31-SDMS-07C

Rev.0

SPECIFICATIONS FOR LOW VOLTAGE DISTIRBUTION PANEL WITH ALUMINUM BUS BAR, MAIN CIRCUIT BREAKER AND 300A OUTGOING MCCBs.

Table of Contents:

List of Figures:

List of Tables:

1. SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirements for design, materials, manufacturing, testing, inspection and performance for low voltage distribution panels with Aluminum busbars, main circuit breaker and outgoing MCCBs. to be used in the distribution network of the Saudi Electricity Company (SEC) in Saudi Arabia.

2. CROSS REFERENCES

This material standard specification shall be read in conjunction with SEC specification No.01-SDMS-01 (latest revision), titled "General Requirements For All Equipment/Materials" which shall be considered as an integral part of this SDMS, also to be read in conjunction with SEC purchase order requirements or contract schedules.

3. APPLICABLE CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/materials covered in this specification. In case of any deviation, the vendor/manufacturer may propose equipment/material conforming to an alternate code or standard without jeopardizing the requirements of this SDMS. However, the provision of SEC standard shall supersede the provision of these standards in case of any differences.

3.1	11-SDMS-01	1000V XLPE Insulated Unarmored Power Cables.
3.2	37-SDMS-03	Molded case circuit breaker for low voltage PMT Cabinets.
3.3	37-SDMS-04	Interface low voltage main circuit breaker.
3.4	IEC 60529	Degrees of Protection Provided by Enclosures (IP Code).
3.5	50-SDMS-01	Current Transformers up to 36 KV.
3.6	38-SDMS-03	Low Voltage Digital Panel Meters.
3.7	IEC 60947-1	Low Voltage Switchgear and Control gear Part-1General Rules

3.8	IEC 60947-2	Low Voltage Switchgear and Control gear Part-2 Circuit Breakers
3.9	IEC 61439-1	Low Voltage Switchgear and Control gear assemblies. Part-1 General Rules.
3.10	IEC 61439-6	LV Switchgear and Control gear assemblies. Part-6 Bus bar trunking systems (busways).
3.11	IEC 60114	Recommendations for Heat-Treated Aluminum Busbar material of the Aluminum-Magnesium-Silicon Type.
3.12	ASTM B236M	Standard Specification for Aluminum Bars for Electrical Purposes (Bus bars) Metric.
3.13	ASTM D1535	Standard Practice for Specifying Color by the Munsell System.
3.14	ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus.
3.15	ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test.
3.16	ASTM A153	Standard Specification for Zinc Coating (hot-dip) on Iron and Steel Hardware.
3.17	ASTM B317	Standard Specification for Aluminum Bars for Electrical Purposes (Bus bars).
3.18	ASTM B 221	Standard Specification for Aluminum alloy extruded bus.

4. DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General

4.1.1 The panel shall be supplied for outdoor use, which contains incoming transformer connections, Aluminum bus bars, instruments panel, main circuit breakers according to panel's rating, 300A molded case circuit breakers (MCCB) for out-going circuits, neutral bus bar, earthing terminals, and the provision for generator connections.

4.1.2 All cable terminations shall be easily accessible from the front.

4.1.3 All insulating materials shall be non-hygroscopic and resistant to tracking and cracking.

4.1.4 Panel completes with all its fittings and attachments shall be capable of withstanding the effects of direct solar radiation at their installed locations. The temperature of metal surfaces exposed to direct solar radiation shall be regarded as 75° C, plus the effect of any internal heating.

4.1.5 Thermal inter-action shall not unduly affect the performance of any components.

4.1.6 All parts of equal size and shape shall be interchangeable. The general design shall be made with minimum number of joints.

4.1.7 All connections inside the panel shall have a minimum clearance, which shall not be less than 25.4 mm between phase and ground as per NEMA standards. In case the above clearance cannot be obtained, adequate insulating material shall be provided.

4.1.8 All bolts & nuts shall be installed in a way that they could not be unbolted from outside the panel. Extra length of fasteners shall be avoided.

4.2 Incoming Transformer Connections

4.2.1 For unit substations, incoming transformer connections shall be through L.V. bus bars. Removable Aluminum links shall be provided to enable the disconnection of incoming transformer bus bar connection from L.V. bus bar. A panel shall be supplied equipped with a SEC approved main circuit breaker on the main incoming busbars.

4.2.2 For stand-alone L.V. Panels they shall permit the use of single core copper cable of the size 630 mm² with compression bi-metallic lugs as per SEC specification No. 12-SDMS-02 (latest revision). These lugs will be supplied by SEC. M10x70 mm bolts with nuts and washers shall be provided. Number of incoming cables shall be as specified as in Table-1 of this specification.

4.3 Busbars

4.3.1 The Bus bars shall be high conductivity Aluminum alloy. The bus bars shall be tin coated and uniform cross section as per ASTM B221 or approved equivalent.

4.3.2 The cross sectional area of bus bars shall be as per Table-1 of this specification.

4.3.3 All bolted electrical joints shall be secured by corrosion proof steel fasteners. All bolts, nuts, washers and studs shall be galvanized and comply with SEC specification No. 01-SDMS-01 (latest revision).

4.3.4 Two insulating steel cover plates, each equipped with a window, which shall be UV resistant, unbreakable, transparent, minimum 3 mm thick, heat resistant, non-hygroscopic and polycarbonate door. The cover shall be casketed /hinged and fitted with locking bar to secure them at the center. Stain less steel hinges shall be welded Hinges shall be fitted by bolts made from stainless steel or brass.

4.3.5 Adequate removable and insulating barrier between the operator and the live bus bars shall be provided.

4.3.6 All bus bars shall be fully insulated with heat-shrink insulation tubes. Main incoming bus bar shall be sequence marked in color from right to left (RED, YELLOW, BLUE) and (BLACK) for the neutral busbar, Phase bus bars shall be sequence marked in color from front to back (RED, YELLOW, BLUE) and (BLACK) for the neutral busbar, bus bar links for branches MCCBs shall be sequence marked in color from front to back (RED, YELLOW, BLUE).

4.3.7 Heat-shrink insulation tubes shall provide insulation enhancement and protection against flashover and accidentally induced discharge with long-term reliability even at high continuous operating temperatures. Heat-shrink insulation tubes shall be extremely durable, resists damage from solvents, ultraviolet light, weathering, mechanical impact and general wear, Flame retardant and non-halogen based material reduces flammability and the toxic and corrosive effects in fire situations.

4.3.8 Bus bars shall be spaced and staggered in such a way that installation of MCCBs and associated cables can be achieved without any difficulty using common tool.

4.3.9 Phase bus bars shall have the provision to accommodate SEC approved CTs as per SEC specification No. 50-SDMS-01 (latest revision) for the ratios given in table 3.

4.4 Generator Connection

Holes of 13mm diameter with bolts, nuts and washers for installation of mobile generator shall be provided. The distance between each two holes shall be 50mm center to center. The holes shall be suitable for lugs provided by SEC, two (2) for L.V. Panel up to 1600A rating and four (4) for L.V. Panel exceeding 1600A.

4.5 Neutral Busbar

The size of neutral bus bar shall be as per Table-1 of this specification. It shall be connected to the frame by insulated bolts, easily removable link. Holes of 13mm diameter shall be provided for each outgoing cable connection. The holes shall be suitable for lugs provided by SEC.

4.6 Current Transformer

Three Current Transformers conforming to SEC specification No. 50-SDMS-01 shall be installed at the incoming bus bars of the distribution panel for metering purpose. CTs secondary neutral terminals shall be earthed. The current rating is indicated in Table-1 of this specification, Insulation Class-E and 120ºC

4.7 Digital Panel Meter

L.V. panel shall be equipped with a digital panel meter according to SEC specification No. 38-SDMS-03 (latest revision) and supplied from SEC approved manufacture; CT ratio shall be preprogrammed by panel manufacturer.

4.8 KWH-Meter Wiring Provision:

All wiring shall be 2.5 mm² copper conductor and black PVC. Connectors shall be full ring insulated crimp type. CT short circuit links shall be provided on terminal block. KWH-Meter wiring shall be made directly without Fuses. Dual wired terminal block for connection of a 3-phase 4-wire CT KWH-Meter shall be provided inside the metering panel.

