

WESTERN RAILWAYS' SPECIFICATIONS FOR L.T. PANEL, ACB, MCCB and MCB

A. LT Panel for 415 Volt Power Supply System –

1. The scope of work includes design, fabrication, supply, loading, transportation, unloading to the site, installation, testing and commissioning of LT panel with following specifications. The work also includes removing of existing feeders and cables from old panels and transformer and reconnecting them properly (by following all safety norms) to the new panel. The re-routed cables shall be properly clamped/saddled/harnessed with the help of GI saddles/M.S. clamps of adequate size.
2. The panel design shall be done through panel design software. The design of the panel shall be submitted to Sr. Divisional Electrical Engineer (Power) Vadodara for approval.
3. The entire panel shall be confirming to relevant IS with latest amendments and IP: 54 protection. The contractor shall submit original test report certified through CPRI/ERDA/government testing agencies.

All the switchgears i.e. ACBs, MCCBs and MCBs shall be of same make.

4. **Panel fabrication** – The Boards shall be fabricated with multifold frame design. Frame should be made out of 2mm thick CRCA sheet steel for outdoor installation. Panel will be single/double front, shall be of 'Form 3B' panel design. Internal fabrication shall be of bolted/press fit type. Galvanized Plain Skin Pass (GPSP)/as per OEM sheets shall be used for mounting of all switchgears. Doors shall be fabricated from 2 mm sheet of multifold design. Side covers shall be removable to extend the panel on both sides. The design of the panel shall be compact and modular compartmentalized. Doors and covers should be powder coated and should have EPDM/Neoprene gasket. Doors should be with protective cover/additional door to offer IP54 protection. ACB doors should be with additional support to provide strength. Unsupported span of sheet steel of main framework and door shall not exceed 1 meter in any direction. Both sides shall be properly ventilated and shall have sufficient space for maintenance.

Suitable engraved black letters on white nameplates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

5. **Painting** – Powder coating shall be done by surface coating comprising pre-treatment, electrostatic powder spraying and curing by the heat treatment process. CRCA Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, de-scaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 70-micron thickness shall then be provided. Suitable engraved black letters on white nameplates and identification labels of metal for all switchboards and circuits shall be provided. These shall indicate the feeder number and feeder designation.
6. All accessories required for installation and commissioning of the switchgears/panels etc., whether specifically mentioned or not, are included in the rate and scope of the work.
7. **Bus-bar** – One set of (three-phases + neutral) bus bars of minimum 97% conductivity electrolytic grade copper bus-bar with current density of 1.6 Amp per sq. mm of appropriate capacity and size shall be provided in each panel. The certification from original Bus Bar manufacturer specifying conductivity may also be submitted. Bus-bar support shall be press-fit grip type only. Material used should be SMC/DMC/Nylon 66 which can withstand temperature rise during short circuit condition. They should have minimum Comparative Tracking Index (CTI) of 600 Volt (as per IS 2824).

All bus bars shall be color-coded. Minimum clearances between phases/live parts shall be 25 mm and phases/live parts/neutral to ground shall be 19 mm except on the equipment terminals. All bus bars should be verified for its conductivity using conductivity meter.

