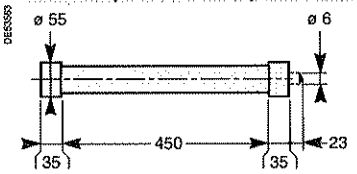
Protection of transformers

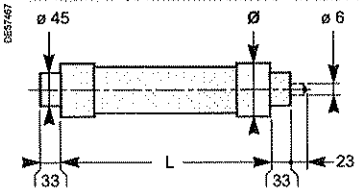
Fuses dimensions

Solefuse (UTE standards)



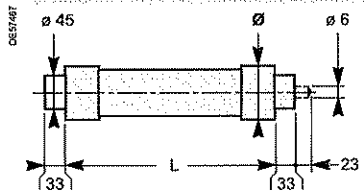
Ur (kV)	Ir (A)	L (mm)	Ø (mm)	Weight (kg)
7.2	6.3 to 125	450	55	2
12	100	450	55	2
17.5	80	450	55	2
24	6.3 to 63	450	55	2

Fusarc CF (DIN standards)



Ur (kV)	Ir (A)	L (mm)	Ø (mm)	Weight (kg)
7.2	125	292	86	3.3
12	6.3	292	50.5	1.2
	10	292	50.5	1.2
	16	292	50.5	1.2
	20	292	50.5	1.2
	25	292	57	1.5
	31.5	292	57	1.5
	40	292	57	1.5
	50	292	78.5	2.8
	63	292	78.5	2.8
	80	292	78.5	2.8
	100	292	78.5	2.8
24	6.3	442	50.5	1.6
	10	442	50.5	1.6
	16	442	50.5	1.6
	20	442	50.5	1.6
	25	442	57	2.2
	31.5	442	57	2.2
	40	442	57	2.2
	50	442	78.5	4.1
	63	442	78.5	4.1
	80	442	86	5.3
36	10	537	50.5	1.8
	16	537	50.5	1.8
	25	537	57	2.6
	31.5	537	78.5	4.7
	40	537	78.5	4.7
	50	537	86	6.4
	63	537	86	6.4

SIBA



Ur (kV)	Ir (A)	L (mm)	Ø (mm)	Weight (kg)
7.2	160	292	85	3.8
	200	292	85	5.4
12	125	292	67	2
	160	292	85	3.8
	200	292	85	3.8
17.5	125	442	85	5.4
24	100	442	85	5.4
	125	442	85	5.4

Interlocks

Switch units

- **the switch can be closed** only if the earthing switch is open and the access panel is in position.
- **the earthing switch can be closed** only if the switch is open.
- **the access panel for connections can be opened** only if the earthing switch is closed.
- **the switch is locked** in the open position when the access panel is removed. The earthing switch may be operated for tests.

Circuit-breaker units

- **the disconnector(s) can be closed** only if the circuit breaker is open and the front panel is locked (interlock type 50).
- **the earth switch(es) can be closed** only if the disconnector(s) is/are open.
- **the access panel for connections can be opened** only if:
  - the circuit breaker is locked open,
  - the disconnector(s) is/are open,
  - the earth switch(es) is/are closed.

***Note:** it is possible to lock the disconnector(s) in the open position for no-load operations with the circuit breaker.*

Functional interlocks

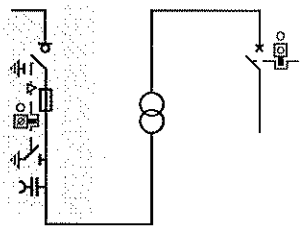
These comply with IEC recommendation 62271-200 and EDF specification HN 64-S-41 (for 24 kV).
In addition to the functional interlocks, each disconnector and switch include:

- **built-in padlocking** capacities (padlocks not supplied)
- **four knock-outs** that may be used for keylocks (supplied on request) for mechanism locking functions.

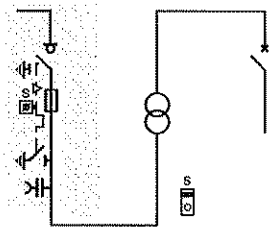
Unit interlock

Units	Interlock											
	A1	C1	C4	A3	A4	A5	50	52	P1	P2	P3	P5
IM, IMB, IMC				☐	☐				☐			
PM, QM, QMB, QMC, DM1-A, DM1-D, DM1-W, DM1-Z, DM1-S, DMV-A, DMV-D, DMV-S, DMVL-A, DMVL-D	☐	☐	☐				☐					
CRM, CVM		☐						☐				
NSM				☐					☐			
GAM				☐		☐						☐
SM										☐	☐	
DM2, DM2-W							☐					

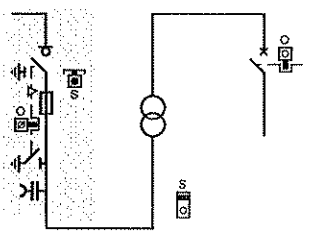
DE59565 **A1 type**



DE59566 **C1 type**



DE59567 **C4 type**



Key-type interlocks

Outgoing units

Aim:

- to prevent the closing of the earthing switch on a transformer protection unit unless the LV circuit breaker is locked in "open" or "disconnected" position.

- to prevent the access to the transformer if the earthing switch for transformer protection has not first been closed.

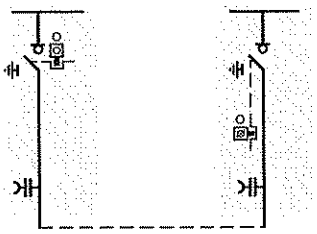
- to prevent the closing of the earthing switch on a transformer protection unit unless the LV circuit breaker is locked in "open" or "disconnected" position.
- to prevent the access to the transformer if the earthing switch for transformer protection has not first been closed.

MT20245EN **Legend for key-type interlocks:**

☐ no key ☐ free key ☐ captive key — panel or door

Interlocks

DE55566 **A3 type**

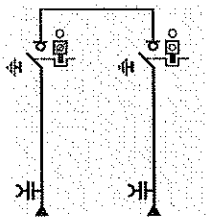


Ring units

Aim:

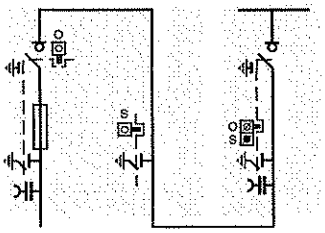
- to prevent the closing of the earthing switch of a load-side cubicle unless the line-side switch is locked "open".

DE55569 **A4 type**



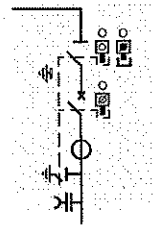
- to prevent the simultaneous closing of two switches.

DE55570 **A5 type**



- to prevent the closing of the earthing switch of the casing unit unless the downstream and the upstream switches are locked in the "open" position.

DE55571 **50 type**



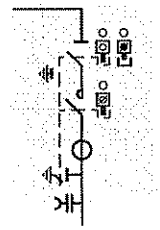
Prevents

- on-load switching of the disconnectors.

Allows

- off-load operation of the circuit breaker with the disconnectors open (double isolation).
- off-load operation of the circuit breaker with the disconnector open (single isolation).

DE59203 **Type 52**



Prevents

- on-load switching of the disconnectors.

Allows

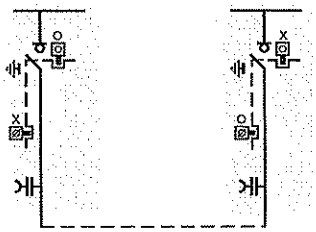
- off-load operation of the contactor with the disconnectors open (double isolation).
- off-load operation of the contactor with the disconnector open (single isolation).

MT20240EN **Legend for key-type interlocks:**

no key | free key | captive key | panel or door

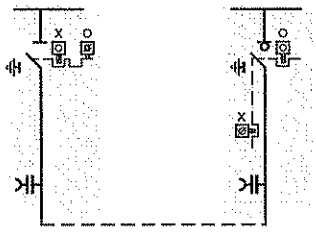
Interlocks

DE55572 **P1 type**



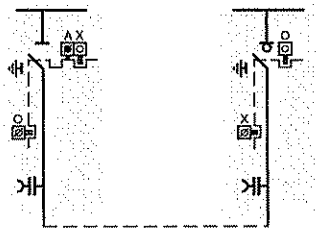
- to prevent the closing of an earthing switch if the switch of the other unit has not been locked in the "open" position.

DE55573 **P2 type**



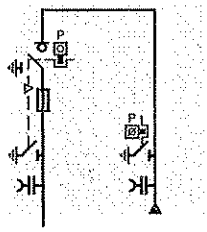
- to prevent on-load operation of the disconnector unless the switch is locked "open"
- to prevent the closing of the earthing switches unless the disconnector and the switch are locked "open".

DE55574 **P3 type**



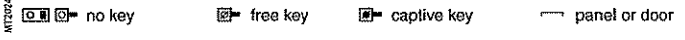
- to prevent on-load operation of the disconnector unless the switch is locked "open"
- to prevent the closing of the earthing switches with the unit energised, unless the disconnector and the switch are locked "open"
- to allow off-load operation of the switch.

DE55575 **P5 type**



- to prevent the closing of the earthing switch of the incoming unit unless the disconnector and the switch is locked "open".

MT20246EN **Legend for key-type interlocks:**



ВЯРНО С ОРИГИНАЛА

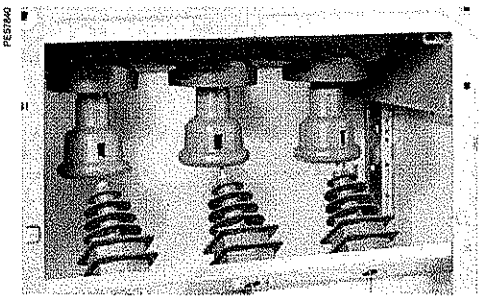
264

Contents

ВЯРНО С ОРИГИНАЛА

265

Connections with dry-type cables for 24 kV
Selection table

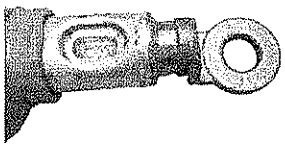


The ageing resistance of the equipment in an MV/LV substation depends on three key factors:

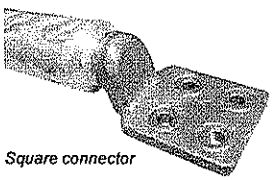
■ **the need to make connections correctly**
New cold fitted connection technologies offer ease of installation that favours resistance over time. Their design enables operation in polluted environments under severe conditions.

■ **the impact of the relative humidity factor**
The inclusion of a heating element is essential in climates with high humidity levels and with high temperature differentials.

■ **ventilation control**
The dimension of the grills must be appropriate for the power dissipated in the substation. They must only traverse the transformer area.



Round connector



Square connector

Network cables are connected:
■ on the switch terminals
■ on the lower fuse holders
■ on the circuit breaker's connectors.

The bimetallic cable end terminals are:
■ round connection and shank for cables ≤ 240 mm²
■ square connection round shank for cables > 240 mm² only.
Crimping of cable end terminals to cables must be carried out by stamping.

The end connectors are of cold fitted type
Schneider Electric's experience has led it to favour this technology wherever possible for better resistance over time.

The maximum admissible cable cross section:
■ 630 mm² for 1250 A incomer and feeder cubicles
■ 240 mm² for 400-630 A incomer and feeder cubicles
■ 120 mm² for contactor cubicles
■ 95 mm² for transformer protection cubicles with fuses.
Access to the compartment is interlocked with the closing of the earthing disconnector.
The reduced cubicle depth makes it easier to connect all phases.
A 12 mm Ø pin integrated with the field distributor enables the cable end terminal to be positioned and attached with one hand. Use a torque wrench set to 50 mN.

Dry-type single-core cable

Short inner end, cold fitted

Performance	Cable end terminal type	X-section mm²	Supplier	Number of cables	Comments
3 to 24 kV 400 A - 630 A	Round connector	50 to 240 mm²	All cold fitted cable end suppliers: Silec, 3M, Pirelli, Raychem, etc.	1 or 2 per phase	For larger x-sections, more cables and other types of cable end terminals, please consult us
3 to 24 kV 1250 A	Round connector	50 to 630 mm²	All cold fitted cable end suppliers: Silec, 3M, Pirelli, Raychem, etc.	1 or 2 per phase ≤ 400 mm²	For larger x-sections, more cables and other types of cable end terminals, please consult us
	Square connector	> 300 mm² admissible		400 < 1 ≤ 630 mm² per phase	

Three core, dry cable

Short inner end, cold fitted

Performance	Cable end terminal type	X-section mm²	Supplier	Number of cables	Comments
3 to 24 kV 400 A - 630 A	Round connector	50 to 240 mm²	All cold fitted cable end suppliers: Silec, 3M, Pirelli, Raychem, etc.	1 per phase	For larger x-sections, more cables and other types of cable end terminals, please consult us
3 to 24 kV 1250 A	Round connector	50 to 630 mm²	All cold fitted cable end suppliers: Silec, 3M, Pirelli, Raychem, etc.	1 per phase	For larger x-sections, more cables and other types of cable end terminals, please consult us

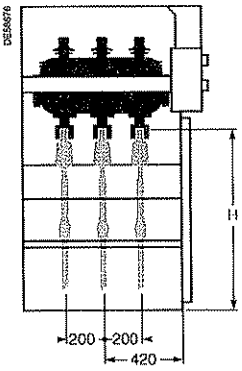
Note:
■ *The cable end terminals, covered by a field distributor, can be square,*
■ *PM/QM type cubicle, round end connections Ø 30 mm max.*

Cable-connection from below for 24 kV
Cable positions

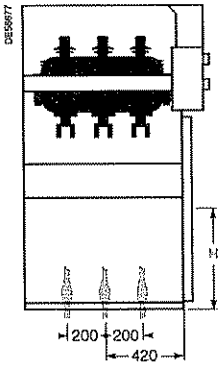
Cable-connection height H measured from floor (mm)

	630 A	1250 A
IM, NSM-cables, NSM-busbars	945	
SM	945	945
IMC	400	
PM, QM	400	
QMC	400	
CRM, CVM	430	
DM1-A	430	320
DMVL-A	430	
DMV-S	320	
DM1-W	370	320
GAM2	760	
GAM	470	620
DMV-A	320	313
DM1-S	543	

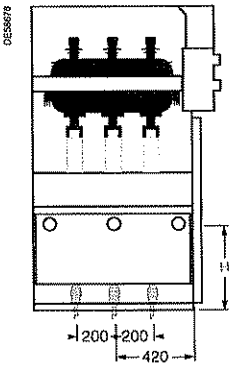
IM, NSM-cables, NSM-busbars, SM



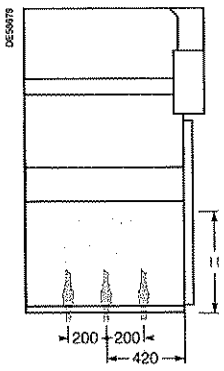
IMC, PM, QM, QMC



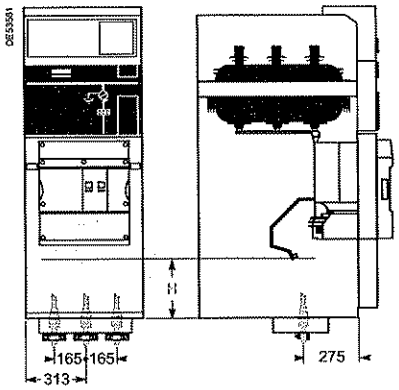
CRM, CVM



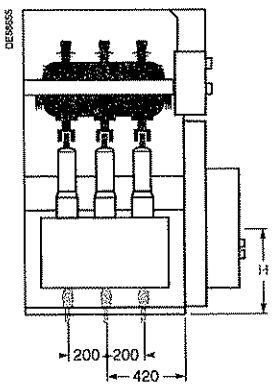
GAM, GAM2



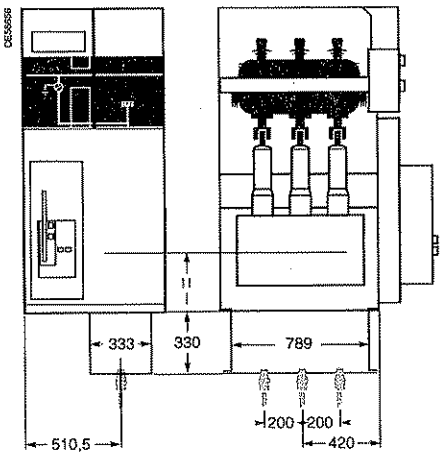
DMV-A, DMV-S (630 A)



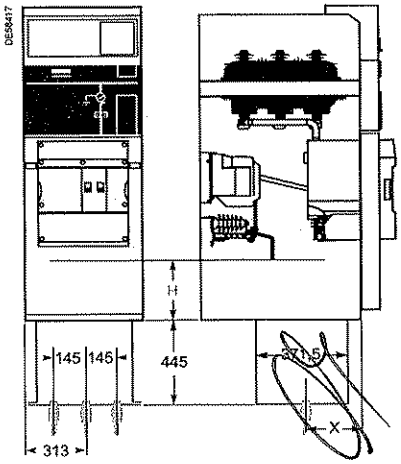
DM1-A, DM1-S, DMVL-A
DM1-W (630 A)



DM1-A, DM1-W (1250 A)

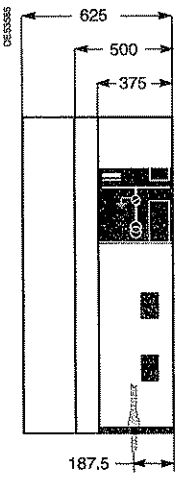


DMV-A (1250 A)



X = 330 : 1 single-core cable
X = 268 : 2 single-core cables
X = 299 : Three core cable

Cable-connection from below for 24 kV
Trenches depth



Cabling from below (all units)

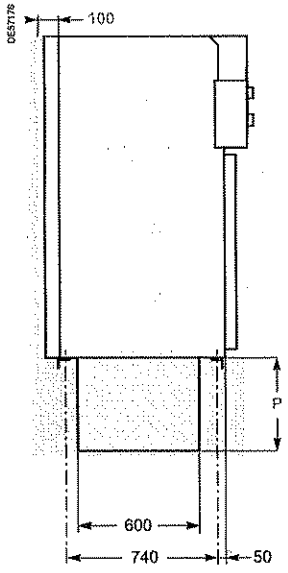
- **Through trenches:** the trench depth P is given in the following table for usual dry single-core cables type (for tri-core cables consult us).
- **With stands:** to reduce depth P or avoid trenches, by placing the units on 400 mm concrete footings.
- **With floor void:** the trench depth is given in the following table for usual types of cables.