4.9 Main Breaker:

SEC approved main incoming breaker (MCCB/ACB) as per SEC specification No. 37-SDMS-04 (latest revision) shall be provided.

4.10 Outgoing MCCBs (for LVDP with Main CB + MCCBs)

4.10.1 Provision for installation of 300A MCCBs according to SEC specification No. 37-SDMS-03 (latest revision) shall be already made for each outgoing feeder and also suitable for installing at least five (5) SEC approved MCCBs. Unless otherwise specified in the tender, number of MCCBs supplied/installed in the L.V. Panel shall be (n – 2) where n is the no. of outgoing MCCBs in Table-1. However minimum number shall be 2.

4.10.2 MCCB outgoing terminals shall be suitable for direct connection of 300mm² Al. cable as per SEC specification No. 11-SDMS-01 (latest revision) by means of bimetallic lugs with M10 bolt and palm width of 30mm. as per SEC specification No.12-SDMS-02 (latest revision).

4.10.3 One Mechanical Link to connect two nearby MCCBs in parallel shall be provided with each panel. It shall be as per attached drawing in page No. 23

4.10.4 These MCCBs shall comply with the following:

- Easily interchangeable with at least five (5) SEC approved manufacturers.
- Without lock and without terminal spreaders.
- With current limiting functions.

4.11 Outgoing Connections (for LVDP with Main CB only)

4.11.1 Outgoing connection to consumer shall be made by means of connecting 630 mm² copper cables to the main busbars by using cable lugs according to SEC specification number 12-SDMS-02 (latest revision).

Components	TRANSFORMER RATING					
	500 kVA		1000 kVA		1500 kVA	
	400/231 V					
LVDP Type	Main CB + MCCBs	Main CB	Main CB + MCCBs	Main CB	Main CB + MCCBs	Main CB
Panel incoming bus bar/link min. rating (A)	800		1600		2500	
CT rating on incoming bus bars (A)	800/5		1500/5		3000/5	
Incoming cables to be connected per phase for standalone panel	1cable 1cx630mm²		2cables 1cx630mm²		3cables 1cx630mm²	
Incoming cables to be connected to neutral for standalone panel	1cable 1cx630mm²		1cable 1cx630mm²		2cables 1cx630mm²	
For panel used in U/S	Incoming connection shall be through removable Aluminum bus bar links from back of the panel					
Main C.B Rating (A)	800	800	1600	1600	2500	2500
Number of Outgoing MCCB's	8	N/A	12	N/A	14	N/A
Outgoing MCCB's Rating (A)	300	N/A	300	N/A	300	N/A
Minimum Spacing MCCB's	Not less than 10mm					
Phase Bus bars min. cross section (mm²)	1x10x80		2x10x80		2x15x100	
Phase Bus bars min. Rating, (A)	800		1600		2500	
Neutral Bus bar min. Size (mm²)	1x5x80		1x10x80		1x15x100	
Neutral Bus bar min. Rating, (A)	400		1000		1600	
Symmetrical Short Circuit Rating for 1 sec. (RMS), kA	25		25		25	

Table 1: Low Voltage Distribution Panel

Notes:

A) The above table is applicable for all ratings of Unit substations.

B) The Stand-alone L.V panel designs shall be rated by current as indicated in the table as:

(I) 800 A L.V. panel to be used for 500kVA (400/231V) transformer rating,

(II) 1600 A L.V. panel to be used for 1000kVA (400/231V) transformer rating,

(III) 2500 A LV panel to be used for 1500 kVA (400/231V) transformer rating.

C) Incoming Busbars for branches MCCB shall withstand up to 500A.

4.12 Grounding

4.12.1 Two terminals having M12 stud with nuts and washers made of stainless steel shall be provided on enclosure of the panel with clear identified grounding mark. The marking shall be done by indelible paint, sticker is not acceptable.

4.12.2 Two nos. removable links between neutral bus bar and panel body with 70 mm² bare copper conductor shall be provided.

4.12.3 All hinged parts shall be connected to the frame work (enclosure) through minimum 35mm² bolted copper braids for main doors and 16 mm² for sub panels.

4.13 Internal Lighting:

The L.V. Panel shall be fitted with a 10 Watt led lamp controlled by the door's operated switch. The auxiliary circuit supplying the lamp shall have a separate miniature circuit breaker located at an accessible position on the metering panel.

4.14 Auxiliary Supply

4.14.1 A pre-wired terminal block for 3 phases, 4-wire connections shall be Installed inside the metering panel. The terminals size shall be suitable for 10mm² standard wiring. 10A miniature circuit breakers shall be provided in the circuit.

4.14.2 The L.V. Panel shall be equipped with a 231V three pin socket outlet on the metering panel, completed with plug top and labeled with the appropriate voltage. The position of the socket outlet shall not impede cable installation or termination. Wiring shall be done by 4mm² copper, 85ºC black PVC insulation with crimping type connectors.

4.15 Labels

4.15.1 Each outgoing circuit shall be provided with three layers traffolite label plate (white/black/white) of 3mm thickness, dimension of 30mm x 80mm, bolted and blank (non-numbered)

4.15.2 These label plates shall be fixed above the MCCB in suitable place.

4.15.3 The outgoing cable feeder no. plate of steel sheet size at least A4 shall be provided. The printed table on the left door inner side shall also be acceptable.

4.16 Enclosure

The enclosure shall be designed as follows:

4.16.1 Weather proof and provided with watershed top. Enclosure shall be made of galvanized steel sheet at least 3mm thickness or Aluzinc at least 2 mm thickness.

4.16.2 Adequate ventilation shall be provided by means of canopy, louvers….etc. to allow natural circulation of air. Ventilation shall be suitable screened to prevent the entry of insects and foreign bodies. Screen material shall be made of strong enough stainless steel. Degree of protection shall be IP 54, of IEC 60529 for Outdoor applications.

4.16.3 For stand-alone L.V. Panels, enclosure shall be suitable for mounting on a flat base at ground level. Holes shall be provided for fixing M16 size foundation bolts.

4.16.4 Access to the L.V. outdoor panel shall from front by means of doors with gasket and steel hinges duly welded, and pad locking arrangement shall be through stainless steel hasp assembly as shown in Figure 1 and Figure 2 and as mentioned below.

i) Doors shall be fitted through three stainless steel welded hinges.

ii) Pressure fit type gasket or extruded type gasket shall be provided. Glue fit type is not acceptable.

4.16.5 All doors shall be provided with door stoppers and locking at open position to protect them from swinging in order to avoid accidents.

4.16.6 The panel shall be fitted with lifting lugs on both side at the top, and located such that the unit is balanced when lifted.

4.16.7 Insertion Pocket for circuit number plate , any instruction manuals, wiring circuit diagram, drawing and catalogue for digital panel meter shall be provided with plastic envelope in the left side of the panel's door.

4.16.8 Finishing Color:

The enclosure shall be adequately protected against corrosion and painted and the color shall be RAL 7035 or as per SEC specification No. 01-SDMS-01 (Last Revision).

4.16.9 SEC item number and secondary voltage shall be marked/printed by indelible paint on the front of the panel’s door.

4.17 Dimensions

LVDP Rating	Length (mm)	Width (mm)	Height (mm)
800 A	1800	650	1900
1600 A	2000	650	1900
2500 A	2400	650	1900

Table 2: Maximum overall dimensions for stand-alone L.V. Panel

5. NAME PLATE

Each panel shall be provided with an aluminum nameplate fixed inside on left door bearing the following information engraved on it with minimum in Arabic and in English:

- Reference to SEC specification
- Rated voltage (V)
- Rated current of bus bar (A)
- Rated current of incoming unit (A).
- Rated current of outgoing unit (A).
- Short circuit current rating (kA)
- CT Ratio installed.
- Bus Bar Material : Aluminum
- SEC purchase order number
- SEC item number
- Manufacturer’s / Vendor’s name
- Year of manufacture
- Gross weight when fully equipped (kg)
- Serial number

6. MONOGRAM & DANGER PLATES:

Danger plate and SEC monogram as per SEC drawing Nos. SEC-01-01 and fig. 49A of SEC specification No. 20-SDMS-02 respectively shall be provided and installed at the front (on SEC approved location) of the L.V panel using M5 stainless steel (oval head rounded neck bolts with nuts and external tooth lock washers) not removable/accessible from the front, that is, without opening the door/front cover.
SEC shall approve location and samples of danger and monogram plates prior the installation.

