

Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

Public Review Draft

Revision history

VERSION	DATE	PURPOSE
0.1	April 2021	Issued for Public Review

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

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Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of metal-enclosed low-voltage power circuit breaker switchgear in accordance with IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1A, March 2020 for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.



JIP33 Specification for Procurement Documents Supplementary Technical Specification

This specification is to be applied in conjunction with the supporting data sheet, quality requirements specification (QRS) and information requirements specification (IRS) as follows.

IOGP S-727: Supplementary Specification to IEEE Std C37.20.1 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

This specification defines the technical requirements for the supply of the equipment and is written as an overlay to IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020, following the IEEE Std C37.20.1-2015 clause structure. Clauses from IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 not amended by this specification apply as written to the extent applicable to the scope of supply.

Modifications to IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 defined in this specification are identified as Add (add to clause or add new clause), Replace (part of or entire clause) or Delete.

IOGP S-727D: Data Sheet for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (IEEE Std C37.20.1)

The data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional

purchaser supplied documents may also be incorporated or referenced in the data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-727Q: Quality Requirements for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (IEEE Std C37.20.1)

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

IOGP S-727L: Information Requirements for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear (IEEE Std C37.20.1)

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

The terminology used within this specification and the supporting data sheet, QRS and IRS follows that of IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020 is in accordance with ISO/IEC Directives, Part 2 as appropriate.

The data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The supplementary specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

- a) regulatory requirements;
- b) contract documentation (e.g. purchase order);
- c) purchaser defined requirements (data sheet, QRS, IRS);
- d) this specification;
- e) IEEE Std C37.20.1-2015 and amendment IEEE Std C37.20.1a-2020.

1 Scope

Add to clause

This specification defines minimum technical requirements for purchase (including design features, fabrication quality, inspection, testing, shipment, and documentation) of low voltage switchgear equipment. This specification does not apply to low voltage switchgear installed in hazardous (classified) areas.

2 Normative references

Add to clause

ABS MODU, Publication Number 6 Part 4, *Rules for Building and Classing Mobile Offshore Drilling Units - Part 4 Machinery and Systems*

API RP 14 F, *Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class 1, Division 1 and Division 2 Locations*

API RP 14 FZ, *Recommend Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations*

ASCE/SEI 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

CAN/CSA C60044:08 (Parts 3–8), *Instrument Transformers CSA C60044*

CAN/CSA C61869-2:14, *Instrument Transformers - Part 2: Additional requirements for current transformers - First Edition*

CAN/CSA C61869-3:14, *Instrument Transformers - Part 3: Additional Requirements for Inductive Voltage Transformers - First Edition*

CSA C22.2 No. 31-14, *Switchgear assemblies*

IEC 62402, *Obsolescence management*

IEEE Std C37.20.2™, *Standard for Metal-Clad Switchgear*

IEEE Std C37.20.7™-2017, *IEEE Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults*

IEEE Std C37.90™, *Relays and Relay Systems Associated with Electric Power Apparatus*

NEMA ICS 5, *Industrial Control and Systems: Control-Circuit and Pilot Devices*

NEMA 250, *Enclosures for Electrical Equipment (1 000 Volts Maximum)*

UL 1436, *STANDARD FOR SAFETY Outlet Circuit Testers and Similar Indicating Devices*

UL 1558, *UL Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear*

46 CFR 111, *Title 46 - Shipping, Chapter I - Department of Coast Guard, Subchapter J - Electrical Engineering, Part 111 - Electrical Systems - General Requirements (for US offshore only)*

3 Definitions

Add new definition

arc resistant accessibility Type 1: Equipment with arc-resistant designs or features at the freely accessible front of the equipment only.

Add new definition

arc resistant accessibility Type 2: Equipment with arc-resistant designs or features at the freely accessible exterior (front, back, and sides) of the equipment only.

Add new definition

arc resistant accessibility Type 2B: Equipment with arc-resistant designs or features at the freely accessible exterior (front, back, and sides) of the equipment only, plus the additional requirements of IEEE Std C37.20.7. The equipment is arc resistant even with the instrument or control compartment doors open.

Add new definition

arc resistant equipment: Equipment designed to withstand the effects of an internal arcing fault, as indicated by successfully meeting the test requirements of IEEE Std C37.20.7.

Add new definition

internal arcing fault: An unintentional discharge of electrical energy in air or insulating gas within the confines of a switchgear enclosure.

Add new definition

blank space: A cubicle with main bus, blank door, and no secondary devices. Steelwork is prepared such that the blank space can be equipped in the field without cutting or welding.

Add new definition

touch-safe: Protected from inadvertent contact by a finger using covers, recessing of terminals or the size of openings.

NOTE—Touch-safe and similar terms, such as finger safe, are widely used to describe products but are not defined by industry standards. Touch-safe is generally equivalent to IP 2X per ANSI/IEC 60529, but most products are not tested to a particular IP rating.

Add new definition

manufacturer: Organization manufacturing and/or supplying the equipment or services, and/or contractor on project; may alternatively be referred to as "vendor", "seller" or "supplier".