Cable section (mm^2)	630 A							1250 A	
	All cubicles expect ...		Other cubicles					SM, GAM	DM1A, DMV-A, DM1-W
			DMVA	CVM		DM1A, DM1S, DM1W, DMVLA			
	12.5 kA/1s	16 kA/1s	12-16 kA/1s	12.5 kA/1s	16 kA/1s	12.5 kA/1s	16 kA/1s	12-16 kA/1s	12-16 kA/1s
	Depth P (mm)								
S < 120	330	550	550	330	550	330	550	–	–
120 < S < 240	330	550	800	–	–	Opposite to circuit breaker: 330 / Under the circuit breaker: 450	550	–	–
S > 400	–	–	–	–	–	–	–	1000	1400

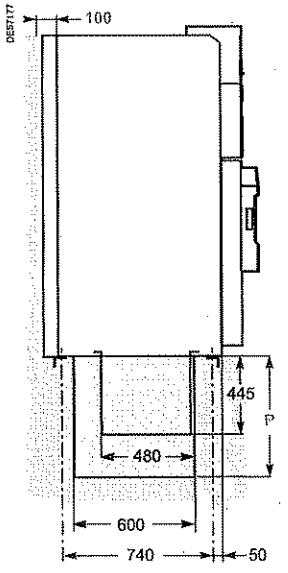
Cable trench drawings

1250 A units (represented without switchboard side panels)

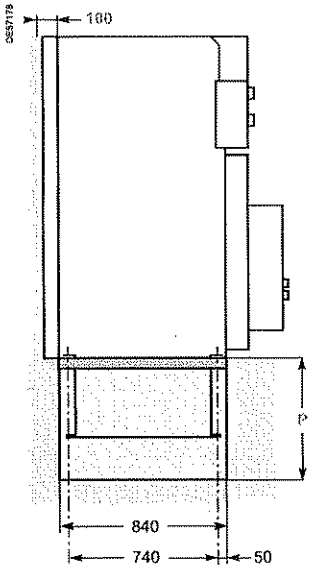
SM, GAM
For single and tri-core cables



DMV-A
For single and tri-core cables

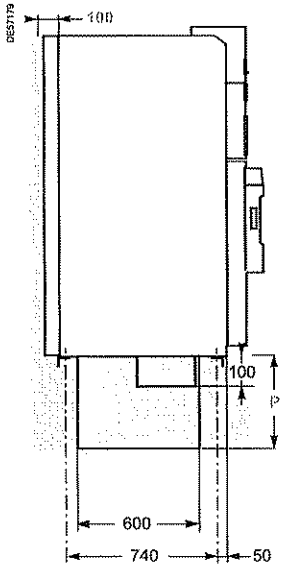


DM1-A, DM1-W
For single-core cables



630 A units

DMV-A, DMV-S
For single cables

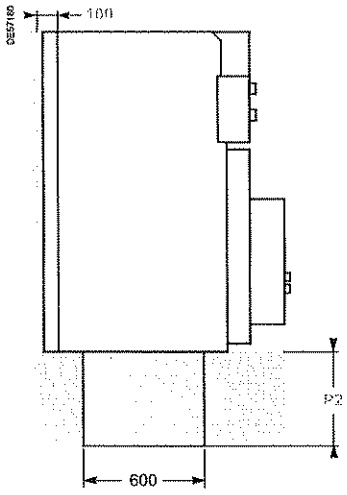


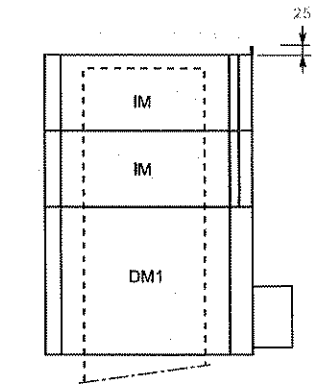
Cable-connection from below for 24 kV

Trench diagrams example for installation IAC: A-FL classified

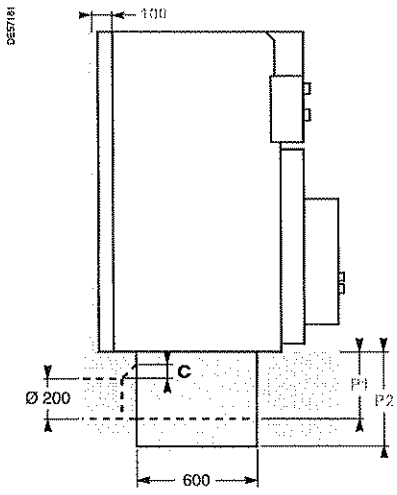
Units represented without switchboard side panels

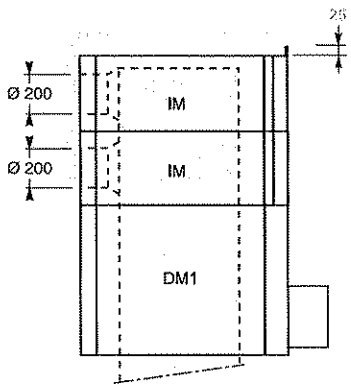
630 A units
Cable entry or exit
through right or left side



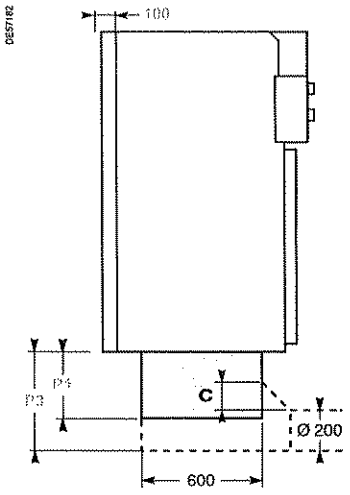


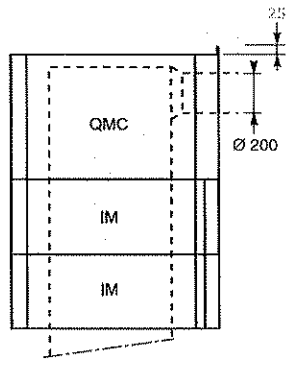
630 A units
Rear entry or exit
with conduits





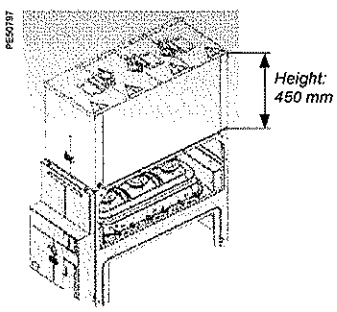
630 A units
Front entry or exit
with conduits





Required dimensions (mm)

Note 1: *for connection with conduits, the bevel (C) must correspond to the following trench dimensions: P1 = 75 mm or P2/P3 = 150 mm.*
Note 2: *please refer to chapter "Layout examples" for a site application.*



Cabling from above

On each 630 A unit of the range, except those including a low-voltage control cabinet and EMB compartment, the connection is made with dry-type and single-core cables.

Remarks:
- *Not available for internal arc IEC 62271-200 in busbar compartment.*
- *Not available in 1250 A.*

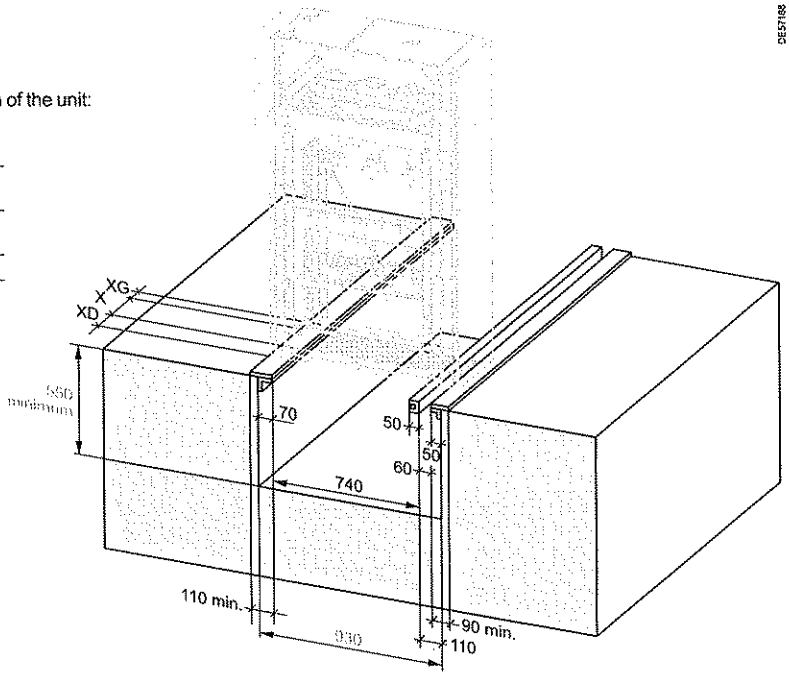
Cable-connection from below for 24 kV

Trench diagrams and floor void drawings example

Installation with floor void for 16 kA 1 s downwards exhaust

■ Position of fixing holes depends on the width of the unit:

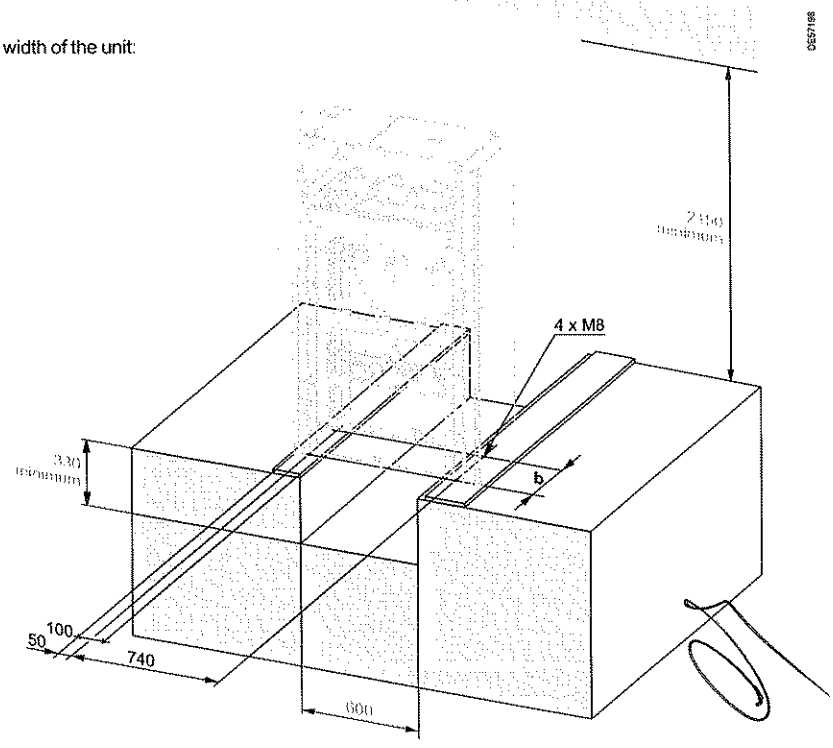
Width	Cubicles	XG (mm)	X (mm)	XD (mm)
375	All	57.5	260	57.5
500	GAM	57.5	260	182.5
	Other	182.5	260	57.5
625	QMC	307.5	260	57.5
	Other	57.5	510	57.5
750	All	432.5	260	57.5



Installation with cable trench for 12.5 kA 1 s downwards exhaust for 16 kA 1 s and 20 kA 1 s upwards exhaust

■ Position of fixing holes **b** depends on the width of the unit:

Cubicle width (mm)	b (mm)
125	95
375	345
500	470
625	595
750	720



Connections with dry-type cables for 36 kV
Selection table

Single-core cables		Units 630 A	
Cable-section (mm^2)	Bending radius (mm)	IM, IMC, QM, CM, CM2, PM, DM1-A, DM1-W, GAM, GAM2, SM, TM, NSM Depth P (mm)	
		P1	P2
1 x 35	525	350	550
1 x 50	555	380	580
1 x 70	585	410	610
1 x 95	600	425	625
1 x 120	630	455	655
1 x 150	645	470	670
1 x 185	675	500	700
1 x 240	705	530	730

***Note:** the unit and the cables requiring the greatest depth must be taken into account when determining the depth P for single-trench installations. In double-trench installations must be taken into account to each type of unit and cable orientations.*

The ageing resistance of the equipment in an MV/LV substation depends on three key factors:

■ **the need to make connections correctly**
New cold fitted connection technologies offer ease of installation that favours resistance over time. Their design enables operation in polluted environments under severe conditions.

■ **the impact of the relative humidity factor**
The inclusion of a heating element is essential in climates with high humidity levels and with high temperature differentials.

■ **ventilation control**
The dimension of the grills must be appropriate for the power dissipated in the substation. They must only traverse the transformer area.

Network cables are connected:
■ on the switch terminals
■ on the lower fuse holders
■ on the circuit breaker's connectors.

The bimetallic cable end terminals are:
■ round connection and shank for cables ≤ 240 mm^2.
Crimping of cable lugs to cables must be carried out by stamping.

The end connectors are of cold fitted type
Schneider Electric's experience has led it to favour this technology wherever possible for better resistance over time.

The maximum admissible copper(*) cable cross section:
■ 2 x (1 x 240 mm^2 per phase) for 1250 A incomer and feeder cubicles
■ 240 mm^2 for 400-630 A incomer and feeder cubicles
■ 95 mm^2 for transformer protection cubicles with fuses.
Access to the compartment is interlocked with the closing of the earthing disconnector.
The reduced cubicle depth makes it easier to connect all phases.
A 12 mm Ø pin integrated with the field distributor enables the cable end terminal to be positioned and attached with one hand. Use a torque wrench set to 50 mN.

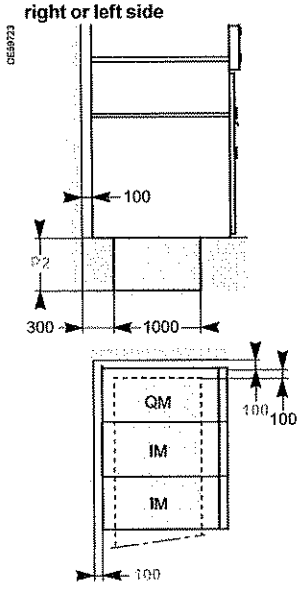
(*) Consult us for alu cable cross sections

Cabling from below

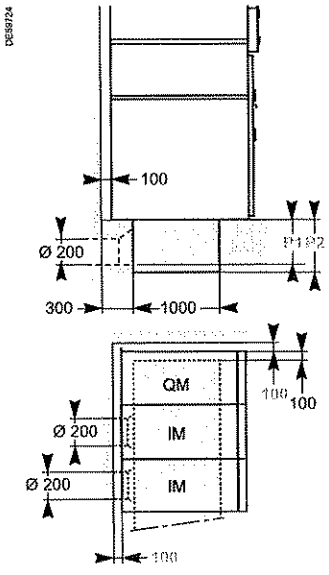
All units through trenches
■ the trench depth P is given in the table opposite for commonly used types of cables.

Trench diagrams

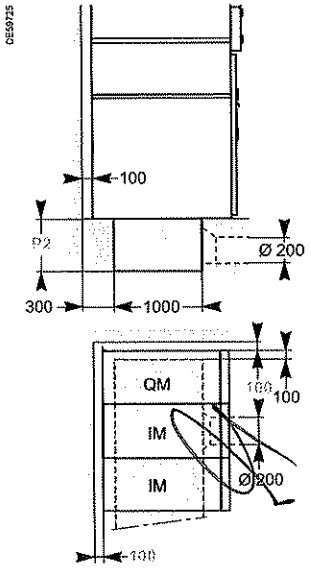
Cable entry or exit through right or left side



Rear entry or exit with conduits



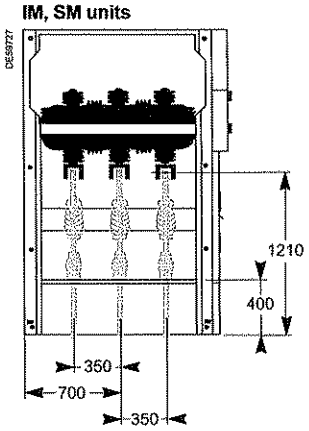
Front entry or exit with conduits



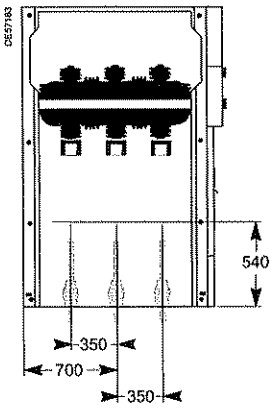
Cable-connection from below for 36 kV
Cable positions

Side view

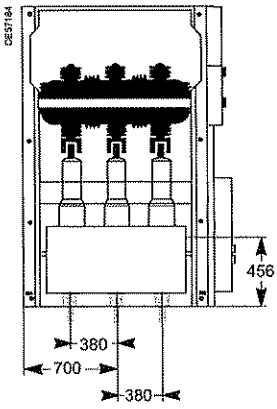
IM, SM units



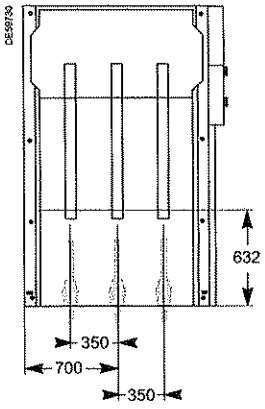
QM, PM units



DM1-A, DM1-W units

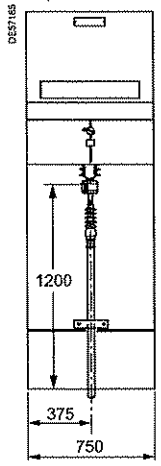


GAM2 unit

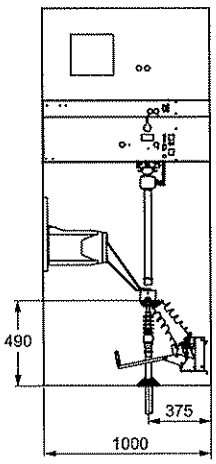


Front view

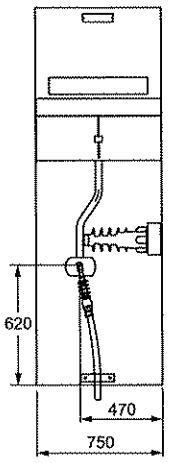
IM, SM



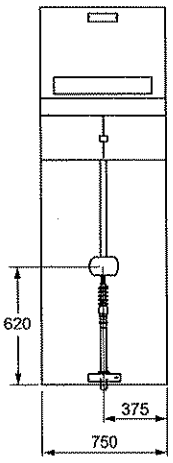
QMC



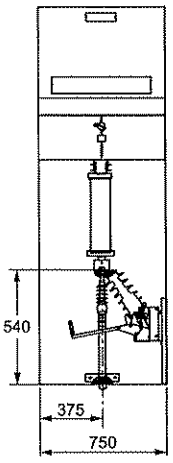
GAM



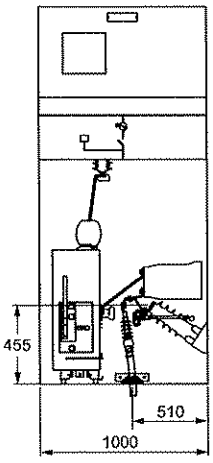
GAM2



QM, PM



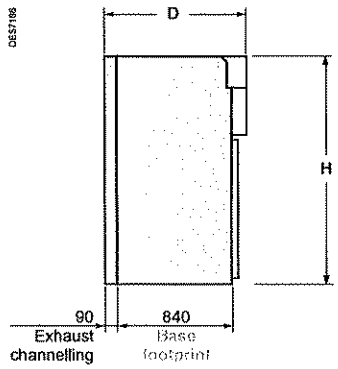
DM1-A, DM1-W



Contents

ВЯРНО С ОРИГИНАЛА

Dimensions and weights for 24 kV



Dimensions and weights

Unit type	Height H (mm)	Width (mm)	Depth D (mm)	Weight (kg)
IM,IMB	1600 (1)	375/500	1030	130/140
IMC	1600 (1)	500	1030	210
PM, QM, QMB	1600 (1)	375/500	1030	140/160
QMC	1600 (1)	625	1030	190
CVM, CRM	2050	750	1030	400
DM1-A, DM1-D, DM1-W, DM2, DMVL-A, DMVL-D	1600 (1)	750	1230	410
DM1-S	1600 (1)	750	1230	350
DMV-A, DMV-D	1695 (1)	625	1115	350
DMV-S	1600 (1)	625	1115	270
CM	1600 (1)	375	1030	200
CM2	1600 (1)	500	1030	220
GBC-A, GBC-B	1600 (1)	750	1030	300
NSM-cables, NSM-busbars	2050	750	1030	270
GIM	1600	125	930	40
GEM (2)	1600	125	930/1060 (2)	40/45
GBM	1600	375	1030	130
GAM2	1600	375	1030	130
GAM	1600	500	1030	170
SM	1600 (1)	375/500 (3)	1030	130/160
TM	1600	375	1030	210
DM1-A, DM1-D, DM1-W, DM1-Z (1250 A)	1600 (1)	750	1230	430

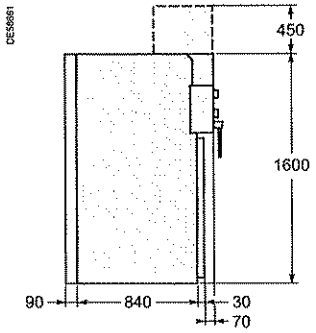
(1) Add to height 450 mm for low-voltage enclosures for control/monitoring and protection functions. To ensure uniform presentation, all units (except GIM and GEM) may be equipped with low-voltage enclosures.

(2) Depending on the busbar configuration in the VM6 unit, two types of extension units may be used:
- *to extend a VM6 DM12 or DM23 unit, use an extension unit with a depth of 1060 mm*
- *for all other VM6 units, a depth of 930 mm is required.*

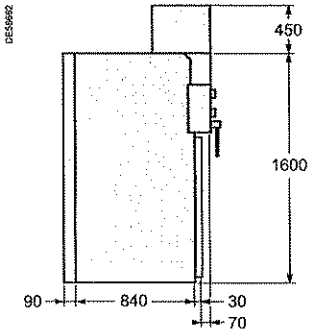
(3) For the 1250 A unit.