7. TESTING:

Panels shall be tested in accordance with the latest standards and as specified herein. All test results shall be provided for review and acceptance by SEC.

7.1 Type (Design) Test:

7.1.1 **Short Circuit Test**

The panel shall be capable of carrying the short circuit current (RMS, Symmetrical) for one (1) seconds as per Table -1 above.

7.1.2 **Temperature Rise Test**

a) Temperature rise test shall be conducted as per IEC 61439-1.

b) Temperature rise test at any point shall not exceed 60˚C relevant to the maximum ambient temperature as specified in SEC specification No. 01-SDMS-01 for LVDP with branch breakers.

c) For Instruments inside the panel, the temperature rise shall not exceed the allowable temperature of the instruments.

7.1.3 Salt Spray Test and Tape (Scratch) Test shall be as given in SEC specification No. 01-SDMS-01.

7.1.4 Certified test reports of Design test performed on an identical unit shall be submitted to SEC for review and approval during bidding stage.

7.2 Routine Test:

All Routine Tests prescribed in the relevant **IEC** shall be performed on all units prior to delivery to SEC.

8. INSPECTION

SEC may wish to witness tests or to visit factory during manufacture of any or all items covered in this specification. Accordingly, the supplier shall give an advanced notice to SEC of the manufacturing and testing schedule.

9. PACKING AND SHIPPING:

Packing and shipping shall generally be as per SEC General Requirements No. 01-SDMS-01 including the following:

9.1 The panel shall be delivered ready for service.

9.2 Supplier shall contact Materials Department of SEC for additional packing, handling and shipment instructions as applicable.

9.3 Packing crates shall be marked with following :

- Manufacturer's name
- Country of origin
- SEC purchase order number
- SEC item number
- Gross weight in kilograms
- Handling instructions
- Final destination store
- Bus bar material : Aluminum

10. GUARANTEE

The vendor shall guarantee the panel against all defects arising out of faulty design or workmanship or defective materials for a period of five (5) years from the date of delivery.

11. SUBMITTALS

11.1 The vendor shall fill and submit one copy of the attached Technical Data Schedule with the quotation. In addition to Data Schedule, clause by clause compliance to this specification shall also be confirmed/ submitted.

11.2 Detailed dimensional drawings of the panel, showing all mounting arrangements, terminals, electrical clearances between phase and earth, hinges, cable clamps, locking arrangement and name plate shall be submitted.

11.3 Single line diagram shall be submitted.

11.4 The supplier shall provide literature describing field experience under similar service conditions to those in section 4.0. A reference's sale list shall be included. This shall detail the quantities sold, name and address of the user, number of years in service, in each case.

11.5 A comprehensive list of manufacturer's recommended spare parts with full details (item description, part No., manufacturer name, supplier name …etc) shall be submitted separately

11.6 Catalogue that indicates the part No. of all the components inside the panel shall be submitted.

11.7 Detail drawing showing the installation of revenue metering CT as required in this specification.

12. DATA SCHEDULE

Low Voltage Distribution Panel
(Sheet 1 of 3)

SEC Inquiry No. _____ Item No. _____

Clause	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
4.0	**DESIGN AND CONSTRUCTION REQUIREMENTS**		
4.1	**General**		
	Rated voltage	400/231V, ±5%	
	Symmetrical Short Circuit Rating for 1 seconds (RMS)	kA	
	Phase bus bar rating	(A)	
	Neutral bus bar rating	(A)	
4.1.8	Min. clearance between phases and phase to ground	25.4 mm	
4.2	**Incoming Transformer Connection**		
4.2.1	Removable copper links		
4.2.3	No. of incoming cables (for Stand-alone)	As per Table-1	
4.3	**Busbars**		
4.3.1	Material	Tinned Aluminum	
	Minimum thickness of tin plating	5% of nominal composition	
4.3.2	Size of phase bus bar		
4.3.3	Electrical joints (bolts, nuts, washers)	Plated as per SEC's Spec. No. 01-SDMS-01	
4.3.4	Insulating barrier to cover live parts	Yes	
4.3.5	Busbar color	Red/Yellow/Blue Black for neutral	
4.4	**Provision for generator connection**	Yes	
4.5	**Size of neutral bus bar**		
4.6	**Current Transformer :** Class Min. Burden Error co-efficient Insultions class Type and make	 0.5 10 VA < 5 Class E-120ºC	

Table 3: Technical Data Schedule 1.

DATA SCHEDULE

Low Voltage Distribution Panel (Sheet 2 of 3)

SEC Inquiry No. _____ Item No. _____

Clause	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
4.7	**Digital Panel Meter** Type, Model & Make		
4.8	**KWH-Meter Wiring Provision**		
4.9	**Main Circuit Breaker** Type, Model & Make Rated current	800 A 1600 A 2500 A	
4.10	**Outgoing MCCB's:** Type, Model & Make Rated current Dimensions(L x W x D) mm No. of supplied MCCBs No. of provisions for fixing MCCB's	300 A	
4.11	**Grounding :** Two terminals of M12 stud Copper braid for hinged parts	Yes 35mm²	
4.12	**Internal Lighting**	10W led	
4.13	**Auxiliary Supply:**		
4.14	**L.V. Cable Supports**		
4.15	**Labels**		
4.16	**Enclosure:** Material Thickness of sheet Degree of protection Type of gasket Locking arrangement Finishing color	Steel sheet/Aluzinc 3mm/2mm IP54 Pressure fit clause 4.17.4 As per RAL 7035	
4.17	**Dimensions L x W x H (mm)** **(for Stand-alone L.V. panel)**		
6.0	**MONOGRAM & DANGER PLATES**	Yes	

Table 4: Technical Data Schedule 2.

DATA SCHEDULE

Low Voltage Distribution Panel (Sheet 3 of 3)

SEC Inquiry No. _____ Item No. _____

A. Additional technical information or features specified by SEC:

B. Additional supplementary data or features proposed by vendor/supplier:

C. Other particulars to be filled up by vendor/supplier:
(use separate sheet if needed)

Address	Manufacturer	Vendor/Supplier
Name of Company		
Location and Office Address		
Authorized Name and Signature		
Date		
Official seal / stamp		

Table 5: Technical Data Schedule 3.