3.1 Abbreviations

LV nominal system voltage not exceeding 1000 Vac or 3200 Vdc

NEMA National Electrical Manufacturers Association

UL Underwriters Laboratory

4 Normal (usual) service conditions

Add new clause

4.1

If seismic requirements are specified, the LV switchgear shall be designed in accordance with the requirements of ASCE/SEI 7-16.

Add new clause

4.2 Environmental contamination

If other service conditions with environmental contamination are specified, the equipment shall be provided as detailed in 4.2.1 through 4.2.3.

4.2.1

The equipment shall be protected against deterioration from corrosive gases by the use of compatible coatings and material selection.

4.2.2

Bare copper, bare silver or their alloys shall not be used for current carrying parts when the presence of corrosive gases is identified.

4.2.3

The corrosion protection method shall be identified in the equipment specification sheet.

Add new clause

4.3 Dependability of materials and parts

4.3.1

The switchgear and sub-components shall be designed for operation for at least 45 000 h (five years) at the continuous-current rating and under normal service conditions.

4.3.2

Under normal service conditions, the bus bars shall not be required to be de-energized for maintenance for the initial five-year operational period.

Add new clause

4.4 Technology readiness and obsolescence

4.4.1

The LV switchgear, excluding electronic components, shall have a design life of and be supported for at least 20 years after delivery.

4.4.2

An obsolescence management plan shall be available from the manufacturer for all switchgear components excluding devices that are specified by the purchaser and not part of the manufacturer's standard offering.

NOTE—IEC 62402 is an example of an obsolescence management guide.

4.4.3

Proposals shall indicate whether the LV switchgear or any sub-component (individually denoted) has less than three years of proven operational service.

5 Ratings

5.3 Rated power frequency

Replace second sentence with

Ratings for ac equipment are based on a frequency of 60 or 50 Hz.

5.7 Phase current transformer accuracies

Add to clause

For relaying applications, accuracies shall conform to IEEE Std C37.20.2, Table 4.

6.3 Production tests

6.3.1 General

Add new clause

6.3.1.1

The switchgear shall be electrically and mechanically assembled into a single line-up prior to testing and inspection.

Add new clause

6.3.1.2

Functional testing of the completed LV switchgear assembly shall include the following:

- a) Operation of all circuit breakers and switching devices (including any auto transfer schemes).
- b) Electrical and mechanical interlocks.
- c) All control devices that are either hard wired or communicating over a network and, if applicable, local human machine interface (HMI).
- d) Current and voltage transformers.
- e) Circuit breaker trip units, protective relays and metering devices.
- f) Indicator lights.

- g) Circuit breaker draw out and mechanical insertions (including operation of the shutter mechanism).
- h) Vertical section space heaters and thermostat if applicable.
- i) Continuous thermal monitoring system if applicable.
- j) Auxiliary equipment provided as part of the system design (e.g. interposing relay panel, mimic panel, remote racking equipment).

6.3.2 Dielectric tests

Delete third sentence of first paragraph

Delete second sentence of second paragraph

Add new clause

6.3.2.1

If grounding studs are specified, they shall be installed prior to the dielectric tests.

Add new clause

6.3.2.2

If cable lugs are specified, they shall be installed prior to the dielectric tests.

7 Construction

7.1 General requirements

7.1.1 Buses and primary connections

Replace first sentence with

Buses and primary connections shall be plated copper.

7.1.1.3 Cable terminations

Add new clause

7.1.1.3.1

Incoming and outgoing cable termination points shall be provided with a NEMA two-hole pattern as a minimum.

Add new clause

7.1.1.3.2

Cable entry provisions shall include removable gland plates for every vertical section.

Add new clause

7.1.1.3.3

If cable termination lugs for the incoming section(s) are supplied by the manufacturer, they shall meet the following requirements:

- a) NEMA two-hole pattern minimum.
- b) Compression type.
- c) Sized for the specified incoming cables.
- d) Arranged to provide clearances as required in 7.4.

Add new clause

7.1.1.5

Main and ground buses shall be pre-drilled for connection of future sections on each end without the need for additional bus supports or bracing.

Add new clause

7.1.1.6

Bolts that have been torqued shall be marked with paint or other visible mark to indicate that proper torque has been applied.

Add new clause

7.1.1.7

A label shall be posted inside each section listing torque requirements for bolted joints connections and cable lug terminations.

Add new clause

7.1.1.8

When a neutral bus is specified, it shall meet the following requirements:

- a) Extend the full length of the switchgear.
- b) Insulated from ground.
- c) The same continuous current rating and short-circuit ratings as the main bus.
- d) When the power system is solidly grounded, provide a means to disconnect the neutral service conductors without disconnecting the field installed cabling, i.e. removable bus link.

Add new clause

7.1.1.9

Cables shall not be used for power buses or main horizontal or vertical tie buses.

Add new clause

7.1.1.10

Space shall be provided to allow field installation and servicing of shipping split joint connections with a front accessible bus cover removed, i.e. assembly of joints and access with a torque wrench.

