If required by the customer, instead of the rupture disk MR can provide a pre-installed pressure-relief device (see Fig. 4) or an on-load tap-changer cover ready for installation of a pressure-relief device by the customer. In both cases the on-load tap-changer cover features a special flange for the pressure-relief device instead of the rupture disk.

We recommend using a pressure-relief device of type MPreC®, which is factory-tested and adapted to the operation of our on-load tap-changers. It meets all requirements of the current IEC 60214-1.

The pressure-relief device responds to a predefined overpressure and opens when this pressure occurs in the oil compartment of the on-load tap-changer. For steep pressure increases the response time of the pressure-relief device is significantly shorter than that of an oil-flow controlled relay.

The protective relay RS2001 provided as standard should be installed even if an additional pressure-relief device is used.

When the device is triggered, a spring-loaded valve cover in the pressure-relief device opens, leading to sudden pressure-relief and operation of a micro-switch. The MPreC® model indicates triggering of the pressure-relief device through a signal pin. Once the overpressure has subsided, the pressure-relief device will close automatically. The signal pin remains locked.



Fig. 4: Pressure-relief device type MPreC®

### 3.2 Version with pre-installed pressure-relief device

Only pressure-relief devices approved by MR are used, e.g. type MPreC®. This ensures that the response characteristics of the pressure-relief device match the respective on-load tap-changer type.

Further information can be found in the operating instructions of the respective pressure-relief device.

### 3.3 Version with pressure-relief device provided and installed by the customer

An MR on-load tap-changer with an on-load tap-changer cover prepared for installation of a pressure-relief device by the customer may only be commissioned once the pressure-relief device has been installed.

The pressure-relief device must be suitable for operation with an on-load tap-changer. The precise response value of the pressure-relief device can be obtained from our sales staff or our agency. This response value is determined by the tap-changer type and the static pressure in the oil compartment, resulting from the oil conservator level H (see Fig. 1).

MR can accept no liability for pressure-relief devices provided and installed by the customer in terms of their proper function, leak-proofness, and vibration-resistant mounting.

### 4. Further information

Detailed information about the above-mentioned safety devices can be found on the Internet under [www.reinhausen.com](http://www.reinhausen.com) and [www.messko.com](http://www.messko.com). We would also be happy to provide advice regarding other safety devices and protection systems. Please contact our sales department or one of our agencies.