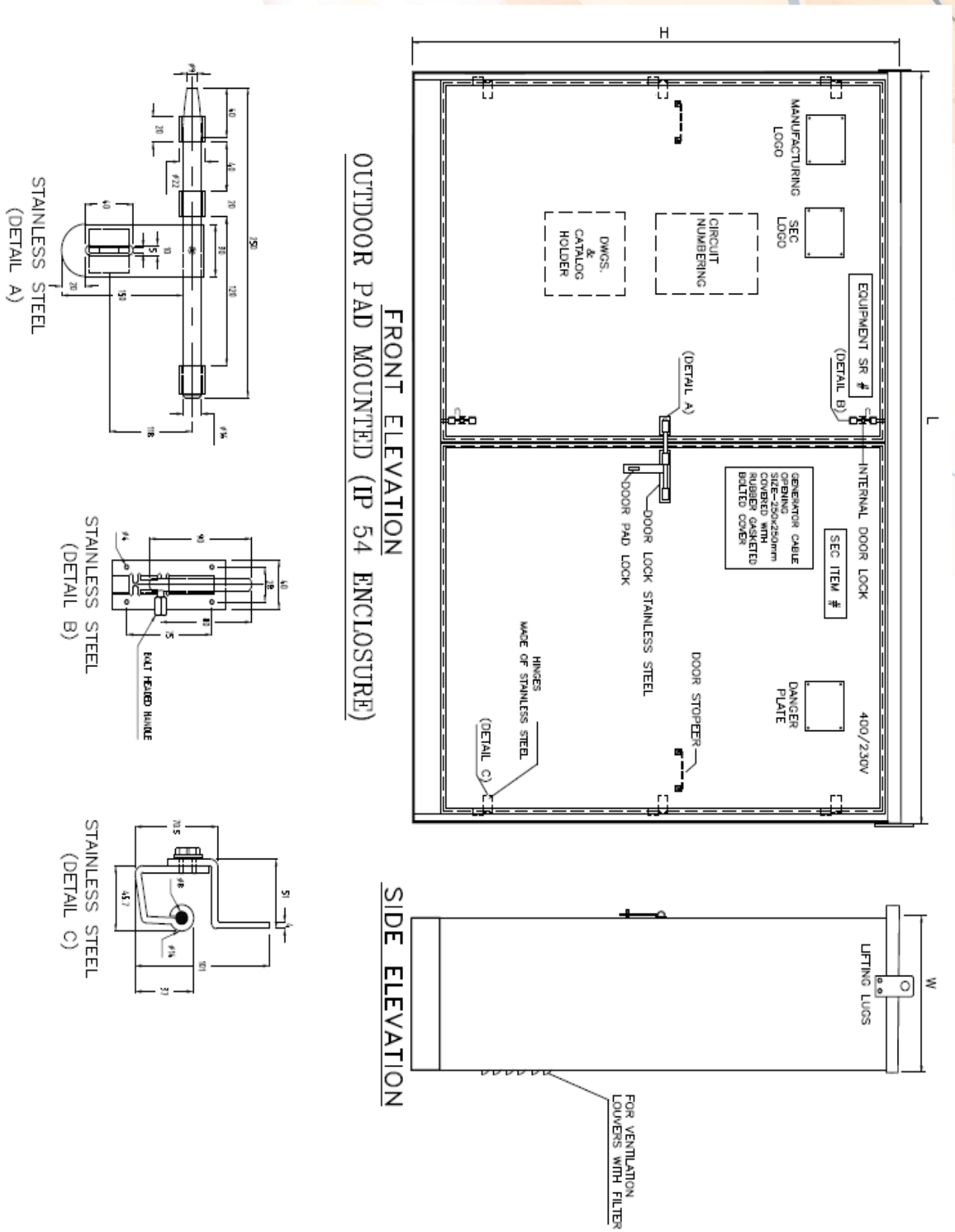

Figure 1: Front View and side view elevation.