Units dimensions for 24 kV

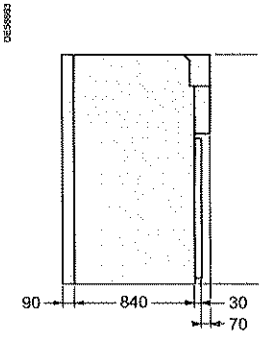
IM, IMB, PM, QM, QMB, SM, IMC, QMC, CM, CM2



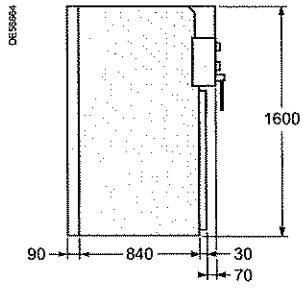
NSM-cables, NSM-busbars, CRM, CVM



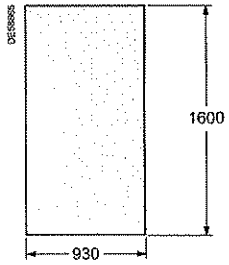
GBM, GAM2



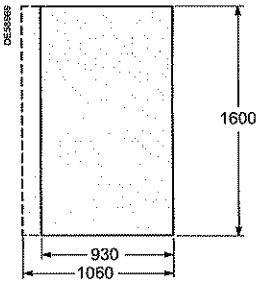
GAM



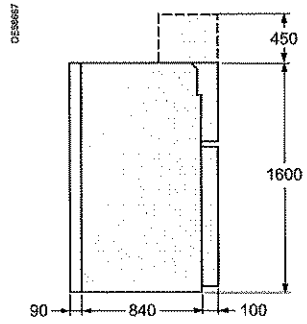
GIM



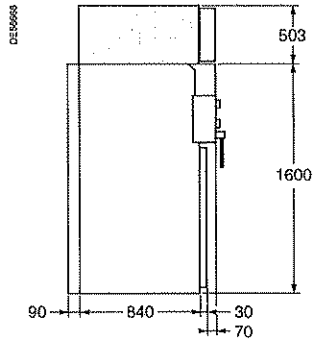
GEM



GBC-A, GBC-B

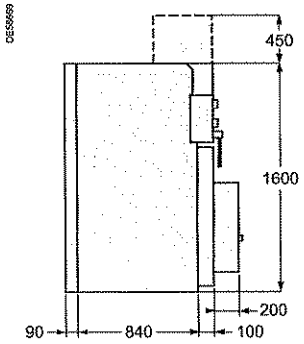


IM with EMB option

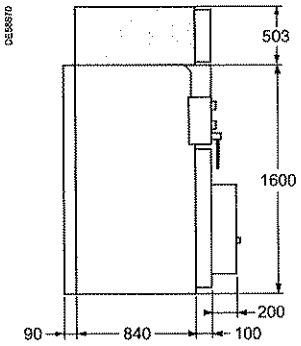


Units dimensions for 24 kV

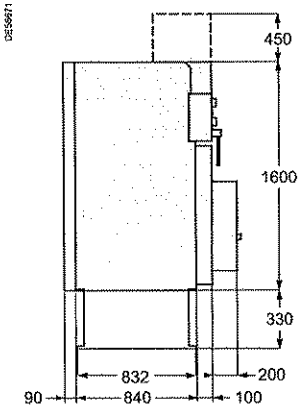
DMVL-A, DMVL-D, DM1-A, DM1-D, DM1-W, DM1-Z, DM1-S, DM2 630 A



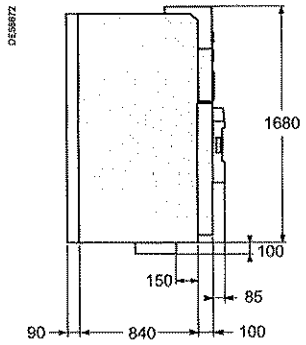
DM1-A 630 A with EMB option



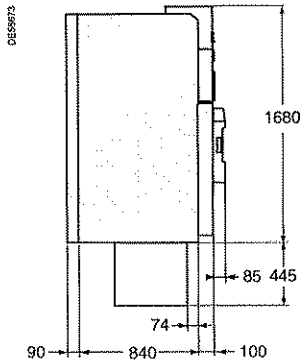
DM1-A, DM1-W 1250 A



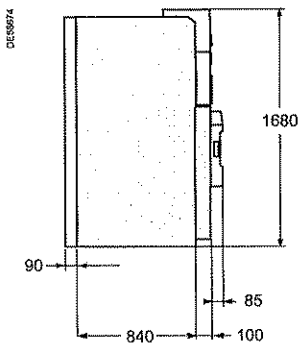
DMV-A 630 A



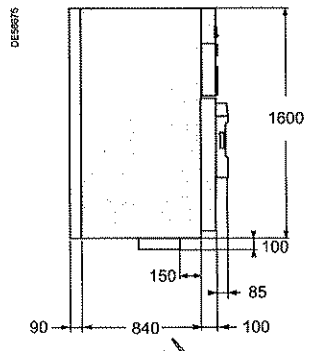
DMV-A 1250 A



DMV-D



DMV-S



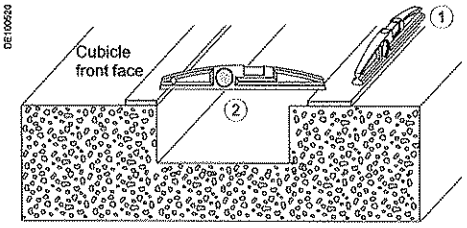
Civil engineering for 24 kV

Ground preparation

To obtain the internal arc performance, ground implementation must comply with the following requirements:

- Straightness: 2 mm / 3 m (Rep.1)
- Flatness: 3 mm maximum (Rep.2)

All the elements allowing the evacuation of the gas (duct, casing, etc.) must be able to bear a load of 250 kg/m^2.



Fixing of units

With each other

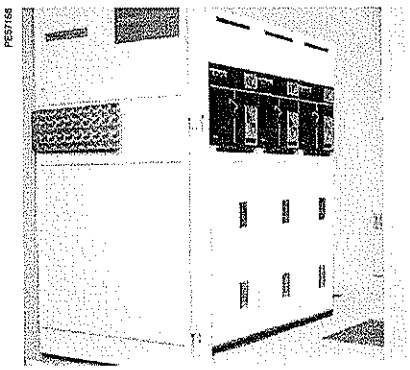
The units are simply bolted together to form the MV switchboard (bolts supplied). Busbar connections are made using a torque wrench set to 28 mN.

On the ground

- For switchboards comprising up to three units, the four corners of the switchboard must be secured to the ground with using:
  - M8 bolts (not supplied) screwed into nuts set into the ground using a sealing pistol
  - screw rods grouted into the ground.
- For switchboards comprising more than three units, each unit may be fixed to the ground
- In circuit-breaker or contactor units, fixing devices are installed on the opposite side of the switchgear.

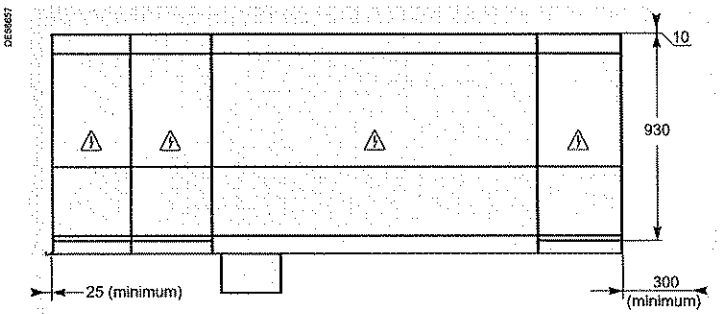
Layout examples for 24 kV

Prefabricated substation (Kiosk)

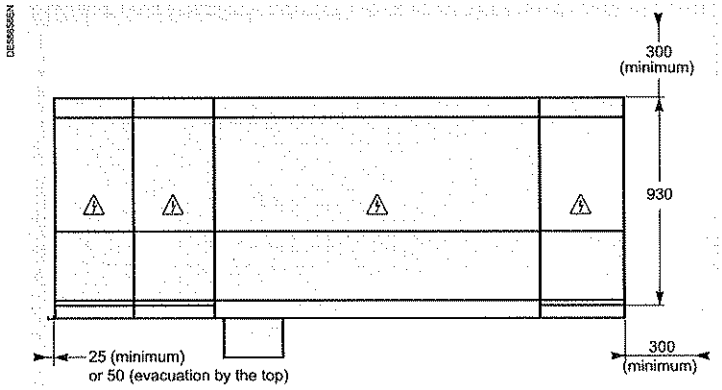


Position of cubicles in a substation

Installation of a switchboard classified IAC: A-FL

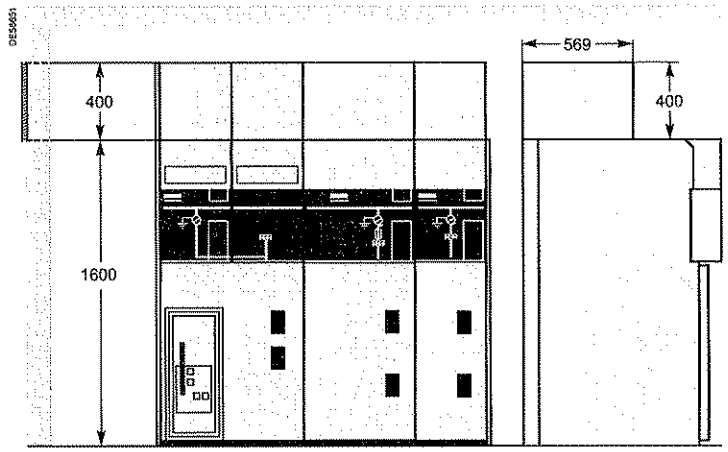


Installation of a switchboard classified IAC: A-FLR



With upwards exhaust left side

(ceiling height ≥ 2150 mm)

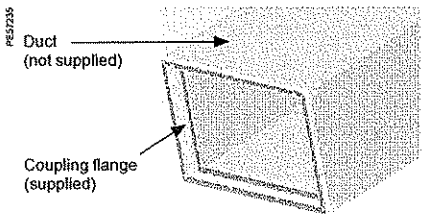


Evacuation duct

To enable the evacuation of gases by the top, users must install a conduit fixed to the coupling flange at right or left of the switchboard.
The end of the duct must block water, dust, moisture, animals, etc. from entering and at the same time enable the evacuation of gases into a dedicated area through a device situated at the outer end of the duct (not supplied).

Evacuation duct example

The evacuation duct must be made of metal sheet of sufficient thickness to withstand pressure and hot gases.



Dimensions and weights for 36 kV

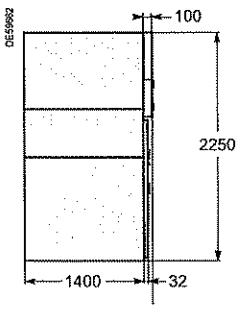
Dimensions and weights

Unit type	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
IM, SM	2250	750	1400 (3)	310
IMC, IMB	2250	750	1400 (2)	420
QM, PM, QMB	2250	750	1400 (3)	330
QMC	2250	1000	1400 (3)	420
DM1-A	2250	1000	1400 (2)	600
DM1-D	2250	1000	1400 (2)	560
DM1-W	2250	1000	1400 (2)	660
NSM	2250	1500	1400 (2)	620
GIM	2250	250	1400	90
DM2	2250	1500	1400 (2)	900
DM2-W	2250	1500	1400 (2)	920
CM, CM2	2250	750	1400 (2)	460
GBC-A, GBC-B	2250	750	1400 (3)	420
GBM	2250	750	1400 (3)	260
GAM2	2250	750	1400 (3)	250
GAM	2250	750	1400 (3)	295

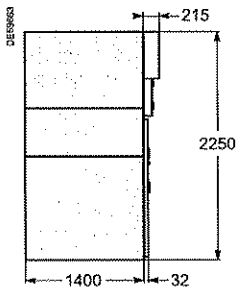
(1) The depth measures are given for the floor surface.
(2) The depth in these units are 1615 mm with the enlarged low voltage compartment.
(3) The depth in these units are 1500 mm with the standard low voltage compartment.

Dimensions

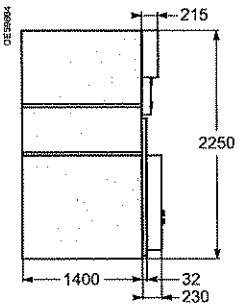
IM, SM, IMC, QM, PM, IMB, GBM, GAM, GAM2, GBC-A,GBC-B QMB, QMC units



CM, CM2, NSM units



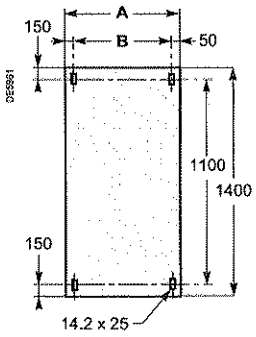
DM1-A, DM1-D, DM2, DM1-W, DM2-W units



Civil engineering for 36 kV

Ground preparation

Units may be installed on ordinary concrete grounds, with or without trenches depending on the type and cross-section of cables.
Required civil works are identical for all units.



Fixing of units

With each other

The units are simply bolted together to form the MV switchboard (bolts supplied). Busbar connections are made using a torque wrench set to 28 mN.

On the ground

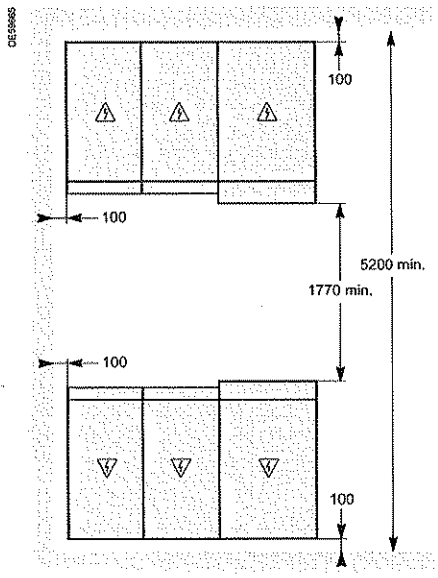
- for switchboards comprising up to three units, the four corners of the switchboard must be secured to the ground using:
  - bolts (not supplied) screwed into nuts set into the ground using a sealing pistol
  - screw rods grouted into the ground
- for switchboards comprising more than three units, the number and position of fixing points depends on local criteria (earthquake withstand capacities, etc.)
- position of fixing holes depends on the width of units.

Unit type	A (mm)	B (mm)
IM, IMC, IMB, QM, PM, SM, CM, CM2, TM GBC-A, GBC-B, GBM, GAM2, IMB, GAM, QMB	750	650
DM1-A, DM1-D, DM1-W, QMC	1000	900
DM2, NSM, DM2-W	1500	1400
GIM	250	150

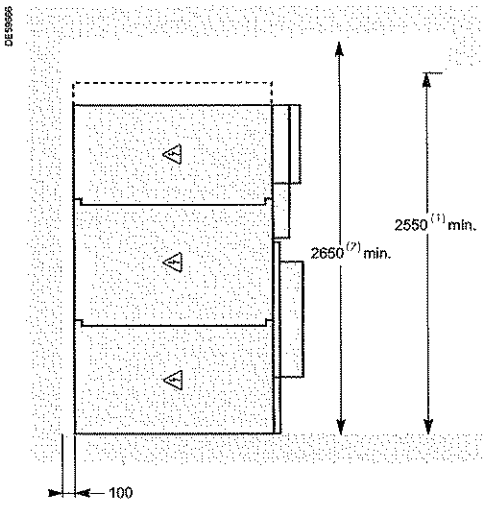
Layout examples for 36 kV

Conventional substation (Masonery)

Top view

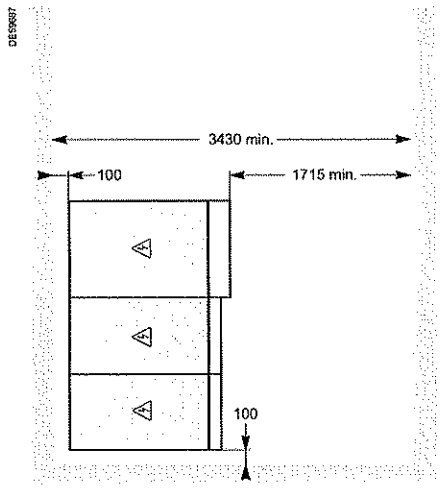


Side view



Minimum required dimensions (mm)
(1) In case of upper incoming option: it must be 2730 mm (no internal arc withstand if selected)
(2) In case of upper incoming option: it must be 2830 mm (no internal arc withstand if selected)

Top view



ВЯРНО С ОРИГИНАЛА

Appendices
Order forms

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ВЯРНО С ОРИГИНАЛА

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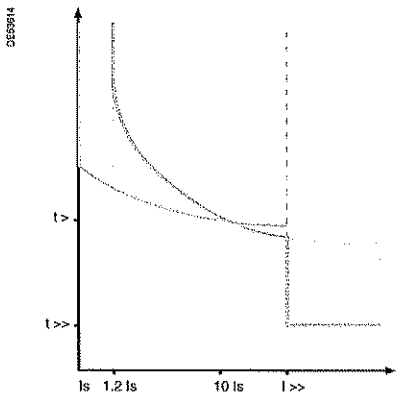
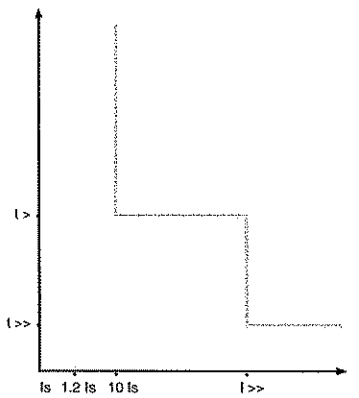
Trip curves for VIP 300 LL or LH relays



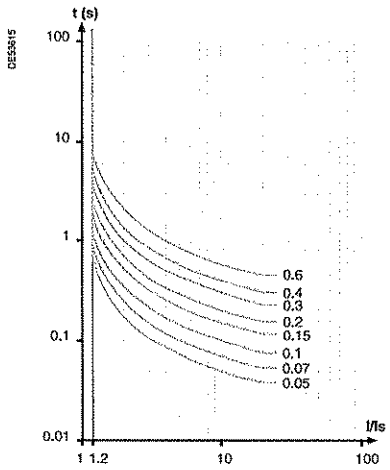
With lower definite time threshold



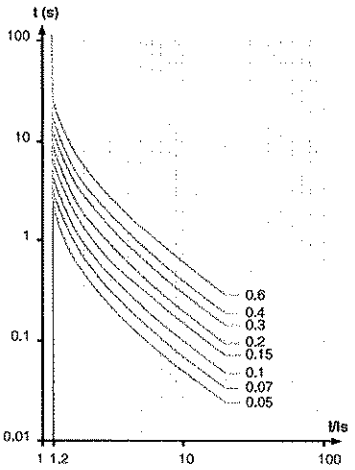
With lower inverse definite time threshold

Definite time tripping curves

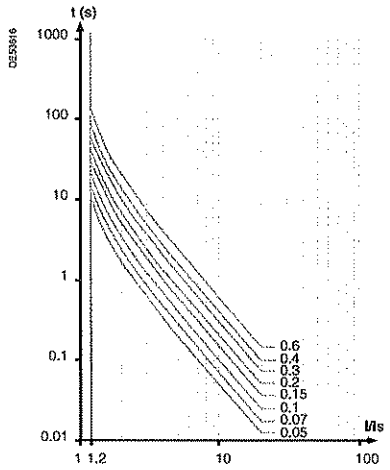
SI curve



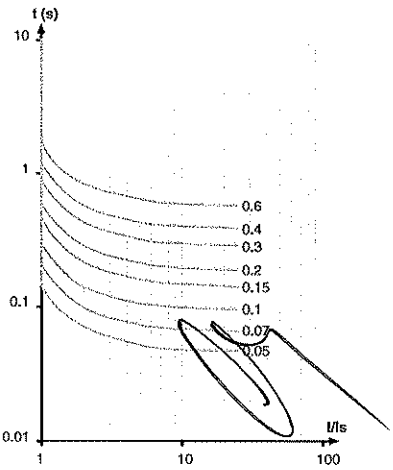
VI curve



EI curve

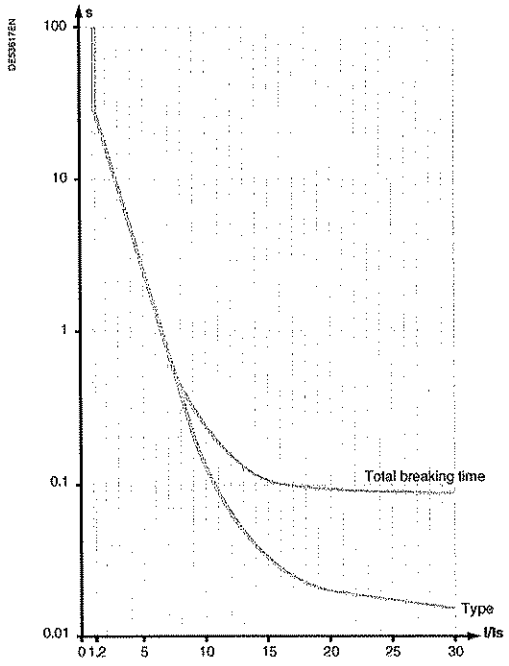


RI curve



Trip curves for VIP 35 relays

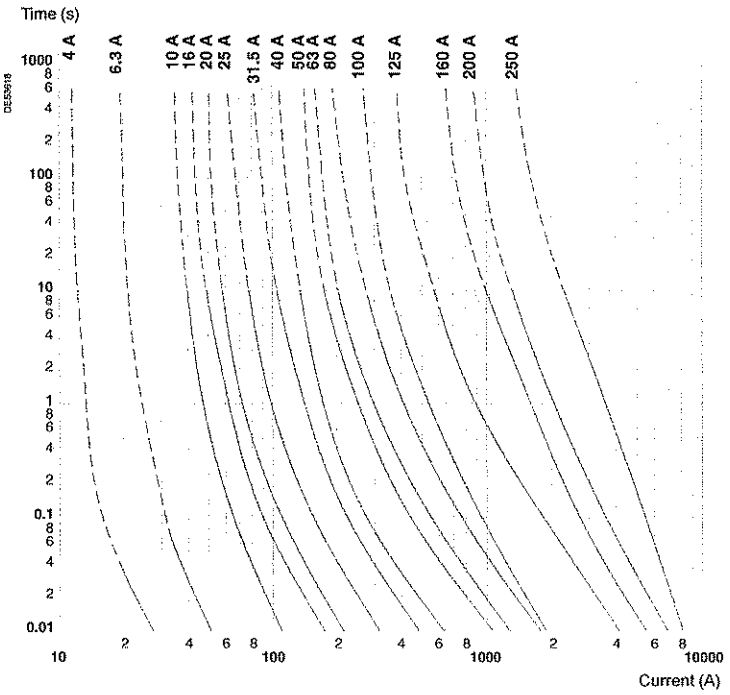
Phase protection curve



The trip curve shows the time before the relay acts, to which must be added 70 ms to obtain the breaking time.