Add new clause

7.1.1.11

When cable bus or bus duct is specified for the incoming line section, the necessary components for the LV switchgear to accept the cable bus or bus duct shall be provided.

7.1.2 Grounding

7.1.2.2 LV ac switchgear

Add new clause

7.1.2.2.1

A 6.35 mm by 50.8 mm (¼ in by 2 in) minimum copper ground bus shall be included at the rear and for the entire length of the assembly.

Add new clause

7.1.2.2.2

The ground bus shall be drilled at each end for a NEMA two-hole lug for field connection and supplied with copper compression type lugs.

Add new clause

7.1.2.2.3

All ground bus joints shall be solidly bolted (self-tapping bolts and screws not allowed).

Add new clause

7.1.2.2.4

For three-phase ungrounded systems, a ground detection system with a visual indication shall be provided.

Add new clause

7.1.2.2.5

If specified, grounding ball studs meeting the requirements in ASTM F855 shall be provided in specific locations as indicated in the data sheet and project drawings.

Add new clause

7.1.2.4 Grounding for current transformer circuits

7.1.2.4.1

One direct connection shall be made from the short circuiting terminal block to the ground bus, without any intermediate terminations or splices.

7.1.2.4.2

Wire insulation shall be green in color and marked "CT Ground" at terminal block and at ground bus termination point.

Add new clause

7.1.2.5 High resistance grounding system

7.1.2.5.1

If specified, a high resistance ground system for each source of supply shall be provided integral to the switchgear assembly.

7.1.2.5.2

If high resistance ground systems are specified, they shall include the following components:

- a) Control and monitoring system that provides system status and alarm outputs.
- b) A neutral-to-ground voltage measurement and neutral current measurement.
- c) Pulsing function in order to assist with the location of the ground fault.
- d) Tapped resistors, adjustable between 1 A and 10 A.
- e) Portable ground fault detector with case.

7.1.2.5.3

High resistance grounding systems shall have lockable control power disconnects and neutral disconnects.

7.1.5.2.4

High resistance grounding systems shall be provided with a connection pad suitable for accepting a NEMA two-hole compression type connector for termination of incoming neutral conductor.

7.1.5.2.5

For double ended main bus systems, the tie circuit breaker shall be electrically interlocked with the high resistance grounding systems to prevent it from closing when a ground fault exists on both buses.

7.1.5.2.6

A separate, permanent externally visible nameplate shall be installed on the switchgear assembly near the controls for each ground fault system to provide instructions for the operation of the high resistance ground system.

7.1.3 Control and secondary circuits and devices, and all wiring

7.1.3.1 General (Addendum 1 of March 5, 2020)

Add new clause f)

- f) Internal wiring shall be installed in a single continuous piece from termination point to termination point, free of splices and taps.

7.1.3.3 Control, secondary, and logic-level wiring (Addendum 1 March 5, 2020)

7.1.3.3.2 Wire size (Addendum 1 March 5, 2020)

Replace fourth paragraph with

Minimum conductor sizes shall be as follows:

- a) Current transformer (CT) secondary wiring: No. 10 AWG.
- b) All control and other wiring: No. 14 AWG, except communication wiring.

7.1.3.3.3 Wire protection and support (Addendum 1 March 5, 2020)

Add to clause

Adhesive-type supports shall not be permitted.

7.1.3.3.4 Wire type (Addendum 1 March 5, 2020)

Delete second bullet item from exception list (for low energy signal communication cables)

Add new clause

7.1.3.3.5 Data communications

If LV switchgear data communications are required, the cabling and connection to the devices intended to be monitored and controlled shall be provided as follows:

- a) Be compatible with the specified communication protocol (or combination of protocols).
- b) Have a mechanical means to prevent unintended separation (e.g. screw type connectors, RJ-45 connector) of the communication network cable connections made in wireways and between vertical sections.
- c) Be rated for 600 Vac.

Add new clause

7.1.3.3.6 Wire Markers

All LV switchgear internal wire terminations shall be marked as follows in order to facilitate tracing of circuits and troubleshooting:

- a) With heat shrink-type wire markers or permanently marked no than every 46 cm (18 in).
- b) Adhesive type wire markers, labels and wire holders are unacceptable.
- c) With a unique number as assigned on the approved schematic and wiring diagrams.
- d) With the same assigned number at each end and at each location where it is terminated.

7.1.3.5 Terminal blocks (Addendum 1 March 5, 2020 — formerly 7.1.3.3)

Add new clause

7.1.3.5.1

Low voltage components (e.g. relays, terminal blocks, fuse holders) having a line to ground voltage of greater than 50 V shall have exposed energized terminals provided as touch-safe or covered by an insulating barrier to provide protection from incidental contact.

Add new clause

7.1.3.5.2

All trip and close circuits shall be provided with pullout dead-front type fuse blocks.

Add new clause

7.1.3.5.3

Both the terminal blocks and the associated wiring between shipping sections shall be permanently marked with identification matching the drawings.

