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## MV POLE-MOUNTED CIRCUIT-BREAKER

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Revision	Data	List of modifications
Rev. 00	16/04/2015	First emission
Rev. 01	25/09/2018	Modification of technical characteristics and ratings. Added some codes to contemplate new typologies of PMCB. Alignment of requirements among all countries. Alignment of type and routine tests with international IEC standards.

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## 1 SCOPE

The scope of this document is to provide the technical requirements for the supply of outdoor MV pole-mounted circuit-breaker (henceforth PMCB) to be used in overhead bare conductors lines and cable lines of the Enel Group Distribution companies, whose Countries are listed below:

- Argentina
- Brazil
- Chile
- Colombia
- Spain
- Italy
- Peru
- Romania

## 2 LIST OF COMPONENTS

The following components are covered by this global standard:

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Type code	Typology	Connection	Command type	Earthing Switches	Embedded LPIT <sup>1</sup>	Rated voltage [kV]	Notes
GSCM002/1	Pole mounted	Open terminals	Direct	NO	YES	24	RUSCD <sup>2</sup> = 60 mm/kV
GSCM002/2					NO		
GSCM002/3			Down-transmitted		YES		
GSCM002/4					NO		
GSCM002/5		Open terminals (extreme pollution)	Direct	NO	YES		
GSCM002/6					NO		
GSCM002/7			Down-transmitted		YES		
GSCM002/8					NO		
GSCM002/9		Plug-in terminals	Direct	YES	YES		
GSCM002/10					NO		
GSCM002/11				NO	YES		
GSCM002/12					NO		
GSCM002/13		Substation	Open terminals	NO	YES		
GSCM002/14					NO		
GSCM002/15	YES						
GSCM002/16	NO						
GSCM002/17	Down-transmitted			YES			
GSCM002/18				NO			

**Table 1: List of components (24 kV)**

See Annex A for drawings and general dimensions. The dimensions don't apply to Substation PMCB intended to be used for the medium voltage feeders leaving from the HV/MV Substations.

<sup>1</sup> LPIT: Low Power Instrument Transformer

<sup>2</sup> RUSCD: Reference unified specific creepage distance. See IEC 60815-3.



Type code	Typology	Connection	Command type	Earthing Switches	Embedded LPIT	Rated voltage [kV]	Notes
GSCM002/19	Pole mounted	Open terminals	Direct	NO	YES	36	
GSCM002/20					YES		Altitude 2700 m
GSCM002/21					NO		
GSCM002/22			NO		Altitude 2700 m		
GSCM002/23			Down-transmitted		YES		
GSCM002/24					NO		
GSCM002/25		Open terminals (extreme pollution)	Direct	YES	YES		RUSCD= 60 mm/kV
GSCM002/26					NO		
GSCM002/27					YES		
GSCM002/28					NO		
GSCM002/29		Plug-in terminals	Direct	YES	YES		
GSCM002/30					NO		
GSCM002/31					YES		
GSCM002/32					NO		
GSCM002/33	Substation	Open terminals	Direct	NO	YES		
GSCM002/34					YES	Altitude 2700 m	
GSCM002/35					NO		
GSCM002/36			NO		Altitude 2700 m		
GSCM002/37			Down-transmitted		YES		
GSCM002/38					NO		

**Table 2: List of components (36 kV)**

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### 3 REFERENCE LAWS AND STANDARDS

#### 3.1 Laws

##### 3.1.1 Colombia

- RETIE - Reglamento Técnico de Instalaciones Eléctricas.

##### 3.1.2 Spain

- R.D. 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico.
- R.D. 337/2014, de 9 de mayo, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión y sus Instrucciones Técnicas Complementarias ITC-RAT 01 a 23.
- R.D. 223/2008, de 15 de febrero, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en líneas eléctricas de alta tensión y sus instrucciones técnicas complementarias ITC-LAT 01 a 09.

##### 3.1.3 All European Countries

- Regulation (EU) of the European Parliament and of the Council 517/2014 of the 16th of April 2014.

#### 3.2 Standards

##### 3.2.1 Common international standards

The below listed reference documents shall be intended in the in-force edition at the contract date (amendments and errata corrige included). Unless otherwise specified, these documents are valid until the new editions replace them. The terms used in this document are according to the standards listed above.

Standards	Edition
IEC 62271-1	See product standard
IEC 62271-100	2008-04
IEC 62271-102	2018-05
IEC 62271-200	2011-10
IEC 60447	2004-01
IEC 60529	1989-11
EN 50181	2010-07
ISO 2081	2008-12
ISO 1461	2009-05
ISO 14713-1	2017-04



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ISO 12944-2	2017-11
IEC 60137	2008-07
IEC 62217	2012-09
IEC 60695-11-10	2017-05
IEC 61869-1	See product standard
IEC 61869-6	See product standard
IEC 61869-10	2017-12
IEC 61869-11	2017-12
IEC 61815-3	2008-10

### 3.2.2 Common technical specifications

DY1050 - Requirements for the 24 Vcc motorisation

GSTR001 - Peripheral Unit

GSCS006 - Bracket

GSC001 - Underground medium voltage cables

GSCT004 - Outdoor voltage transformers up to  $U_m$  36 kV

GSCT005 - Technical Characteristics of LPITs for RGDM/RGDAT

### 3.2.3 Particular technical specifications

Unless otherwise specified, these technical specifications are valid until the new editions replace them.

#### 3.2.3.1 Chile

ETGI-1020 - Especificaciones técnicas generales - Requisitos de diseño sísmico para equipo eléctrico.

DMAD-0184 - Poste de hormigón armado 13,5 m.

DMAD-0180 - Poste de hormigón armado 11,5 m.

#### 3.2.3.2 Colombia

NSR - 10 Norma Sismo Resistente Colombiana.

#### 3.2.3.3 Peru

E-SE-010 - Acción sísmica en equipos eléctricos y mecánicos.

#### 3.2.3.4 Italy

PVR006 – Barcode

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#### 4 SERVICE CONDITIONS

Service conditions are the normal service conditions according to to 62271-200, with the following additions/modifications.

Minimum ambient air temperature for outdoor installation	- 30 °C
Ice coating (IEC 62271-1)	22 mm
Relative humidity (IEC 62271-1)	98%
Network neutral earthing systems	Effectively earthed neutral system Non effectively earthed neutral system

**Table 2: Requirements for PMCB service conditions**

For Colombia the maximum reference altitude is 2.700 m (Type codes GSCM002/20, GSCM002/22, GSCM002/34 and GSCM002/36). Refer to IEC 62271-1 for altitude correction factor.

#### 5 COMMON CHARACTERISTICS

##### 5.1 Characteristics of the PMCB

The pole mounted PMCB shall be compliant with IEC 62271-200. The substation (see tables 1 and 2) PMCB shall be compliant with IEC 62271-200 or IEC 62271-201.

The solutions for the insulation of PMCB are SF6 gas<sup>3</sup> or solid insulation with vacuum or SF6 circuit breaker.


The PMCB has to be manufactured in compliance with the reference national laws and with the standards pointed out in section 3.2.

The enclosure shall have a SF6 volume less than 1500 liters and its filling, to be implemented exclusively in the factory, shall be made in order that the maximum operating relative pressure at 45 °C does not exceed 0,5 [kg/cm<sup>2</sup>]. The PMCB shall be a sealed pressure system (IEC 62271-200).

The elements used in the factory for filling and recovering the SF6 at the end of life shall be identified with a self-adhesive plate and protected from accidental shocks. On the plate it shall be written in local language: "Remove the cap at the end of the PMCB's operating life only for the possible recovery of gas". This plate shall have a yellow RAL 1021 background and the words in black RAL 9005.

The PMCB shall have an overpressure valve, equipped with a metallic disc for the protection against accidental strains, placed at a proper distance from the valve itself and equipped with lateral grids which allow the gas vent and prevent the fall of material to the ground.

<sup>3</sup> Gas alternative to SF6 can be considered and are subject to Enel approval.

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The panels for the accessing the mechanical parts of the PMCB shall be removable without removing parts of the commands; it is allowed only removing the extensions of the operating shafts of the circuit-breaker/line disconnecter and of the earthing switches that allow the use of the earthing stick. A condensation disposal system for the command compartment shall be provided.

The PMCB shall be provided with appropriate lifting eyebolts in its upper part. The weight must not exceed 300 kg.

On the top of the switch-disconnector it shall be provided a fixing system in order to allow the installation of the outdoor voltage transformer described in the Global Standard GSCT004. During the design and manufacturing of the PMCB, the maximum weight of this transformer shall also be considered for strains during operation, transportation and installation.