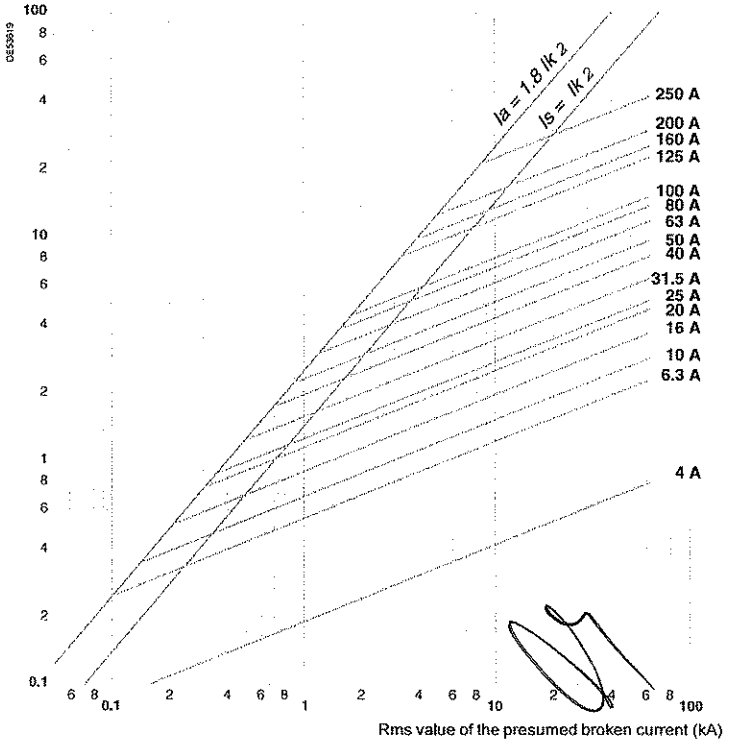
Fusarc CF fuses
Fuse and limitation curves

Fuse curve 3.6 - 7.2 - 12 - 17.5 - 24 - 36 kV



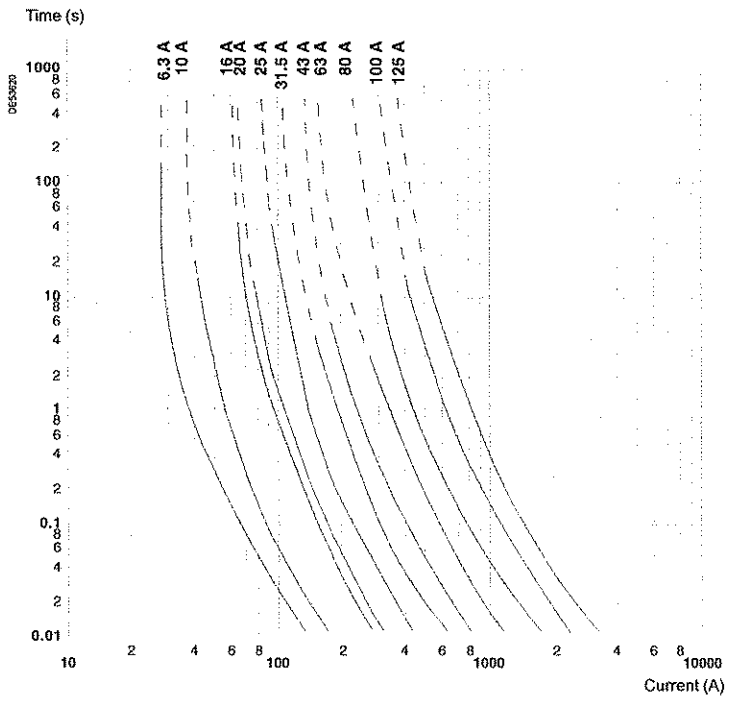
Limitation curve 3.6 - 7.2 - 12 - 17.5 - 24 - 36 kV

The diagram shows the maximum limited broken current value as a function of the rms current value which could have occured in the absence of a fuse.



Solefuse fuses
Fuse and limitation curves

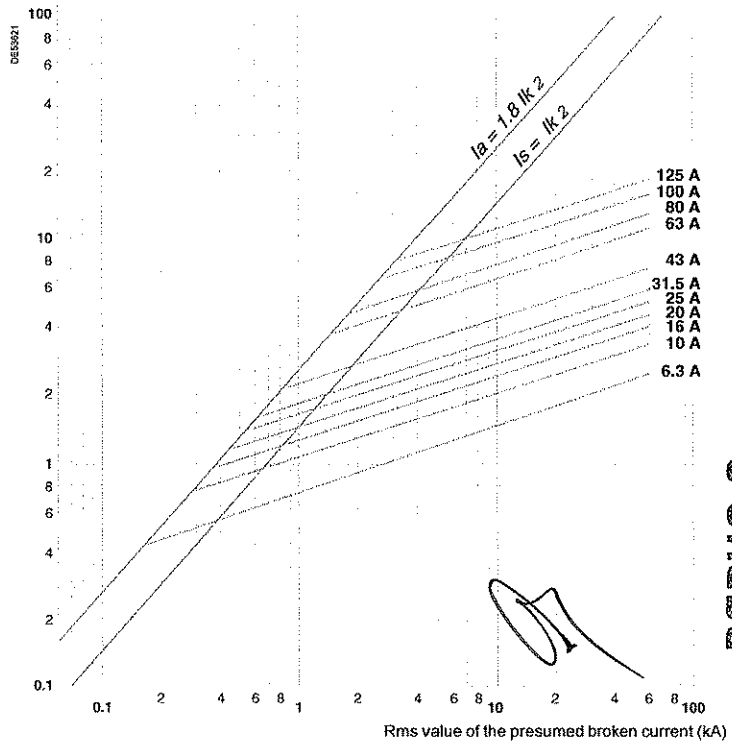
Fuse curve 7.2 - 12 - 17.5 - 24 kV



Limitation curve 7.2 - 12 - 17.5 - 24 kV

Maximum value of the limited broken current (kA peak)

The diagram shows the maximum limited broken current value as a function of the rms current value which could have occured in the absence of a fuse.



Order form

SM6
Switching

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic cubicle Quantity

Rated voltage Ur				(kV)
Service voltage				(kV)
Short-circuit current Isc				(kA)
Rated current Ir				(A)
Internal arc withstand		12.5 kA 1s for 24 kV		16 kA 1s for 36 kV
Type of cubicle				
24 kV	SM 375	IM 375	IMC 500	IMB 375
	SM 500 (for 1250 A)	IM 500		
36 kV	SM 750	IM 750	IMC 750	IMB 750
Position in the switchboard		First on left	Middle	Last on right
Direction of lower busbars for IMB				
		Left (impossible as first cubicle of switchboard)		Right

Options

Common options

Replacement of CIT by		CI1	CI2
Electrical driving motorization and/or coil voltage (not applicable on SM cubicle)	24 Vdc	110 Vdc	120/127 Vac (50 Hz)
	32 Vdc	120-125 Vdc	220/230 Vac (50 Hz)
	48 Vdc	137 Vdc	120/127 Vac (60 Hz)
	60 Vdc	220 Vdc	220/230 Vac (60 Hz)
Signalling contact		1 C on SW and 1 O & 1 C on ES (not applicable on SM cubicle)	
		2 O & 2 C on SW	2 O & 3 C on SW and 1 O & 1 C on ES
Interlocking		Tubular key type	Flat key type
	For all cubicle (except SM) A4	A3 SM6-SM6	P1 SM6-SM6
	Localisation of 2nd lock for A3	On switch	On earthing switch
	Localisation of 2nd lock for A4		Cubicle no.
	SM cubicle only	P2 SM6-SM6	P3 SM6-SM6
Replacement of 630 A upper busbar by 1250 A (not possible for IMB)			
Digital ammeter or fault current indicator	AMP 21D		Flair 23DV zero sequence
	Flair 21D	Flair 22D	Flair 23DV

24 kV options

Remote control signalling			
2 lights	2 lights and 2 PB	2 lights and 2 PB + 1 switch	
Voltage of the lights (must be the same than electrical driving mechanism)			
24 V	48 V	110/125 V	220 V
Roof configuration (A, B or C only one choice possible)			
A - Cable connection by the top (cable maxi 240 mm² with VPIS)			
		Single core	2 x single core
B - Low voltage control cabinet (h = 450 mm)			With unpunched door
C - Wiring duct			
Cable connection by the bottom (not applicable on IMB, cable maxi 240 mm²)			
	Three core	Single core	2 x single core
50 W heating element			
Surge arresters for IM 500			
7.2 kV	10 kV	12 kV	17.5 kV	24 kV
Operation counter			
CTs for IMC (quantity)	1	2	3
Visibility of main contacts			
Pressure indicator device		Analogic manometer **without** visibility of main contacts	
Pressure switch		Analogic manometer **with** visibility of main contacts	
Busbar field distributors for severe conditions (only for 630 A)			
Internal arc version (not possible with "top incomer" option)	16 kA 1 s		20 kA 1 s
Gaz exhaust direction	Downwards (only for 16 kA 1s)		Upwards

36 kV options

Electrical driving mechanism (with O/C coils and AC contacts)	
O/C coils without electrical driving mechanism	
Cable connection by the top (single core cable maxi 240 mm² with VPIS)	
Cable connection by the bottom (2 x single core, cable maxi 240 mm², not applicable on IMC)	
Surge arresters (not applicable on IMB, IMC cubicles)	36 kV

RAPIDO OFFERTA
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Order form

SM6
Switching
Automatic Transfer System

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic cubicle

Quantity [ ]

Rated voltage Ur			(kV) [ ]
Service voltage			(kV) [ ]
Short-circuit current Isc			(kA) [ ]
Rated current Ir			(A) [ ]
Internal arc withstand	12.5 kA 1s for 24 kV [ ]		16 kA 1s for 36 kV [ ]
Type of cubicle/upper busbar for 24 kV			
Ir = 630 A, Ir busbar = 400 A	NSM busbar [ ]		NSM cable [ ]
Ir = 630 A, Ir busbar = 630 A	NSM busbar [ ]		NSM cable [ ]
Ir = 630 A, Ir busbar = 1250 A			NSM cable [ ]
Type of cubicle for 36 kV	NSM busbar [ ]		NSM cable [ ]
Position in the switchboard	First on left [ ]	Middle [ ]	Last on right [ ]
Incoming bottom busbar for NSM busbar	Left [ ]		Right [ ]
Cable connection by the bottom (cable maxi 240 mm²) **for NSM cable**	Three core on both [ ]	Single core on both [ ]	2 x single core on both [ ]
Stand by source			Generator without paralleling [ ]
	Utility with paralleling [ ]		Utility without paralleling [ ]
Control unit HMI language	French [ ]	English [ ]	Spanish [ ] Portuguese [ ] Chinese [ ]

Options

Common options

Signalling contact			1 C on SW and 1 O & 1C on ES [ ]
Operation counter			[ ]
Interlocking SM6-SM6		Tubular key type [ ]	Flat key type [ ]
	1 x P1	Right cubicle [ ]	Left cubicle [ ]
	2 x P1		Right and left cubicle [ ]
	1 x A3	Right cubicle [ ]	Left cubicle [ ]
		On switch [ ]	On earthing switch [ ]
	2 x A3 Right cubicle	On switch [ ]	On earthing switch [ ]
	Left cubicle	On switch [ ]	On earthing switch [ ]
Control and monitoring			[ ]
Protocol type	DNP3 [ ]	IEC 101/204 [ ]	Modbus (by default) [ ]
Modem type	FFSK [ ]	RS485 [ ]	RS232 (by default) [ ]
	PSTN [ ]	GSM [ ]	FSK [ ]

24 kV options

2 heating elements			[ ]
Busbar field distributors for severe conditions (only for 630 A)			[ ]
Internal arc version (not possible with "top incomer" option)		16 kA 1 s [ ]	20 kA 1 s [ ]
Gaz exhaust direction	Downwards (only for 16 kA 1s) [ ]		Upwards [ ]

BRPHOC PORTUGAL

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Order form

SM6
Protection
Circuit breaker

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic cubicle — Qty

Common 24/36 kV

Rated voltage Ur						(kV)
Service voltage						(kV)
Short-circuit current Isc						(kA)
Rated current Ir						(A)
Internal arc withstand			12.5 kA 1s for 24 kV		16 kA 1s for 36 kV	
24 kV For **SF1** circuit breaker	DM1-A 750		DM1-D left 750		DM1-D right 750	
	DM1-S 750		DM1-Z 750		DM1-W 750	
			DM2 left 750		DM2 right 750	
For **SFset** circuit breaker			DM1-D left 750		DM1-D right 750	
For **Evolis** frontal 630 A CB	DMV-A		DMV-S		DMV-D right	
For **Evolis** lateral 630 A CB			DMVL-A		DMVL-D	
36 kV For **SF1** circuit breaker	DM1-A 1000		DM1-D left 1000		DM1-D right 1000	
	DM1-W 1000		DM2 left 1500		DM2 right 1500	
					DM2-W right 1500	
Position in the switchboard	First on left		Middle		Last on right	
Circuit breaker					See specific order form	
Current transformers (CT) and LPCTs					See specific order form	

Basic 24 kV

Busbar (Ir ⩾ Ir cubicle)

For DM1-A, DM1-S, DM1-W, DMVL-A, DMVL-D ,DM1-D, DM2			
	400 A	630 A	1250 A
For DM1-A, DM1-D, DM1-W, DM1-Z			1250 A
For DMV-A, DMV-D		630 A	1250 A
For DMV-S		630 A	

Protection

For DM1-S, DMV-S	VIP35 with CRc		VIP300LL with CRa
			VIP300LL with CRb
For DM1-S	Sepam series 10 with CRa		Sepam series 10 with CRb
For DMV-A, DMV-D			Sepam series 20/40
For DM2, DM1-Z, DM1-W		Statimax 5A, 2 s	Statimax 1A, 2 s

Control for DMV-A and DMV-D

Local (shunt trip coil compulsory)			
Remote (opening coil and closing coil compulsory)			
Local and remote (opening coil and closing compulsory)			
Voltage of the auxiliaries	48/60 Vdc		110/125 or 220/250 Vdc
			110/130 or 220/240 Vac (50 Hz)
Voltage of signalling	48/60 Vdc	110/125 Vdc	220/250 Vdc
	110/130 Vac (50 Hz)		220/240 Vac (50 Hz)

Cable connection by the bottom

For DM1-A, DM1-W, DMVL-A		
3 x single core cable maxi 240 mm²		6 x single core cable maxi 240 mm²
Current sensors	MV type CT	LPCT ring type for DM1-A 630 A
		LPCT MV type for DM1-D,DM1-W 630 A

Basic 36 kV

Voltage of the auxiliaries	48/60 Vdc		110/125 or 220/250 Vdc
			110/130 or 220/240 Vac (50 Hz)
Voltage of signalling	48/60 Vdc	110/125 Vdc	220/250 Vdc
	110/130 Vac (50 Hz)		220/240 Vac (50 Hz)

Options — Qty

ВАРИО ОПЦИИТА

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SM6
Protection
Circuit breaker

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Options

Common options

Interlocking — Tubular key type ☐ — Flat key type ☐

Not applicable on DM2	A1 ☐	C1 ☐	C4 ☐
Signalling contact	2 O & 2 C on SW (not applicable with VTs) ☐		
	2 O & 3 C on SW and 1 O & 1 C on ES (not applicable with VTs) ☐		
	1 O & 2 C on SW (available only on cubicle with VTs) ☐		
VTs (not applicable for DM1-S, DMV-S)	See specific order form		

24 kV options

Roof configuration (not applicable on DMV-A, DMV-S, DMV-D)
(A, B or C only one choice possible)

A - Cable connection by the top (cable maxi 240 mm² with VPIS)

		Single core ☐	2 x single core ☐
	DM2	1 set ☐	2 sets ☐

B - Low voltage control cabinet

	DM2	1 cabinet ☐	2 cabinets ☐

C - Wiring duct	**DM2**	1 set ☐	2 sets ☐
	Other cubicles	1 set ☐	

Surge arrester			☐
50 W heating element			☐
Replacement of 630 A upper busbars 400-630 A by 1250 A			☐
Busbar field distributors for severe conditions (only for 630 A)			☐
Internal arc version (not possible with "top incomer" option)		16 kA 1 s ☐	20 kA 1 s ☐
Gaz exhaust direction	Downwards (only for 16 kA 1s) ☐		Upwards ☐

36 kV options

Cable connection by the top (single core cable maxi 240 mm² with VPIS)	☐
Cable connection by the bottom (for DM1-A and DM1-W only)	
3 x 2 x single core cable maxi 240 mm²	☐
Surge arrester	36 kV ☐
Sepam relay protection	See specific order form

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Order form

SM6
Protection
Fuse switch

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

BASIC CUBICLE — Quantity [ ]

Rated voltage Ur				(kV) [ ]
Service voltage				(kV) [ ]
Short-circuit current Isc				(kA) [ ]
Rated current Ir				(A) [ ]
Internal arc withstand		12.5 kA 1s for 24 kV [ ]		16 kA 1s for 36 kV [ ]
Type of cubicle				
24 kV	QM 375 [ ] QM 500 [ ]	QMB 375 [ ]	QMC 625 [ ]	PM 375 [ ]
36 kV	QM 750 [ ]	QMB 750 [ ]	QMC 1000 [ ]	PM 750 [ ]
Position in the switchboard		First on left [ ]	Middle [ ]	Last on right [ ]
Current transformers for QMC 24 kV (to see price structure)				
Quantity of CTs		1 [ ]	2 [ ]	3 [ ]
Direction of lower busbars for QMB			Left [ ]	Right [ ]

OPTIONS

Common options

Fuses (see fuse price structure)			Service voltage ≤ 12 kV [ ]
Replacement of mechanism			CIT by CI1 (only for PM) [ ]
Electrical driving motorization	24 Vdc [ ]	110 Vdc [ ]	120/127 Vac (50 Hz) [ ]
	32 Vdc [ ]	120-125 Vdc [ ]	220/230 Vac (50 Hz) [ ]
	48 Vdc [ ]	137 Vdc [ ]	120/127 Vac (60 Hz) [ ]
	60 Vdc [ ]	220 Vdc [ ]	220/230 Vac (60 Hz) [ ]
Shunt trip	Opening (on CI1) [ ]		Closing and opening (on CI2) [ ]
	24 Vdc [ ]	110 Vdc [ ]	120/127 Vac (50 Hz) [ ]
	32 Vdc [ ]	120-125 Vdc [ ]	220/230 Vac (50 Hz) [ ]
	48 Vdc [ ]	137 Vdc [ ]	120/127 Vac (60 Hz) [ ]
	60 Vdc [ ]	220 Vdc [ ]	220/230 Vac (60 Hz) [ ]
			380 Vac (50/60 Hz) [ ]
Auxiliary contact signalling			1 C on SW and 1 O & 1 C on ES [ ]
	2 O & 2 C on SW [ ]		2 O & 3 C on SW and 1 O & 1 C on ES [ ]
Interlocking	A1 [ ] C1 [ ] C4 [ ]	Tubular key type [ ]	Flat key type [ ]
Replacement of 630 A upper busbar by 1250 A (not possible for QMB)			[ ]
Blown fuse signalling contact (for QM, QMB, QMC)			[ ]

24 kV options

Replacement of mechanism			CI1 by CI2 (only for QM) [ ]
Remote control signalling (for QM only)			
	2 lights [ ]	2 lights and 2 PB [ ]	2 lights and 2 PB + 1 switch [ ]
Voltage of the lights (must be the same than electrical driving mechanism)			
	24 V [ ]	48 V [ ]	110/125 V [ ] 220 V [ ]
Blown fuse signalling contact (mechanical indication PM, electrical for the other cubicles)			[ ]
Roof configuration (A, B or C only one choice possible)			
A - Cable connection by the top (cable maxi 240 mm² with VPIS)		Single core [ ]	2 x single core [ ]
B - Low voltage control cabinet (h = 450 mm)			With unpunched door [ ]
C - Wiring duct			[ ]
50 W heating element			[ ]
Operation counter			[ ]
Digital ammeter (not applicable for QMB)			AMP21D [ ]
Visibility of main contacts			[ ]
Pressure indicator device		Analogic manometer **without** visibility of main contacts	[ ]
	Pressure switch [ ]	Analogic manometer **with** visibility of main contacts	[ ]
Busbar field distributors for severe conditions (only for 630 A)			[ ]
Internal arc version (not possible with "top incomer" option)		16 kA 1 s [ ]	20 kA 1 s [ ]
Gaz exhaust direction		Downwards (only for 16 kA 1s) [ ]	Upwards [ ]

36 kV options

Replacement of mechanism		CIT by CI2 (only for PM) [ ]
Cable connection by the top (single core cable maxi 240 mm² with VPIS)		[ ]