Add new clause

7.1.3.5.4

LV switchgear manufacturer's wiring shall be connected to only one side of the field wiring terminal blocks.

Add new clause

7.1.3.5.5

A maximum of two wires shall be terminated on any one terminal.

Add new clause

7.1.3.5.6

Terminal strips located in individual compartments shall be provided with a minimum of 20% spare control terminal blocks without reducing the size of the field wiring allocated space.

Add new clause

7.1.3.14

If specified, circuit breakers shall be provided with provisions for testing and calibrating using external secondary injection without disconnecting the permanent wiring.

7.1.4 Miscellaneous

7.1.4.1 Nameplate marking

Add new list item j)

j) Purchase order number.

Add new clause

7.1.4.1.1

The LV switchgear individual compartments shall be provided with engraved nameplates and field markings depicting the information within the project nameplate schedule or single line drawing.

Add new clause

7.1.4.1.2

Nameplates shall be engravable type with black letters on a white background.

Add new clause

7.1.4.1.3

Nameplates shall be mounted with stainless steel screws on the front of the compartment.

Add new clause

7.1.4.1.4

Compartment nameplates size shall be at least 25.4 mm (1 in) wide by 63.5 mm (2.5 in) long.

Add new clause

7.1.4.1.5

Compartment nameplate characters shall be at least 4.8 mm (0.1875 in) high.

Add new clause

7.1.4.1.6

Separate nameplates shall identify door mounted items (e.g. meters, switches, indicating lights and other similar devices).

Add new clause

7.1.4.1.7

Separate device markers shall identify the individual components within each compartment (e.g. terminals, relays, switches, fuse blocks, and other similar devices).

Add new clause

7.1.4.1.8

When the operation of any integral secondary selective, electrical interlock or mechanical interlock system in the assembly is not evident, instruction plates shall be engraved and displayed near the point of operation.

Add new clause

7.1.4.1.9

A permanent nameplate shall be provided on the front and rear exterior of the switchgear to identify the equipment number and description, as specified in the project drawings.

Add new clause

7.1.5 Arc resistance design and construction

7.1.5.1

If arc resistance is specified, the switchgear shall have an arc resistant Type 2B enclosure accessibility rating.

7.1.5.2

Arc resistant assemblies shall be tested in accordance with the requirements of IEEE Std C37.20.7-2017, for not less than 0.5 second based on prospective current of the highest rated circuit breaker without insertion of any current limiting device in the test circuit.

7.1.5.3

If a plenum is required, it shall run the full length of the LV switchgear and be fully rated to withstand the forces associated with an arc fault within the assembly.

7.1.5.4

Minimum room dimension requirements and other guidelines (e.g. for plenum or arc duct) related to the performance of the arc resistant LV switchgear shall be provided.

7.1.5.5

Front doors of LV switchgear shall be secured with latches (tie down bolts are not allowed).

7.1.5.6

Special tools shall not be required to latch the front compartment door or engage the arc resistant function.

7.1.5.7

If accessories are required to maintain the arc resistant rating of the switchgear with circuit breaker removed (e.g. solid door), the quantity for each circuit breaker rating (e.g. physical size) shall be specified.

7.1.5.8

Control and instrument compartments shall be separate from circuit breaker and bus compartments and designed to minimize the passage of arc fault products.

7.1.5.9

Circuit breaker secondary and all control and monitoring terminals necessary for maintenance and troubleshooting shall be located in a type 2B control and instrument compartment.

7.1.5.10

The LV switchgear shall be designed for closed door racking of the power circuit breakers that maintains the integrity of the arc resistance design.

7.1.5.11

Circuit breakers shall be provided with a means to manually trip the circuit breaker with the door closed without compromising the integrity of the arc-resistant construction.

7.1.5.12

The methodology defined in IEEE Std C37.20.7-2017 that is utilized to achieve the arc resistant certification of the LV switchgear (full withstand capability without protective device, self-extinguishing, current-limiting circuit breaker/fuses or duration-limiting device) shall be identified.

Add new section

7.1.6 Certifications

7.1.6.1

The LV switchgear shall be listed or certified by a nationally recognized testing laboratory (NRTL) for the United States or accredited certification organization (ACO) for Canada.

NOTE—Applications for this equipment in other countries may have additional requirements for certification (UL 1558 for US applications).

7.1.6.2

If specified, the LV switchgear assemblies to be installed on floating offshore installations in United States Coast Guard (USCG) and American Bureau of Shipping (ABS) jurisdictions shall comply with 46 CFR 111 and ABS MODU Publication Number 6 Part 4, respectively.

NOTE—Additional guidance and information for USCG and ABS requirements for LV switchgear installed on floating facilities in US territorial waters can be found in API RP 14 F/FZ.

7.2 Materials and finish

7.2.2 Finishes and color

Replace fifth paragraph with

Unpainted parts and hardware shall be plated for corrosion resistance or be made of stainless steel.

7.3 Barriers

Add to clause

Sheet steel barriers shall be provided between all power and control compartments.

