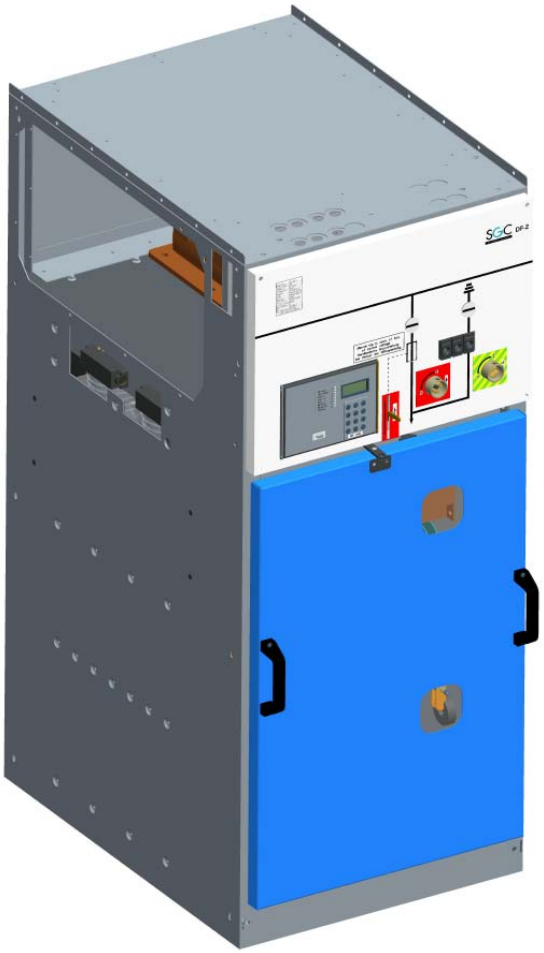
# DF-DT (G)

## MEDIUM VOLTAGE SWITCHGEAR

THE MODULAR CONCEPT



## User Manual

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The information given is applicable to the standard version of the DF-2 Medium Voltage Switchgear. Therefore SwitchGear Company nv. cannot be held liable for any damage resulting from specifications that differ from the standard version of the DF-2 Medium Voltage Switchgear.

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# PREFACE

## This document

This document is intended as a reference for qualified and trained operators to operate the medium voltage switchgear in a safe and economical way.

This document uses the term “medium voltage switchgear” to denote a random, but in actual practice, existing combination of DF cubicles that, mutually coupled and connected, constitute a client-specific transformation or distribution station. See: “General description”.

The chapters and sections are numbered. The page numbers (consisting of the chapter number and the page number) and the document code can be found at the bottom of every page.

In the documentation the words “left”, “right”, “front” and “behind” are used to indicate a specific part of the medium voltage switchgear. The starting point is always the position of the operator, standing in front of the medium voltage switchgear, facing the switchgear.

## Pictograms and safety symbols in and on the medium voltage switchgear

Depending on the version, the following pictograms are used on the medium voltage switchgear:

**WARNING**
High Voltage Danger
Access to this cubicle is only allowed after this cubicle and both the directly adjacent cubicles (previous and next one) are voltage-free.

**WARNING**
Drilling prohibited.
Drilling is strictly prohibited on surfaces bearing this pictogram.

## Pictograms used in this manual

The following pictograms apply to the medium voltage switchgear user documents:

**CAUTION!**
A procedure that can, if not carried out with the proper care, result in damage to the medium voltage switchgear, the surrounding area or the environment.

**WARNING**
High Voltage Danger

**CAUTION!**
Clamping danger

**WARNING**
Drilling prohibited.
Drilling is strictly prohibited on surfaces bearing this pictogram.

Notes, suggestions and advice.

Render this cubicle, the next one and the previous cubicle, voltage-free, before carrying out the work described.

Open the load break switch and the earthing switch before carrying out the work described in the manual.

Consult the indicated information sources first.

Protect the medium voltage switchgear from water or damp.

## Related documentation

The following technical documentation for medium voltage switchgear is available:

- User manual DF-2
- User manual DF-3

## Service and technical assistance

For information concerning specific settings, maintenance or repair work that is not mentioned here, please contact SGC - SwitchGear Company nv.

- When contacting SGC - SwitchGear Company nv, always provide the following information:
  - Cubicle type and voltage
  - Serial number of the cubicles

## Identification of the cubicles

Every cubicle of the medium-voltage switchgear is equipped with a type plate (Figure 1 A) and a stamped serial number (Figure 1 B).

### Type Plate (Figure 1 A)

The type plate denotes:

- Cubicle type
- Serial number
- Voltage
- Supplementary technical specifications

### Serial Number (Figure 1 B)

Next to the type plate, the stamped serial number can also be found on the front side of the lateral wall or on the horizontal wall, around the front panel. The serial number is visible after disassembling the front panel.