Minimum size of bus-bar in sq. mm –

- a) Main bus-bar – Capacity of individual incoming switch/1.6 (current density of copper).
 - b) Bus-bar for connection from main bus-bar to outgoing individual switches – Outgoing Individual switch capacity/1.6 (current density of copper).
8. Connection between MCCB/switches to Vertical/Horizontal Bus-bar should be made using PVC insulated and sheathed multi strand copper conductor single core, FRLS cable of proper size 1100 Volt grade confirming to IS:694 of 2010 or latest, or flexible bus-bar of proper size.
9. For rating 100 Amp and below, Clip-on terminal, (Make – Elmex, Connectwell,) with bus-bar should be used. For rating 125 Amp and above Cast Resin mould with copper bus-bar should be used.
10. **Multifunction Energy meter** – One LED display Multifunction Meter min Class 1.0 Accuracy with RS485 Modbus protocol communication port, to monitor vital electrical parameters such as V, A, F, PF, kW, kVA, kVAR, kWh, kVAh, kVARh, Run hours, On hours, Phase angle, Interrupts, THD, Events (High-Low), Neutral Current, Energy import and export etc. shall be provided on panel incomer side with CT and through control MCB of 6 Amp, 10 kA rating.
11. **Wiring** – Internal control wiring shall be made with minimum 1.5 sq. mm PVC insulated copper multi stranded wire confirming to IS 694 (1998) or latest complete with copper crimping sockets of proper size and ratings. 2.5 sq. mm should be used for CT wiring.
The wiring shall be coded and labeled with approved ferrules for identification. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall use at both end of wires. All control wires meant for external connections are to be brought out on a terminal board.
Separate communication wiring should be laid through all feeders for switchgear and meters. The communication wiring should be sufficient for conveying ON-OFF-Trip feedback. The communication wiring should be terminated on to separate marshalling box in the panel. The communication cable should be low impedance, twin pair twisted and shielded (Belden/Lapp or equivalent)
12. Suitable lugs and cable glands for all incoming and outgoing cables shall be provided.
13. Three nos. of indicating lamps (LED type) of Red, Yellow and Blue colours with holders and wiring shall be provided on each incomer, and ON/OFF LED indicator for each outgoing switch.
14. **Earthing** – The panel board shall be properly earthed as per IS. Two earth terminals of 12 mm diameter G.I. nut/bolt with washers shall be provided on either side of the panel and all sheet steel section shall be electrically connected with a separate G.I. earth strip of 50 x 6 mm size across the panel at bottom and to the nearest earth terminal.
15. Metallic Caution Board in three languages riveted to the panel board as per IS 2551/1963.
16. **Labels** – The following information is required on the label –
Assembly Manufacturer's name –
Identification number –
Date of manufacture –
17. The successful tenderer should submit delivery challan/copy of original voucher of OEM / Authorized dealer to ascertain originality of items like MCCBs, ACB, CTs, PTs etc.
18. Catalog No. and specification details of each type/capacity of MCCB, ACB etc. to be submitted by the firm.
19. Panel shall be procured only from CPRI/ERDA type test certified panel manufacturer, and he shall confirm and submit the report for –
 - (i) Verification of the short circuit and temperature rise test.
 - (ii) Degree of protection IP 54.
20. A factory inspection for the panel to eliminate defects at earlier stage shall be arranged by the firm and shall be carried out with Railway representative if asked by Railway authority. If asked for heat run test at rated current should be carried at manufacturer's factory.

21. The panel board shall be wall mounted/CC flooring with MS stand made of MS angle of size 50 x 50 x 6 mm and skeleton type angle structures with holes for cable entry and exit as per site condition.

The angle structure of panel should be covered with M.S. Sheet and duly painted. The wall mounting panel board shall be fixed on the wall/pillar with suitable fixing arrangement as per site conditions and with appropriate size/ capacity and Nos. of GI screws/nut bolts/fasteners etc.

22. The panel shall be erected on anti-vibrating rubber pad of adequate thickness to avoid undue vibrations.
23. Heavy duty M.S. angle structure or concrete platform made from a standard concrete mixture of preparation 1:3:6 of suitable height shall be made, wherever required.

Inspection of materials –

All the material, erection and installation work shall be subject to inspection to ensure that the work is done in accordance with specification, drawings and is of the best quality suitable for the purpose. Following inspection schedule shall be followed:

- (i) **At the manufacturer's premises** – The contractor shall offer the inspection and testing of the materials at the manufacturer's premises at his own cost for routine / acceptance test, if asked by the Railway.
However, manufacturer's test certificate for the type test shall also be submitted. All tests will be carried out as per the relevant standards.
- (ii) **After receipt of material** – Inspection of all the items shall be done at depot/site by Consignee/ Authorized Railway Representative. Contractor shall produce all the test reports, material documents in original etc. during inspection.
All the defects/discrepancies, if any, pointed out during inspection should be attended by the contractor immediately.
- (iii) **Stage Inspections** – Stage inspections shall be carried out by Consignee/Authorized Railway Representative from time to time during execution of the work at site. All the shortcomings noticed during stage inspection shall be attended by the contractor.
- (iv) **Final Inspections** – After completion of work, contractor shall offer it for final inspection and testing. All the shortcomings noticed during final inspection shall be attended by the contractor, immediately.