7.4 Buses and connections

Replace first sentence with

All bus and connections shall either be bare or insulated as specified.

Delete NOTE

Add to clause

If bus insulation is specified, the requirements in 7.4.1 through 7.4.5 shall apply.

7.4.1

Bus and bus bar joint insulating materials shall be non-hygroscopic, flame retardant, and tracking resistant.

7.4.2

Bus bar joints shall be covered with formed insulating boots attached with non-metallic hardware (taping of bolted joint is not allowed).

7.4.3

Bus insulation materials shall meet or exceed the maximum voltage rating of the LV switchgear.

7.4.4

Bus bar joint insulating boots shall be installed at the factory, unless impractical due to shipping requirements.

7.4.5

If insulated main bus is specified, the field installed bus bar joint insulating boots shall be supplied with attachment hardware and installation instructions.

NOTE—The field installed boots are required to complete the assembly of shipping splits at the site.

7.5 Access doors and covers

Delete second paragraph

Add new clause

7.5.1

Any removable panels weighing more than 16 kg (35 lbs) shall have two lifting handles.

Add new clause

7.5.2

Breaker compartment doors shall be provided with door handle latches that require deliberate operation to open the door.

Add new clause

7.5.3

Provisions shall be made for padlocking breakers in the test and disconnected positions.

Add new clause

7.5.4

All bolted doors and removable panels shall be secured with captive slotted fasteners, machine screws, machine bolts engaging captive nuts or tapped holes in structural members.

Add new clause

7.5.5

Rear access doors for cable compartments shall be as follows:

- a) Full height.
- b) Removable or open beyond 90°.
- c) Hinged (full length or three hinges minimum).
- d) Bolted or with latches.
- e) Pad-lockable.
- f) Equipped with doorkeeper or positioner.
- g) Provided with a label identifying the circuit breaker or circuit designation.

Add new clause

7.5.6

All hinged doors exceeding a height of 1143 mm (45 in) or a width of 610 mm (24 in) shall be provided with door keepers or positioners.

7.7 Indoor LV switchgear

7.7.1 General

Add to clause

Enclosures shall be NEMA 1 rated as a minimum.

Add new clause

7.7.4

If non-ferrous metals such as aluminium are used for eddy current heating reasons, they shall be of equivalent strength and rigidity to steel sections.

7.8 Outdoor LV switchgear

7.8.2 Requirements

Add new clause

7.8.2.1

Enclosures for outdoor LV switchgear shall be designed and fabricated in accordance with the requirements in 7.8.2.1.1 through 7.8.2.1.5.

7.8.2.1.1

Gaskets shall be held in metal retainers to prevent moving during assembly.

7.8.2.1.2

Roof shall be sloped to permit drainage.

7.8.2.1.3

Outer doors shall be formed and gasketed with weatherproof joints to prevent entry of dust, rain and snow.

7.8.2.1.4

External joints shall be seal welded for the full length of the joint or bolted with gaskets.

7.8.2.1.5

External joints shall be covered with a metal cap to prevent the entry of dust, rain and snow.

Add new clause

7.8.2.2

Every outdoor LV Switchgear assembly shall be provided with at least one 120-volt GFCI-protected receptacle.

Add new clause

7.8.2.3

Where an outdoor assembly includes four or more vertical sections, at least one 120-volt GFCI-protected receptacle shall be provided on each end with a maximum distance between the receptacles of 9 m (30 ft).

Add new clause

7.8.2.4

Outdoor LV switchgear enclosures shall have one LED type light fixture per vertical section.

7.10 Arrangements with stationary circuit breakers

Replace clause with

Stationary circuit breakers shall not be provided

Add new clause

7.11.8 LV Switchgear configuration

7.11.8.1

Provisions shall be made for the addition of vertical sections with future breakers at both ends of the line-up.

NOTE—Provisions include but are not limited to removable plates or side sheets furnished on the end of vertical sections, terminal blocks for vertical section interconnect wiring, and pre-drilled main and ground bus.

7.11.8.2

In double-ended LV switchgear arrangements, each main and tie breaker shall be in separate vertical sections.

NOTE—This does not preclude metering, auxiliary equipment, or a feeder breaker being in the same vertical section with the main breaker or tie breaker.

7.11.8.3

Equipped and unequipped spaces shall be capable of being modified to add future circuit breakers of the same ampere rating indicated on the project drawings or one line diagram without a shutdown of the switchgear.

7.11.8.3.1

Equipped spaces shall be furnished with all hardware, wiring, doors, and miscellaneous equipment including CTs and monitoring devices required to permit the completion of the compartment only by the addition of a circuit breaker.

7.11.8.3.2

Unequipped spaces shall:

- a) Be provided with doors.
- b) Be provided with only the power stabs.
- c) Be provided with power stab covers (both line and load side) to prevent accidental contact with live parts when door is opened.
- d) Not be used for mounting any other devices such as control switches or auxiliary equipment.