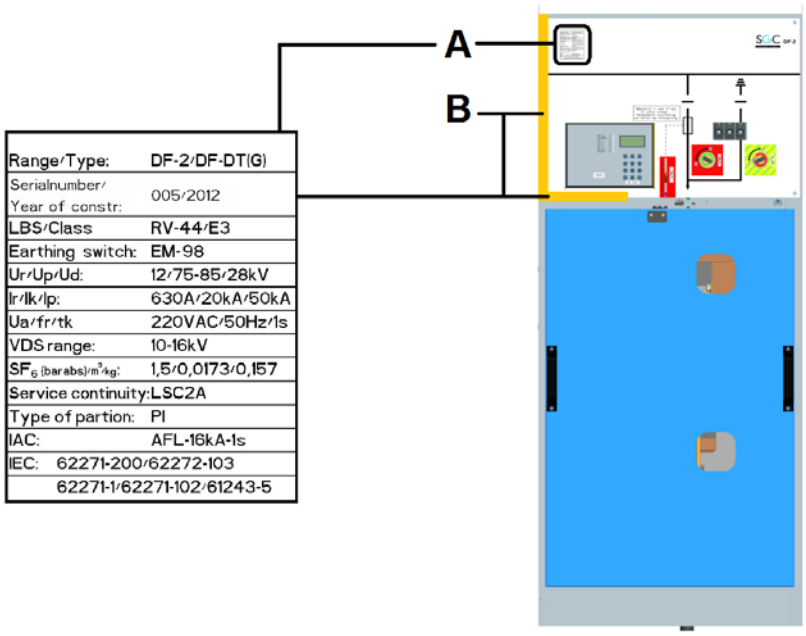


**Figure 1: Identification of the cubicles**

## General safety directions and instructions

SGC - SwitchGear Company nv does not accept any liability for damage or injury caused by not (strictly) following the safety directions and instructions, or by negligence during the installation, the use, the maintenance, or the repair of the medium voltage switchgear and its (possibly) additional options.
Depending on any specific user circumstances, or depending on any additional, fitted options, extra safety instructions may be required. Please contact SGC - SwitchGear Company nv immediately if you encounter a potential danger during the operation of the medium voltage switchgear.

**The owner/operator of the medium voltage switchgear is fully responsible at all times for observing the locally applicable safety instructions and guidelines.**

### User manual

- Anyone who uses or operates the medium voltage switchgear, must be familiar with the contents of the user manual, and follow the directions contained within very closely. The owner/operator must educate the users in accordance with the user manual and he or she must obey all directions and instructions.
- Never change the order of the required actions.
- Always keep the user manual close to the medium voltage switchgear.

### Pictograms and safety symbols

The pictograms, symbols and instructions applied to the medium voltage switchgear are a part of the safety equipment. They may therefore not be covered or removed, and must be present and clearly readable throughout the entire life cycle of the medium voltage switchgear.

- Replace or repair unreadable or damaged pictograms, symbols and instruction immediately. Contact SGC - SwitchGear Company nv for replacements.

### Operators

The execution of the work detailed herein (transport, installation, use and maintenance) is strictly reserved for trained and qualified operators, who are familiar with the dangers that may arise from operating the material. Temporary employees and personnel in training cannot operate the medium voltage switchgear under any circumstances.

### Technical specifications

- Technical specifications must not be changed.
- Modification of the medium voltage switchgear (or parts thereof) is not permitted.

### Transport, storage, installation, operation and maintenance

- See corresponding documents:
  - “Safety guidelines – transport”
  - “Safety guidelines – storage”
  - “Safety guidelines – installation”
  - “Safety guidelines – operation”
  - “Safety guidelines – maintenance”

## Intended Use

The medium voltage switchgear is designed exclusively for use as transformation and distribution stations, according to the guidelines and conditions provided by SGC - SwitchGear Company nv. Every other different or extended use, does comply with the intended use.[1]
SGC - SwitchGear Company nv does not accept any liability for damage(s) or injuries resulting from deviation(s) of the intended use.

The medium voltage switchgear complies with the current norms and guidelines. See: Technical Brochure.

- Operate the medium voltage switchgear strictly in a technically perfect condition, in accordance with the intended use outlined above.

Leave the sealed connections entirely intact, at all times. Breaking the sealed connections irrevocably voids any guarantee claims.

[1] The “Intended use” as defined in EN 292-1 “is the use for which the technical product is suited as specified by the manufacturer including his directions in the sales brochure.” In case of doubt, it is the use that can be deduced from the construction, the model and the function of the technical product that is considered normal use. Operating the product within the limits of its intended use also involves observing the instructions in the user manual.

# 1 GENERAL DESCRIPTION

## 1.1 DF-DT (G), the modular concept

SGC - SwitchGear Company's DF-DT (G) offers the capability to custom assemble any required transformation or distribution switchgear in a rational and economic way, by using a number of functional basic modules: DF-2 and DF-3 cubicles.

By correctly combining these basic modules (and their possible options), a customer-specific medium voltage switchgear is created (with a nominal voltage of 12, 17.5 or 24 kV) that offers a high level of operator safety. The technical specifications of your medium voltage switchgear can be found on the type plates on the cubicles. See "Identification of the cubicles".