BATIMAT OPTIMUM

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Order form

SM6
Protection
Vacuum contactor (Direct Motor Starter) for 24 kV

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic cubicle				Quantity
Rated voltage Ur				(kV) 7.2
Service voltage				(kV)
Short-circuit current Isc (6.3 kA without fuse)				(kA)
Rated current Ir (max. 400 A without fuse)				(A)
Internal arc withstand				12.5 kA 1s
Position in the switchboard	First on left ☐	Middle ☐	Last on right ☐	
Busbar Ir	400 A ☐	630 A ☐	1250 A ☐	
Phase current sensors	1 CT ☐	2 CT ☐	3 CT ☐	
			3 LPCT ring type ☐	
Key interlockings for 52 type	Tubular key type ☐		Flat key type ☐	

Options						
MV fuses	25 A ☐	31.5 A ☐	40 A ☐	50 A ☐	63 A ☐	
	80 A ☐	100 A ☐	125 A ☐	160 A ☐	200 A ☐	250 A ☐
Busbar field distributors for severe conditions (only for 630 A)						☐
Key interlockings for C1 type	Tubular key type ☐			Flat key type ☐		
Voltage transformer (quantity)	1 ☐		2 ☐		3 ☐	
Internal arc version (not possible with "top incomer" option)			16 kA 1 s ☐		20 kA 1 s ☐	
Gaz exhaust direction	Downwards (only for 16 kA 1s) ☐				Upwards ☐	

Contactor			
Vacuum contactor	Magnetic hold ☐		Mechanical latching ☐
Open release	48 Vdc ☐	125 Vdc ☐	250 Vdc ☐
Closing coil	110 Vac/dc ☐	120 Vac/dc ☐	125 Vac/dc ☐
	220 Vac/dc ☐	240 Vac/dc ☐	250 Vac/dc ☐

ВЗРНОС ОРИГИНАЛ

293

SM6
Metering

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

BASIC FUNCTIONS — QUANTITY

Common 24/36 kV

Rated voltage Ur									(kV)
Service voltage									(kV)
Short-circuit current Isc									(kA)
Rated current Ir									(A)
Internal arc withstand				12.5 kA 1s for 24 kV				16 kA 1s for 36 kV	
Type of cubicle/upper busbar for 24 kV									
Ir = 630 A, Ir busbar = 400 A	CM		CM2		TM		GBC-A		GBC-B
Ir = 630 A, Ir busbar = 630 A	CM		CM2		TM		GBC-A		GBC-B
Ir = 630 A, Ir busbar = 1250 A	CM		CM2		TM		GBC-A		GBC-B
Ir = 1250 A, Ir busbar = 1250 A							GBC-A		GBC-B
Type of cubicle for 36 kV	CM 750			CM2 750				GBC-A 750	
				TM 750				GBC-B 750	
Position in the switchboard	First on left			Middle				Last on right	
Direction of lower busbars for GBC-A				Left				Right	
Signalling contact (for CM, CM2 and TM only)								1 O and 1 C on SW	
Fuses (for CM, CM2 and TM only)								See fuse price structure	

Basic 24 kV

VTs for GBC (to see price structure)	Phase/phase				Phase/earth	
CTs for GBC (to see price structure)	Quantity 1		2		3	
Ratio choice for GBC						
Protections	1 secondary				1 high secondary	
	2 secondaries				1 low secondary	

Basic 36 kV

Voltage transformers	See specific order form

OPTIONS

24 kV options

Roof configuration (A, B or C only one choice possible)

A - Cable connection by the top (cable maxi 240 mm² with VPIS)	Single core		2 x single core	
B - Low voltage control cabinet (h = 450 mm)			With unpunched door	
C - Wiring duct				
50 W heating element for CM, CM2, TM				
Busbar field distributors for severe conditions (only for 630 A and CM, CM2 and TM cubicles)				
Blown fuse auxiliary contact (for CM, CM2 and TM only)			1 O and 1 C	
Internal arc version (not possible with "top incomer" option)	16 kA 1 s		20 kA 1 s	
Gaz exhaust direction	Downwards (only for 16 kA 1s)		Upwards	

36 kV options

Current transformers and voltage transformers for GBC	See specific order form
Cable connection by the top (single core cable maxi 240 mm² with VPIS)	
Replacement of 630 A busbar by 1250 A (for CM, CM2 and TM only)	

SM6
Other functions

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic cubicle — Quantity

Rated voltage Ur			(kV)
Service voltage			(kV)
Short-circuit current Isc			(kA)
Rated current Ir			(A)
Internal arc withstand	12.5 kA 1s for 24 kV		16 kA 1s for 36 kV
Type of cubicle/upper busbar for 24 kV			
Ir = 630 A, Ir busbar = 400 A	GAM 500	GAM2 375	GBM 375
Ir = 630 A, Ir busbar = 630 A	GAM 500	GAM2 375	GBM 375
Ir = 1250 A, Ir busbar = 1250 A	GAM 500		GBM 375
Type of cubicle for 36 kV	GAM 750	GAM2 750	GBM 750
Position in the switchboard	First on left	Middle	Last on right
Direction of lower busbars for GBM			
Left (impossible on the first cubicle of the switchboard)			Right

Options

24 kV options

Roof configuration (A, B or C only one choice possible)

A - Cable connection by the top (cable maxi 240 mm² with VPIS)		
	Single core	2 x single core
B - Low voltage control cabinet (h = 450 mm)		With unpunched door
C - Wiring duct		
Wiring duct for GBM		
ES auxiliary contact (only on GAM 500)		1 O and 1 C
Surge arresters for GAM 500, 630 A		
7.2 kV	10 kV	12 kV	17.5 kV	24 kV
Interlocking on GAM 500		
	Tubular key type	Flat key type
	A3 SM6-SM6	P5 SM6-SM6
Localisation of 2nd lock for P5		Cubicle no.
Heating element (on GAM 500 630 A and on GAM2)		
Digital ammeter or Fault current indicator	AMP 21D (except GBM)	Flair 23DV zero sequence
	Flair 21D	Flair 22D	Flair 23DV
Internal arc version (not possible with "top incomer" option)	16 kA 1 s	20 kA 1 s
Gaz exhaust direction	Downwards (only for 16 kA 1s)	Upwards

36 kV options

Cable connection by the top (single core cable maxi 240 mm² with VPIS)
Replacement of 630 A busbar by 1250 A (for GAM2 only)
Surge arresters for GAM2

SF1
Lateral disconnectable or withdrawable

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic circuit breaker — Qty

Rated voltage Ur				(kV)
Service voltage				(kV)
Impulse voltage Up				(kVbil)
Short-circuit current Isc				(kA)
Rated current Ir				(A)
Frequency		60 Hz		50 Hz
Mechanism position	Disconnectable	A1		B1
	Withdrawable			B1

Colour for push buttons and indicators
Push buttons open/close: Red/black
Indicator open/close: Black/white
Operating mechanism charged/discharged: White/yellow

Circuit breaker options

1st opening release (see possible choices combination table below)

Shunt opening release **YO1**

24 Vdc	60 Vdc	220 Vdc	220 Vac (50 Hz)
30 Vdc	110 Vdc	48 Vac (50 Hz)	120 Vac (60 Hz)
48 Vdc	125 Vdc	110 Vac (50 Hz)	240 Vac (60 Hz)

Undervoltage release **YM**

24 Vdc	60 Vdc	220 Vdc	220 Vac (50 Hz)
30 Vdc	110 Vdc	48 Vac (50 Hz)	120 Vac (60 Hz)
48 Vdc	125 Vdc	110 Vac (50 Hz)	240 Vac (60 Hz)

Mitop	Without contact	With contact

2nd opening release (see possible choices combination table below)

Shunt opening release **YO2**

24 Vdc	60 Vdc	220 Vdc	220 Vac (50 Hz)
30 Vdc	110 Vdc	48 Vac (50 Hz)	120 Vac (60 Hz)
48 Vdc	125 Vdc	110 Vac (50 Hz)	240 Vac (60 Hz)

Undervoltage release **YM**

24 Vdc	60 Vdc	220 Vdc	220 Vac (50 Hz)
30 Vdc	110 Vdc	48 Vac (50 Hz)	120 Vac (60 Hz)
48 Vdc	125 Vdc	110 Vac (50 Hz)	240 Vac (60 Hz)

Mitop	Without contact	With contact

Remote control

Electrical motor **M**

24…32 Vdc	110…127 Vdc/ac
48…60 Vdc/ac	220…250 Vdc/ac

Shunt closing release **YF**

24 Vdc	60 Vdc	220 Vdc	220 Vac (50 Hz)
30 Vdc	110 Vdc	48 Vac (50 Hz)	120 Vac (60 Hz)
48 Vdc	125 Vdc	110 Vac (50 Hz)	240 Vac (60 Hz)

Leaflets language	French	English

Different releases combinations

Shunt opening releases **YO1/YO2**	1			2	1	1	
Undervoltage release **YM**			1		1		1
Mitop		1				1	1

BRPHOC
COMMATA

Order form

SFset
Lateral disconnectable for SM6 24 kV

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic circuit breaker			Quantity
Rated voltage Ur			(kV)
Service voltage			(kV)
Impulse voltage Up			(kVbil)
Short-circuit current Isc			(kA)
Rated current Ir			**630 A maximum**
Frequency	60 Hz ☐		50 Hz ☐
Mechanism position	A1 ☐		B1 ☐

Colour for push buttons and indicators
Push buttons open/close: Red/black
Indicator open/close: Black/white
Operating mechanism charged/discharged: White/yellow

Control unit and sensors			
VIP 300P (not available for all electrical characteristics)	CSa 200/1	Is = 10 to 50 A ☐	Is = 40 to 200 A ☐
	CSb 1250/1	Is = 63 to 312 A ☐	Is = 250 to 1250 A ☐
VIP 300LL	CSa 200/1	Is = 10 to 50 A ☐	Is = 40 to 200 A ☐
	CSb 1250/1	Is = 63 to 312 A ☐	Is = 250 to 1250 A ☐

Circuit breaker options

2nd opening release (see possible choices combination table below)

Shunt opening release **YO2**

24 Vdc ☐	60 Vdc ☐	220 Vdc ☐	220 Vac (50 Hz) ☐
30 Vdc ☐	110 Vdc ☐	48 Vac (50 Hz) ☐	120 Vac (60 Hz) ☐
48 Vdc ☐	125 Vdc ☐	110 Vac (50 Hz) ☐	240 Vac (60 Hz) ☐

Undervoltage release **YM**

24 Vdc ☐	60 Vdc ☐	220 Vdc ☐	220 Vac (50 Hz) ☐
30 Vdc ☐	110 Vdc ☐	48 Vac (50 Hz) ☐	120 Vac (60 Hz) ☐
48 Vdc ☐	125 Vdc ☐	110 Vac (50 Hz) ☐	240 Vac (60 Hz) ☐

Remote control

Electrical motor **M**

24...32 Vdc ☐	110...127 Vdc/ac ☐
48...60 Vdc/ac ☐	220...250 Vdc/ac ☐

Shunt closing release **YF**

24 Vdc ☐	60 Vdc ☐	220 Vdc ☐	220 Vac (50 Hz) ☐
30 Vdc ☐	110 Vdc ☐	48 Vac (50 Hz) ☐	120 Vac (60 Hz) ☐
48 Vdc ☐	125 Vdc ☐	110 Vac (50 Hz) ☐	240 Vac (60 Hz) ☐

Test box (VAP 6)		☐
Leaflets language	French ☐	English ☐

Different releases combinations

Mitop	1	1	1
Shunt opening release **YO2**		1	
Undervoltage release **YM**			1

B57810 C
OPPIMATA

Order form

Evolis
Frontal fixed version
for SM6 24 kV (up to 17.5 kV)

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Switch or circuit breaker Quantity

Rated voltage Ur (kV)	12 ☐	17.5 ☐	
Service voltage		(kV) ☐	
Short-circuit current Isc			25 kA
Rated normal current Ir (A)	630 ☐	1250 ☐	
Phase distance			185 mm

Circuit breaker options

Opening release (see possible choices in combination table below)

Shunt opening release **MX**

24 Vac ☐	24...30 Vdc ☐	100...130 Vdc/ac ☐
48 Vac ☐	48...60 Vdc ☐	200...250 Vdc/ac ☐

Low energy release **Mitop**

1 AC fault signalling SDE and reset 200...250 Vac are included ☐

Remote control (operation counter already included)

Electrical motor **MCH**

24...30 Vdc ☐	100...125 Vdc ☐	200...250 Vdc ☐
48...60 Vdc/ac ☐	100...130 Vac ☐	200...240 Vac ☐

Shunt closing release **XF**

24 Vac ☐	24...30 Vdc ☐	100...130 Vdc/ac ☐
48 Vac ☐	48...60 Vdc ☐	200...250 Vdc/ac ☐

Operation counter CDM			☐
Additional auxiliary contacts OF (4 AC)	1 ☐	2 ☐	
Ready to close contact PF (1 AC)			☐

Locking of the circuit breaker in the open position

By padlock ☐

or by locks and keys — Tubular key type ☐ — Flat key type ☐

If locks	1 lock ☐	2 identical locks ☐	2 different locks ☐

Disabling of O/C circuit breaker push buttons ☐

Different releases combinations

Shunt opening release **MX**	1		1
Mitop		1	1

Order form

Evolis
Lateral disconnectable version for SM6 24 kV (up to 24 kV)

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.
Green box [X] corresponds to none priced functions.

Basic circuit breaker	Quantity
Rated voltage Ur	**24 (kV)**
Service voltage	**(kV)**
Impulse voltage Up	**(kVbil)**
Rated normal current Ir	**630 A maximum**
Phase distance	**250 mm**
Mechanism position	**B1**

Colour for push buttons and indicators
Push buttons open/close: Red/black
Indicator open/close: Black/white
Operating mechanism charged/discharged: White/yellow

Circuit breaker options

1st opening release (see possible choices combination table below)

Shunt opening release **YO1**

24 Vdc	110 Vdc	110 Vac (50 Hz)
48 Vdc	125-127 Vdc	220-230 Vac (50 Hz)
	220 Vdc	120 Vac (60 Hz)

Undervoltage release **YM**

24 Vdc	110 Vdc	110 Vac (50 Hz)
48 Vdc	125-127 Vdc	220-230 Vac (50 Hz)
	220 Vdc	120 Vac (60 Hz)

2nd opening release (see possible choices combination table below)

Shunt opening release **YO2**

24 Vdc	110 Vdc	110 Vac (50 Hz)
48 Vdc	125-127 Vdc	220-230 Vac (50 Hz)
	220 Vdc	120 Vac (60 Hz)

Undervoltage release **YM**

24 Vdc	110 Vdc	110 Vac (50 Hz)
48 Vdc	125-127 Vdc	220-230 Vac (50 Hz)
	220 Vdc	120 Vac (60 Hz)

Low energy release **Mitop**

Remote control (operation counter already included)

Electrical motor **M**

24...32 Vdc	110...127 Vdc/ac
48...60 Vdc/ac	220...250 Vdc/ac

Shunt closing release **YF**

24 Vdc	110 Vdc	110 Vac (50 Hz)
48 Vdc	125-127 Vdc	220-230 Vac (50 Hz)
	220 Vdc	120 Vac (60 Hz)

Operation counter (already included if remote control supplied)

Different releases combinations

Shunt opening releases **YO1**	1		1	1	1			
Shunt opening releases **YO2**			1					
Undervoltage release **YM**		1		1		1		
Mitop					1	1	1	

ВЯРНО С ОРИГИНАЛА

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Notes

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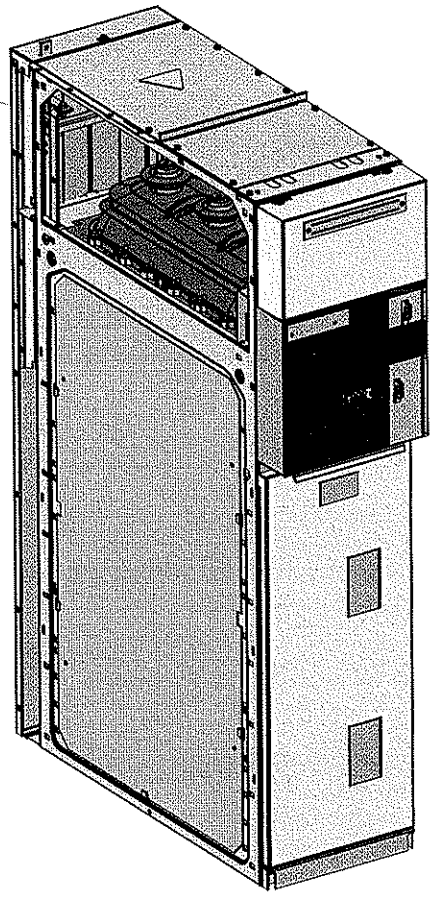
Distribution Moyenne Tension
Medium Voltage Distribution

SM6-24

Cellules modulaires
Modular cubicles

Conditions d'installation
Installation requirements



ВЯРНО С ОРИГИНАЛА

Schneider Electric

302

Conditions d'installation
Installation requirements

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BARIO G
OPTIMATA

303

Performance arc interne
Internal arc performance

Introduction

Un arc interne est une forme de court-circuit très sévère qui peut survenir dans une installation électrique.
Contrairement à un court-circuit dit « boulonné » où le courant de défaut circule dans des conducteurs solides, un arc interne fait cheminer le courant dans l'air (devenant plasma) entre deux conducteurs.
En plus des effets classiques d'un court-circuit (échauffement des conducteurs, efforts électromagnétiques), l'arc interne se caractérise donc par une quantité d'énergie énorme transmise au fluide.
L'énergie dissipée, allant jusqu'à plusieurs dizaines de mégajoules sur une seconde, provoque des effets de pression et thermiques .
Le défaut d'arc interne est rare, mais sa criticité impose d'en maîtriser les effets.

Introduction

The internal arc fault is a very severe short-circuit that can occur in electrical equipment.
Whereas a conventional bolted short circuit fault makes the current flow in solid conductors, the internal arc fault makes the current flow in the air (which becomes also plasma) between two conductors.
In addition to the usual consequences of a short-circuit fault (conductors overheating, electromagnetic stresses), the internal arc transmits a huge energy amount to the fluid. The dissipated energy, which reaches more than 10 megajoules over one second, provokes hazardous pressure effects and thermal effects.
The internal arc fault is rare, but it is so critical that we must manage its effects.

Causes

L'arc interne est causé par la rupture de rigidité diélectrique entre deux parties au potentiel différent.
Un arc survient entre deux phases ou entre une phase et la masse. Il dégénère alors souvent en défaut triphasé.
L'amorçage initial peut être créé par :
- Le vieillissement des isolants solides que constituent les gaines de câbles, les résines Epoxy (fissures).
- L'intrusion d'un animal entre les parties conductrices, soit créant directement un pont conducteur entre 2 phases, soit dégradant l'isolation des câbles (rongeurs) .
- L'introduction d'un objet entre les phases lors d'une opération de maintenance, comme une clé mettant en court-circuit le jeu de barres.
- Une fuite de gaz isolant (pour les appareils fonctionnant dans le SF6) ou une perte de vide (pour les appareils fonctionnant dans le vide).

Causes

The internal arc fault starts when the dielectric strength is lost between two parts at a different voltage. An arc appears between two phases or between one phase and earth. It often degenerates into a three-phases fault.
The original arc can be the result of:
- *Insulating parts ageing (damaged cables sheath, cracked Epoxy resin).*
- *The intrusion of an animal, thus directly creating a short-circuit between conductors, or damaging the insulation (rodents).*
- *The introduction of an object between the phases during a maintenance work, typically a wrench in the busbar.*
- *A insulating fluid leakage (for the SF6 insulated devices) or a vacuum loss (for the vacuum devices).*

Conséquences

L'arc interne se manifeste par des effets de pression, sollicitation mécanique importante de l'appareil puis par des effets thermiques, expulsion abondante de gaz chauds à maîtriser.
L'arc interne se découpe en 3 phases génériques :
- **La phase onde de choc : 0-5ms**
- **La phase montée en pression : 5-30ms.**
- **La phase expulsion et thermique : 30ms- ...**

Les gaz chauds créés sont évacués en continu. Ils doivent être correctement canalisés, non seulement pour que la pression tende vers zéro, mais aussi pour maîtriser leur direction de sortie.

Consequences

The consequences of internal arc are pressure effects, severe mechanical stress of the device and thermal effects (heavy expulsion of hot gases that is to be managed).

The internal arc fault divides into 3 phases:
- ***The shock wave phase: 0-5ms***
- ***The pressure rise phase: 5-30ms***
- ***The expulsion and thermal phase: 30ms***

The generated hot gases are expulsed in a continuous way. They must be correctly canalized in order that the pressure falls to zero, but also to manage their exhaust direction.

Performance arc interne
Internal arc performance

Conséquences (suite)

A ces phases génériques peut s'ajouter une phase d'éclatement de membrane, lorsque la surpression dans un compartiment hermétique est libérée vers les autres compartiments par l'ouverture d'une membrane calibrée.
Elle est caractérisée par une deuxième onde de choc et un transfert de la surpression aux autres compartiments.
Outre ses effets mécaniques et thermiques, l'arc interne est dangereux pour :
- sa toxicité : l'air expulsé est chargé de vapeurs plastiques et métalliques irrespirables,
- son bruit : l'onde de choc initiale est une onde acoustique dangereuse (160dB),
- son rayonnement transmis : sans obstacle intermédiaire, le rayonnement émis est capable de bruler la peau au second degré en 100 ms.