## 5.2 Rated characteristics.

Rated voltage		[kV]	24	36
Rated insulation level	- Rated short-duration power-frequency withstand voltage (Common value)	[kV]	50	70
	- Rated short-duration power-frequency withstand voltage (Across the isolating distance)	[kV]	60	80
	- Rated lightning impulse withstand voltage (Common value)	[kV]	125	170
	- Rated lightning impulse withstand voltage (Across the isolating distance)	[kV]	145	195
Rated frequency		[Hz]	50 (and 60)	
Rated normal current		[A]	630	
Rated short-time withstand current		[kA]	16	
Rated peak withstand current		[kA]	40 (and 41,6)	
Rated duration of short-circuit		[s]	1	
Internal arc test	Type of accessibility		C	
	Rated arc fault current	[kA]	16	
	Rated arc fault duration	[s]	1	
External degree of protection			IP54	

**Table 3: Characteristics of the PMCB**

## 5.3 SF6

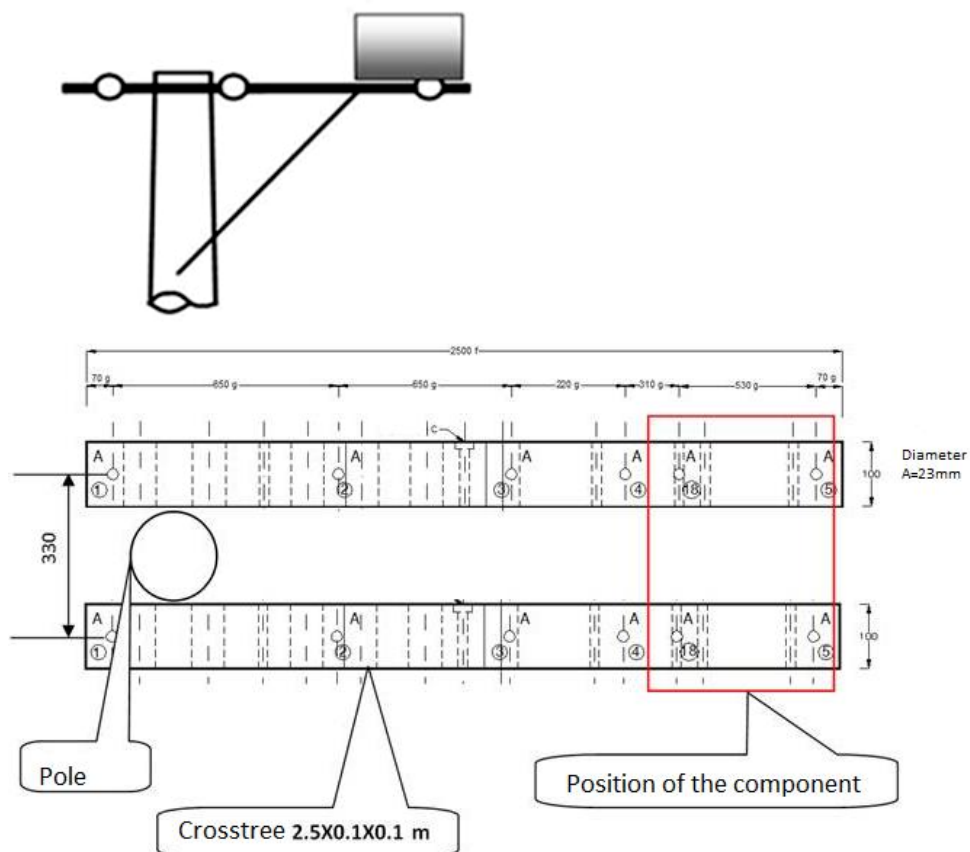
The expected operating life with regard to leakage performance shall be 40 years.

## 5.4 Bracket

The PMCB shall be provided with the standardized bracket GSCS006 to be connected to the pole.

### 5.4.1 Colombia

The PMCB shall be designed also to be installed on a horizontal surface, as shown in the figure below:



### 5.4.2 Chile

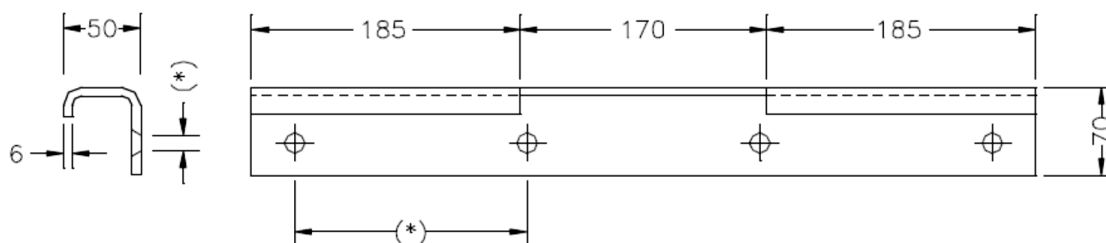
The PMCB shall be provided with a support which has to comply with the technical specification DMAD-0180 and DMAD-0184.

### 5.4.3 Italy, Peru, Romania and Spain

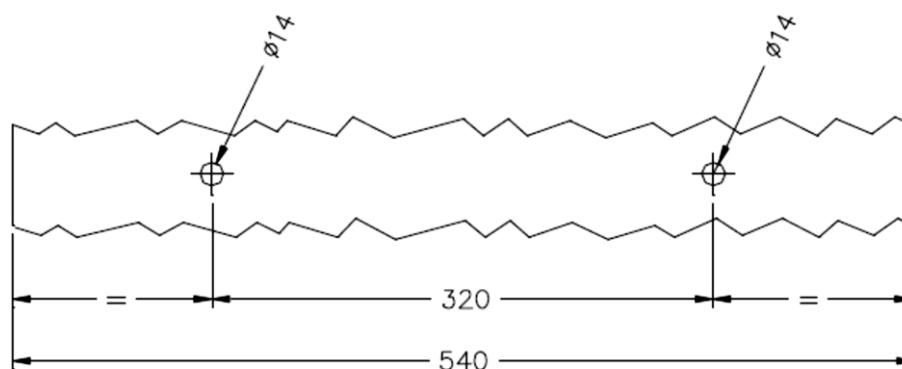
For Italy, Romania and Peru, the bracket shall be fixed with the dedicated stainless steel band DS3230/2 and braces DS3240/2. For Spain, the bracket shall be fixed with specific screws for any type of pole.

The PCMB shall be provided with the coupling supports in stainless steel between the bracket and the PMCB (part.1 and 2).

Part.1



Part.2



\* The number and size of the holes for fixing the equipment and the centre to centre distance shall be stated by the Manufacturer in order to ensure the stability of the structure with a weight which is the double of the normal weight of the equipment.

## 5.5 Commands

The PMCB will contain:

- 1 MV circuit-breaker (CB);
- 1 Line Disconnecter (LD)
- 2 Earthing switches (ES) (if applicable)

The motor for the circuit breaker spring recharge shall comply with the DY1050 and shall have:

- a shunt release three-pole closing device;
- a shunt release three-pole opening device;
- an anti-pumping device which has the purpose to prevent reclosing after the first close-open operation when there is an opening during the first closing request. This device shall not be deactivated by functional restrictions.

The PMCB shall communicate with the Peripheral Unit according to the interlocks and to the other requirements of this Global Standard. Connections with the peripheral unit GSTR001, type of connector and pin assignment, shall comply with the requirements of DY1050.

With the auxiliary power supply voltage shall be possible a complete restoration of the MV circuit breaker stored energy. In case of lack of supply voltage, it shall be possible the restoration of the energy by means of a manual system placed in front of PMCB.

The manual commands of the earthing switches (if present) shall be independent unlatched operation type, deadcenter overcoming both in opening and closing operation, rotary or translational vertical movement (IEC 60447)<sup>4</sup>. The operations of disconnecter and earthing switches shall be done applying a force not higher than 250 N

The operation direction shall be compliant with IEC 60447. On each operating point, it shall be written the function of the device ("LD", "ES1" and "ES2"), the function of the operation (see Table 5) and the movement direction.

Language	Opening	Closing
Italian	A	C
Spanish	A	C
Portuguese	A	F
Romanian	D	I

**Table 5. Function of the operation**

## 5.6 Devices and signal position

The circuit-breaker, the line disconnecter and the earthing switches shall be equipped with "safe position devices" for the indication of the real position of the main moving contacts of the switches, as required by IEC 62271-200.

The indicators of the positions shall be luminescent and protected from the action of weather by adopting a transparent protection and shall be of an adequate dimension to be clearly visible from the ground (even in the case of installation on a horizontal surface, see par. 6.5.1); a lenticular transparent protection is allowed.

Near the indicators, nameplates shall be applied. These nameplates, for "circuit-breaker" (CB) "line disconnecter" (LD) and "earthing switches" (ES), shall be in black on white background. These nameplates shall be designed to be used in environments of climatic category type C5 "Very High" (ISO 14713-1) or C5-I "Very High (industrial)" (ISO 12944-2).