The modularity of the DF-DT(G) concept is not limited to the ability to build various configurations with the DF-2 and DF-3 cubicles. Each separate DF-DT(G) cubicle is also an assembly of modules that – built into the compartments created for this purpose - determine the function of that particular cubicle. See "1.2 Compartments".

## 1.2 Compartments

DF-DT(G) cubicles consist of 4 compartments. The design of these compartments determines the functionality of the cubicle.

The respective compartments are:

A. Control and low-voltage compartment
B. Bus bar compartment
C. Apparatus compartment
D. Cable compartment

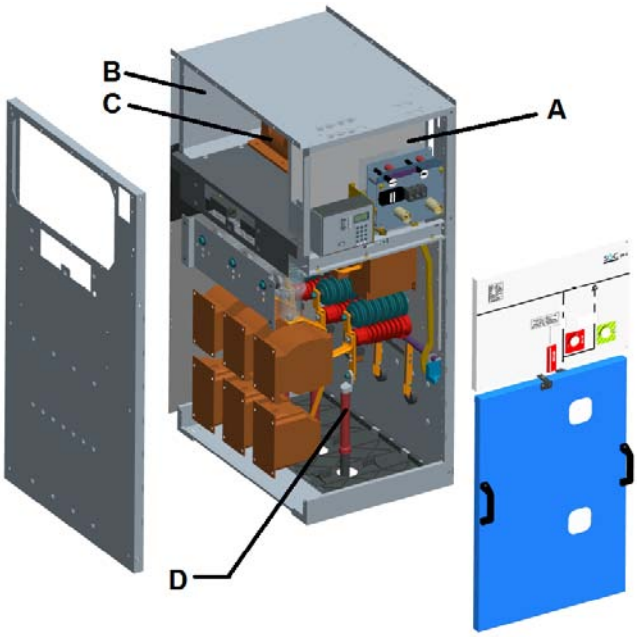


**Figure 2: Medium-voltage switchgear compartments**

### 1.2.1 Control and low-voltage compartment

The control and low-voltage compartment is located behind the removable front panel. Depending on the implementation, inside and on this compartment one of the following items can be found:

- Synoptic diagram (on the front panel) with:
  - controls and indicators of the load break switch
  - controls and indicators of the circuit breaker, the controls can be integrated in the synoptic diagram, or they can be located behind the front panel (to be specified when ordering)
- Load break switch drive mechanism
- Control module circuit breaker
- Protection relay
- Voltage indicators
- Manual trip possibility on circuit breaker
- Options and accessories (i.e. auxiliary contacts, closing and under-voltage release, key interlocks, minimum voltage relays, motor operation, etc. And all required electrical connection options)

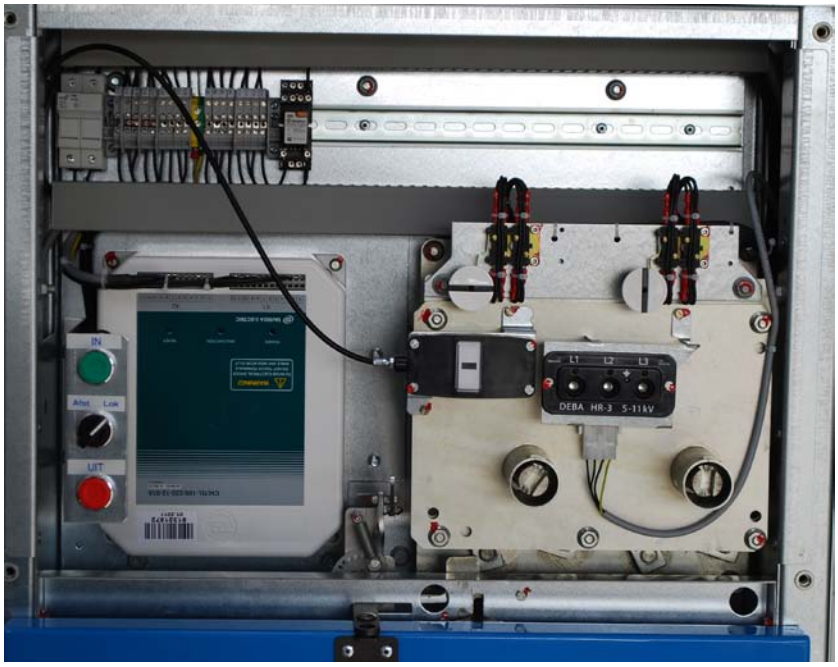


**Figure 3: Low-voltage compartment after removing the front panel**

### *1.2.1.1 Synoptic diagram*

The synoptic diagram (Figure 4) on the front panel provides a schematic overview of how the current flows and of the different positions of the sub components of the particular cubicle.

Color codes may vary from country to country. Your medium voltage switchgear is equipped with color codes valid in your country.