Consequences (continued)

In addition to these three generic phases, a valve opening phase can take place, when the overpressure in a hermetic compartment is released to the other compartments by the way of a calibrated valve opening.
This phase is characterized by a second pressure wave and a pressure transfer to the other compartments.
As well as its mechanical and thermal effects, the internal arc fault is hazardous because of:
- *Its toxicity: the released gases are loaded with toxic plastic and metal vapors.*
- *Its noise: the original pressure wave is a hazardous acoustic wave (160 dB).*
- *Its transmitted radiation: without any obstacle, the emitted radiation can burn the skin (second degree level) in 100 ms.*

⚠ DANGER

RISQUES D'ÉLECTROCUTION, D'ARC ÉLECTRIQUE OU DE BRÛLURES
- L'installation de cet équipement doit être confiée exclusivement à des personnes qualifiées, qui ont pris connaissance de toutes les notices d'installation et contrôlé les caractéristiques techniques de l'équipement.
- Ne travaillez JAMAIS seul.
- Coupez toute alimentation avant de travailler sur cet équipement. Tenez compte de toutes les sources d'alimentation et en particulier des possibilités d'alimentation extérieure à la cellule où est installé l'équipement.
- Portez des gants isolants pour éviter tout contact avec un conducteur accidentellement mis sous tension.

Le non-respect de ces instructions provoquera la mort ou des blessures graves.

⚠ *DANGER*

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS
- *Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.*
- *NEVER work alone.*
- *Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.*
- *Wear insulating gloves to avoid any contact with a conductor that has accidentally been energized.*

Failure to follow these instructions will result in death or serious injury.

Les différentes performances arc interne

The different internal arc performances

	AFL	AFLR	Evacuation basse par caniveau/ *Evacuation by the bottom via trench*	Evacuation haute par conduit / *Evacuation by the top via duct*
12,5 kA 1s	X		X	
16 kA 1s	X		X	
		X	X	X
20 kA 1s	X	X		X

Installation sans la performance arc interne

Installation without internal arc performance

! ATTENTION

Dans certaines conditions d'installation, la performance arc interne n'est pas garantie dans le cadre d'un raccordement des câbles par le haut.

! *CAUTION*

In certain installation conditions, internal arc performance is not guaranteed when cables are connected by the top.

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

La norme CEI 62271-200 annexe A impose un niveau de protection testé pour les personne se trouvant au voisinage de l'appareillage sous enveloppe métallique dans des conditions d'arc interne.

IEC 62271-200 standard appendix A imposes a tested level of protection to persons in the vicinity the switchgear in metal enclosures under internal arc conditions.

Classes accessibilité

2 versions de classes d'accessibilité sont disponibles :
- IAC : A-FL,
- IAC : A-FLR.

IAC : A-FL

A : Type A, limité au personnel autorisé seulement
F : accès par la Face avant
L : accès par les faces Latérales

Lorsqu'un tableau classifié IAC : A-FL est adossé à un mur, ce mur ne participe pas à la performance arc interne.

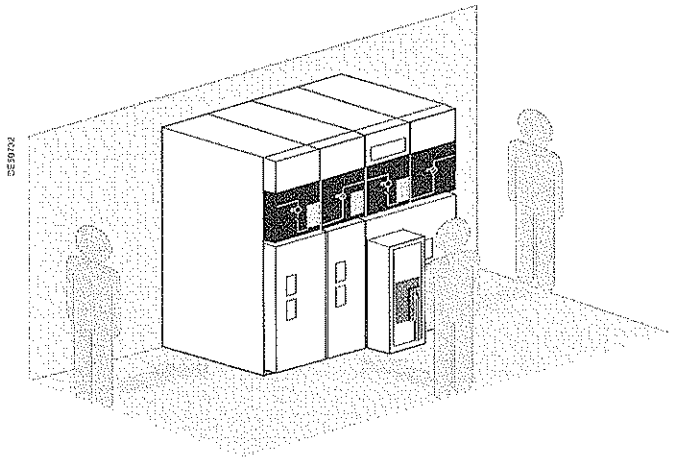
Accessibility classes

2 versions of accessibility classes are available:
- *IAC: A-FL,*
- *IAC: A-FLR.*

IAC: A-FL

A: Type A, restricted to authorized personnel only
F: access by Front side
L: access by Lateral sides

When a switchboard is classified IAC: A-FL wall-mounted, this wall does not contribute to the internal arc performance.

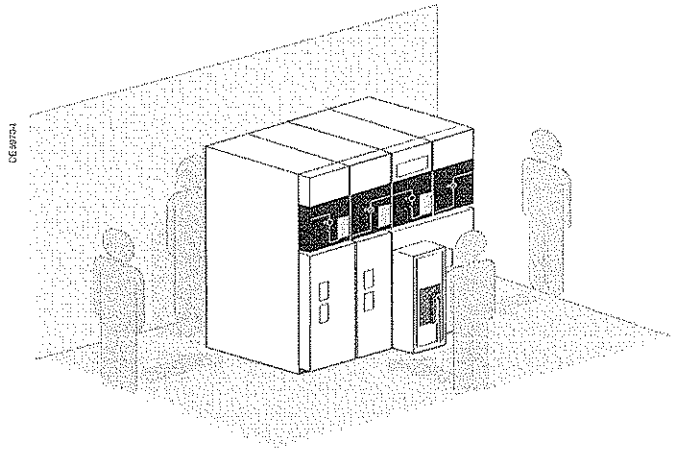


IAC : A-FLR

A : Type A, limité au personnel autorisé seulement
F : accès par la Face avant
L : accès par les faces Latérales
R : accès par la face Arrière

IAC: A-FLR

A: Type A, restricted to authorized personnel only
F: access by Front side
L: access by Lateral side
R: access by Rear side



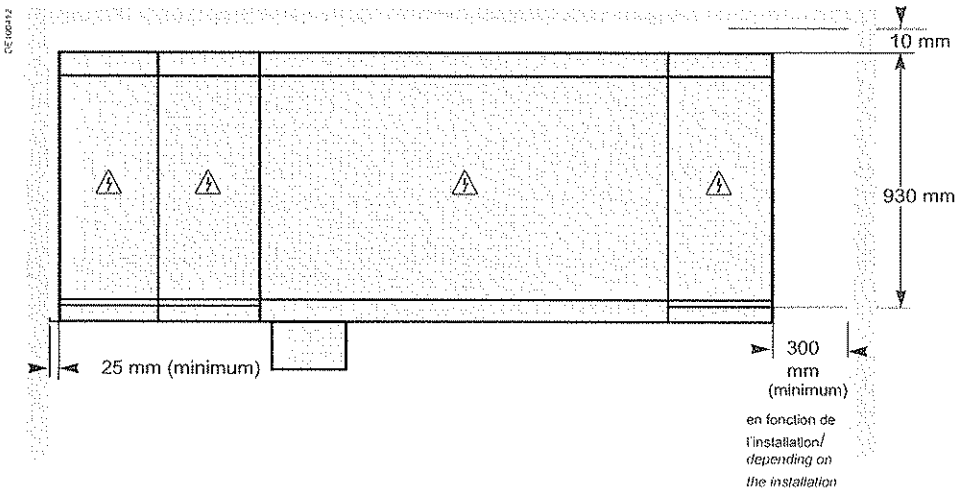
Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Position des cellules dans le poste
Position of cubicles in the substation

Installation du tableau classifié IAC A-FL par rapport au bâtiment

Installation of the switchboard IAC: A-FL classified relative to building

La hauteur sous plafond doit être de 2150 mm minimum.
The ceiling height must be 2150 mm minimum.



Implantation (vue de dessus).

Implantation (top view).

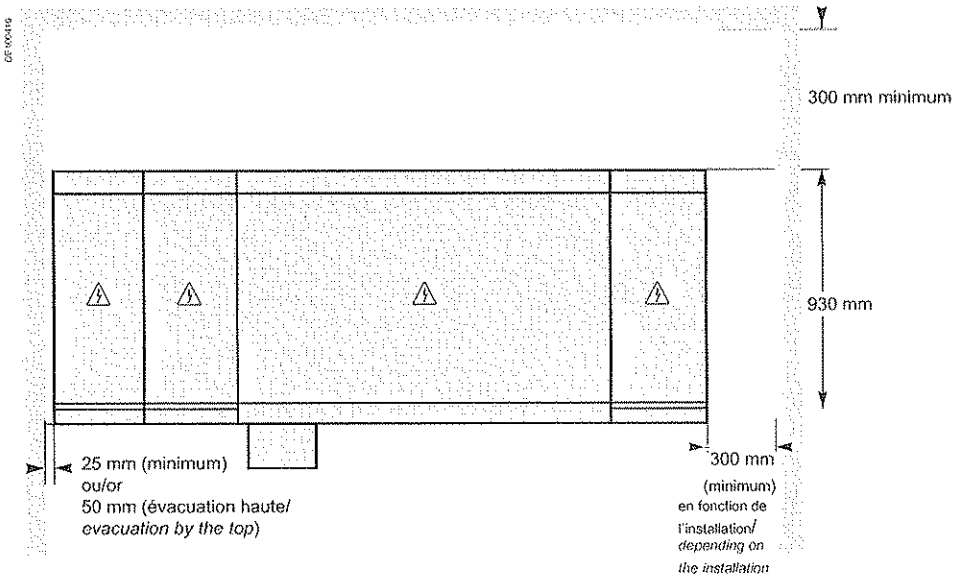
L'implantation du tableau est aussi possible accolé au mur de droite avec les mêmes conditions.
The implantation of the switchboard is also possible for a wall to the left.

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Installation du tableau classifié IAC A-FLR par rapport au bâtiment

Installation of the switchboard IAC: A-FLR classified relative to building

La hauteur sous plafond doit être de 2150 mm minimum.
The ceiling height must be 2150 mm minimum.



Implantation (vue de dessus).

Implantation (top view).

L'implantation du tableau est aussi possible accolé au mur de droite avec les mêmes conditions.
The implantation of the switchboard is also possible for a wall to the left.

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Mode d'évacuation

2 modes d'évacuation sont disponibles :
- l'évacuation **basse** par caniveau,
- l'évacuation **haute** par conduit.

Evacuation types

2 evacuation modes are available:
- *evacuation by **the bottom** via a trench,*
- *evacuation by **the top** via a duct.*

Evacuation basse

Ce mode permet l'évacuationdes gaz dans le caniveau par l'intermédiaire d'un «flap» intégré dans le fond de la cellule. La surface sous les «flaps» doit être libre de tout obtsacle (voir plan ci-dessous). Afin d'évacuer les gaz, une des extrémités du caniveau doit déboucher librement dans un espace aéré et ventilé.

Evacuation by the bottom

This mode enables gases to be evacuated in a duct via a flap situated underneath the cubicle. The area under the «flaps» must be free of obtsacle (see layout below) To enable the evacuation of gases, one of the ends of the duct must open into a well-ventilated area.

! AVERTISSEMENT

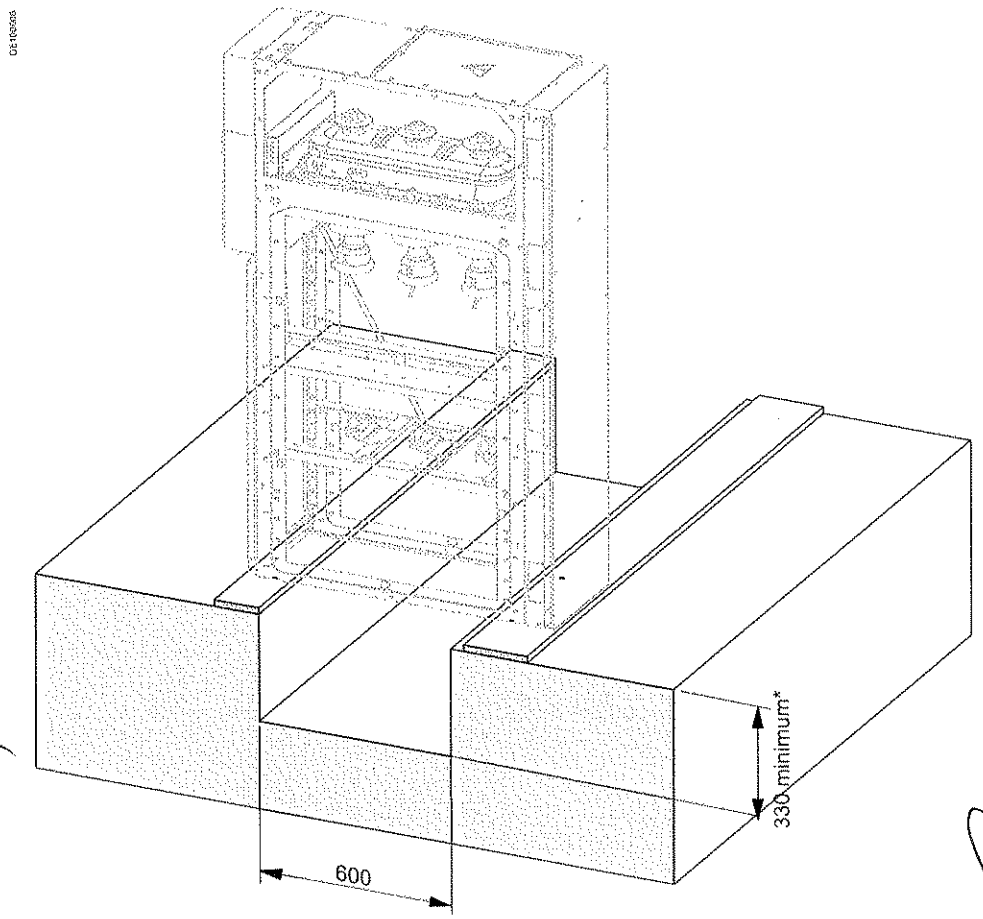
Le non-respect de ces instructions provoquera la mort ou des blessures graves.

! WARNING

Failure to follow these instructions will result in death or serious injury.

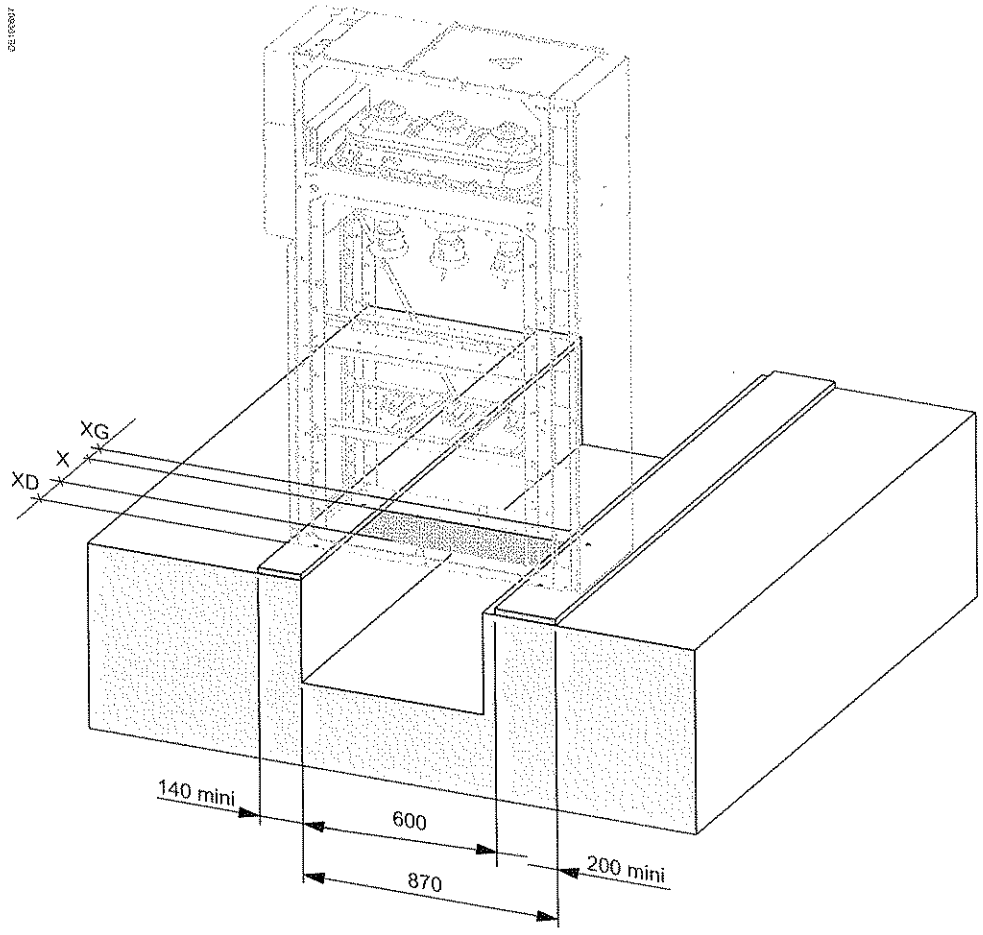
Dimensions des caniveaux pour performance 12,5 kA/1 s (en mm)

Dimensions of ducts for 12.5 kA/1 s performance (in mm)



Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Plan de la zone libre de tout obstacle (in mm) *Area map free of obstructions (in mm)*



Largeur / *Width*	Cellules / *Cubicles*	XG (mm)	X (mm)	XD (mm)
375	Toutes / *All*	57,5	260	57,5
500	GAM Autres / *Other*	57,5 182,5	260 260	182,5 57,5
625	QMC Autres / *Other*	307,5 57,5	260 510	57,5 57,5
750	Toutes / *All*	432,5	260	57,5

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Préparation du sol pour la performance arc interne 12,5 kA/ 1 s

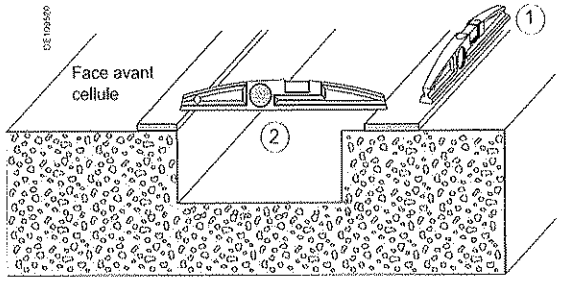
Afin d'obtenir la performance arc interne, la réalisation des sols doit être conforme aux éxigences de rectitude et de planéités imposées.
L'utilisation de profils métaliques est conseillée:
- rectitude : 2 mm/ 3 m (Rep.1),
- planéité : 3 mm maximun (Rep.2).

Tous les éléments permettant l'évacuation des gaz (caniveau, cuvelage, etc ...) doivent supporter une pression de 250 Kg/m².

Preparing the floor for the internal arc performance12,5 kA/ 1 s

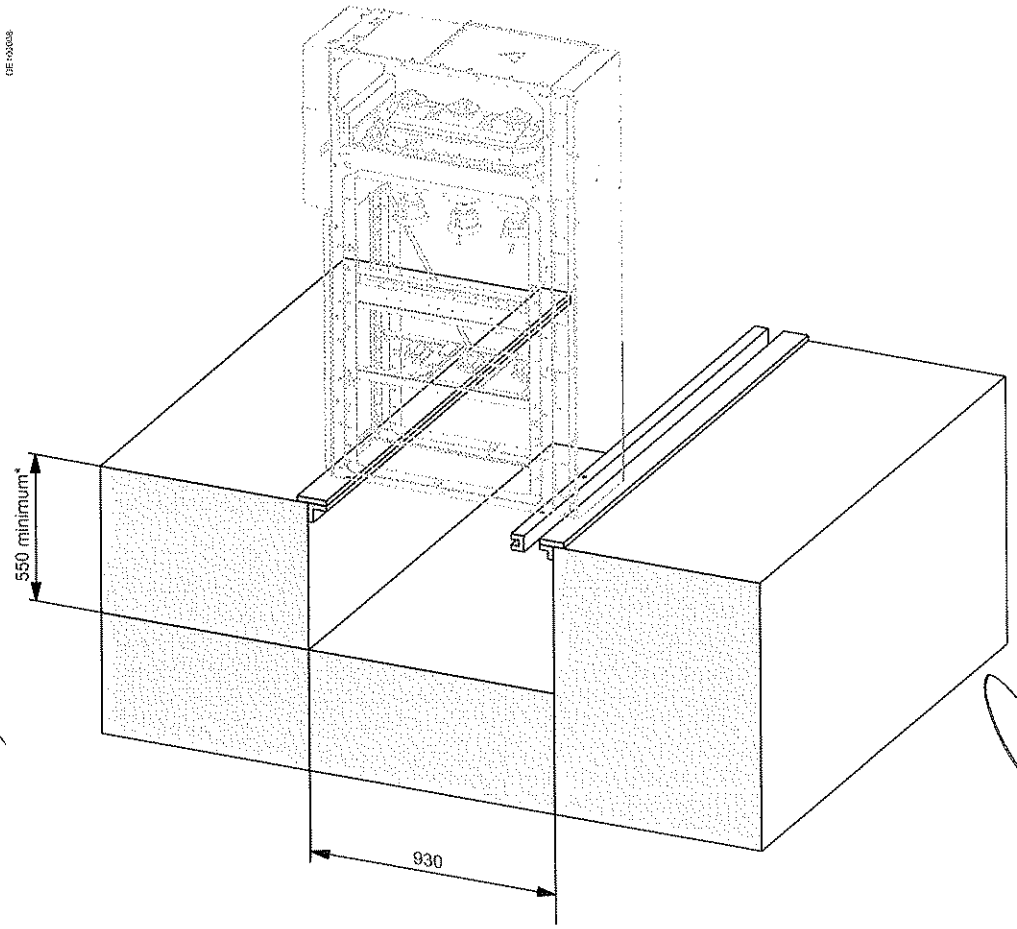
To obtain the performance arc, implementation of grounds must comply with the requirements of straightness and flatness imposed.
The use of metal angles brackets is recommended:
- *straightness: 2 mm/ 3 m (Rep.1),*
- *flatness: 3 mm maximun (Rep.2).*

All the elements allowing the evacuation of the gas (duct, casing, etc ...) must be able to bear a load of 250 Kg/m².