The following indications shall be provided:

- circuit breaker's signal position:
  - black letter "I" on white background corresponding to the close position of the circuit-breaker;
  - white letter "O" on black background corresponding to the open position of the circuit-breaker;
- line disconnecter's signal position:

---

<sup>4</sup> Same requirements are applicable to the disconnectors if the manufacturer uses a spring system (e.g. using a switch-disconnector).

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- black letter “I” on red background corresponding to the close position of the disconnecter;
- black letter “O” on green background corresponding to the open position of the disconnecter;
- earthing switch’s signal position:
  - black letter “I” on yellow background corresponding to the close position of the earthing switch;
  - black letter “O” on grey background corresponding to the open position of the earthing switch;

The signal positions shall be visible even with the protection shell removed.

For Brazil the letters indicating the signal position of circuit-breaker, line disconnecter and earthing switches shall be “D” for the open position and “L” for the close one.

## 5.7 Earth connections

Every metallic parts of the enclosures and/or metallic partitions and the local command shall be connected to the provided M12 earthing point.

The operating shafts of the circuit-breaker, line disconnecter and of the earthing switches and the other metallic objects shall be connected to the earth with copper conductors whose section shall not be less than 16 mm<sup>2</sup>.

In case of concrete poles, a wire of a proper section will be used (not part of the supply) to connect the earthing point of the pole mounted circuit-breaker to the earthing point of the local command.

In case of PMCB with plug-in terminals, from the PMCB earthing point a copper bar shall be derived and it shall develop above and along the entire length of the PMCB and, in correspondence of the bushings, it shall be provided with three M12 bolts per side on which the earthing connections of the MV cable shields shall be fixed.


## 5.8 Protective coating

The enclosure of the PMCB and the command cover, which has to be in stainless steel AISI 316, does not need a protective coating.

The welded parts in stainless steel shall be treated with surface passivation using nitric acid or equivalent.

The parts in ferrous material of the operating commands inside the enclosure, treated with an iridescent conversion coating or equivalent (Fe/Zn12/C in compliance with ISO 2081), shall be protected by an electrolytic coating of 12 µm of zinc. The assembling nuts and bolts and the small accessories, unless otherwise specified, shall be protected with electrolytic zinc, except the external ones which must be in stainless steel AISI 316.

All the external metallic parts which are not in stainless steel shall be designed to be used in environments of climatic category type C5 "Very High", in compliance with standard ISO 14713-1 They shall be protected with a hot dip galvanization process according to ISO 1461 with a minimum thickness of 140 µm.

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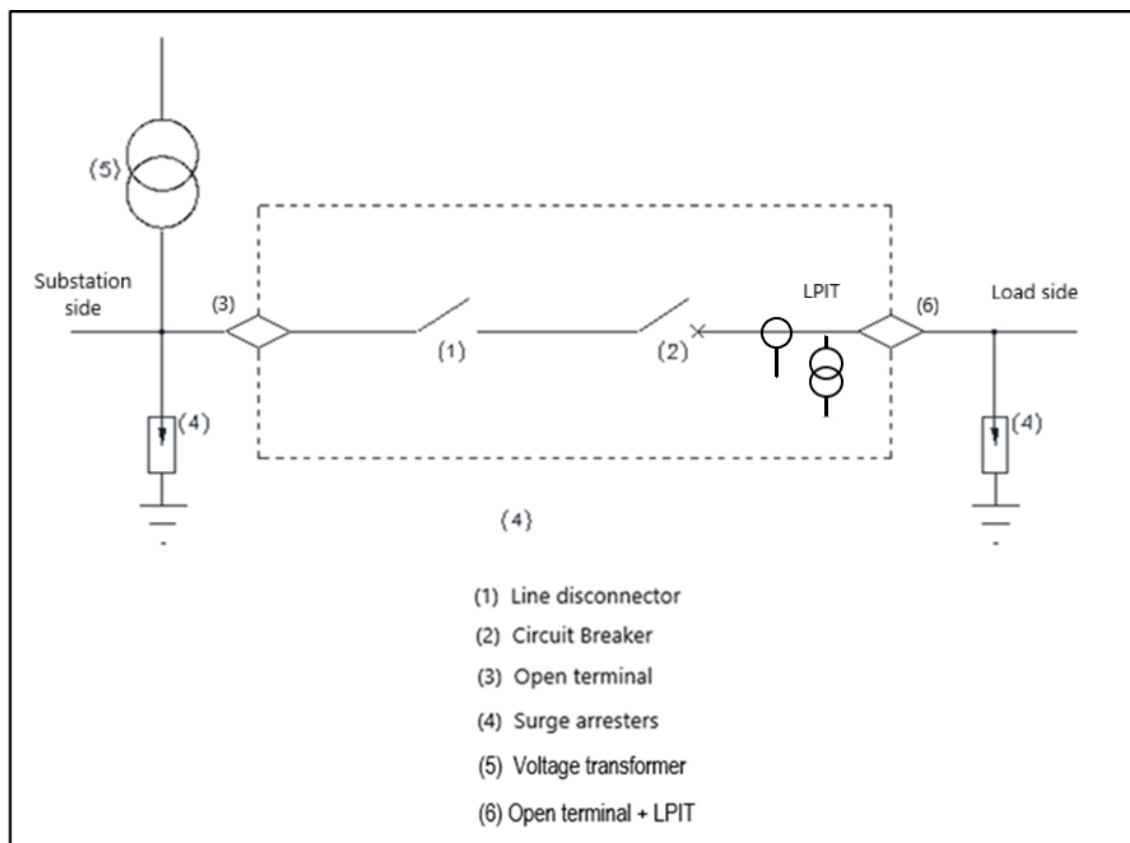
### 5.9 Low-Power Instrument Transformers (LPIT)

When requested (see tables 1 and 2), the PMCB shall integrate Current and Voltage Low-Power Instrument Transformers according to the technical specification GSCT005 “TECHNICAL CHARACTERISTICS OF LPITs FOR RGDM/RGDAT” with the following addition:

- The connection cable shall be 18m long.

### 6 PMCB WITH OPEN TERMINALS

The PMCB shall be realized with one circuit-breaker and one line disconnector. The functional electric scheme is the one of the figure below.<sup>5</sup>



**Figure 1. PMCB with open terminals**

<sup>5</sup> The elements (4) and (5) are not part of the supply of the PMCB.



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## 6.1 Characteristics of the MV circuit-breaker

The circuit-breaker shall comply with the IEC 62271-100.

The characteristics of the circuit-breaker are shown in table 6.

Rated voltage	[kV]	24	36
Rated normal current	[A]	630	
Rated short-circuit breaking current	[kA]	16	
Rated peak withstand current	[kA]	40 (and 41,6)	
Rated duration of short-circuit	[s]	1	
Sequence of operations		O-0,3s-CO-15s-CO	
Circuit-breaker class		C2, E2, M2, S2	
Rated capacitive switching currents	- Rated line-charging breaking current [A]	10	10
	- Rated cable-charging breaking current [A]	31,5	50
First-pole-to-clear factor		1,5	
Break-time		<=80 ms	

**Table 6: Characteristics of the MV circuit-breaker**

Circuit breaker command shall be spring type, charged by an electrical motor<sup>6</sup>.

The circuit breaker command shall be able to perform the following sequence of operations:

- with functioning motor:
  - O – 0,3 s – CO – 15 s – CO starting from the status of closed circuit breaker and charged closing springs
- with non-functioning motor:
  - O – 0,3 s – CO starting from the status of closed circuit breaker and charged closing springs;
  - CO starting from the status of open circuit breaker and charged closing springs;
  - O starting from the status of closed circuit breaker and discharged closing springs.

With closed circuit breaker, the opening springs shall always be charged.

If during an operation a request to perform the opposite operation is received by the PMCB, the last one shall be performed after the conclusion of the on-going operation.

<sup>6</sup> Technologies alternatives to springs with the same functional characteristics can be considered and are subject to Enel approval.

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## 6.2 Characteristics of the line disconnecter

The line disconnecter shall comply with the IEC 62271-102 and shall have two positions (open and closed).

The characteristics of the disconnecter are shown in table 7.

Rated normal current	[A]	630
Rated short-time withstand current	[kA]	16
Rated peak withstand current	[kAc]	40 (and 41,6)
Rated short-circuit duration	[s]	1
Line disconnecter class		M1

**Table 7: Characteristics of the line disconnecter**

## 6.3 Manual command

Shall allow both the opening and the closing by translation (pulling the earthing stick downwards).

The same opening manual operation shall be realized in the first step to open the circuit breaker and then the disconnecter. The disconnecter must open only when the circuit-breaker is physically opened,

The closing manual operation shall be realized in the first step to close the line disconnecter. Only when the line disconnecter is physically closed it will be allowed to close the circuit breaker.