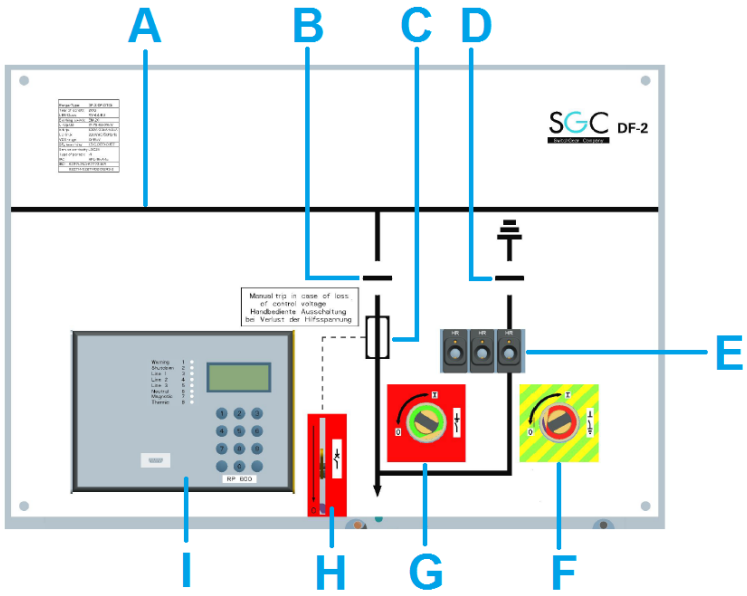


**Figure 4: Synoptic diagram DF-DT(G)**

A. Current flow diagram
B. Indicator 'position load break switch' (open / closed)
C. Indicator 'position circuit breaker' (open / closed)
D. Indicator 'position earthing switch' (open / closed)
E. Voltage indicators
F. Control field earthing switch
   The arrow on the control field indicates the required turning direction for opening (0) and closing (I) the earthing switch.
G. Control field load break switch
   The arrow on the control field indicates the required turning direction for closing (I) the load break switch.
H. Manual trip circuit breaker
   The manual trip can only be used if the pressure buttons (here located behind the front panel) do not function as the result of auxiliary voltage dropping off.
I. Protection relay

### *1.2.1.2 Drive mechanism*

DF-DT(G) cubicles are equipped with a drive mechanism to control the load break switch and the circuit breaker. The drive mechanism is located behind the front panel.

#### *1.2.1.2.1 Drive mechanism combination load break switch - earthing switch*

Depending on the implementation, the load break switch and/or the earthing switch is operated manually or by a motor. Manual operation is performed by using the handle. Operation of the load break switch and the earthing switch is housed in a single drive mechanism. Both switches have their own, independent operational axis. The operational axes are mechanically connected (interlocked) to prevent incorrect switching operations.

#### *1.2.1.2.2 Drive mechanism circuit breaker*

Depending on the implementation, the circuit breaker is operated locally or remotely.
Local, manual operation is performed by using pressure buttons available behind the front panel.

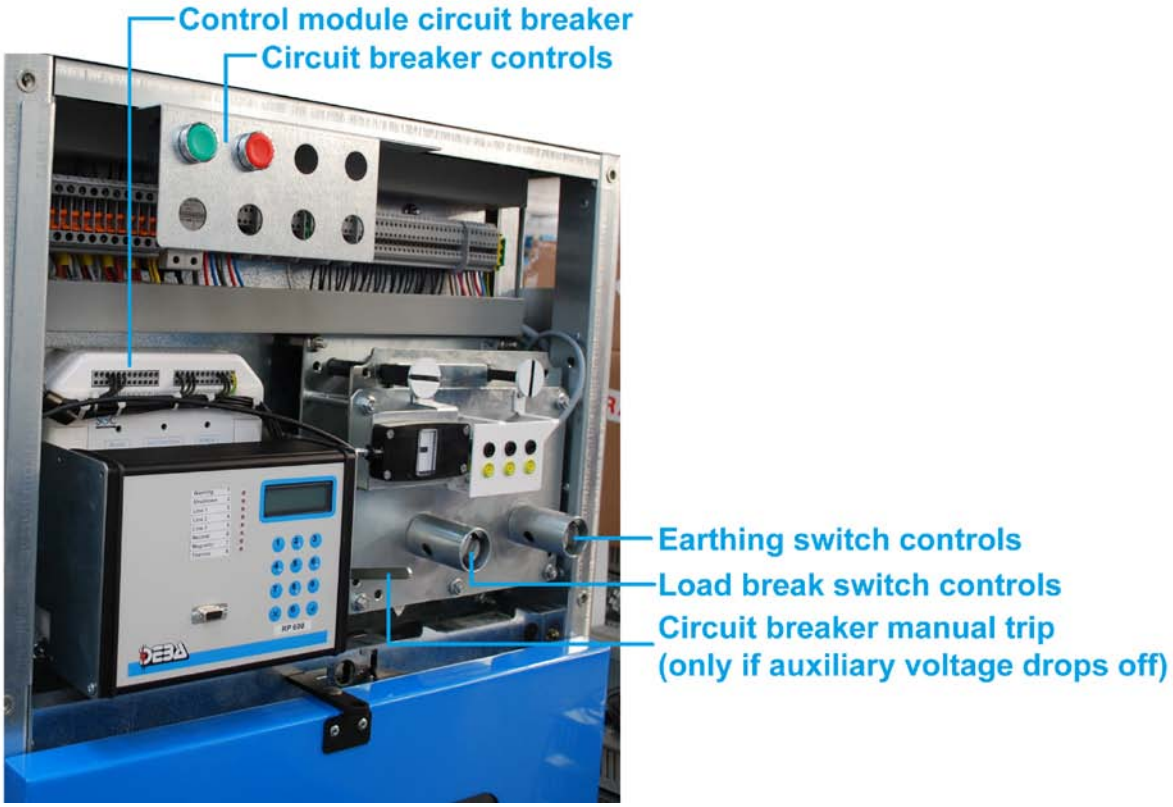


**Figure 5: Drive mechanism DF-DT(G)**

### *1.2.1.3 Options and accessories*

For every cubicle type, different options are available.