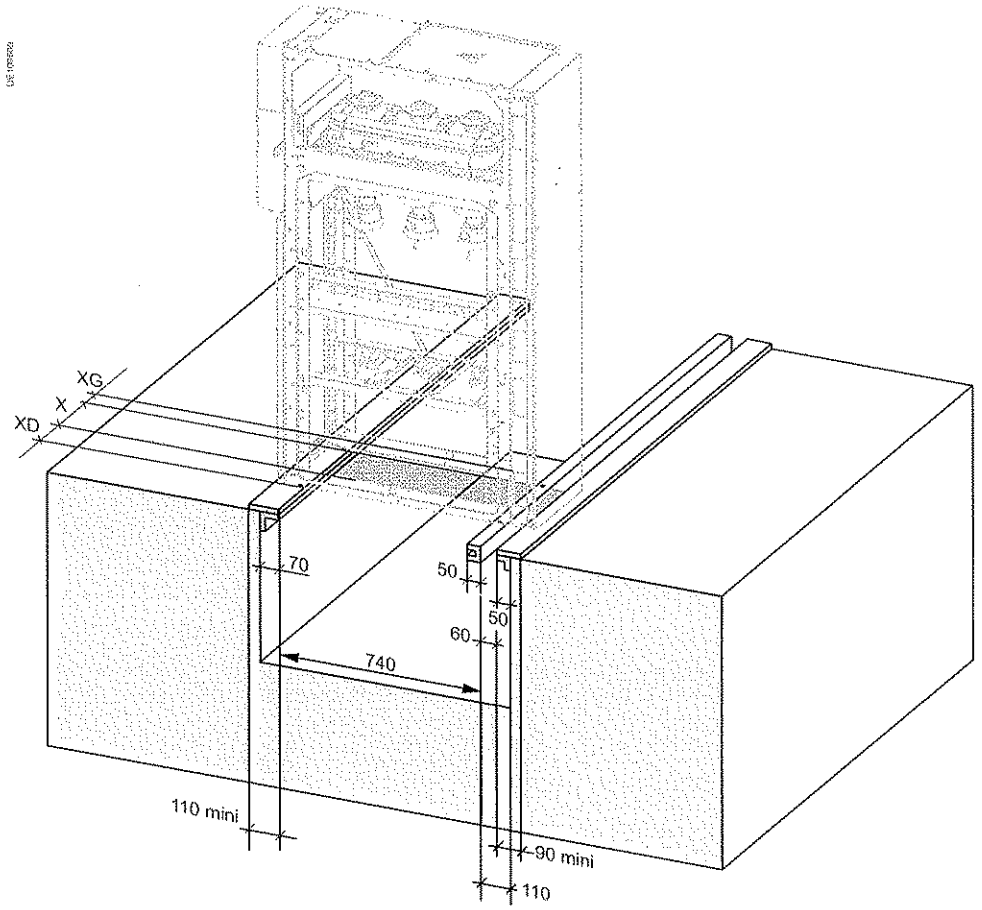
Dimensions des caniveaux pour la performance arc interne 16 kA/1 s (en mm)

Dimensions of ducts for 16 kA/1 internal arc performance (in mm)



Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Plan de la zone libre de tout obstacle (en mm) *Area map free of obstructions (in mm)*



Largeur / *Width*	Cellules / *Cubicles*	XG (mm)	X (mm)	XD (mm)
375	Toutes / *All*	57,5	260	57,5
500	GAM Autres / *Other*	57,5 182,5	260 260	182,5 57,5
625	QMC Autres / *Other*	307,5 57,5	260 510	57,5 57,5
750	Toutes / *All*	432,5	260	57,5

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Préparation du sol en 16 kA/1 s

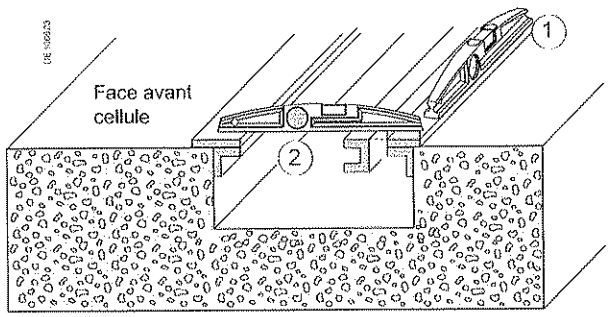
Afin d'obtenir la performance arc interne, la réalisation des sols doit être conforme aux exigences de rectitude et de planéités imposées.
L'utilisation de profils métaliques est conseillée:
- rectitude : 2 mm/ 3 m (Rep.1),
- planéité : 3 mm maximun (Rep.2).

Tous les éléments permettant l'évacuation des gaz (caniveau, cuvelage, etc ...) doivent supporter une pression de 250 Kg/m².

Preparing the floor for 16 kA/ 1 s

To obtain the performance arc, implementation of grounds must comply with the requirements of straightness and flatness imposed.
The use of metal angles brackets is recommended:
- *straightness: 2 mm/ 3 m (Rep.1),*
- *flatness: 3 mm maximun (Rep.2).*

All the elements allowing the evacuation of the gas (duct, casing, etc ...) must be able to bear a load of 250 Kg/m².



Dimensionnement de la profondeur des caniveaux en fonction de la section des câbles et de la performance 12 kA/1s ou 16 kA/1s en évacuation basse (cf. illustrations 10,11,14) (en mm)

Sizing the depth of duct according to the cable section 12 kA/1 s or 16 kA/1s performance in evacuation by the bottom (drawings 10,11,14) (in mm)

Section de câbles / *cable section* (mm²)	630 A								1250 A	
	Toutes les cellules sauf... / *All cubicles expect ...*		Autres cellules / *Other cubicles*							
			DMVA	CVM		DM1A-DM1S-DM1W-DMVLA-DMVLD			SM-GAM	DM1A/DMV-A/ DM1-W/DMVL-A/ DMVL-D
	12,5 kA/1s	16 kA/1s	12-16 kA/1s	12,5 kA/1s	16 kA/1s	12,5 kA/1s		16 kA/1s	12-16 kA/1s	12-16 kA/1s
S<120	*330*	*550*	550	330	550	330		550	–	–
120<S<240	*330*	*550*	800	–	–	Opposé au disjoncteur / *opposite to circuit breaker:* 330	Sous le disjoncteur / *under the circuit breaker:* 450	550	–	–
S>400	–	–	–	–	–	–		–	1000	1400

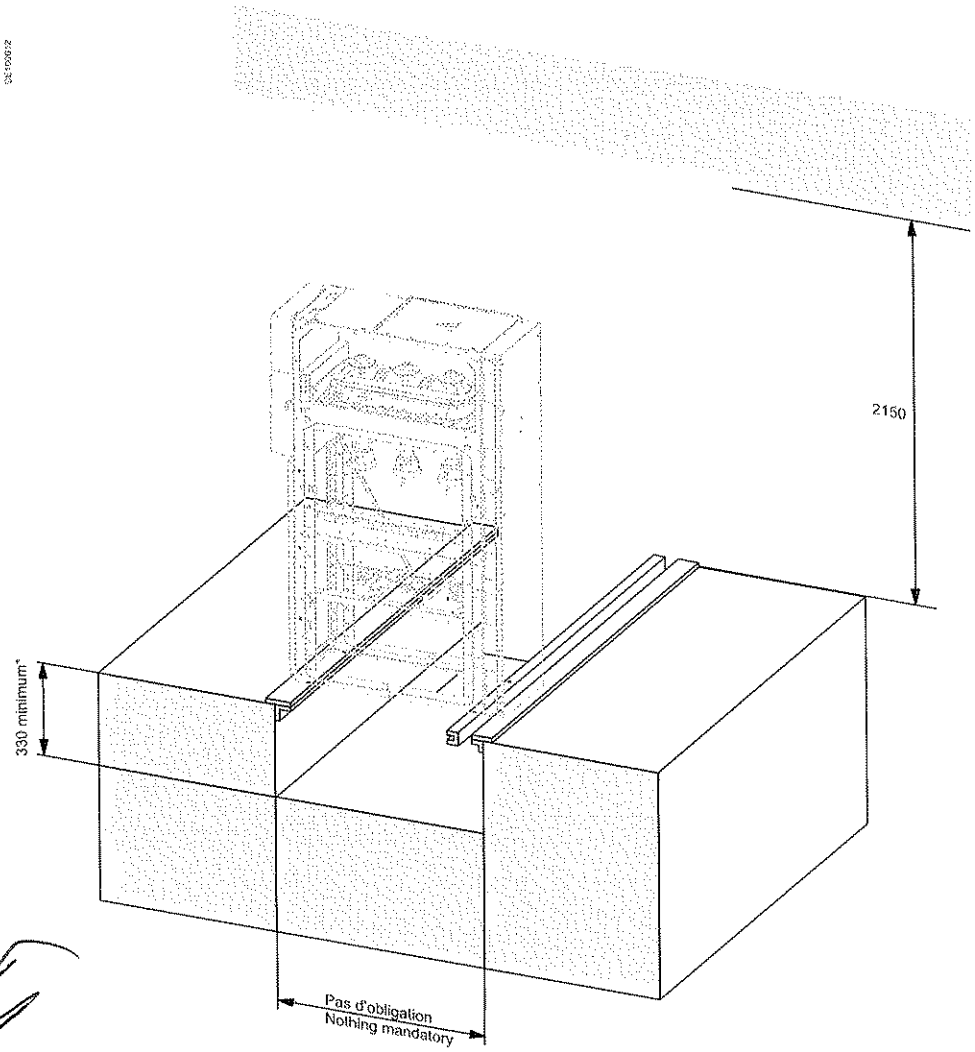
Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Evacuation haute

Dimension des caniveaux pour performance 16 kA/1s et 20 kA/1 s (en mm)

Evacuation by the top

Dimension of ducts for 16 kA/1 s and 20 kA/1 s performance (in mm)



Ce mode permet l'évacuation des gaz et nécessite l'utilisation d'un conduit placé sur le dessus de la cellule. Pour permettre l'évacuation des gaz, l'extrémité du tableau doit être équipé d'une bride d'interface (**fournit avec l'équipement**), sur laquelle est fixée le conduit d'évacuation (voir le plan de la bride en annexes 1).

*This mode enables gases to be ejected and requires the use of a duct situated above the cubicle. To enable the evacuation of gases, the end of the switchboard must be equipped with a coupling flange (**supplied by schneier Electric**), on wich is fixed on the evacuation duct (see the coupling flange layout in Appendix 1).*

Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Fixation des cellules

Fixing of cubicles

Fixation des cellules entre elles

Les cellules qui composent le poste sont maintenues entre elles par simple boulonnage (visserie livrée avec les cellules). Les vis du jeux de barre doivent être serrées au couple à l'aide d'une clé dynamométrique

Fixing of cubicles to each other

The units are simply bolted together to built the MV switchboard (bolts supplied). Screws of busbars must be tightened with a torque wrench.

Fixation des cellules au sol

Toutes les cellules doivent être fixées avec 4 vis M8, ou des tiges filetées fixées au sol.

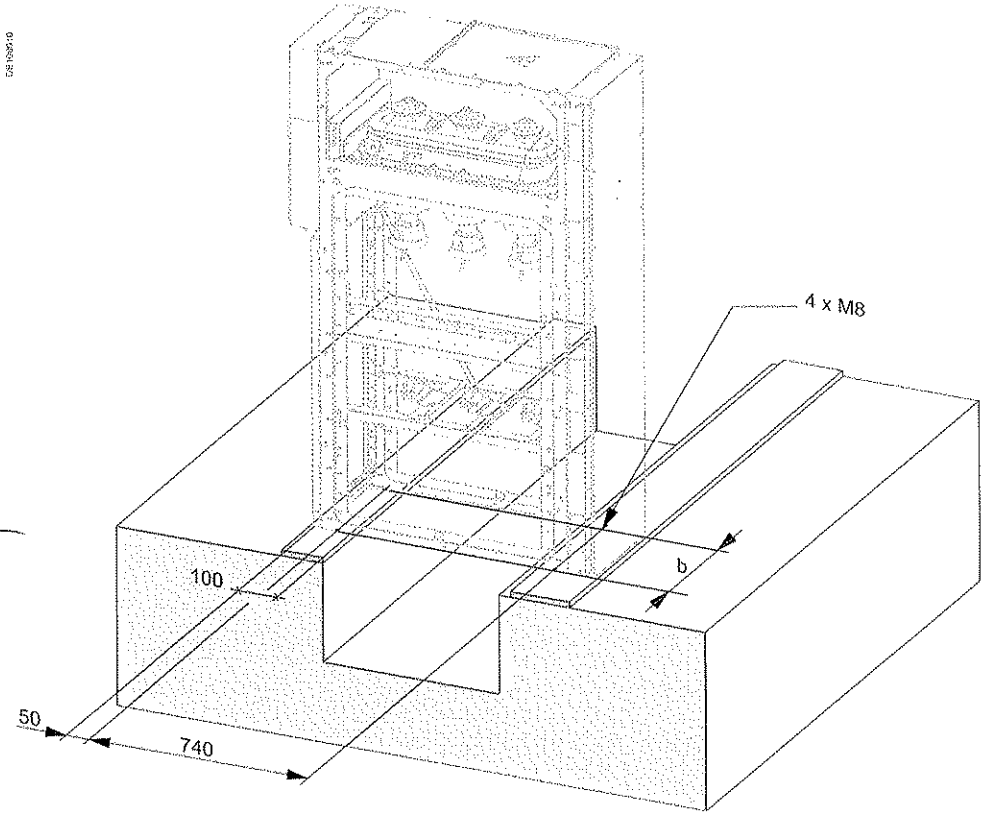
Fixation des cellules on the ground

All cubicles must be secured to the ground with using M8 bolts or screw rods grouted into the ground.

largeur de cellule (mm)	125	375	500	625	750
b (mm)	95	345	470	565	720

Fixation des cellules pour performance 12,5 kA/1 s (in mm)

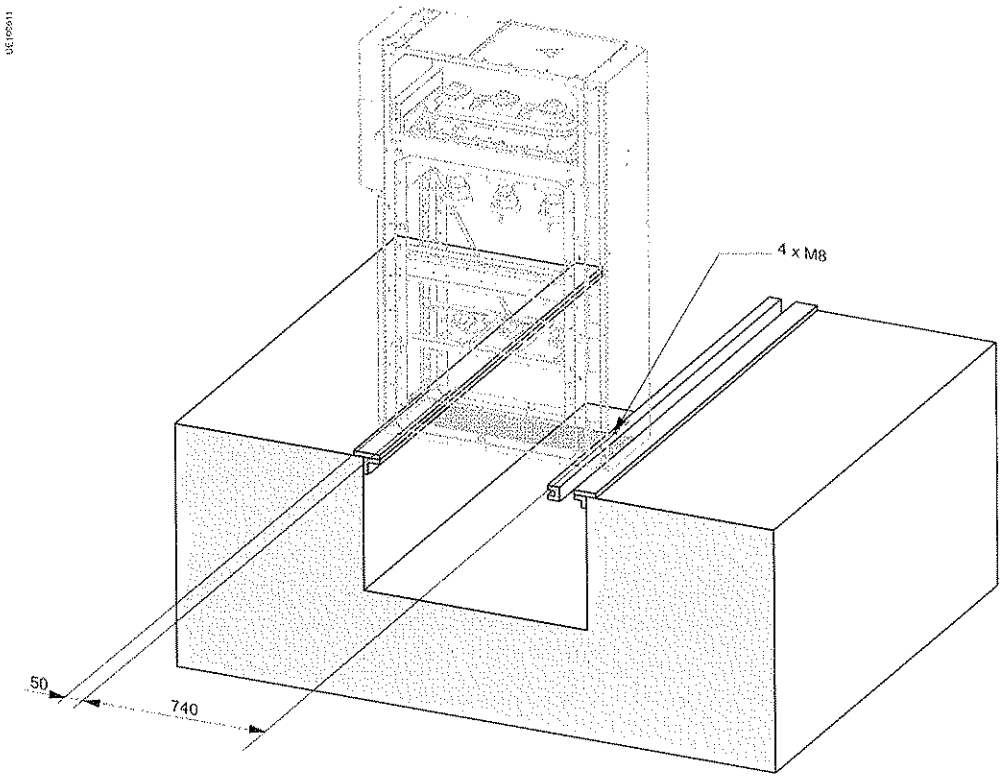
Fixing of cubicles for 12,5 kA/1 s performance *(in mm)*



Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Fixation des cellules pour performance 16 kA/1 s et 20 kA/ 1 s (en mm)

Fixing of cubicles for 16 kA/1 s and 20 kA/ 1 s performance *(in mm)*



Conduit d'évacuation

Pour permettre l'évacuation des gaz en évacuation haute, les utilisateurs devront installer un conduit à fixer à la bride d'interface.

L'extrémité de ce conduit doit interdire les entrées d'eau, de poussières, d'humidité, d'animaux, etc, touten permettant l'évacuation des gaz dans une zone dédiée par l'intermédiaire d'un dispositif placé à l'extrémité extérieure du conduit (non fourni).

Evacuation duct

To enable the evacuation of gases by the top, users must install a conduit fixed to the coupling flange.

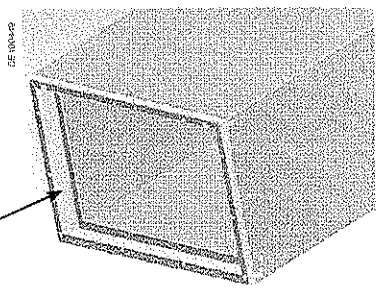
The end of the duct must block water, dust, moisture, animals, etc. from entering and at the same time enable the evacuation of gases into a dedicated area through a device situated at the outer end of the ductt (not supplied).

Suggestion de conduit d'évacuation

Le conduit d'évacuation doit être en tôle d'épaisseur suffisante pour résister aux pressions et gaz chauds.

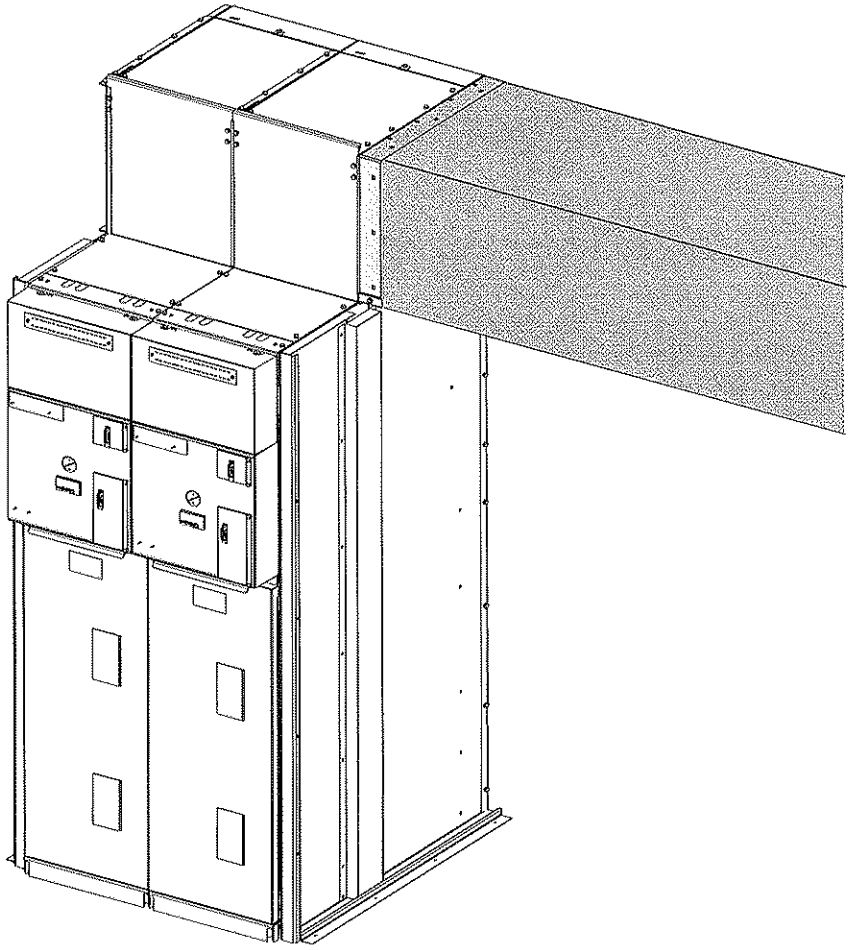
Evacuation duct example

The evacuation duct must be made of metal sheet of sufficient thickness to withstand pressure and hot gases.