B. Technical Specifications for Air Circuit Breakers (ACB) 415 Volt, 50 Hz, AC Supply

ACB Rating – 630 to 6300 Amp

- (i) ACBs shall be air brake, manually operated, draw out type complete with all accessories necessary for installation and commissioning of it i.e. operating mechanism, spreader terminals etc. of appropriate rating and shall conform to IS/IEC 60947-1, 2.
- (ii) Rated ultimate short circuit braking capacity (KA_{rms}) – 50 KA
No. of poles – Four-pole, Neutral – 100%
Rated short time withstand capacity (KA_{rms}) – 50 KA
Rated impulse withstand voltage of main circuit (KV) – 12 KV
- (iii) All ACBs shall have protection against $I_{cu} = I_{cs} = I_{cw}$ for 1 sec for total selectivity, with microprocessor based inbuilt adjustable protection, overload, short circuit, instantaneous, earth fault LSIG protection etc. and shall provide indication of cause of tripping for individual faults.
- (iv) Neutral in case of four-pole ACB shall be 100% rated.
Microprocessor based release shall be EMI/EMC compatible (Electromagnetic interference).
Multistate LED to indicate Power ON and micro-processor unhealthy condition. The release shall also provide separate fault indications by LEDs for each type of fault without using an external power supply.
Release shall have LCD/OLED Bar graph display with current metering with % loading, maximum and minimum current.

- (v) **ACB release** – ACB Release should be equipped with switchable thermal memory for cable protection on reparative Overload faults. The release shall draw power from main breaker CTs and shall require no external power supply for its operation.
- (vi) **Interlock** – ACBs shall have easily removable arc chutes with use of tool. Breaker shall have Arc Chutes Interlock means in case Arc chutes are not properly inserted breaker shall not be switched ON. Breaker shall have inbuilt Electrical and Mechanical anti-pumping feature.
- (vii) **Shunt coil fixing arrangement** – Accessories like Shunt release, under voltage release and Closing Coil shall be provided as needed and shall be front mounted. It shall be possible to view the accessories mounted with the inscribed voltages on the ACB through transparent windows. This shall be possible without removing front facia.
- (viii) A necessary set of auxiliary contacts/switches shall be provided (minimum 4 NO + 4 NC).
- (ix) All ACBs shall be provided with Door Interlock Facility. One shall not be allowed to open the panel door without ensuring that the ACB is in “**ISOLATED**” position.
- (x) Lockable Trip Push Button shall be provided wherever Interlock between ACBs is specified.
- (xi) All ACBs shall have sealable sliding shutters to prevent unauthorized access to “**TRIP**” and “**CLOSE**” push buttons.
- (xii) All ACBs shall have the possibility of extending Electrical Life by replacing the arcing contacts at site for all ratings and this shall be possible without changing the Pole Assembly.
- (xiii) **Up-gradation of ACB** – ACB release up-gradation should be possible without changing internal CTs.
- (xiv) It shall be possible to terminate aluminium links directly (without any adaptors) as specified in IS13947-2.
- (xv) ACBs shall have safety shutters to prevent accidental contact with live cradle terminals.
- (xvi) **Trip Record** – Last 10 Trip Records should be available on release for customer reference for system diagnosis.
- (xvii) **Pollution Degree Suitability** – ACB should be suitable for pollution Degree 4. (Circuit breakers in industrial settings, where conductive dust and moisture are common, would typically be designed for Pollution Degree 3 and 4).
- (xviii) The ACBs shall be fully rated at a free air ambient temperature of 50°C.
- (xix) On site testing facility should be available through front mounting test port to check satisfactory working of ACB release. Contractor to ensure free testing of release after during inspection before commissioning and before lapse of warranty period through approved service personnel OR approved service centre of original equipment manufacturer at site.
- (xx) In case of any deviation from specifications, following standards of ACB shall be adhered to. IEC – 60947 (Part I & II), IS / IEC – 60947 (Part I & II), IEC – 60695 – 2 – 1, BS EN 60947 – 2.
- (xxi) The ACBs shall be type tested and certified for compliance to standards. All ACBs shall have “CE” marking.