Contact SGC - SwitchGear Company nv for more information.

### 1.2.2 Bus bar compartment

The bus bar compartment is located behind the control and low voltage compartment. The various cubicles of the medium voltage switchgear are electrically connected by means of a bus bar.
The modular bus bar consists of three bars, made from electrolytic copper F25, which should be fitted when the medium voltage switchgear is installed.

See 3.2.2 Fitting the bus bars.

### 1.2.3 Apparatus compartment

The apparatus compartment is between the bus bar compartment and the cable compartment. This compartment houses the load break switch.

#### *1.2.3.1 Load break switch*

The RV 44 load break switch acts as the physical segregation between the bus bar compartment and the cable compartment. The load break switch is filled with $SF_6$ gas (sulphur hexafluoride) and sealed for life. The special characteristics of the $SF_6$ gas in the casing fulfil an isolating as well as an arc extinguishing function. The load break switch is a double-position switch that connects or interrupts the electrical voltage between the high voltage cables and the bus bar.
The position of the load break switch is clearly indicated on the synoptic diagram. Depending on the implementation, the load break switch is operated manually or electrically. See "1.2.1.2 Drive mechanism".

### 1.2.4 Cable compartment

The cable compartment is behind the interlocked, removable door. Depending on the implementation, this compartment contains one or more of the following items:

- EM-98 earthing switch
- Circuit breaker
- Provisions for securing the supply cable(s)

#### *1.2.4.1 Earthing switch*

The EM-98 earthing switch is located underneath the RV 44 load break switch, on the right wall of the cubicle. Switching is done in air (in contrast to that of the load break switch). The earthing switch is a two-position switch that opens the earthing knife (no earthing) or closes it (visible earthing).
The position of the earthing switch is clearly indicated on the synoptic diagram. Depending on the implementation, the load break switch is operated manually or electrically. The earthing switch is housed with the load break switch in one, mechanically interlocked drive mechanism. See "1.2.1.2 Drive mechanism".

### *1.2.4.2 Circuit breaker*

The circuit breaker, which is fixed into place, acts as protection of the output feeders, transformers or motors.

DF-DT(G) type cubicles, allow the following components to be integrated in the cable compartment:

- Current transformers
- Voltage transformers on the rail side
- Voltage transformers on the generator side
- Overvoltage protection (Surge arresters)
- Muffle resistance

### *1.2.4.3 Provisions for securing the supply cables*

The following provisions allow the supply cables to be connected quickly and easily:

- removable floor panels with grommets
- fixed cable supports
- adjustable cable supports (depth)

The connections fitted to your medium voltage switchgear have been adjusted for your specific operating voltage.