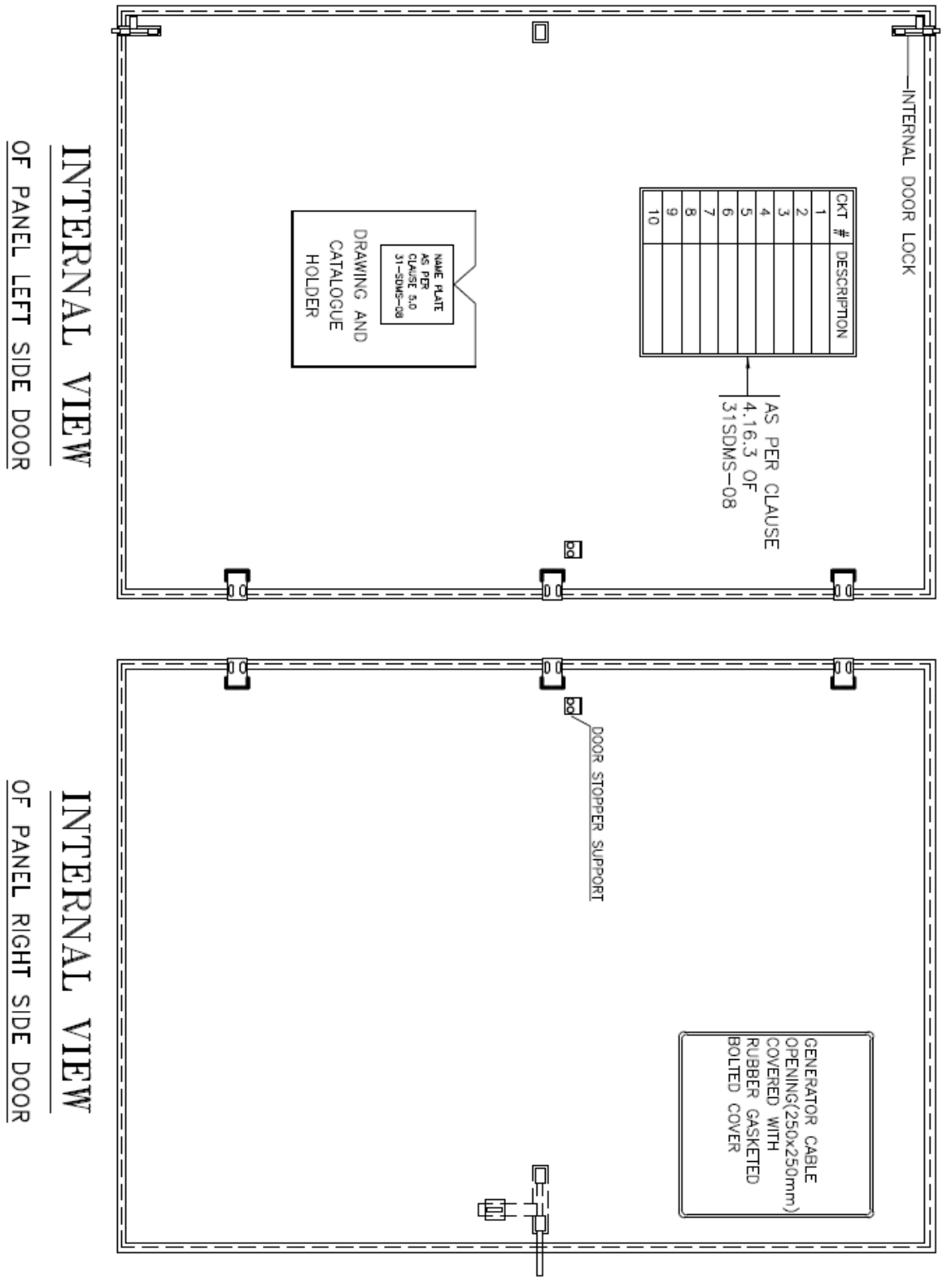

Figure 2: Door Details-internal view

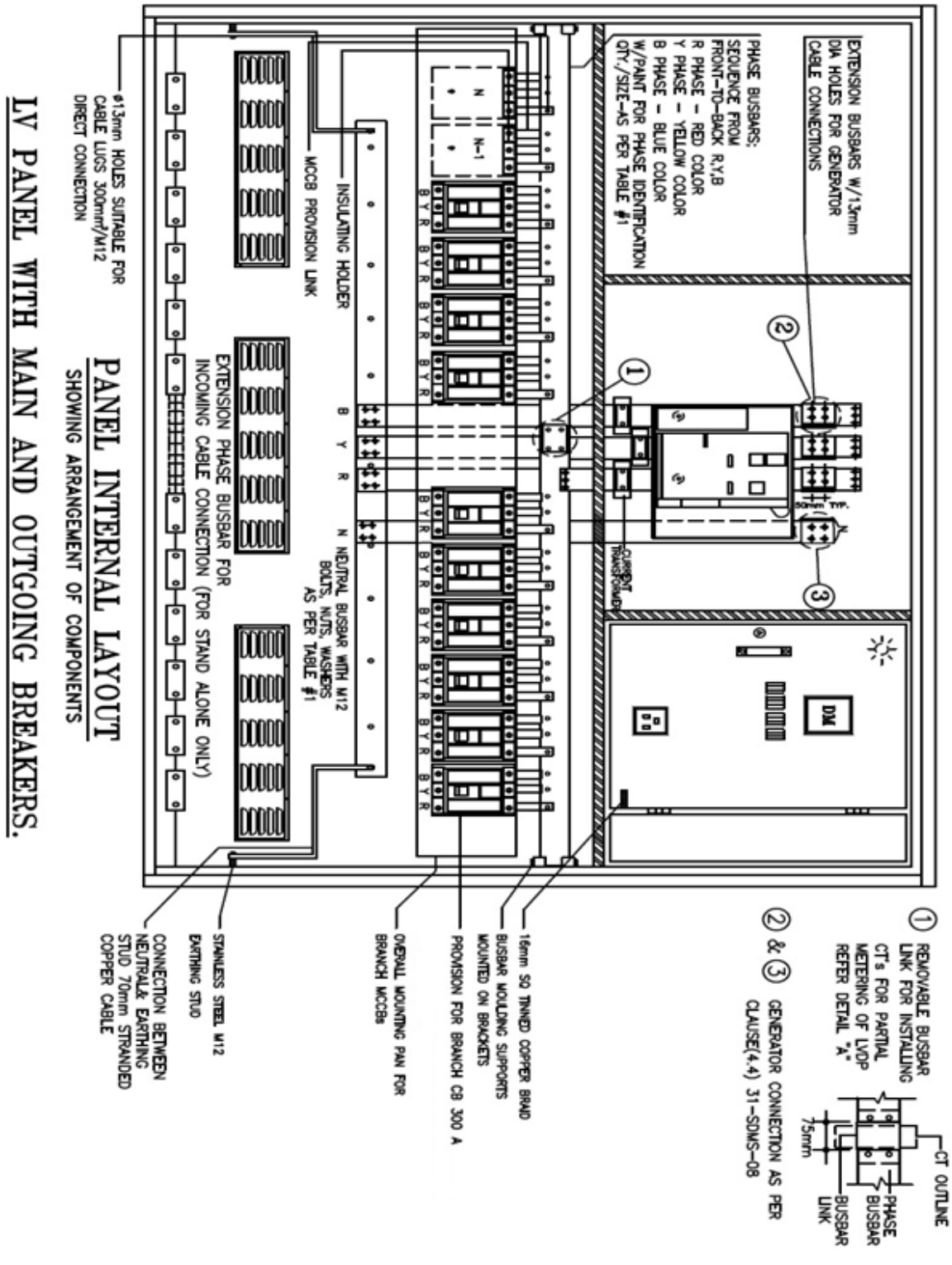

Figure 3: Panel with (MCB+MCCBs) Internal Layout.

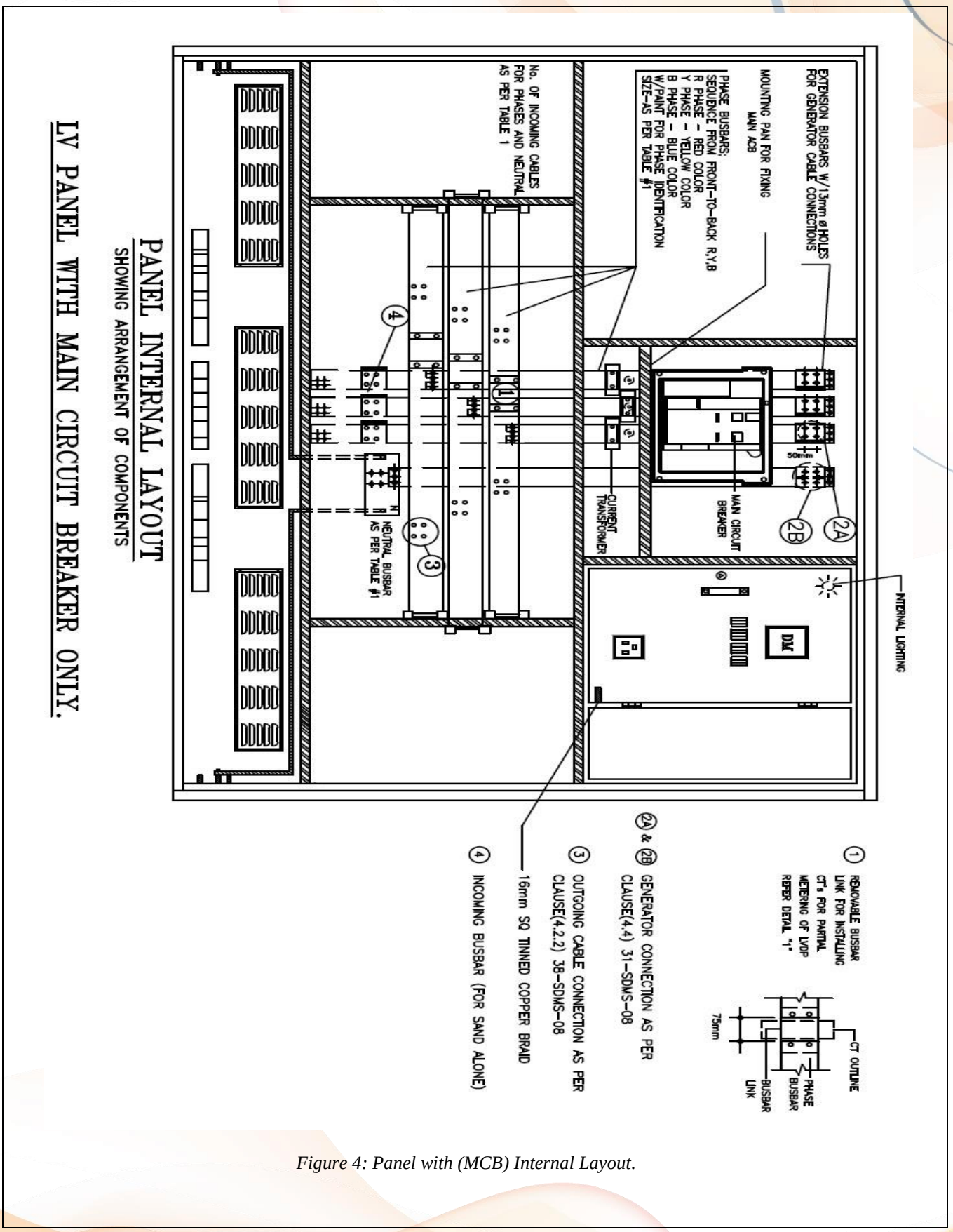

Figure 4: Panel with (MCB) Internal Layout.

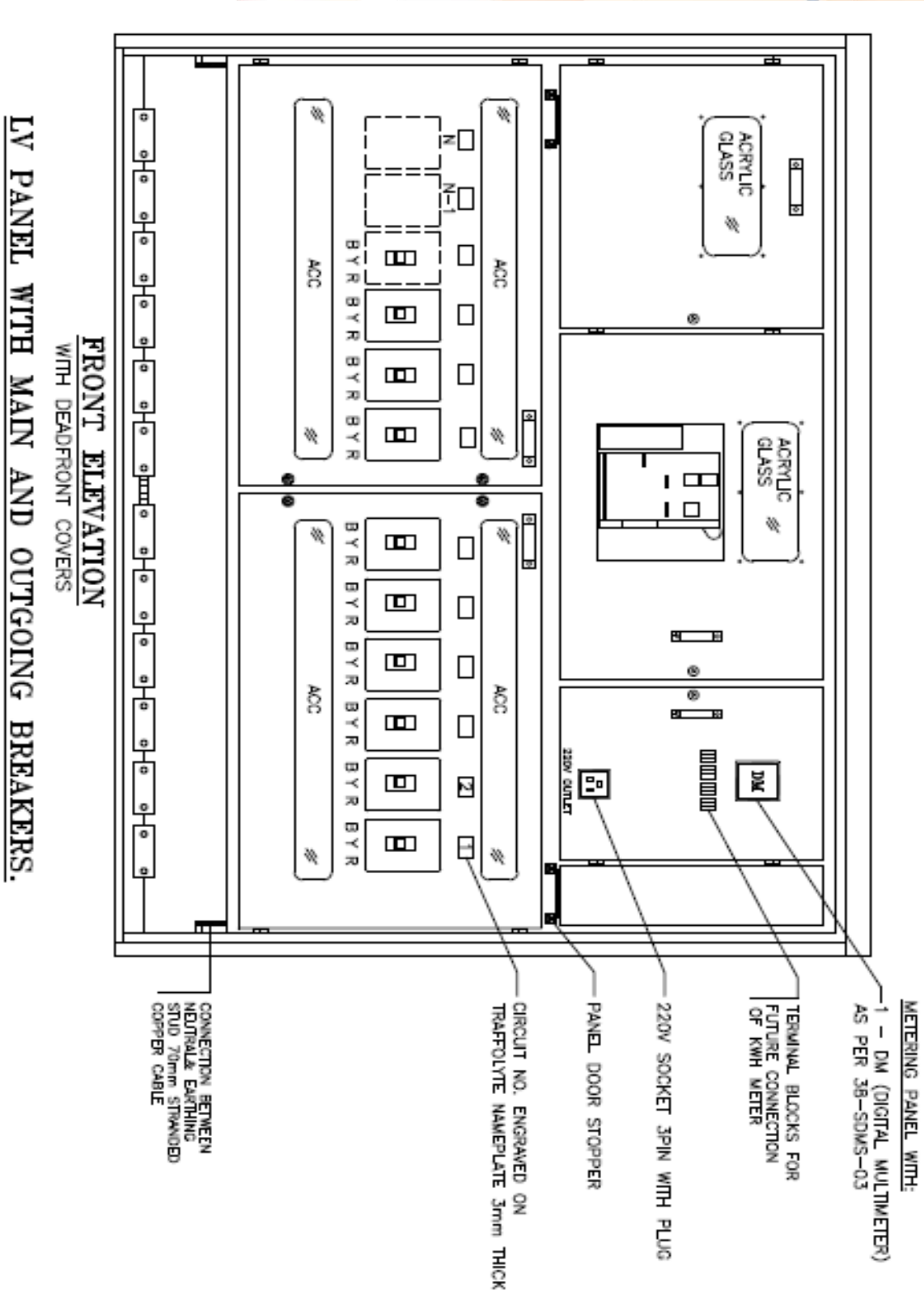

Figure 5: Panel with (MCB+MCCBs) front elevation.