For “down-transmitted” command type PCMBs, the circuit-breaker and line disconnecter shall be operated with the earthing stick directly on a local command with a lever put at  $4 \div 4,5$  m from the base of the pole.

It is necessary to consider a distance between 4m and 12m from the “down-transmitted” local command to the PMCB.

For “direct” command type PCMBs, the lever to operate the line shall be put on the enclosure on the command cover (in front of the pole mounted circuit-breaker).

The manual command shall be designed in order to allow the application of a padlock with an arc of 8 mm thickness in the open and close position of the disconnecter

## 6.4 Remote command

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A motor shall be provided for the circuit breaker spring<sup>7</sup> recharge.

The remote command will allow opening and closing of the circuit-breaker.

It shall be possible to substitute the electronic board and the electric motor in an easy way and without removing the entire apparatus.

The PMCB shall be compliant to the technical specification DY1050, with the modifications listed below:

- The connection cable between PMCB and Peripheral Unit, to be supplied with the PMCB, shall be 10x1,5 mm<sup>2</sup> outdoor type, 10 m long. Only for Spain, the connection cable between pole mounted circuit-breaker and peripheral unit shall be 10x2,5 mm<sup>2</sup> and 20 m long.
- Both the extremities of this cable shall have pre-isolated terminals for the terminal box used and identification marks according to the connection table 12.
- This cable shall be prepared joining two conductors in parallel for each polarity of the power circuit, mechanically joint by a heat shrinking for a minimum length of 20 cm. Every necessary hole for cable passage shall have appropriate cable gland in order to restore the degree of protection of the shell (IEC 60529).
- The total resistance (LV cable + coil) of open and close command circuit shall be between 5 and 5000 Ω in all environmental conditions according to limits of the ambient temperature (see table 2).

## 6.5 Interlocks

The sequence of operations for commissioning shall be:

- closing of the disconnecter
- closing of the circuit-breaker

The sequence of operations for making out of service the line shall be done in reverse order than what written before.

The following interlocks shall be realized:

- the disconnecter shall be operated only with circuit-breaker in open position; this condition shall be realized by a mechanical interlock;
- the circuit-breaker operation shall be possible only with the disconnecter in closed position (end-of-operation switch).

Further linkages or interlocks shall not be introduced.

The mechanical interlocks, locks and obstruction stoppages shall be designed in order to withstand a force of 750 N.

See Annex C for interlocks check-in.

## 6.6 Insulated bushings

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<sup>7</sup> Technologies alternatives to springs with the same functional characteristics can be considered and are subject to Enel approval.

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The insulated bushings, shall be compliant with the standard IEC 60137. The housing shall be made of silicone without EPDM; they must have a standard RUSCD of 53,7 mm/kV, except types GSCM002/5,6,7,8,9,10,25,26,27,28 that shall be 60 mm/kV, and shall withstand a bending moment at the base of the attack of minimum 250 Nm.

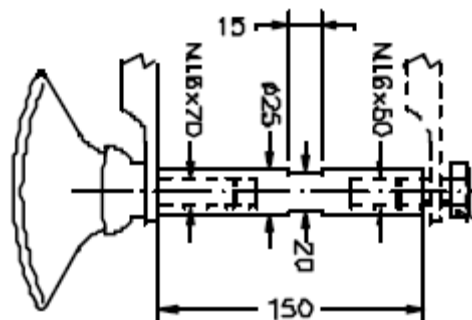
## 6.7 End fitting

### 6.7.1 Italy and Romania

The far of the insulator end shall be threaded M16x60.

The connection between the bare conductor line and the insulator shall be made with an eyelet terminal compatible with the M16 of the far end of the internal conductor of the insulator.

In the case of screened cable line connected with usual terminals, the earthing for work must be realized on the attacks (which are on demand, not part of the supply) to be put on the insulators, as shown in the figure below.

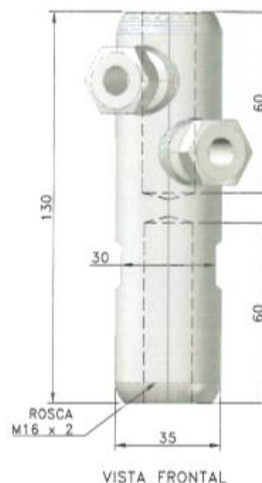
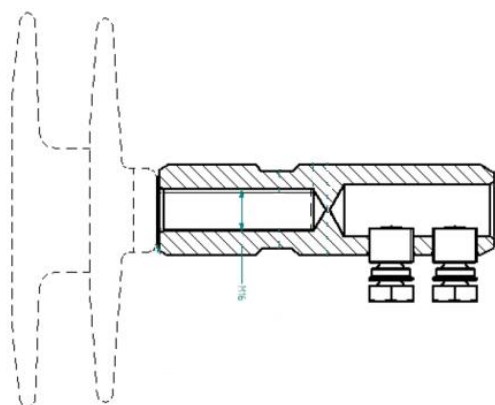


In the case of covered conductor, the earthing for work must be realized directly on the anchor lines.

However, in any case, all dispositions against electrocution must be adopted meticulously, because the positions of the main contacts of the circuit-breaker and line disconnector is independent from the insertion of the portable earthings.

### 6.7.2 Brazil

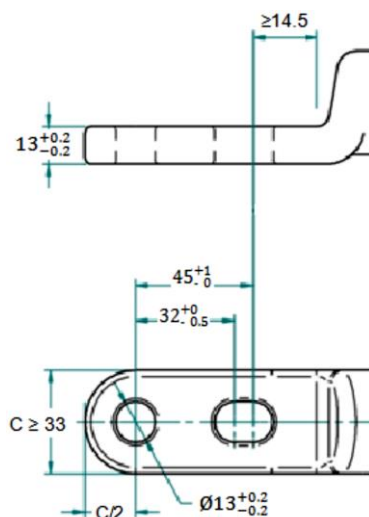
The far end of the internal conductor, that has to be threaded M16x2x60, shall be of bi-metallic material compatible with the terminal of the next figure.



### 6.7.3 Argentina, Chile, Colombia, Spain and Peru

The far end of the internal conductor shall be compatible with the eyelet terminal of the figure below, put in vertical position. The 2 holes of the terminal must be used for fixing the conductor to the PMCB.

For the PMCB to be supplied to Spain, if the connection with the terminal below is done by means of a separate accessory, this accessory shall be installed in the factory and the manufacturer shall guarantee that the accessory can not be removed from the PMCB by means of a tool.

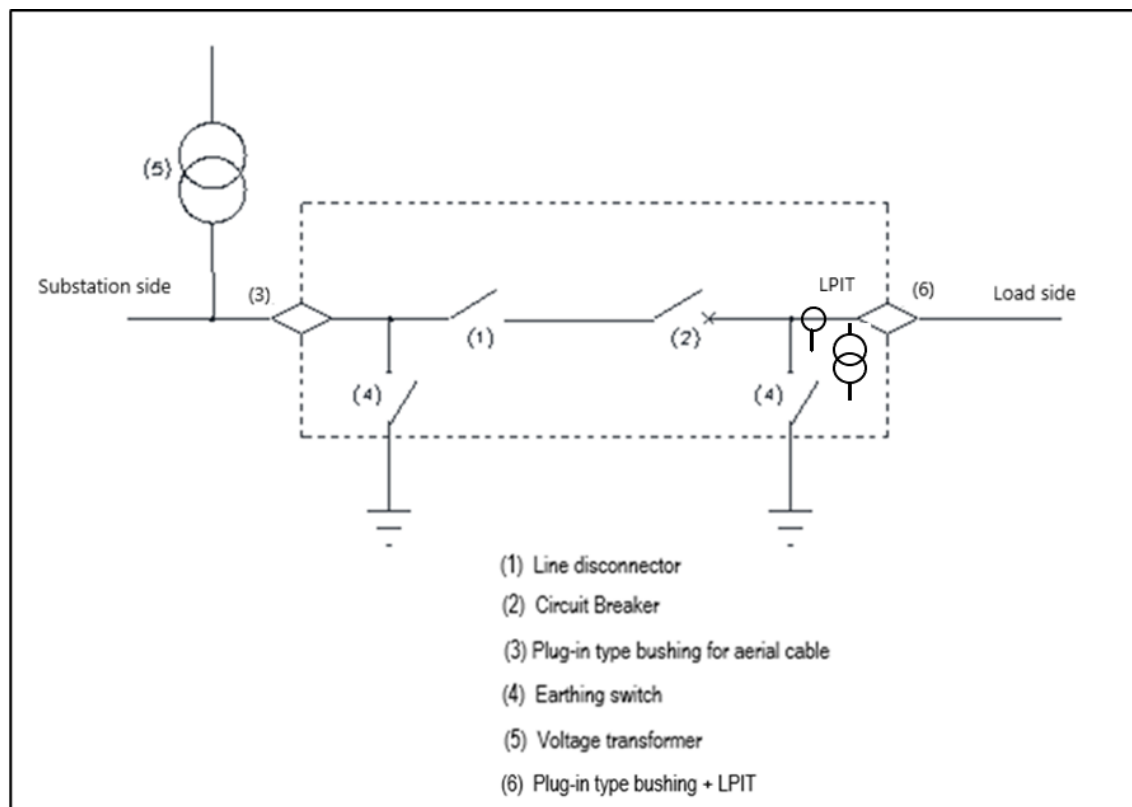


## 7 PMCB WITH PLUG-IN TERMINALS

Two versions of this component are considered:

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A) PMCB with one circuit breaker, one line disconnector and two earthing switches. The functional electric scheme is the one of Figure 2.<sup>8</sup>

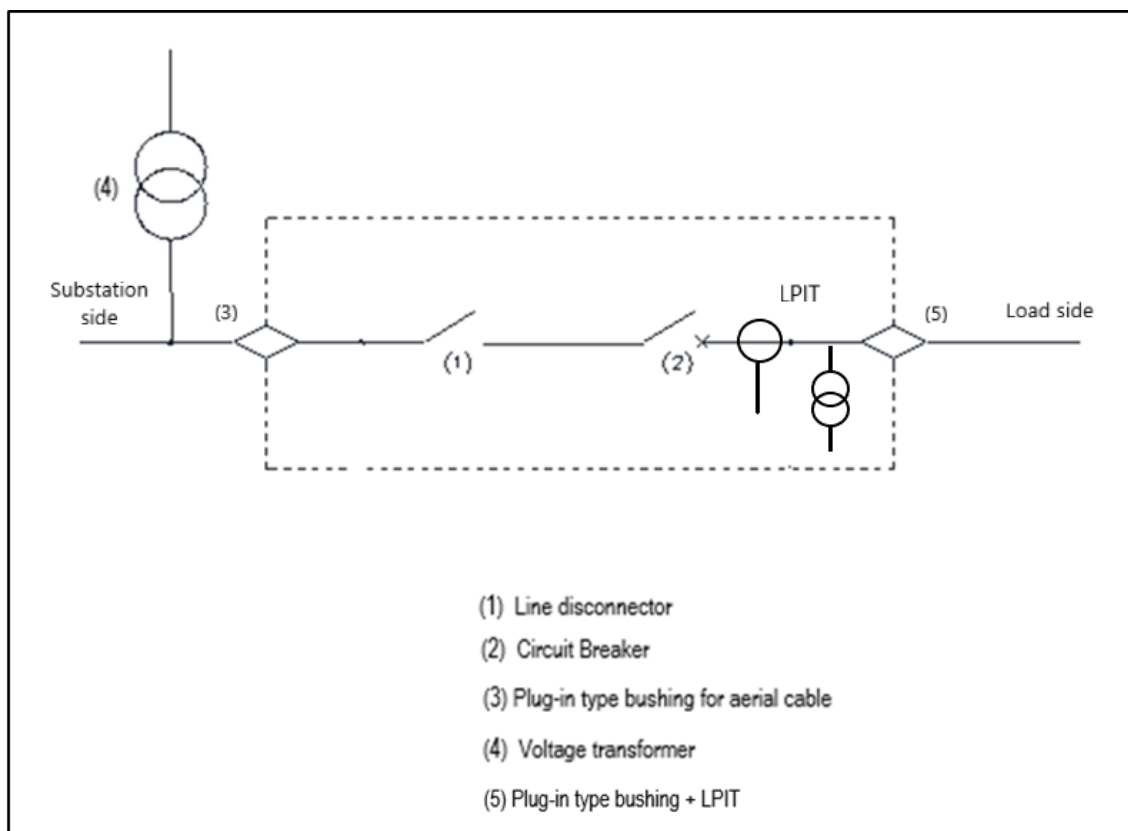


**Figure 2. PMCB with plug-in terminals and two earthing switches (A type)**

B) PMCB with one circuit breaker and one line disconnector. The functional electric scheme is the one of Figure 3<sup>9</sup>

<sup>8</sup> The element (5) is not part of the supply of the PMCB.

<sup>9</sup> The element (4) is not part of the supply of the PMCB



**Figure 3. PMCB with plug-in terminals (B type)**

This chapter 7 applies also to codes GSCM002/9, 10, 27 and 28. The only characteristic that is not applicable is that related to chapter 7.7. Instead chapter 6.6 and 6.7 are applicable.

### 7.1 Characteristics of the MV circuit-breaker


See paragraph 6.1

### 7.2 Characteristics of the line disconnector

See paragraph 6.2

### 7.3 Characteristics of the earthing switches (only for A type)

The earthing switches shall comply with the IEC 62271-102. Their characteristics are shown in table 8.

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Rated short-time withstand current	[kA]	16
Rated peak withstand current	[kAc]	40 (and 41,6)
Short-circuit making capacity	[kA]	40 (and 41,6)
Rated duration of short-circuit	[s]	1
Mechanical endurance class		M0
Electrical endurance class		E2

**Table 8: Characteristics of the earthing switches**

The two earthing switches, which are independent between them, must be moved only with the disconnecter and circuit-breaker in open position.

#### 7.4 Manual command

In case of PMCB with plug-in terminals, type B, the manual command is the same of PMCB with open terminals and “direct” command type (see 6.3), but the PMCB shall be installed at 6 m from the ground.

In case of PMCB with plug-in terminals, type A, the manual command is the same of PMCB with open terminals and “direct” command type (see 6.3), but the PMCB shall be installed at 6 m from the ground and the following modifications are required:

- a manual command for each earthing switch shall be provided.
- the operations for the earthing switches shall be made from the ground, with the earthing stick.
- the manual command of the earthing switches shall be realised in order to allow the application of a padlock with an arc of 8 mm thickness in the open and close positions of the earthing switches.
- the lever of the PMCB to open or close the line shall be red RAL 3026 (e.g., polyurethane paint) and shall have a nameplate with the characters “CB-LD” referring to the circuit-breaker and line disconnecter in black RAL on white RAL background,
- the levers of both the earthing switches shall be yellow RAL 1026 (e.g., polyurethane paint) and shall have a nameplate with the characters “ES1” and “ES2” in black RAL on white RAL background.

The levers may be taken away in order to remove the front panels. Their assembling must be allowed only in an obliged position, to avoid that they can be exchanged between them and with that one of the circuit-breaker + line disconnecter. The levers shall be removed for transportation.

#### 7.5 Motorized command

See paragraph 6.4.



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## 7.6 Interlocks

In case of PMCB with plug-in terminals, type B, the interlocks are the same of PMCB with open terminals (see 6.5).

In case of PMCB with plug-in terminals, type A, the interlocks shall be the following.

The sequence of operations for putting in service the line shall be:

- opening of the earthing switches
- closing of the line disconnecter
- closing of the circuit-breaker

The sequence of operations for putting out of service the line shall be done in reverse order than what written before.

The following interlocks shall be realised:

- the circuit-breaker and the line disconnecter are interlocked each other;
- the line disconnecter and the earthing switch can be operated only with circuit-breaker in open position; this condition shall be realised by a mechanical interlock;
- the earthing switch can be closed only with line disconnecter in open position;
- the circuit-breaker operation can be possible only with the disconnecter in closed position (end-of-operation switch).

Further linkages or interlocks shall not be introduced.

The mechanical interlocks, locks and obstruction stoppages shall be designed in order to withstand a force of 750 N.

See Annex C for interlocks check-in.

## 7.7 Plug-in Bushings

To connect the MV cable terminals, the PMCB shall be equipped with outdoor cone plug-in bushings in accordance with EN 50181, suitable for outdoor installation. Bushings shall have 630 A rated normal current (type C interface). To connect the MV cable to the bushings, symmetrical T-separable connectors shall be used.

In order to avoid that the cable weight interferes with the bushing resistance, a support shall be provided on the bottom of the PMCB (the support may be removable for transportation). The height between the axis of the bushing and the support shall be at least 420 mm.

The support shall have a tension clamp for each cable according to the Global Standard GSC001 to transmit the mechanical tension in the cable to the supporting structure.

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## 8 MANOMETER

To measure the SF6 pressure, on the type codes to be supplied in Spain a manometer shall be provided.

The manometer shall not be extractable and, in supply normal conditions, the pressure indication shall be between 25% and 75% of the area marked as safe. The area marked as safe shall be green RAL 6017 whereas the other area shall be red RAL 3000. It must be visible from the bottom of the pole.

## 9 NAMEPLATES

### 9.1 Rating plates

Each PMCB shall have two stainless steel AISI 316 rating plates in the language of the Country in which it has to be delivered. One rating plate shall have four eyelets for fixing it at the base of the pole with a stainless steel band or it shall be provided with a support to put on the pole. The other rating plate shall be placed on the PMCB.