7.11.8.3.3

Blank spaces provided in the LV switchgear assembly shall be empty cubicles with doors and without power stabs or other equipment.

7.11.8.4

If a breaker interlocking or transfer scheme is specified, it shall be arranged in accordance with the requirements in 7.11.8.4.1 through 7.11.8.4.3.

7.11.8.4.1

The transfer scheme shall be disabled if any transfer breakers are in the test or disconnected position.

7.11.8.4.2

Manual transfer schemes having no electrical interlocks, sync checks, or controls shall have a key type interlock to achieve mechanical interlocking between circuit breaker operations.

7.11.8.4.3

The transfer scheme shall operate as indicated in the supplemental descriptions provided with the project drawings.

Add new clause

7.11.9

If the circuit breaker is in the test position or disconnected position, or has been withdrawn from the cubicle, automatic shutters shall be provided in breaker compartments to prevent accidental contact with live parts of primary circuit.

7.12 Primary cable space

Add to clause

Barriers shall be provided between the cable compartment and bus compartment to protect against inadvertent contact with the main or vertical bus bars while cable terminations are made.

7.13 Precautionary labels

Add new clause

7.13.1

Caution nameplates shall be provided on the doors of compartments with an external voltage source.

Add new clause

7.13.2

A caution nameplate shall be provided on the door of each vertical section with external powered space heaters indicating the panel and breaker information as specified in the project drawings.

7.14 Lifting devices

Replace existing clause

A traveling overhead crane mounted on top of each switchgear assembly or a wheeled hoist type circuit breaker lifting device shall be provided with the lifting capacity shown on the device.

Add new clause

7.15 LV power circuit breakers

7.15.1

Circuit breakers shall be three pole, air-break and stored-energy type with draw-out construction.

7.15.2

LV power circuit breakers shall be rated and tested in accordance with IEEE Std C37.13, IEEE Std C37.16, IEEE Std C37.17 and NEMA C37.50, as applicable.

7.15.3

Breakers shall be electrically operated with provisions for manual operation and manual charging of the spring mechanism.

7.15.4

Circuit breakers shall be designed for electrical operation with the spring charge, trip and close voltages as specified.

7.15.5

Circuit breakers shall be provided with an integral trip unit with the following characteristics:

- a) Microprocessor based.
- b) Direct-acting overcurrent trip.
- c) Solid state RMS sensing.

7.15.6

The trip device display on the circuit breaker shall be visible with the compartment door closed.

7.15.7

The application of current-limiting fuses to extend the circuit breaker rating shall cause the breaker to trip if any of the fuses operate.

7.15.8

Draw out circuit breakers shall be provided with a manual racking mechanism, including handle, which allows for three positions; connected, test, and disconnected.

7.15.9

Circuit breakers shall be provided with padlocking provisions for all draw-out positions.

7.15.10

Circuit breakers shall be provided with padlocking provisions for keeping the breaker in the open position when connected to the main circuit.

7.15.11

Circuit breaker compartment doors shall be able to be closed when the draw-out breaker is in either the test or disconnected position.

7.15.12

In addition to contacts required for circuit breaker operations and indication, the following shall be supplied and wired out to accessible terminals:

- a) Two normally open (NO) and two normally closed (NC) mechanism operated contacts (MOC) or internal auxiliary contacts.
- b) Two normally open (NO) and two normally closed (NC) truck operated contacts (TOC).

7.15.13

All electrically operated breakers shall have provisions for remote operation when specified.

7.15.14

If specified, circuit breaker trip units shall be equipped with a selectable arc energy reducing system activated via a local switch, remote switch or communication device.

NOTE—This feature is usually referred to as "maintenance mode".

7.15.15

Detailed documentation shall be provided if the circuit breaker or the trip unit is equipped with an instantaneous override or similar feature.

7.15.16

Close and trip circuits for each LV power circuit breaker shall be individually fused or protected by molded case circuit breakers in each breaker compartment.

7.15.17

If specified, zone selective interlocking shall be provided between main circuit breaker(s), tie circuit breaker (if present) and feeder circuit breaker(s).

7.15.18

The load side of the trip circuit fuse for each circuit breaker shall be monitored for loss of control voltage with a dry fail safe contact.

7.15.19 Circuit breaker position indicator

7.15.19.1

A circuit breaker position indicator shall be provided to indicate the breaker positions (disconnected, test and connected).

7.15.19.2

The circuit breaker position indicator shall be visible without opening the compartment door.

7.15.20

If specified, each circuit breaker shall be provided with a trip coil circuit monitoring provision (relay or indicating light).

7.15.21

Fuses used to extend circuit breaker interrupting or withstand ratings shall be identified in the submittal drawings as part of the circuit breaker information.

Add new clause

7.16 Instrument and control power transformers

7.16.1 Voltage transformers

7.16.1.1

VTs shall be provided as indicated on the one-line diagram and in accordance with IEEE Std C57.13.

7.16.1.2

Secondary voltage shall be 120 V, with primary voltage as indicated on the one-line diagram.