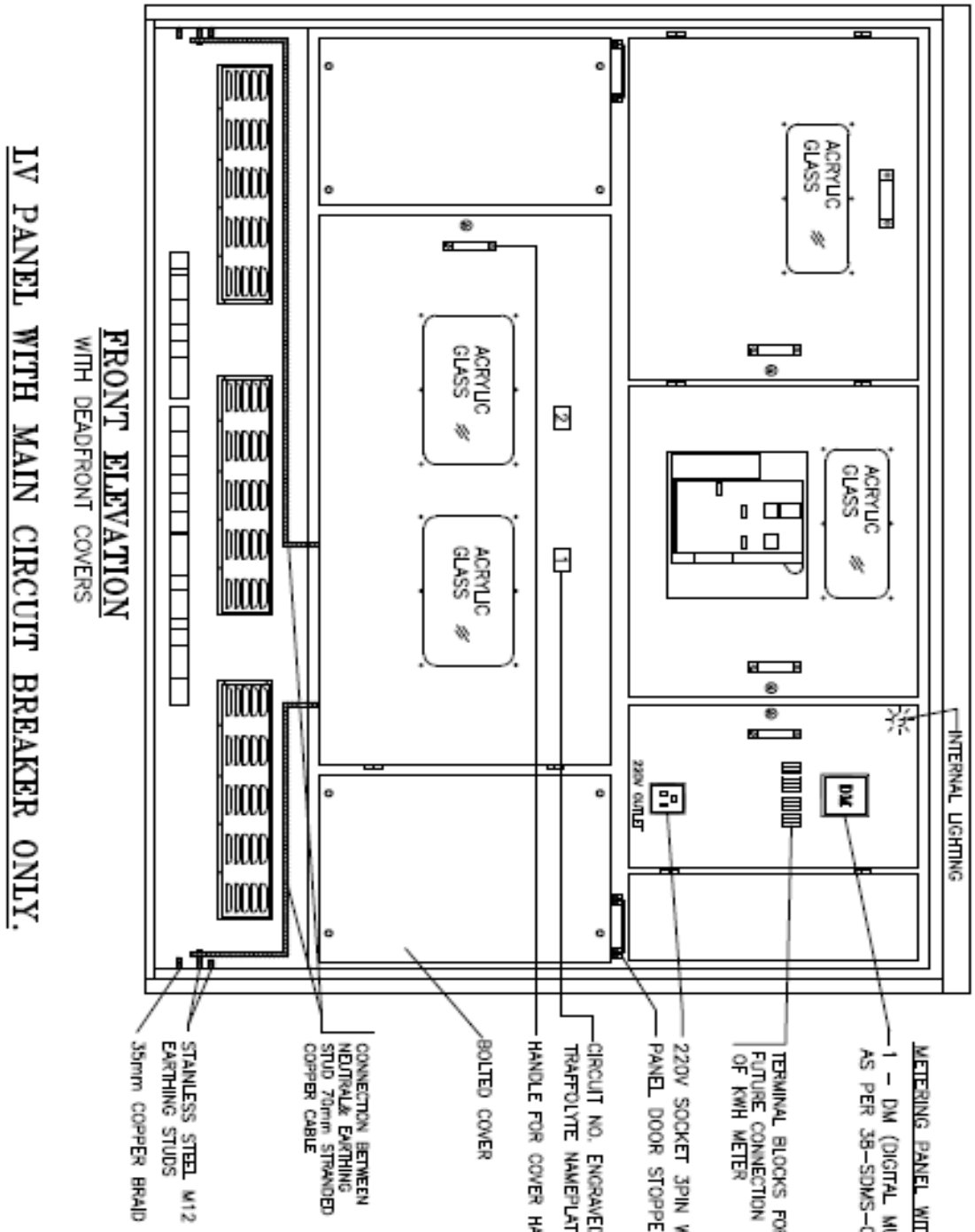

Figure 6: Panel with (MCB) front elevation.

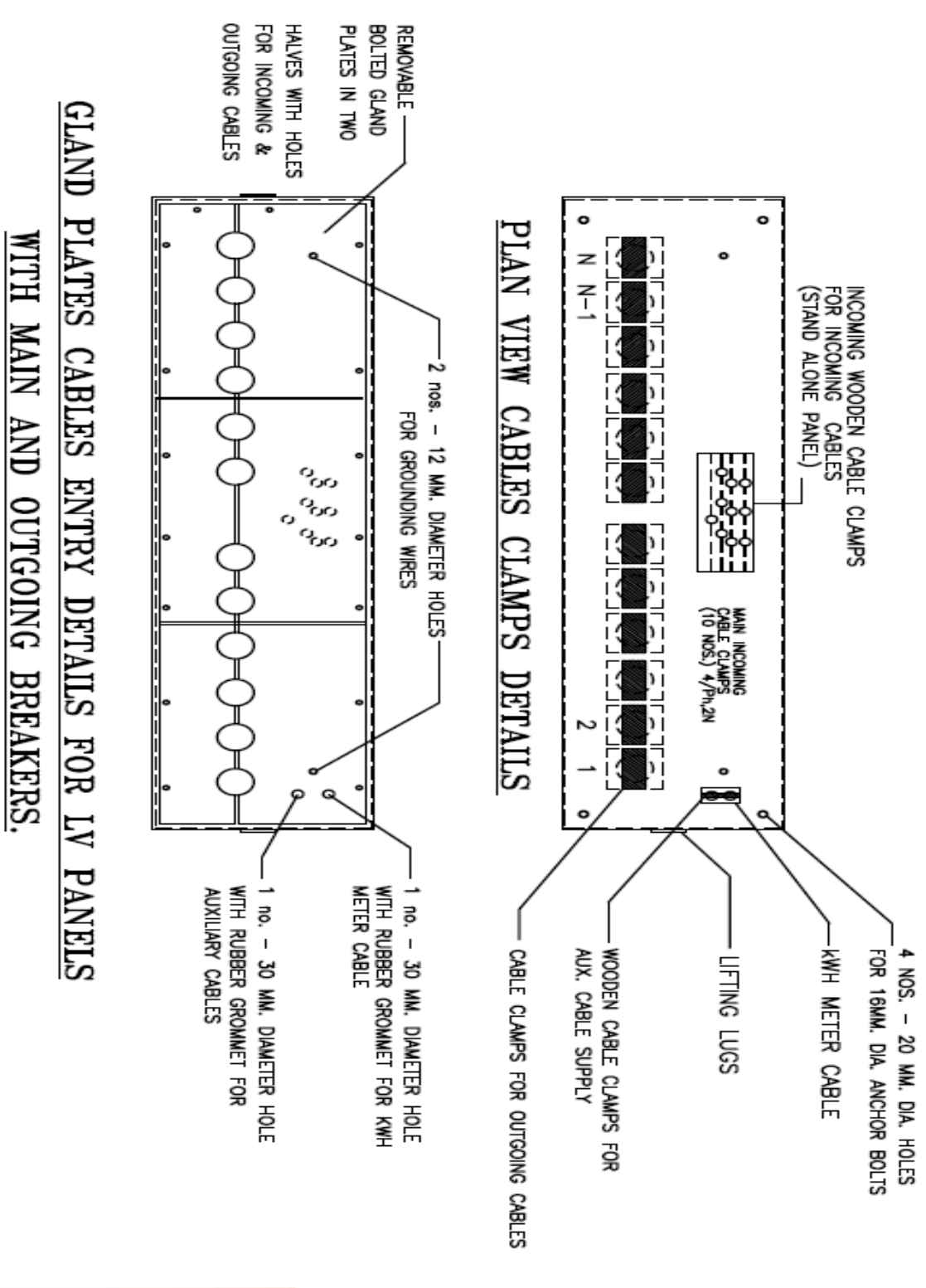

Figure 7: Plan View Of Gland Plate for Panel with (MCB+MCCBs).