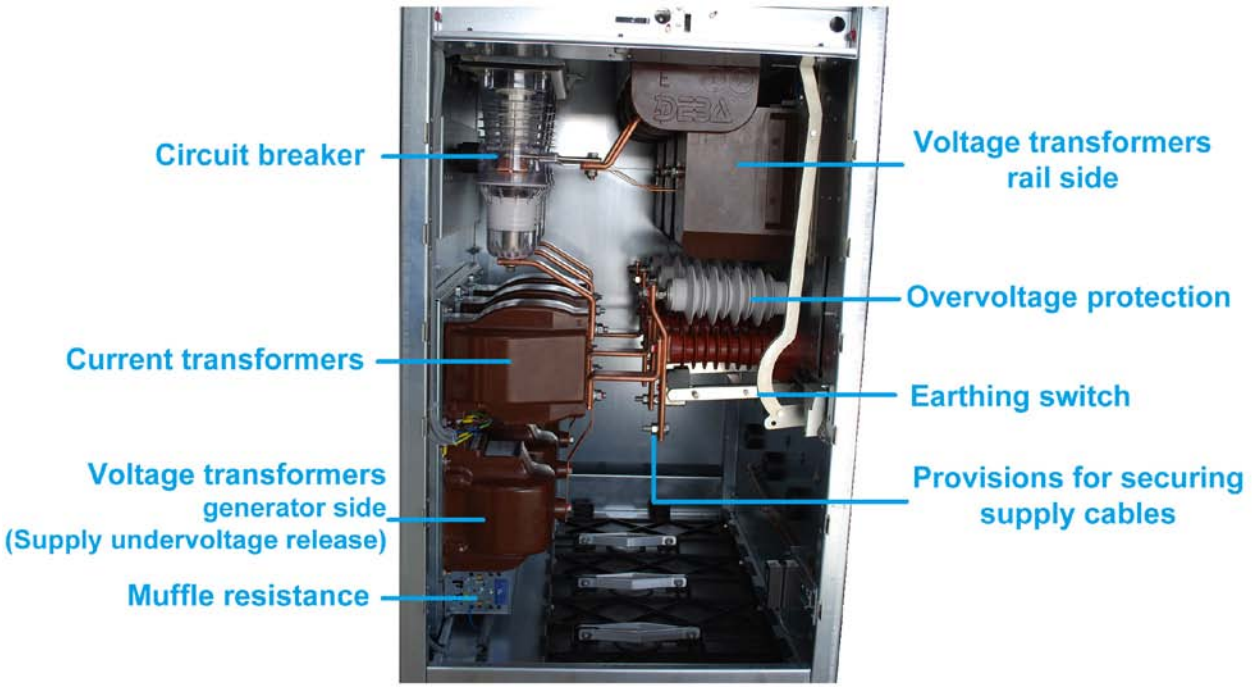


**Figure 6: Cable compartment of the DF-DT(G) medium voltage switchgear**

# 2 INSTALLATION

## 2.1 Safety guidelines - installation

### 2.1.1 General

Installation of the medium voltage switchgear is reserved strictly for trained and authorized operators, who respect the locally applicable safety prescriptions & guidelines.
The actual connection and first start-up is to be performed by trained and authorized personnel in service of the power supply company.

- See also: "General safety prescriptions and instructions".
- Never leave tools or equipment behind in, or on, the medium voltage switchgear.
- Install the medium voltage switchgear exclusively in spaces that fully comply with the following recommendations (according to IEC 60298)

### 2.1.2 Recommendations - installation room

Recommendations regarding the installation room parameters are subdivided in recommendations concerning:

- floor surface
- environmental conditions
- air circulation
- free height of the installation area
- dimensions of the access doors to the installation area
- free space in front of the cubicles
- internal arc resistance

#### *2.1.2.1 Floor surface*

The surface fit for the medium voltage switchgear placement, needs to be sufficiently strong and perfectly flat. The maximum allowed difference in level is **2 mm/m**.

### 2.1.2.2 Environmental Conditions

DF-DT(G) cubicles have been designed for **indoor** installation, provided that the following environmental conditions are met:

| description | values |
|---|---|
| environmental temperature | min. -15 °C - max. +45 °C |
| relative air humidity (%) | min. 10% - max. 70% (without condensation) |
| installation altitude (m.a.s.l.) | max. 1.000 m above sea level |

**Table 1: Environmental conditions**

Consequently:

- Avoid installation in dusty areas.
- Avoid installation in areas with a high level of relative air humidity.
- Avoid installation in areas susceptible to possible lightning strikes.
- Avoid installation in areas where cubicles may be exposed to aggressive gases or fluids.

Contact SGC - SwitchGear Company nv if the cubicles need to be or installed in places where the required environmental conditions cannot be guaranteed.

### 2.1.2.3 Ventilation

- Ensure proper air circulation in the installation area.
- Secure the air circulation openings to prevent small animals or rodents from gaining access to the installation area.

Particularly when the medium voltage switchgear contains one or more transformer cubicles, special attention needs to be placed on air circulation. Consult the table below to calculate the corresponding values. The table displays capacity losses with regard to the capacity of the cast resin transformers.

| Transformer Capacity (KVA) | P (W) |
|---|---|
| 100 | 1.605 |
| 160 | 2.175 |
| 250 | 2.850 |
| 315 | 3.412 |
| 400 | 4.012 |
| 500 | 4.837 |
| 630 | 5.745 |
| 800 | 6.787 |
| 1.000 | 7.875 |
| 1.250 | 10.350 |
| 1.600 | 12.450 |
| 2.000 | 16.125 |

**Table 2: Overview of capacity losses in cast resin transformers**

#### *2.1.2.4 Free height of the installation area*

The free height of the installation room has to be **at least 2.000 mm**. Depending on the distribution network manager however, a larger minimum free height may be required. An ideal free height, universally accepted by all distribution network managers, is 2.500 mm.

Dry transformers with a capacity of ≥ 1250 KVA require a minimal height of at least **2.500 mm**.

#### *2.1.2.5 Dimensions of the access doors to the installation area*

The provided height and width measurements apply to all doors that offer access to the installation room. These minimum requirements also apply if the installation room is not directly accessible from the outside.

| description | value |
|---|---|
| Height of the access door | min. 2.200 mm |
| Width of the access door | min. 100 mm + width of the widest cubicle |

**Table 3: Dimensions of the access doors**

If the medium voltage switchgear does not contain any transformer cubicle(s), a minimal door height of **2.000 mm** suffices. If a transformer cubicle has been included, the dimensions of the transformer always need to be taken into account. For the correct dimensions of the different cubicles, please see: “Dimensions & weights”.

If the medium voltage switchgear is to be installed in basements or cellars, an access hatch is required, with a length and width of at least 400 mm larger than the dimensions of the largest cubicle or transformer.