7.16.1.3

VTs for metering or protective relaying purposes shall be protected by disconnecting-type current-limiting primary fuses.

7.16.1.4

Each VT shall have the secondary winding protected by disconnecting-type current-limiting fuses or molded case circuit breaker with one leg of the secondary winding grounded.

7.16.1.5

The VT shall have the same insulation level as the switchgear.

7.16.1.6

Secondary protective devices for VTs shall be located in the low-voltage control compartment (separate from circuit breaker compartment).

7.16.1.7

Fuse holders shall be labelled to indicate size and type of fuse and to identify the VT (e.g. Phase "A" VT).

7.16.2 Control power transformers

7.16.2.1

The kVA rating of the CPT shall be determined by the manufacturer and include the following:

- a) Additional loads external to the switchgear as indicated on the one-line diagram or project drawings.
- b) The larger of either the simultaneous tripping or charging of all circuit breakers.
- c) With at least of 15% additional VA capacity.

7.16.2.2

Control power transformer basic impulse level rating shall be the same as the switchgear.

7.16.2.3

A relay with a form C contact shall be provided for remote alarming of any loss of control power.

7.16.2.4

Secondary voltage shall be 240/120 or 120 V, with primary voltage as indicated on the one-line diagram.

7.16.2.5

Primary windings shall be protected by disconnect-type current-limiting fuses.

7.16.2.6

Secondary windings for CPTs shall be protected by disconnect-type current-limiting fuses or molded case circuit breakers with the neutral of the secondary winding grounded.

7.16.3 Current transformers

7.16.3.1

CTs for metering or protective relaying purposes shall be rated in accordance with the requirements of IEEE Std C57.13 and as indicated on the one-line diagram(s).

7.16.3.2

CTs shall be window type, provided with 600 Vac insulation class for both primary and secondary windings.

7.16.3.3

CT burden calculations, including metering or relay burden ratings for all the associated devices, shall be provided by the manufacturer.

7.16.3.4

CT characteristic curves shall be provided for all CTs.

7.16.3.5

CT secondary connections, including those of multi-ratio CTs, shall be wired out to accessible short-circuiting terminal strips.

7.16.3.6

CTs with the same rating and application shall be identical and interchangeable.

7.16.3.7

The secondary leads from protective and metering CTs shall be wired to short-circuiting terminal blocks.

7.16.3.8

Wiring for CTs secondary leads shall be terminated with insulated, compression ring type lugs.

Add new clause

7.17 Instruments, meters and control devices

7.17.1

If specified, microprocessor-based multifunction indicating meters shall have the following functions as a minimum:

- a) Digital communication capability.
- b) 0.5% accuracy or better.
- c) Displays current and voltage for each phase.
- d) Display kW, kVARS and PF.
- e) Display harmonic measurements including % THD.

7.17.2

Indicating lights shall be provided for circuit breaker status as follows:

- a) Clear LED type with 100,000-hour illumination life minimum.
- b) Replaceable light emitting diode (LED) lamps.
- c) Colored lenses: closed (red), open (green), tripped (amber).

7.17.3

If analog-type metering is specified, they shall be provided as follows:

- a) Have a circular 250-degree-scale switchboard type.
- b) Have a 1% accuracy.
- c) Be 115 mm (4.5 in) square.
- d) Be flush mounted.
- e) Have each ammeter and voltmeter provided with four-position rotary type switch.

7.17.4

Control switches shall be rotary cam type with engraved dial plates and have oval handles.

7.17.5

The installed height of meters, switches and relays shall be installed between 610 mm (2 ft.) and 1.8 m (6 ft.) from the floor to the top of device.

7.17.6

If circuit breaker control switches are provided, they shall have the following:

- a) Pistol grip handles.
- b) Momentary contact, spring return to center.
- c) Red (“closed”) and green (“open”) mechanical indication.

7.17.7

Instruments and meters shall have 5 A current and/or 150 V potential coils for operation with instrument transformers.

7.17.8

Current coils of power monitoring equipment shall be capable of withstanding momentary CT secondary currents of twenty times the CT rating without sustaining damage.

7.17.9

If specified, test switches shall be provided as follows:

- a) Installed on the circuit breakers compartment door.
- b) Allow for isolation of power monitoring and protective relay equipment inputs and outputs.
- c) Type FT-1.
- d) Wired to provide three-phase bus potential and three-phase line current.
- e) Wired in the circuit breaker trip circuits.

7.17.10

For lockout devices tripping more than one breaker, a dedicated test switch shall be provided for each lockout contact per circuit breaker.

7.17.11

If protective relays are indicated on the one line or project drawings, the protective relays shall be provided as follows:

- a) Comply with the service conditions, ratings and testing requirements specified in IEEE Std C37.90.
- b) Multifunctional microprocessor based.
- c) With trip indication having a manual reset function.
- d) With indication for each type of fault.
- e) With digital communication capability.

7.17.12

If door mounted lockout relays (Device 86) are supplied, they shall comply with the following:

- a) Manually reset type with oval or pistol grip handles.
- b) High speed (i.e. operation in less than one (1) cycle).
- c) Two (2) positions - "Hand Reset" and "Tripped".
- d) Coil "health" monitored with one (1) white indicating light.