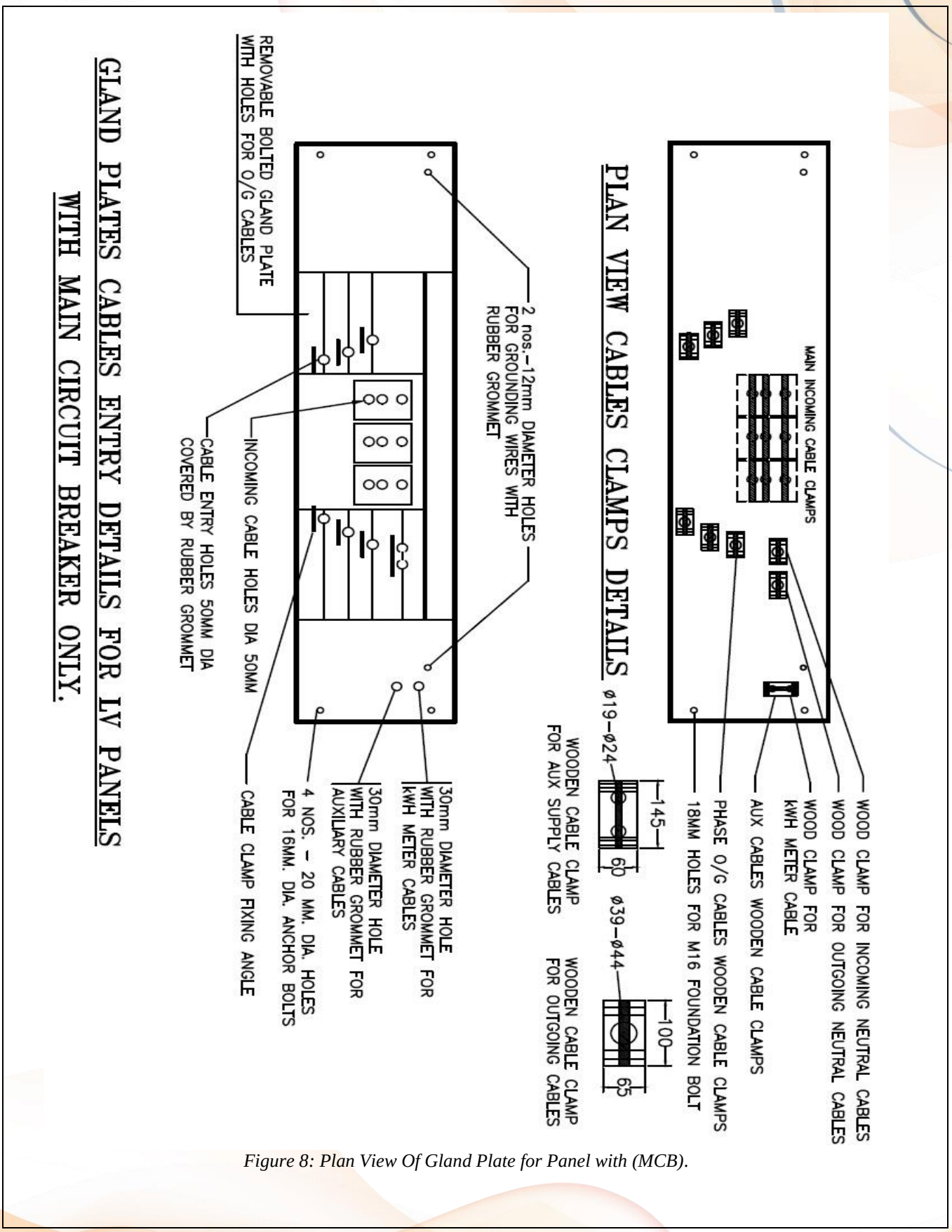

Figure 8: Plan View Of Gland Plate for Panel with (MCB).

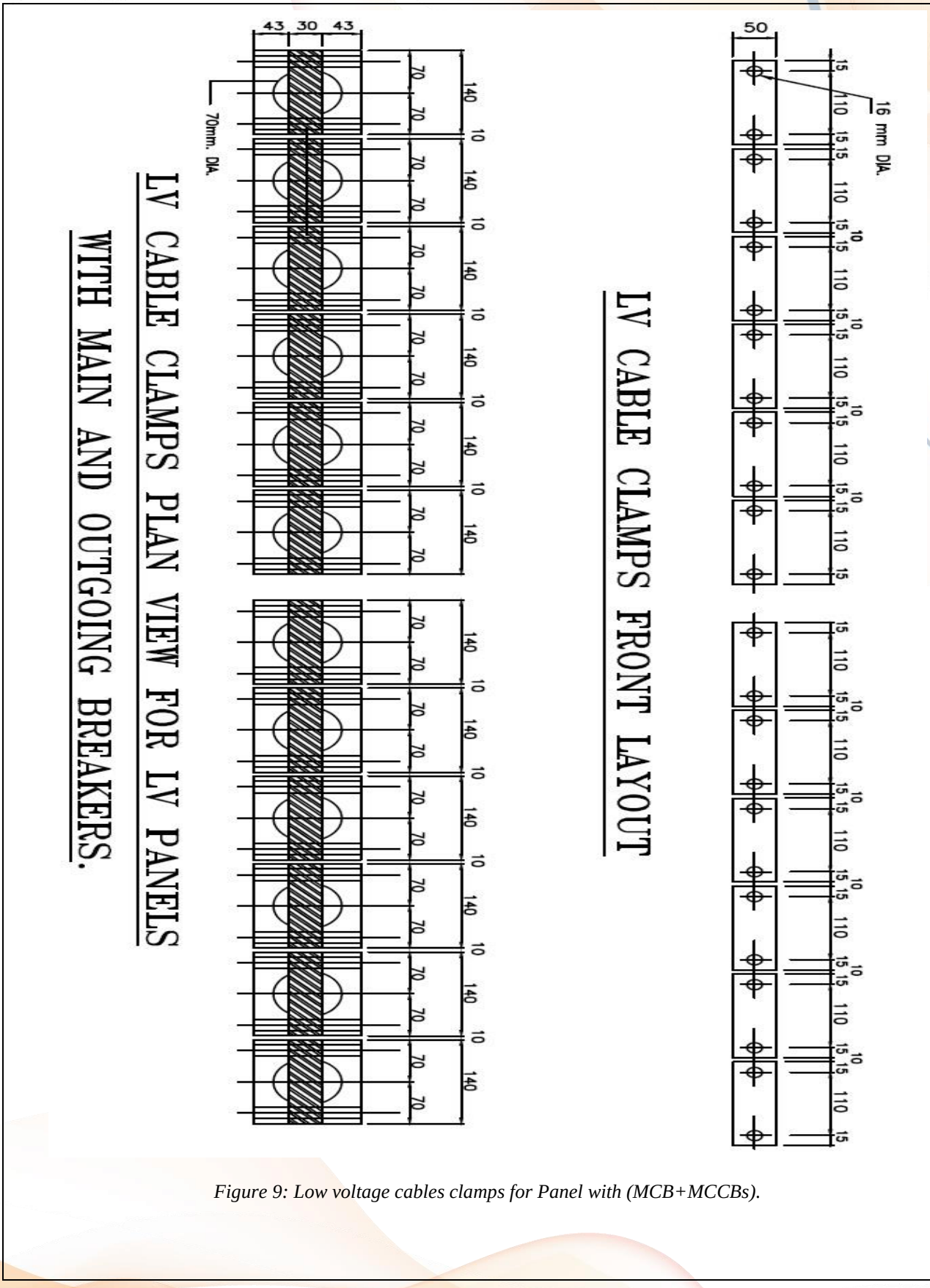

Figure 9: Low voltage cables clamps for Panel with (MCB+MCCBs).