The rating plate shall contain information on the code that the Manufacturer assigns to each series of the same type. It shall contain the mandatory information required by IEC 62271-200 (table 101), the Enel Group type code (see tables 1 and 2) and the local components codification (see Annex B).

Only for Italy, in the proximity of the rating plate it must be put a barcode with the characteristics described in Nota Operativa Presidio Vendor Rating PVR006.

Only for Colombia on the rating plate there shall be also the Customer's Name.

An informative stainless steel AISI 316 nameplate with the sentence "Contains fluorinated greenhouse gases covered by the Kyoto Protocol", in accordance with Regulation (EU) of the European Parliament and of the Council 517/2014 of the 16th of April 2014, has to be provided.

### 9.2 Operating sequence nameplate and synoptic scheme

The PMCB shall be equipped with a stainless steel AISI 316 "operating sequence nameplate" on which there shall be the sequence of operations to be executed, for the put in service. It shall also contain the PMCB's electric scheme. This nameplate shall be positioned on the protective shell of each command so as to be clearly visible.

### 9.3 Marks of the phases

In correspondence of EN 50181 bushings, and EN 60137 insulators the marks 4 – 8 – 12 to identify the three different phases shall be applied. These marks shall be designed to be used in environments of climatic category type C5 "Very High" (ISO 14713-1) or C5-I "Very High (industrial)" (ISO 12944-2).

## 10 MAINTENANCE

The PMCB shall have an instruction manual in local language in accordance with the point 10.4 of IEC 62271-1 and with the following indications.

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The PCMB shall be maintenance free for the entire expected service life (40 years), excluding the following admitted activities:

- An electrical operation, with a periodicity not less than 1 year
- A visual inspection from the ground, with a periodicity not less than 5 year
- Condition-based maintenance, e.g. following the above listed periodical activities

These statements shall be written in the instruction manual.

## 11 SUPPLY REQUIREMENTS

Each PMCB shall be supplied with:

- installation, operation and maintenance manual in the language of the Country in which the PMCB has to be delivered;
- manual with procedures to be adopted for storage, after factory test and transportation;
- a connection cable together with connectors for connecting the PMCB and the peripheral unit and a connection cable for connecting the LPITs (if present);
- standardized bracket (see. 5.4).

The insulators and the bushings shall be opportunely protected to safeguard them from impacts that may damage them during the transportation.

Outside of the box containing the PMCB, it shall be clearly written:

- name of the Distribution Company;
- name of the supplier;
- description of the product;
- code assigned by the supplier;
- type code and serial number of the Distribution Company;
- gross weight.

In case of PMCB for Colombia, the manufacturer shall include the mandatory RETIE certificate in the TCA dossier.

In case of PMCB for Spain, the manufacturer shall include in the TCA dossier the mandatory certificate prescribed at ITC-03 in R.D. 337/2014.

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## 12 TESTING

On the PMCB the tests described in the following paragraphs shall be performed.

The tests to be performed on the PMCB are divided in:

- Type tests
- Routine tests

### 12.1 Type tests

#### 12.1.1 Visual inspection

A PMCB prototype shall be subject to a visual inspection in order to verify the absence of defects and that the construction features and the dimensions are compliant with this technical specification.

#### 12.1.2 Dielectric tests

The tests shall be performed in accordance with IEC 62271-200 § 6.2 and shall be:

- lightning impulse test
- power frequency test
- test on auxiliary and control circuits.

#### 12.1.3 Partial discharge test

The test shall be performed in accordance with IEC 62271-200 § 6.2.9.

#### 12.1.4 Measurement of the main circuit resistance

The test shall be performed in accordance with IEC 62271-200 § 6.4.

#### 12.1.5 Temperature-rise test

The test shall be performed in accordance with IEC 62271-200 § 6.5.

#### 12.1.6 Short-time withstand current and peak withstand current tests

The test shall be performed in accordance with IEC 62271-200 § 6.6.

#### 12.1.7 Control of the degree of protection (IP)

The control shall be made in accordance with IEC 62271-200 § 6.7, in every part of the PMCB defined in this global standard.

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### 12.1.8 Tightness tests

The tests shall be performed in accordance with IEC 62271-200 § 6.8, therefore in connection with the tests required in 62271-100 and 62271-102. Qm test (refer to IEC 60068-2-17) shall be the chosen method for this test.

### 12.1.9 Electromagnetic compatibility tests (EMC)

The tests shall be performed in accordance with IEC 62271-200 § 6.9.

### 12.1.10 Additional test on auxiliary and control circuits

The test shall be performed in accordance with IEC 62271-200 § 6.10.

### 12.1.11 X-radiation test procedures for vacuum interrupters

The test shall be performed in accordance with IEC 62271-200 § 6.11.

### 12.1.12 Verification of making and breaking capacities

The tests shall be performed in accordance with IEC 62271-200 § 6.101.

### 12.1.13 Mechanical operation tests

The tests shall be performed in accordance with IEC 62271-200 § 6.102.

For the mechanical and electromechanical interlocking tests (IEC 62271-200 § 6.102.2) the test shall be performed on all mechanical interlocks, locks and obstruction stoppages considering a withstand force of 750 N.

### 12.1.14 Pressure withstand test for gas-filled compartments

The test shall be performed in accordance with IEC 62271-200 § 6.103.

### 12.1.15 Internal arc test

The test shall be performed in accordance with IEC 62271-200 § 6.106 considering a minimum approach distance of 3 m.

### 12.1.16 Tests for insulating elements

The insulated bushings shall pass all the tests of the standard IEC 60137, including the Tracking and erosion test according to IEC 62217.

In the case that the PMCB has a solid insulation, the apparatus shall pass the electrical environmental ageing test, as stated in paragraph 9.3.3 of IEC 62217.

## 12.2 Particular type tests for circuit-breaker

### 12.2.1 Mechanical and environmental tests

The tests shall be performed in accordance with IEC 62271-100 § 6.101 (excluded § 6.101.4, § 6.101.5 and § 6.101.6)

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### **12.2.2 Short-circuit current making and breaking tests**

The tests shall be performed in accordance with IEC 62271-100 § 6.102 to 6.106

### **12.2.3 Critical current tests**

The test shall be performed in accordance with IEC 62271-100 § 6.107.

### **12.2.4 Single-phase and double-earth fault tests**

The tests shall be performed in accordance with IEC 62271-100 § 6.108.

### **12.2.5 Short-line fault tests**

The test shall be performed in accordance with IEC 62271-100 § 6.109.

### **12.2.6 Capacitive current switching tests**

The tests shall be performed in accordance with IEC 62271-100 § 6.111.

### **12.2.7 Electrical endurance tests**

The test shall be performed in accordance with IEC 62271-100 § 6.112.

## **12.3 Particular type tests for line disconnectors and earthing switches**

### **12.3.1 Verification of line disconnector and earthing switches' safe devices**

The line disconnector and the earthing switch shall be tested in accordance with IEC 62271-102 § 6.105.

### **12.3.2 Operation under severe ice conditions**

The line disconnector and the earthing switch shall be tested in accordance with IEC 62271-102 § 6.103.

### **12.3.3 Operation at temperature limits**


The line disconnector and the earthing switch shall be tested in accordance with IEC 62271-102 § 6.104.

## **12.4 Particular type tests for LPIT**

When required (see tables 1 and 2) the PMCB sensors shall be tested according to the document GSCT005 "Technical Characteristics of LPITs for RGDM/RGDAT".

## **12.5 Additional type tests for Chile, Colombia and Peru**

The manufacturer shall elaborate a report to demonstrate the required seismic qualification level according to the Standards indicated in paragraph 3.2.3.

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## 12.6 Routine tests

### 12.6.1 Visual inspection

The test shall be performed in accordance with IEC 62271-200 § 7.5. It shall be performed on a random PMCB among those ones that belong to the batch submitted to the commissioning.

The control shall be made comparing the constructive and dimensional features with those ones in the drawings and pictures approved by the Distribution Companies and kept by the manufacturer.

### 12.6.2 Dielectric test on main circuit

The test shall be performed in accordance with IEC 62271-200 § 7.1.

### 12.6.3 Tests on auxiliary and control circuits

The test shall be performed in accordance with IEC 62271-200 § 7.2.

### 12.6.4 Measurement of the resistance of the main circuit

The test shall be performed in accordance with IEC 62271-200 § 7.3.

### 12.6.5 Tightness tests

The test shall be performed in accordance with IEC 62271-200 § 7.4.

### 12.6.6 Partial discharge measurement

The manufacturer, in accordance with IEC 62271-200 § 7.101, shall provide appropriate documentation stating the regular partial discharge test during the own production cycles. The Distribution Companies reserve the right to perform additional tests on organic material elements taken during the production process.