#### *2.1.2.6 Free space in front of the cubicles*

The free space in front of the cubicles depends on the assembly of the medium voltage switchgear.

If the medium voltage switchgear does not contain any transformer cubicle(s), the minimum free passage is **800 mm**. Medium voltage switchgear with a transformer cubicle with a capacity of ≥ 1.000 KVA requires a free passage of at least **2.000 mm**.

### *2.1.2.7 Internal arc resistance*

To prevent major material damage, serious physical injury or electrocution in the (unlikely) event of an internal arc, the following installation guidelines apply:

- Between the rear side of the cubicles and the wall of the installation room, ample free space needs to be provided, as displayed in Figure 7. This layout corresponds with an assembly where the side plates of the cubicles reach the rear side of the installation room. As a result, the free space behind the cubicles is entirely closed off. Consequently, a possible internal arc will trigger the overpressure system of the rear plates.

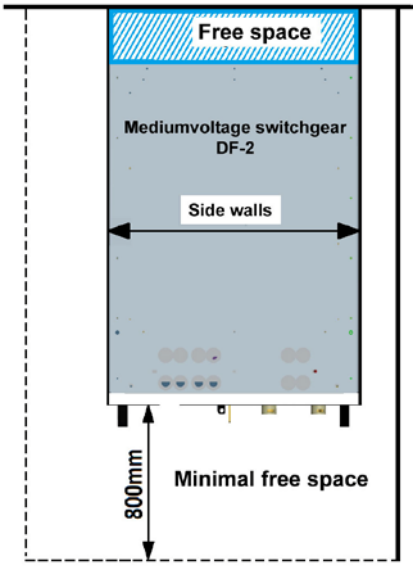


**Figure 7: Top view of installed cubicles**

A transformer cubicle can always be placed with its rear side against the wall.

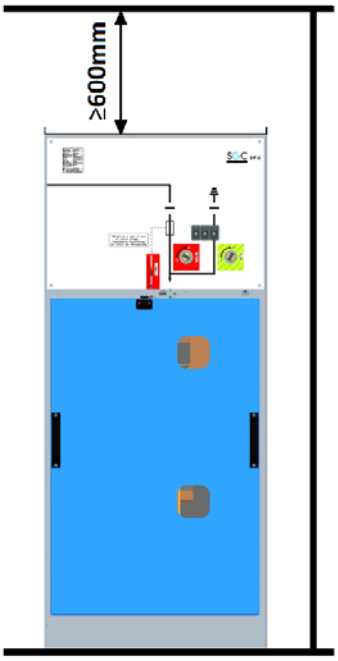


**Figure 8: Minimal free height**

- Anchor each cubicle of the medium voltage switchgear to the floor using 4 bolts. See 3.1 Anchoring the cubicle.
- Connect each cubicle mutually using the provided fixing materials. See 3.2 Assembly of the cubicles.

Medium voltage cubicles installed according to the aforementioned guidelines always restrict an internal arc to its compartment of origin.