7.17.13

A separate dedicated set of fuses or circuit breakers shall be provided for each power supply that is utilized for protection, control, or monitoring devices.

7.17.14

Control power circuits leaving the switchgear for any location external to the switchgear (such as transformer rapid pressure rise relays, motor start/stop circuits) shall be individually fused.

7.17.15

Control relay output contacts or other auxiliary (interposing) control-circuit device contacts for field wiring to external equipment shall have a contact ampacity performance rating suitable for the intended switching application in accordance with NEMA ICS 5.

7.17.16

Surge suppressors shall be installed across all control relay coils, except for electronic relays that include internal surge suppression

7.17.17

Plug-in type relays shall be provided with retaining clips.

Add new clause

7.18 Enclosure Space Heaters

7.18.1

Space heaters shall be wired to an accessible terminal block provided for connection to an external power source.

7.18.2

Space heaters shall be guarded by an expanded metal cage around the heaters to prevent burns due to incidental contact.

7.18.3

Space heaters shall be operated at 120 Vac.

7.18.4

Space heaters shall be sized to provide a 5 K rise over actual ambient temperature to prevent condensation.

7.18.5 Space Heater Thermostat Control

If thermostat control is specified, a control unit shall be provided as per 7.18.5.1 through 7.18.5.5.

7.18.5.1

The control unit supply disconnect shall be a circuit breaker equipped with a means to lockout.

7.18.5.2

The control unit shall have a control circuit that includes a momentary push button.

7.18.5.3

The control unit momentary push button shall energize the space heaters (by bypassing the thermostat) to verify the operation of the space heaters.

7.18.5.4

The control unit shall be provided with an ammeter.

7.18.5.5

The control unit ammeter shall have an appropriately sized scaled so that the failure of a single space heater element results in a discernible change in ammeter reading.

7.18.5.6

The normal operating ampacity of space heater circuit shall be inscribed on the ammeter nameplate.

7.18.6

Each space heater circuit shall be supplied with a molded-case circuit breaker or fused disconnect for use as a disconnect device.

7.18.7

A warning nameplate shall be provided on the door of each vertical section that contains space heaters and read "WARNING: EXTERNAL POWER SOURCE".

Add new clause

7.19 Accessories

7.19.1

A hand crank or handle (if not integrated into the circuit breaker design) for moving the breaker into the connected, test, or disconnected position shall be provided.

7.19.2

A device for manually charging (If not integrated into the circuit breaker design) the stored energy operating mechanism of electrically operated breakers shall be provided.

7.19.3

If specified, a remote racking device to electrically move the circuit breaker in all positions with the door closed shall be provided.

7.19.4

If drawout protective relays are provided, then test plugs for each relay type shall be provided.

7.19.5

If specified, a portable test kit for solid-state trip units shall be provided.

7.19.6 LV switchgear condition-based monitoring

If continuous thermal monitoring is specified, it shall be in accordance with 7.19.6.1 through 7.19.6.3.

7.19.6.1

LV switchgear assemblies shall be equipped with factory integrated continuous thermal monitoring technology.

7.19.6.2

Thermal monitoring shall provide hotspot detection sensors for main incoming sections (main circuit breaker or lug) and other areas of concern, such as individual compartments or shipping split connections.

7.19.6.3

Continuous thermal monitoring system shall include a fault relay dry contact output and communications (status and alarming).

7.19.7

If specified, the vertical section doors and panels shall include NRTL or ACO approved thermal scanning inspection windows to allow infrared scanning of the equipment without opening the equipment doors or removing covers.

7.19.8

If specified, the circuit breaker compartment(s) shall be provided with an absence of voltage tester device that is NRTL listed to UL 1436 in order to assist with establishing an electrically safe work condition and provide a means of verification of isolation without opening the compartment front or rear door.

Add new clause

7.20 Shipping and preservation

7.20.1

Shipping sections of stationary structures shall be furnished with removable lifting angles, lugs, or plates engineered for use with crane hooks or slings.

7.20.2

Items shipped separately from the switchgear, including removable elements, shall be clearly identified with proper description and location of installation.

7.20.3

Shipping sections of stationary structures shall be provided with individual identification tags bearing the equipment number of the assembly of which it is a part.

7.20.4

Shipping section Identification tags shall be permanently attached and visible.

7.20.5

Foreign materials (e.g. blocking, bracing) requiring removal before energizing the equipment shall be clearly identified with tags, signs or markings.

7.20.6

The electrical connection point for the space heaters shall be as follows:

- a) Be available without uncrating the equipment.
- b) Be clearly labelled.
- c) Indicate the electrical service required.

7.20.7

All equipment and removable items shall be protected from dust, water, humidity and vibration during shipping and storage.

7.20.8

Instruments, relays, switches and meters installed in the LV switchgear doors shall be protected, blocked and braced to prevent damage during shipment.

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