### 12.6.7 Mechanical operation tests

The test shall be performed in accordance with IEC 62271-200 § 7.102.

### 12.6.8 Tests of auxiliary electrical, pneumatic and hydraulic devices

The test shall be performed in accordance with IEC 62271-200 § 7.104.

## 12.7 Particular routine tests for LPIT

When required (see tables 1 and 2) the PMCB sensors shall be tested according the document GSCT005 "Technical Characteristics of LPITs for RGDM/RGDAT".

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## 12.8 Routine tests plan

All the routine tests indicated in the following table shall be carried out by the supplier on all the samples prepared for the commissioning. For each piece that belongs to the prepared batch, the supplier shall prepare a test report with the results of the tests performed.

The routine tests shall be repeated by the supplier, under the Distribution Companies surveillance, on a sample chosen randomly among those ones of the batch that has already been successfully tested by the supplier. The tests shall be carried out on samples defined by the sampling plan below

At the end of the commissioning, within the measurement uncertainty, there shall not be differences between the measured values and those ones in the acceptance ranges of the approved test values.

In case of commissioning attended by the Distribution Companies, the entire batch will be rejected if the results of one of any test is negative.

A	1 sample for type
B	Sampling plan: reduced, LQA = 0,65 level II (in case of negative result, in the new commissioning the sampling plan shall be ordinary)
D	documentation check

**Table 9: Sampling plan**

N.	TEST	Sampling plan
1	Visual inspection (a)	A
2	Dielectric tests on auxiliary and control circuits (b)	B
3	Verification of the functionality of the electric scheme	B
4	Measurement of main circuits resistance (e)	B
5	Mechanical operation tests of the circuit-breaker (d)	B
6	Verification of the mechanical functionality of line disconnector and earthing switch (c)	B
8	Partial discharges control for organic material elements	D
9	Dry power frequency tests on main circuit (g)	B
10	Verification of proactive coating (h)	A
11	Tightness tests (i)	D

**Table 10: Testing plan**

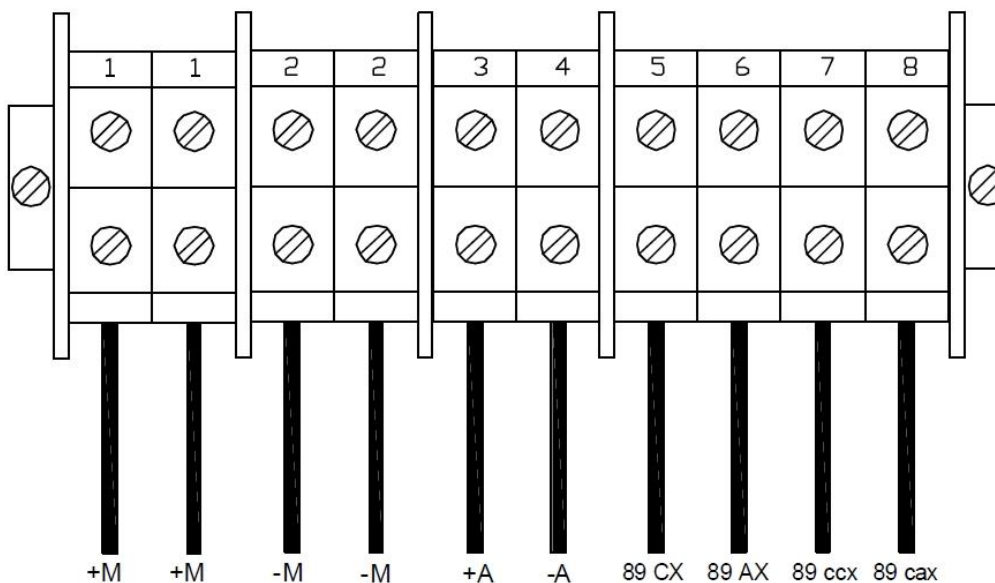
a	Including the verification of the enclosures' degree of protection (IP).
b	2 kV power frequency testing voltage during 60 seconds.



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c	On the earthing switches, line disconnecter, 5 closing operations and 5 opening operations verifying the mechanical interlocks functioning (IEC 62271-200 § 7.102). During the last operation, it shall be measured the main contacts closing speed on the earthing switches, and the closing and opening speed and line disconnecter.
d	5 closing and 5 opening operations at $V_{min}$ (19,2 Vcc) and $V_{max}$ (28,8 Vcc). At $V_n$ (24 Vcc) perform 5 C-O cycles and 5 O-t-C-O cycles (IEC 62271-100 § 7.101). In the last cycle of every sequence, measure the operation times, the absorption current of the coils and of the spring charging motor. All the measured times and maximum values of absorption shall be included in the limits specified by the Manufacturer and, in any case, they shan't be outside the $\pm 10\%$ of the reference values obtained during the type tests.
e	Test to be performed on the same configuration used during the homologation process.
g	The test shall be performed with the operating devices closed and on the sectioning distance. All the tests shall be performed at a 50 kV power frequency voltage (for 24 kV line disconnecter) or 70 kV power frequency voltage (for 36 kV line disconnecter).
h	Perform the thickness verification with sampling plan "B" and the adherence verification on one sample only.
l	Test to be certified on single units by the supplier

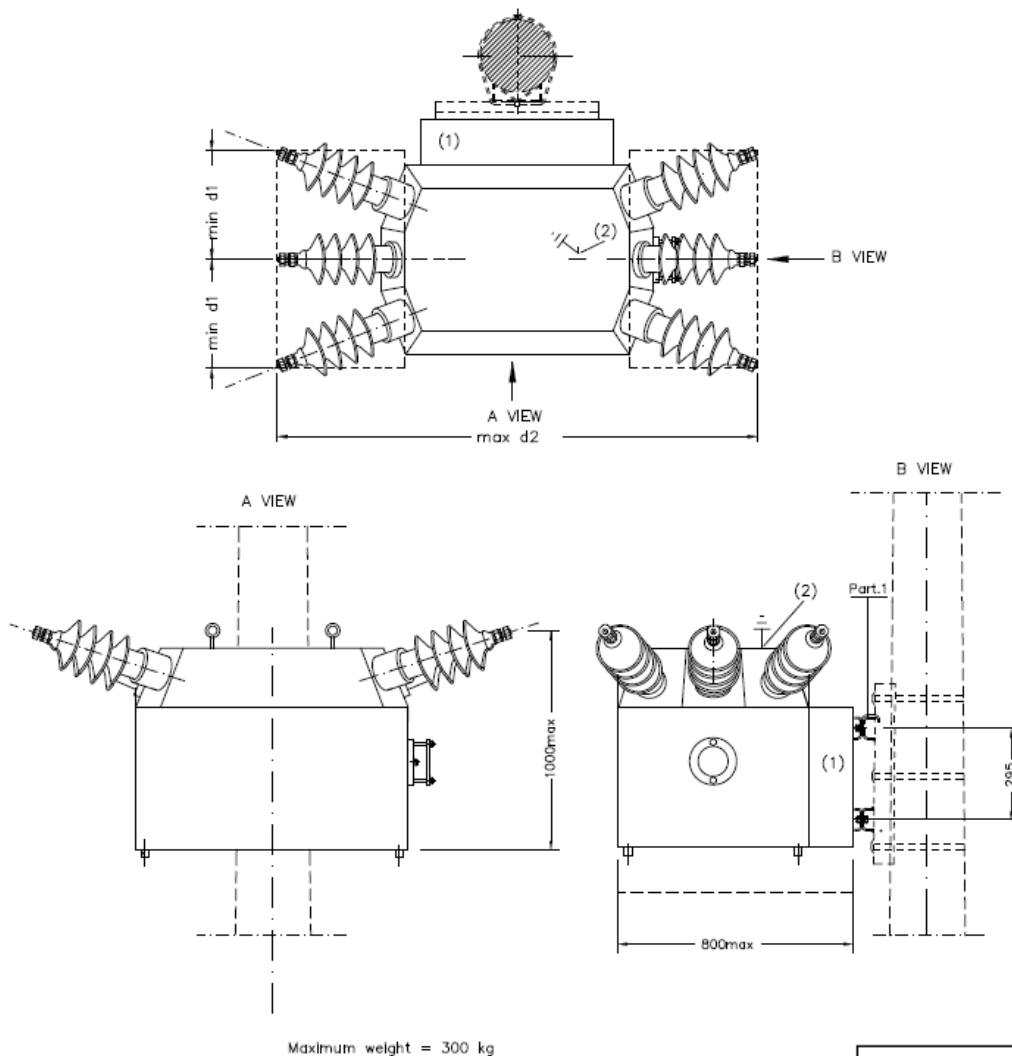
**Table 11: Additional information**



Circuit-breaker	Function		Peripheral Unit
1	+M	Motor power supply (+24 V <sub>DC</sub> )	1
1	+M	Motor power supply (+24 V <sub>DC</sub> )	1
2	-M	Motor power supply (-24 V <sub>DC</sub> )	2
2	-M	Motor power supply (-24 V <sub>DC</sub> )	2
3	+A	Commands power supply (+24 V <sub>DC</sub> )	3
4	-A	Commands power supply (-24 V <sub>DC</sub> )	4
5	89CX	Closing command	5
6	89AX	Opening command	6
7	89ccx	Signal closing position circuit-breaker	7
8	89cax	Signal opening position circuit-breaker	8