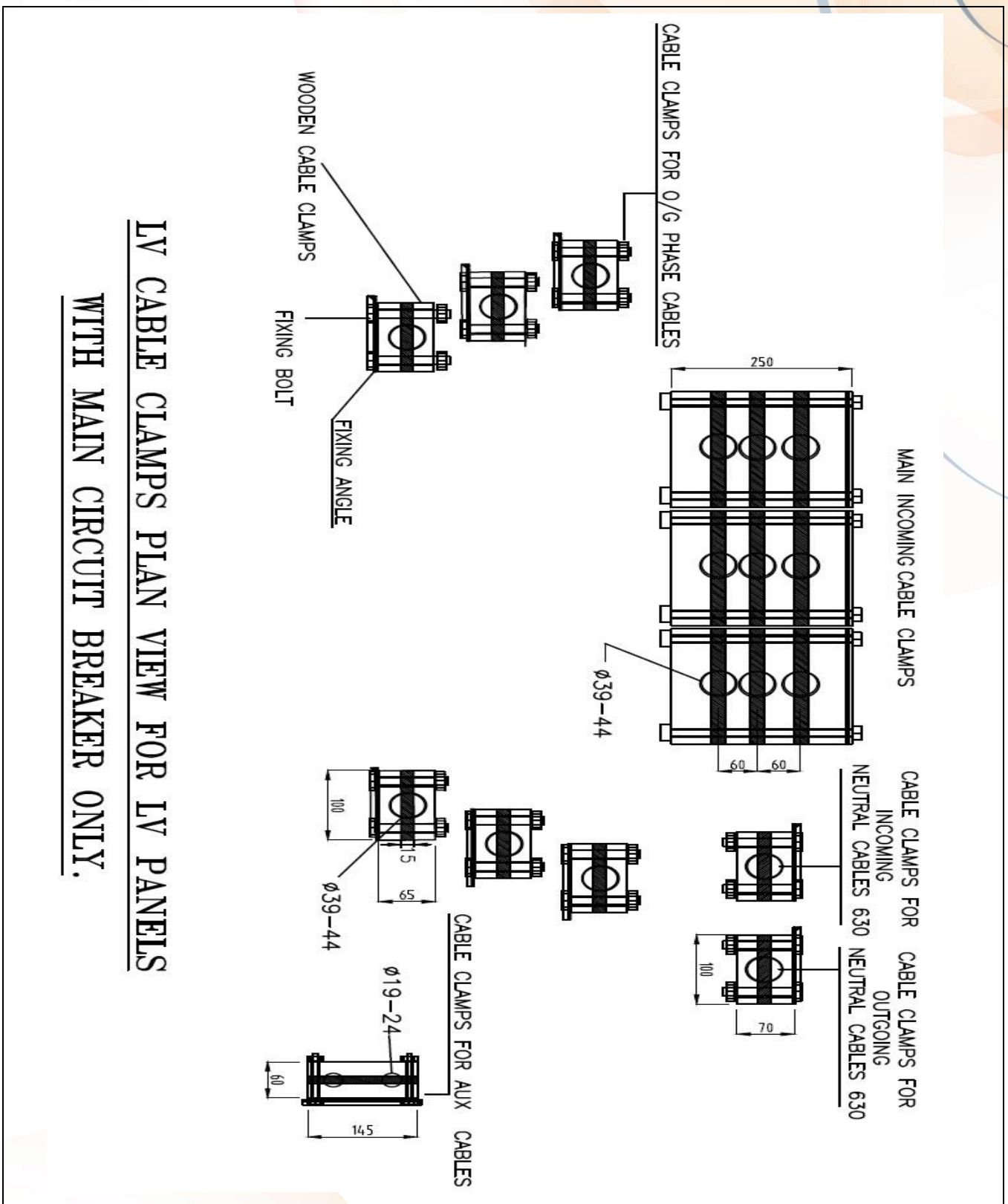

Figure 10: Low voltage cables clamps for Panel with (MCB+MCCBs).

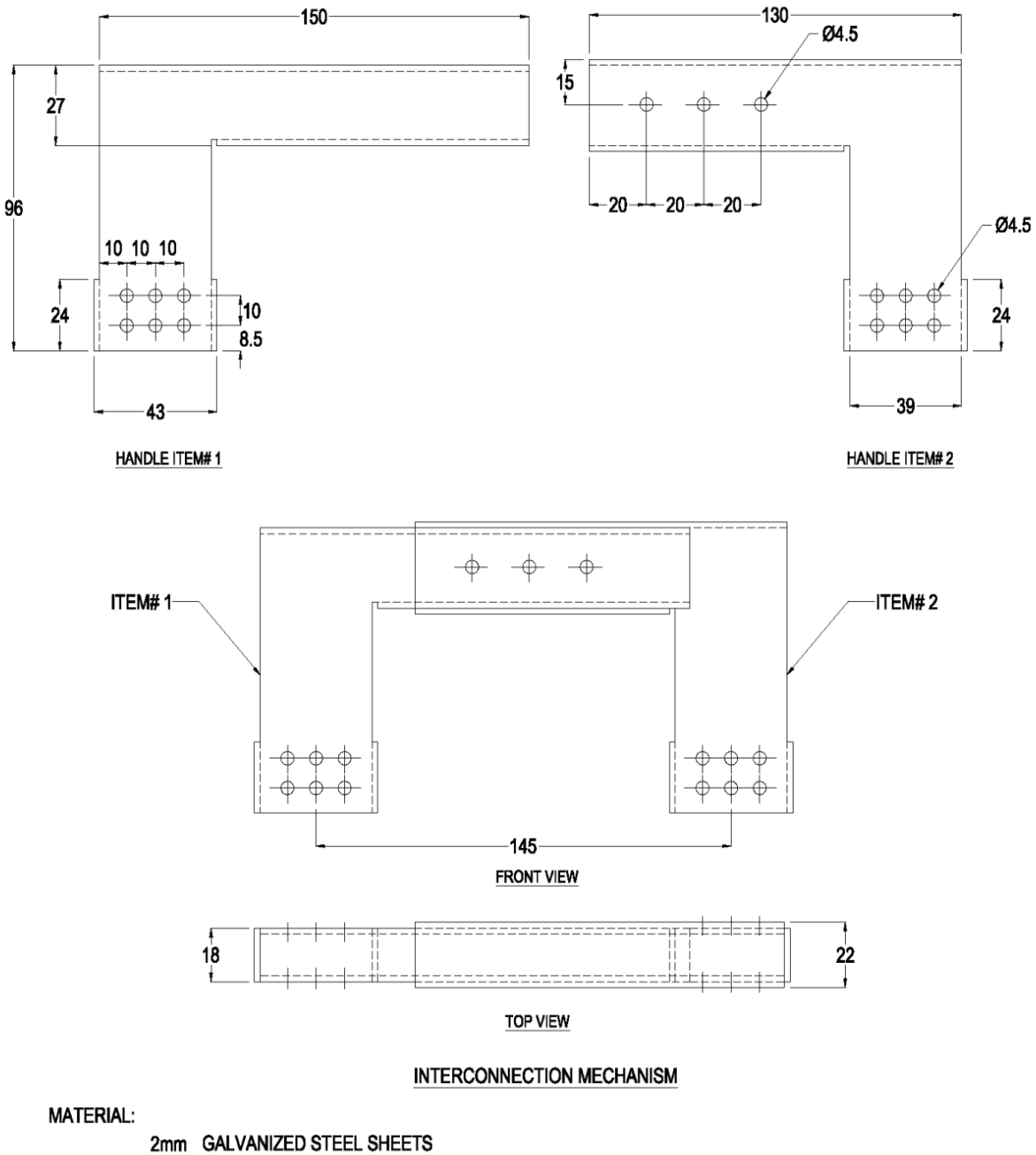

Figure 11: Handle For Two Interconnected Breakers.

CIRCUIT NUMBER	D E S C R I P T I O N
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

NOTE

TABLE SIZE SHALL BE PROPORTIONAL TO THE INSIDE OF THE LEFT SIDE DOOR OF THE PANEL

Figure 12: Circuit Label.