Conditions pour obtenir la performance arc interne
Conditions to obtain the internal arc performance

Exemple en évacuation haute — *Top evacuation example*



Conditions sévères d'humidité et/ ou pollution du matériel MT
Harsh conditions of moisture and / or pollution of the MV equipment

Les tableaux MT remplissent des fonctions de sécurité et doivent donc être installés conformément à certaines pratiques professionnelles.

MV switchboards fulfil safety functions and must therefore be installed in line with certain profession practices.

Ce document a pour objectif de fournir des consignes d'ordre général afin d'éviter ou de réduire considérablement la dégradation du matériel sur les sites exposés à une forte humidité ou à une pollution importante.

The purpose of this document is to provided general guidelines on how to avoid or greatly reduce MV equipment degradation on sites exposed to high humidity and heavy pollution.

Conditions de service normales pour le matériel MT intérieur

Le matériel MT intérieur comprend des cellules MT modulaires ou des Ring Main Units compactes généralement installées dans des postes préfabriqués avec les transformateurs et l'appareillage BT.

Tous les matériels MT sont conformes aux normes spécifiques et à la norme internationale **CEI 62271-1** Appareillage à haute tension - Partie 1 (clauses communes). Cette dernière définit les conditions normales d'installation et d'utilisation d'un tel matériel.

Normal service conditions for indoor MV equipment

MV equipment consists of modular MV cubicles or compact Ring Main units generally installed in prefabricated substations along with transformers and LV switchgear.

*All MV equipment comply with specific standards and with the **IEC 60694** «Common specifications for high-voltage switchgear and controlgear». The latter defines the normal conditions for the installation and use of such equipment.*

Par exemple, concernant l'humidité, la norme mentionne :

Les conditions d'humidité sont les suivantes :
- la valeur moyenne d'humidité relative mesurée sur une période de 24 h n'excède pas 90 %,
- la valeur moyenne de la pression de la vapeur d'eau mesurée sur une période de 24 h n'excède pas 2,2 kPa,
- la valeur moyenne d'humidité relative mesurée sur une période d'un mois n'excède pas 90 %,
- la valeur moyenne de la pression de la vapeur d'eau mesurée sur une période d'un mois n'excède pas 1,8 kPa.

Occasionnellement, ces conditions peuvent provoquer de la condensation.

For instance, regarding humidity, the standard mentions:

The conditions of humidity are as follows:
- *the average value of the relative humidity, measured over a period of 24 h does not exceed 90 %*
- *the average value of the water vapour pressure, over a period of 24 h does not exceed 2, kPa*
- *the average value of the relative humidity, over a period one month does not exceed 90 %*
- *the average value of water vapour pressure, over a period one month does not exceed 1,8 k Pa*

For these conditions, condensation may occasionally occur.

Note 1 : La condensation peut survenir dans le cas de variations soudaines de température en période de forte humidité.
Note 2 : Pour supporter les effets d'une forte humidité et de la condensation, tels qu'une interruption de l'isolation ou la corrosion des parties métalliques, il convient d'utiliser l'appareillage spécialement conçu pour de telles conditions et testé en conséquence.
Note 3 : Il est possible de prévenir la condensation en concevant un bâtiment ou une enveloppe spécial, une ventilation et un chauffage adaptés au poste, ou en utilisant un dispositif de déshumidification.

***Note 1**: condensation can be expected where sudden temperature changes occur in period of high humidity.*
***Note 2**: to withstand the effects of high humidity and condensation, such as a breakdown of insulation or corrosion of metallic parts, switchgear designated for such conditions and tested accordingly should be used.*
***Note 3**: Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by use of dehumifying equipment.*

Comme l'indique la norme, la condensation peut aussi surve-nir occasionnellement dans des conditions normales. La norme poursuit en mentionnant les mesures spéciales susceptibles d'être appliquées aux locaux pour prévenir la condensation (Note 3).

As indicated in the standard, condensation may occasionally occur even under normal conditions. The standard goes on to indicate special measures concerning the substation premises that can be implemented to prevent condensation (Note 3).

Utilisation dans des conditions critiques

Dans des conditions critiques d'humidité et de pollution, qui dépassent largement les conditions d'utilisation normales mentionnées ci-dessus, le matériel électrique normalement conçu peut subir des dommages à cause de la corrosion rapide des parties métalliques et de la dégradation superficielle des parties isolantes.

Use under severe conditions

Under certain severe conditions concerning humidity and pollution, largely beyond the normal conditions of use mentioned above, correctly designed electrical equipment can be subject to damage by rapid corrosions of metal parts and surface degradation of insulating parts.

ARPHO OBTENUTA

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Consignes en conditions sévères d'humidité et/ou pollution
Guidelines in harsh conditions of moisture and / or pollution

Mesures préventives pour limiter les effets de la condensation

Concevez et adapter les ventilations du poste avec précaution

- Pour réduire les variations de température, maintenez la ventilation du poste au niveau minimum requis afin d'évacuer la chaleur générée par le transformateur.
- Quand cela est possible, utilisez de la ventilation naturelle plutôt que de la ventilation forcée.
- Si la ventilation forcée est nécessaire, faites fonctionner les ventilateurs en continu.
- Si dans le poste, seule la ventilation forcée est possible, alors faites la fonctionner en continu.
- Placez les ouvertures de ventilation du poste le plus loin possible de la cellule MT.
- N'ajoutez jamais d'ouvertures de ventilation aux cellules MT.

Évitez les variations de température

- Installez des résistances anti-condensation à l'intérieur des cellules MT et faites-les fonctionner en continu, i.e. sans commande manuelle ou automatique.
- Améliorez l'isolation thermique du poste.
- Evitez que le transformateur soit dans le même local que l'appareillage MT.
- S'il est nécessaire de chauffer le poste, assurez-vous que le système de régulation de la température empêche les variations brusques de température ou bien laissez fonctionner le chauffage en continu.
- Éliminez les courants d'air froids provenant des caniveaux pour câbles, des dessous de portes, etc..

Éliminez les sources d'humidité dans le voisinage du poste

- Empêchez la prolifération des plantes autour du poste.
- Réparez les fuites dans le toit du poste.
- Empêchez l'humidité provenant des canivaux pour câbles de pénétrer dans les cellules MT.

Installez un système de climatisation

- La climatisation est le moyen le plus sûr pour maîtriser l'humidité et la température.

Assurez-vous que le câblage est conforme aux règles applicables

- Prêtez une attention particulière au positionnement des blindages, des écrans de répartittion de champs et des écrans semi-conducteurs.
- Dans la mesure du possible, utiliser des extrémités de câbles de technologie à froid, mais il faut s'assurer qu'elles sont correctement installées.

Mesures préventives pour limiter les effets de pollution

- Équipez les ouvertures de ventilation du poste de grilles de type chevron pour limiter la pénétration de la poussière et de la pollution.
- Maintenez la ventilation du poste au niveau minimum requis pour que l'évacuation de la chaleur générée par le transformateur limite la pénétration de poussière et de pollution.
- Utilisez des cellules MT avec un degré de protection (IP) suff samment élevé.
- Utilisez des systèmes de climatisation avec f ltres pour limiter la pénétration de la poussière et de la pollution.
- Nettoyez régulièrement toutes les traces de pollution des parties métalliques et des parties isolantes.

Preventive measures to limit the effects of condensation

Carefully design or adapt substation ventilation:

- *Keep substation ventilation to the minimum required for evacuation of transformer heat to reduce temperature variations.*
- *Use natural ventilation rather than forced ventilation whenever possible.*
- *If forced ventilation is required, run fans continuously.*
- *If there is only and forced ventilation mode switch in on continuously.*
- *Locate the substation ventilation openings as far as possible from the MV cubicle.*
- *Never add ventilation openings to MV cubicles.*

Avoid temperature variations

- *Install anti-condensation heaters inside MV cubicles and let them run continuously, i.e. without automatic or manual control.*
- *Improve the termal insulation of the substation.*
- *Avoid the transformer is in the same location as the MV switchgear.*
- *If heating is required, make sure the temperature regulation system avoids large temperature swings or leave heating on continuously.*
- *Eliminate cold air drafts cable trenches, under doors, etc..*

Eliminate sources of humidity in the substation environment

- *Avoid excessive plant growth around the substation.*
- *Repair any leaks in the substation roof.*
- *Prevent humidity from cable trenches from entering MV cubicles.*

Install an air conditioning system

- *Air conditioning is the surest way of controlling humidity and temperature.*

Make sure cabling is in accordance with applicable rules

- *Pay special attention to the positioning of earthing screens, stress control screens and semiconductor screens.*
- *Use cold-shrink cable terminations is possible, but make sure they are properly installed.*

Preventive measures to limit the effects of pollution

- *Equip substation ventilation openings with chevron-type baffles to reduce entry of dust and pollution*
- *Keep substation ventilation to the minimum required for evacuation of transformer heat to reduce entry of pollution and dust.*
- *Use MV cubicles with a sufficiently high degree of protection (IP).*
- *Use air conditionning systems with filters to restrict entry pf pollution and dust.*
- *Regularly clean all traces of pollution from metal and insulating parts.*

Ventilation
Ventilation

Dimensionner les ouvertures de ventilation

Méthode de calcul

Il existe un certain nombre de méthodes pour estimer la taille requise des ouvertures de ventilation des postes, soit pour la conception de nouveaux postes, soit pour l'adaptation de postes existants qui ont connu des problèmes de condensation.

Méthode de base

Cette méthode est fondée sur la dissipation de puissance du transformateur (effet de joule).
Les surfaces requises pour les ouvertures de ventilations S et S' peuvent être estimées en utilisant les formules suivantes :

$$S = \frac{1,8 \times 10^{-1} P}{\sqrt{H}} \quad \text{et} \quad S' = 1,1 \times S$$

Où :
S = surface de l'ouverture de ventilation inférieure (entrée d'air) [m²] (surface de la grille déduite).
S' = surface de l'ouverture de ventilation supérieure (sortie d'air) [m²] (surface de la grille déduite).
P = puissance dissipée totale [W], P est la somme de la puissance dissipée par :
- le transformateur (à vide et à cause de la charge),
- l'appareillage BT,
- l'appareillage MT.

H = hauteur entre les points du milieu des ouvertures de ventilations [m].

Sizing the ventilation openings

Calculation methods

A number of calculation methods are available to estimate the required size of substation ventilation openings, either for the design of new substations or the adaptation of existing substations for which condensation problems have occured.

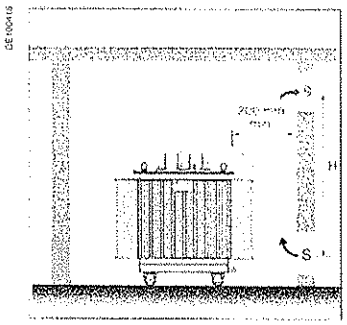
Basic method

This method is based on transformer dissipation.
The required ventilation opening surface areas S and S' can be estimated using the following formulas.

$$S = \frac{1.8 \times 10^{-1} P}{\sqrt{H}} \quad \textit{and} \quad S' = 1.1 \times S$$

Where :
***S**= lower (air entry) ventilation opening area [m²] (grid surface deducted).*
***S'**= upper (air exit) ventilation opening area [m²] (grid surface deducted).*
***P**= total dissiped power [W], P is the sum of the power dissipated by:*
- *the transformer (dissipation at no load and due to load)*
- *the LV switchgear*
- *the MV switchgear.*

***H**= height between ventilation opening mid–points [m].*



Note : Cette formule est valable pour une température moyenne annuelle de 20 °C et une altitude maximum de 1000 m.

Exemple :
Dissipation de puissance du transformateur = 7970 W
Dissipation de puissance de l'appareillage BT = 750 W
Dissipation de puissance de l'appareillage MT = 300 W
La hauteur entre les points du milieu des ouvertures de ventilation est égale à 1,5 m.

Calcul :
Puissance dissipée
P = 7970 + 750 + 300 = 9020 W

$$S = \frac{1,8 \times 10^{-1} P}{\sqrt{1,5}} = 1,32 \text{ m}^2$$

et
S'= 1.1 x 1,32= 1,46 m²

***Note**: This formula is valid for a yearly average temperature of 20 °C and a maximum altitude of 1000 m.*

Example:
Transformer dissipation= 7970 W
Lv switchgear dissipation= 750 W
MV switchgear dissipation= 300 W
The height between ventilation opening mid–points is 1,5 m.

Calculation:
Dissipated Power
P = 7970 + 750 + 300 = 9020 W

$$S = \frac{1.8 \times 10^{-1} P}{\sqrt{1.5}} = 1.32 \text{ m}^2$$

and
S'= 1.1 x 1.32= 1.46 m²

Ventilation
Ventilation

Méthode plus complète

Une autre possibilité est la formule suivante basée sur divers aspects de la conception du poste.

$$S = \frac{(P - 2{,}4 * \Sigma_i (K_i * S_i) * T}{417 * G \sqrt{H} * T^{1{,}5}} \quad \text{et} \quad S' = 1{,}1 \times S$$

Où :
S = surface de l'ouverture de ventilation inférieure (entrée d'air) [m²].
S' = surface de l'ouverture de ventilation supérieure (sortie d'air) [m²] (surface de la grille déduite).
P = puissance dissipée totale [W], P est la somme de la puissance dissipée par :
- le transformateur (à vide et à cause de la charge),
- l'appareillage BT,
- l'appareillage MT.

Si = surface de l'enveloppe i [m²].
Ki = coeffecient de transmission de la surface i [W/m2K].
- k = 7 pour la tôle acier,
- k = 3 pour 10 cm de béton et 2,5 pour 20 cm,
- k = 0 pour le sol (pas de transmission de chaleur par le sol),

T = type d'enveloppe (hausse de la température du transformateur) [k].
G = coefficient de la grille
- G = 0,28 à 0,77 pour les grilles de type chevron (0,38 pour des chevrons simples à 90 °C)
- G < 0,2 pour les types les plus complexes comme les grilles à chicanes profilées.
- G autour de 0,6 pour la tôle perforée de trous rectangulaires

H = hauteur entre les points du milieu des ouvertures de ventilations [m].

More complete method

Another possibility is the following formula based on various aspects of substation design.

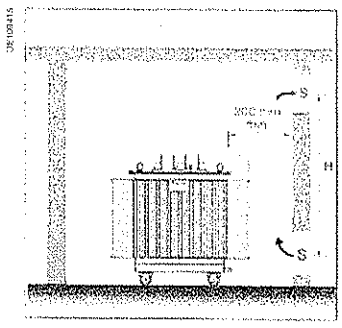
$$S = \frac{(P - 2{,}4 * \Sigma_i (K_i * S_i) * T}{417 * G \sqrt{H} * T^{1{,}5}} \quad \textit{and } S' = 1.10 * S$$

Where:
S=lower (air entry) ventilation opening area [m²].
S'= upper (air exit) ventilation opening area [m²].
P= total dissiped power [W], P is the sum of the power dissipated by:
- *the transformer (dissipation at no load and due to load)*
- *the LV switchgear*
- *the MV switchgear.*

Si= area of enclosure surface i [m²].
Ki= transmission coefficient of surface [W/m2K].
- *k= 7 for steel sheets*
- *k= 3 for 10 cm and 2,5for 20 cm of concrete,*
- *k= 0 for the ground (no heat transmission throught the ground)*

T= class of enclosure (transformer temperature rise) [k].
G= grid coefficient
- *G= 0.28 to 0.77 for chevron blade louvers (0.38 for 90 °simple chevron)*
- *G < 0.2 for more complex types such as overlapped C beams.*
- *G around 0.6 for punched sheet with rectangular holes*

H= height between ventilation opening mid–points [m].



Ventilation
Ventilation

Méthode plus complète (suite)

Note : Cette méthode donne des surfaces des ouvertures de ventilation plus petite que celles obtenues avec la méthode de base car elle prend en compte la dissipation qui passe par les murs, le toit et les portes.

Exemple :
Dissipation de puissance du transformateur = 7970 W
Dissipation de puissance de l'appareillage BT = 750 W
Dissipation de puissance de l'appareillage MT = 300 W
La surface du poste se décompose comme suit :
- 14,6 m² de murs en béton (10 cm d'épaisseur),
- 7 m² de toit en béton (10 cm d'épaisseur),
- 6 m² de portes métalliques.

L'enveloppe est de catégorie 10 K.
La grille de ventilation est de type grille en chevron (G = 0,4).
La hauteur entre les points du milieu des ouvertures de ventilation est égale à 1,5 m.

Calcul :
Puissance dissipée
P = 7970 + 750 + 300 = 9020 W

$$\sum_i (K_i * S_i) = 14.6*3+7.0*3+6.2*7 = 108,2 \text{ W/K}$$

$$S = \frac{(9020 - 2,4*108,2*10)}{417*0,4*\sqrt{1,5}*10^{1,5}} = 0,99 \text{ m}^2$$

et S' = 1,1 x 0,99 = 1,09 m²

More complete method (continued)

Note: *This gives smaller ventilation opening areas than the previous method beacause it takes dissipation through the walls, roof and doors into account.*

Example:
Transformer dissipation= 7970 W
Lv switchgear dissipation= 750 W
MV switchgear dissipation= 300 W
The substation area is made up of:
- *14.6 m² of concrete walls (10 cm thick)*
- *7.0 m² of concrete roof (10 cm thick)*
- *6.2 m² of metallic doors*

The enclosure class is 10 K.
The ventilation grid is of the chevron louver type (G= 0.4).
The height between ventilation opening mid-- points is 1,5 m.

Calculation:
Dissipated Power
P = 7970 + 750 + 300 = 9020 W

$$\sum_i (K_i * S_i) = 14.6*3+7.0*3+6.2*7 = 108.2 \text{ W/K}$$

$$S = \frac{(9020 - 2.4*108.2*10)}{417*0.4*\sqrt{1.5}*10^{1.5}} = 0.99 \text{ m}^2$$

and S' = 1.1 x 0.99 = 1.09 m²

Essai

Les méthodes énoncées ci-dessus peuvent être utilisées pour estimer la taille requise des ouvertures de ventilation du poste, toutefois les meilleurs résultats sont obtenus en procédant à des essais.

Pour les nouveaux postes, les essais doivent être effectués par le fabricant du poste afin de s'assurer que le système de ventilation fourni n'est pas surdimensionné.

Pour les nouveaux postes existant sujets à des problèmes de condensation, les essais servent à déterminer s'il est possible de réduire les surfaces des ouvertures de ventilation sans excéder les limites maximum de hausse de température du transformateur dans les pires conditions possibles.

Testing

The above methods can be used to estimate the required size of substation ventilation openings, however the best results are obtained by testing.

For new substation, tests should be carried out by the substation supplier to ensure that the provided ventilation system is not oversized.

For existing substations presenting condensation, tests can be carried out to determine whether ventilation opening areas can be reduced without exceeding the maximum temperature rise liimits of the transformer under the worst possible conditions.

Ventilation
Ventilation

Emplacement des ouvertures de ventilation
Ventilation opening locations

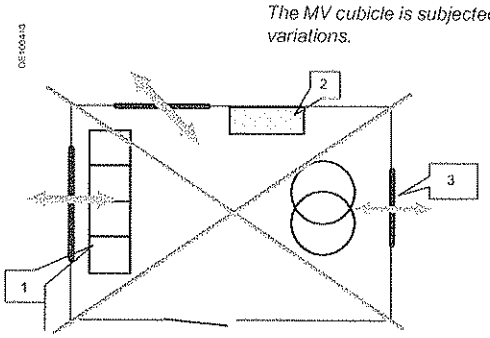
Pour favoriser l'évacuation de la chaleur générée par le transformateur via la convection naturelle, les ouvertures doivent être placées en haut et en bas du mur près du transformateur.
La chaleur dissipée par le tableau MT est négligeable.
Pour éviter les problèmes de condensation, les ouvertures de ventilation du poste doivent être situées le plus loin possible du tableau.

To facilitate evacuation of the heat produced by the transformer via natural convection, ventilation openings should be located at the top and bottom of the wall near the transformer.
The heat dissipated by the MV switchboards is negligible.
To avoid condensation problems, the substation ventilation openings should be located as far as possible from the switchboard.

Poste MT/BT «sur-ventilé»
La cellule MT est soumise à des variations de températures soudaines.

«Over» ventilated MV/LV substation
The MV cubicle is subjected to sudden temperature variations.

1 : tableau MT
2 : tableau BT
3 : ventilation Haute et Basse

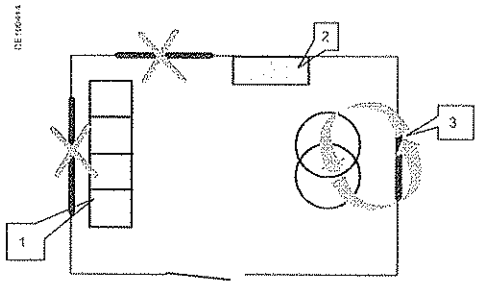


1: MV switchboard
2: LV switchboard
3: Upper and Lower ventilations

Poste avec ventilation adaptée
La cellule MT n'est plus soumise à des variations de températures soudaines.

Substation with adapted ventilation
The MV cubicle is no longer subjected to sudden temperature variations.

1 : tableau MT
2 : coffret BT
3 : ventilation Haute et Basse



1: MV switchboard
2: LV enclosure
3: High and Low ventilations