**Table 12: Connection between pole-mounted circuit breaker and Peripheral Unit**

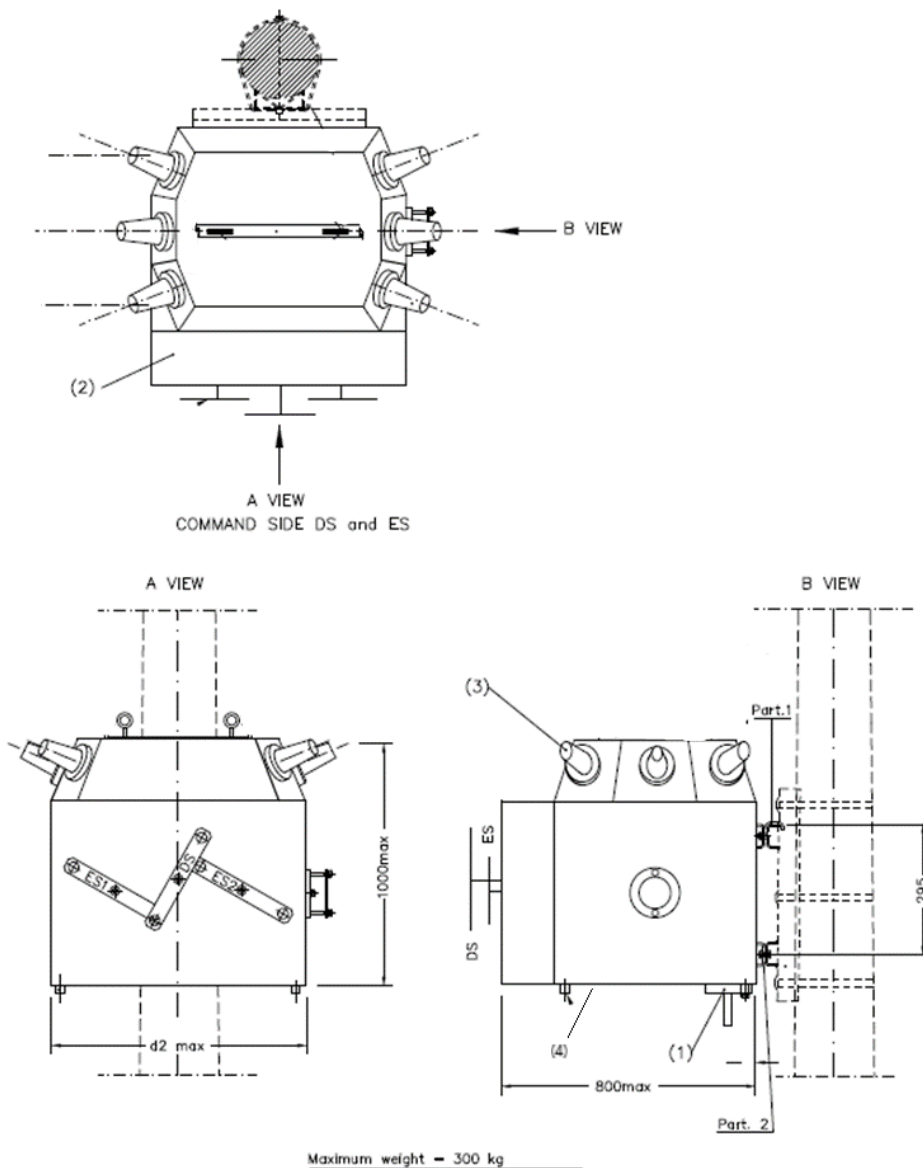
**ANNEX A – DRAWINGS AND GENERAL DIMENSIONS**



- (1) PMCB command zone
- (2) PMCB earthing point

	24 kV <small>V<sub>max</sub></small>	36 kV <small>V<sub>max</sub></small>
d1 (mm)	350	450
d2 (mm)	1550	1860

**PMCB with open terminals**



- (1) Earthing point
- (2) PMCB command zone
- (3) Plug-in type bushing
- (4) Cable screen earthing point at bottom side

	24 kV	36 kV
d2 (mm)	800	1100

**PMCB with plug-in type bushings**

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### ANNEX B – LOCAL COMPONENT CODIFICATION

Type code	Argentina	Brazil	Chile	Colombia	Iberia	Italy	Peru	Romania
GSCM002/1	0103-2781	T140087	140004	TBD				
GSCM002/2	0103-2780	T140086	140001	TBD				
GSCM002/3					140616	140017		140001
GSCM002/4					140615	140018		140002
GSCM002/5							T140075	
GSCM002/6							T140074	
GSCM002/7					140614			
GSCM002/8					140592			
GSCM002/9		T140083						
GSCM002/10		T140085						
GSCM002/11	0103-2779	T140082				140019	T140076	140004
GSCM002/12	0103-2778	T140070				140020	T140073	140003
GSCM002/13	0103-2777			T140110	140591			140005
GSCM002/14	0103-2776			TBD	140590			140006
GSCM002/15	0103-2775	T140081		T140111			T140071	
GSCM002/16	0103-2774	T140069		T140112			T140072	
GSCM002/17						140021		
GSCM002/18						140022		

#### Type codes for 24 kV

**TBD: To be defined**

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Type code	Argentina	Brazil	Chile	Colombia	Iberia	Italy	Peru	Romania
GSCM002/19		T140010	140003					
GSCM002/20				T140115				
GSCM002/21		T140009	140002					
GSCM002/22				TBD				
GSCM002/23					140589			
GSCM002/24					140588			
GSCM002/25								
GSCM002/26								
GSCM002/27		T140079						
GSCM002/28		T140008						
GSCM002/29		T140078						
GSCM002/30		T140005						
GSCM002/31					140587			
GSCM002/32					140586			
GSCM002/33		T140077						
GSCM002/34				T140114				
GSCM002/35		T140004						
GSCM002/36				TBD				
GSCM002/37								
GSCM002/38								

**Type codes for 36 kV**

**TBD: To be defined**

### ANNEX C – INTERLOCKS CHECK-IN

Status	Circuit Breaker	Disconnecter	Allowed	Forbidden	Impossible
0	Open	Open	0,1	2	3
1	Open	Closed	0,1,3		2
2	Closed	Open			
3	Closed	Closed	1,3	2	0

Non reachable status

**Table 13: Interlock check-in for PMCB without earthing switches**

Status	Circuit Breaker	Disconnecter	Earthing SW1	Earthing SW2	Allowed	Forbidden	Impossible
0	Open	Open	Open	Open	0,1,2,4	8	3,5,6,7,9,10,11,12,13,14,15
1	Open	Open	Open	Closed	0,1,3	5,9	2,4,6,7,8,10,11,12,13,14,15
2	Open	Open	Closed	Open	0,2,3	6,10	1,4,5,7,8,9,11,12,13,14,15
3	Open	Open	Closed	Closed	1,2,3	7,11	0,4,5,6,8,9,10,12,13,14,15
4	Open	Closed	Open	Open	0,4,12	5,6	1,2,3,7,8,9,10,11,13,14,15
5	Open	Closed	Open	Closed			
6	Open	Closed	Closed	Open			
7	Open	Closed	Closed	Closed			
8	Closed	Open	Open	Open			
9	Closed	Open	Open	Closed			
10	Closed	Open	Closed	Open			
11	Closed	Open	Closed	Closed			
12	Closed	Closed	Open	Open	4,12	8,14,13	0,1,2,3,5,6,7,9,10,11,15
13	Closed	Closed	Open	Closed			
14	Closed	Closed	Closed	Open			
15	Closed	Closed	Closed	Closed			

Non reachable status

**Table 14: Interlock check-in for PMCB with earthing switches**

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In order to check the correct functioning of the interlocks, it shall be necessary to verify their operation according Tables 1 or 2 (as appropriate).

## Terminology

**Status:** Define the status of the different components of the PMCB.

For example, status 3 at Table 2 defines the following situation:

- **Circuit Breaker:**       **OPEN**
- **Disconnecter:**       **OPEN**
- **Earthing Switch 1:**   **CLOSED**
- **Earthing Switch 2:**   **CLOSED**

**Allowed:** Status that is possible to reach from the current status.

**Forbidden:** Status that is impossible to reach from the current status as a result of the operation of the interlocks

**Impossible:** Status that is physically impossible to reach from the current status.