# 3 MOUNTING

## 3.1 Anchoring the cubicle

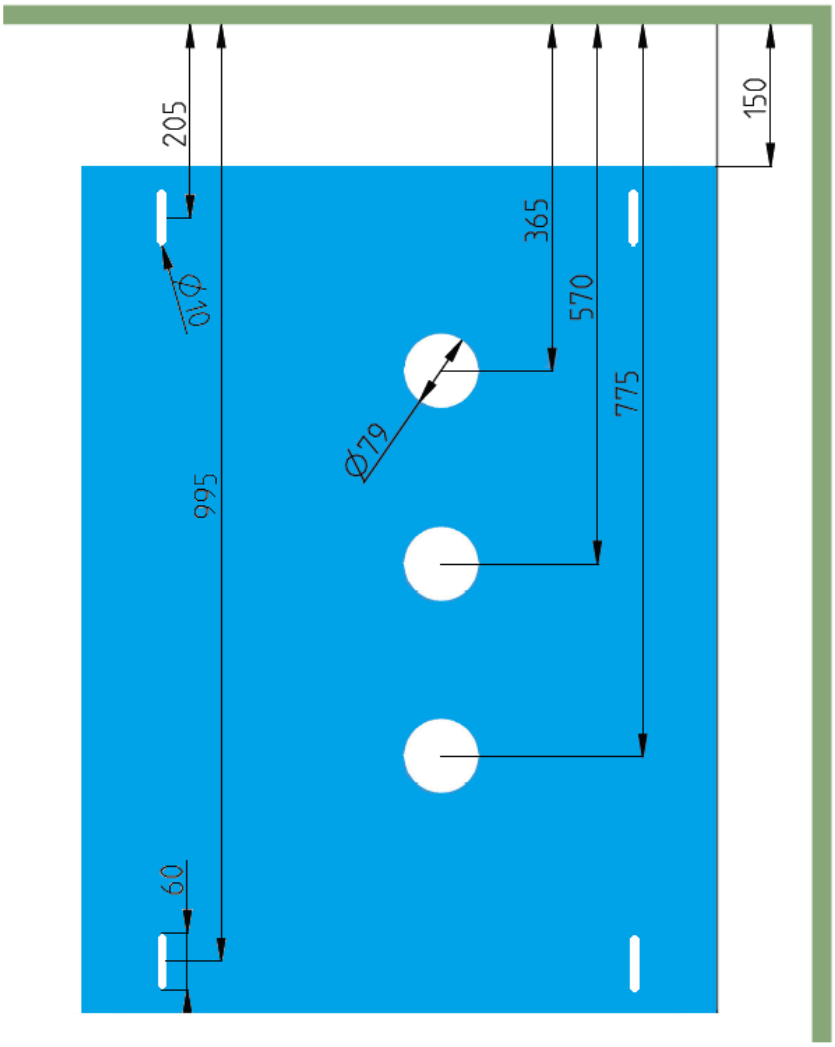


**Figure 9: Coupling DF-3 field to DF-2**

Consult the installation plans, the electrical schematics, and the floor plans before starting with the actual positioning of the medium voltage switchgear.
For horizontal dimensions, please refer to the corresponding cubicle's general user manual since they are cubicle-specific.

Leave the indicated free space between the rear side of the cubicle and the wall of the installation room to allow the overpressure system of the rear plates to function properly. A transformer cubicle can be placed with its rear side against the wall.

- Position the first cubicle level, in its definitive place in the installation area.

- Anchor the first cubicle to the floor by using four bolts. Use the provided openings as illustrated in figure Figure 10.

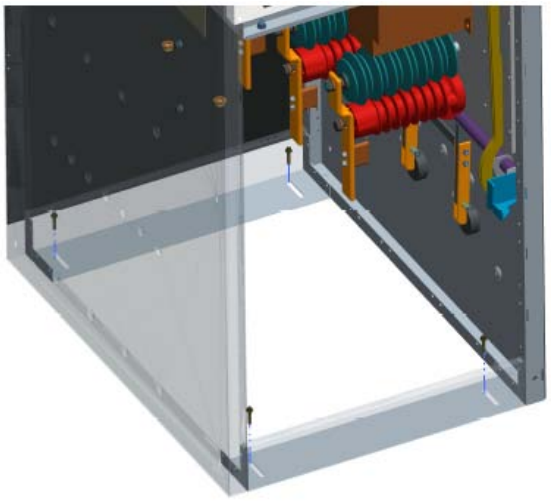

**Figure 10: Mounting: Anchoring DF-DT(G) cubicle**

- Disassemble the front panel (Figure 11): Unscrew the 4 hexagonal tap bolts (C). Remove the 4 spring washers (B). Remove the front panel (A). The control and low-voltage compartment is now accessible.

- Position the second cubicle against the first one.

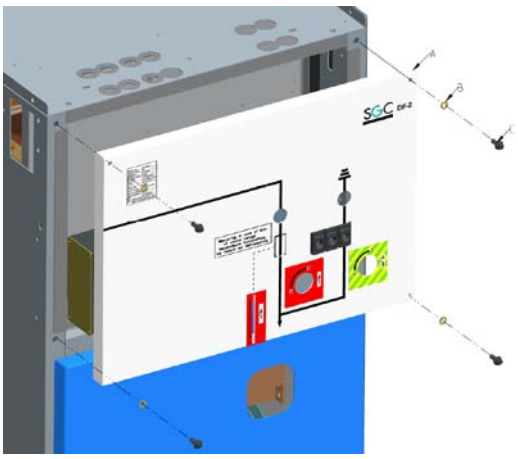

**Figure 11: Disassembling front panel of DF-DT(G)**

Ensure that the cubicles remain exactly aligned and perfectly level to enable a torque-free assembly of the frame, the earthing copper connection pieces, and the bus bar.
Possibly included cubicle bases are factory-included and are provided individually. Install the cubicles in the correct order according to the installation plans and the electrical schematics.

- Install each remaining cubicle accordingly and ensure that all front panels have been removed.
- Remove the lifting lugs on the cubicles (where available), by unscrewing the bolts. The cubicles are now ready to be a assembled. See 3.2 Assembling the cubicles.

## 3.2 Assembling the cubicles

When assembling the cubicles, the following important steps apply:

- Coupling the cubicles
- Assembling the bus bars
- Securing coupling piece DF-3 / DF-2 (if applicable)

### 3.2.1 Coupling cubicles

If the DF-DT(G) is coupled to medium voltage of the following type:

- DF-2/DF-2+ please refer to the corresponding user/installation manual
- DF-3/DF-3+ please refer to the corresponding user/installation manual

### 3.2.2 Assembly of the bus bars

If the DF-DT(G) is coupled to medium voltage of the following type:

- DF-2/DF-2+ please refer to the corresponding user/installation manual
- DF-3/DF-3+ please refer to the corresponding user/installation manual

# 4 INITIAL COMMISSIONING

The actual connection to the distribution grid and the first commissioning of the medium voltage switchgear can only be carried out by authorized and trained personnel in service of the power supply company, and by strictly obeying the locally applicable safety guidelines.

Notes:



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