C. Technical Specifications for Moulded Case Circuit Breakers (MCCB)

MCCB Rating – 630 to 6300 Amp

- (i) Moulded Case Circuit Breakers (MCCB) should be equipped with quick make, quick break and trip free mechanism. The MCCB should be of current limiting design.
- (ii) All MCCBs shall be of four-pole, 415 Volt, AC, 50 Hz.

The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs} = I_{cu} = 100\%$).
- (iii) All MCCB protection release should be Microprocessor based having inbuilt adjustable protection against Overload and Short Circuit (S). If used as incomer, then it should have earth fault protection

and time delay in addition to the above protection. It should be possible to use Earth Leakage Relay with MCCB. MCCBs should not have load line bias.

- (iv) The breaking capacity of MCCB shall be a minimum of 25 KA for ratings up to 160 Amp and 36 KA for rating more than 160 Amp to 250 Amp and 50 KA for rating more than 400 Amp to 630 Amp.
- (v) All MCCBs should be four-pole with 100% neutral.
- (vi) The capacity and quantity of MCCBs, etc. in a particular panel shall be as mentioned in the corresponding item of tender schedule.
- (vii) MCCBs shall be complete with operating mechanism, spreader terminals, Extended rotary handle with door defeat facility and padlocking facility, Trip, Auxiliary contact along with UV/shunt release, and other accessories of appropriate rating, as per site requirement, conform to IS: 13947 Part 2, IEC 60947-2, EN 60947. MCCB incoming and outgoing connection to be connected by copper bus-bar.
- (viii) Manual on-load changeover switch /auto transfer switch shall be provided in the panels, wherever mentioned in the schedule.
ATS four-pole shall have facility of Priority Source Selection and shall be suitable for three-phase as well as single-phase sources.
Protections – Under Voltage/Over Voltage, Phase Sequence, Single Phasing, Frequency, Terminal Shrouds, Phase Barriers and Source Separator shall be provided. ATS shall conform to IS/IEC 60947-6-1.
Manual on-load changeover switch four-pole shall have staggered terminals for easy cable termination. Terminal Shrouds, Phase Barriers and Source Separator shall be provided. Switch shall be conforming to IEC 60947-3, IS/IEC 60947-3.

D. Technical Specifications for MCB (Miniature Circuit Breakers) –

MCB Rating – 6 to 630 Amp

- (i) MCB shall conform to IS/IEC 60898-1-2002, ISI / CE Marked, Rated short circuit breaking capacity – 10 KA, IP 20 protected terminals.
- (ii) The MCB housing shall have unique property of dielectric strength, arc resistance, insulation, flame retardant and temperature resistance.
- (iii) The MCB shall be suitable for isolation.
- (iv) The MCB shall be of Minimum Energy Limiting of Class - 3, line load biased, trip free mechanism and true contact position indicator.
- (v) The MCB shall have bi-connect terminals for both bus-bar and cable termination on both sides.
- (vi) The MCB shall have Label holder to make circuit identification easy.
- (vii) The MCB shall have rated impulse voltage of minimum 4 kV and operating temperature -25°C to +70°C.
- (viii) The MCB shall have the termination capacity of 35 sq. mm for rigid and 25 sq. mm for flexible.
- (ix) The MCB shall have electrical life of 20,000 electrical operating cycles (up to 32 Amp) and 10,000 operating cycles (40 Amp to 63 Amp) and mechanical life minimum 1, 00,000 operating cycles.
- (x) The MCB shall be suitable for accessories fitment (auxiliary contact, shunt release and trip alarm contact).