

24	SPECIFICATION FOR CAPACITOR UNITS	2
24.1	GENERAL REQUIRMENTS	2
24.1.1	General Requirements:.....	2
24.1.2	Specification for series reactors to prevent amplification of system harmonics	3
24.1.3	Automatic Power factor controllers	3
24.1.4	Capacitor Bank enclosure.....	3
24.1.5	Installation	3
24.1.6	Routine test and Type tests for capacitors	3
24.1.7	References and Applicable Standards for capacitor banks	4

24 SPECIFICATION FOR CAPACITOR UNITS

24.1 GENERAL REQUIRMENTS

24.1.1 General Requirements:

- 1 The Capacitor units shall be dry, self –healing type with individual discharge resistors shall be protected against internal faults, over the pressure, etc. and shall fully comply with and tested to the requirements of the International Electro-technical Commission Publication No IEC 60831, Part -1 and Part -2.
Note: The use of oil containing PCB (Poly- chlorinated biphenyls) is strictly prohibited.
- 2 The voltage rating of capacitor units shall be 480 V as a minimum.
- 3 Capacitor units shall be temperature class D.
- 4 Capacitor units shall be metal encapsulated.
- 5 Capacitor units shall be capable of continuous operation in accordance with the over voltage and over current requirements of IEC 60831.
- 6 Built-in discharge resistors for capacitors shall be seized to ensure safe discharge of capacitor to less than 50 V in one minute after a switch off and capacitor should not restart until minimum 3 minutes after the restoration of the supply.
Note: Manual switching or connecting the discharge circuit is not permitted.
- 7 Each capacitor shall be provided with a permanent nameplate, which includes the following information:
 - (a) Year of manufacture;
 - (b) Rated reactive power;
 - (c) Rated Voltage (rms);
 - (d) Number of stages;
 - (e) Rated frequency;
 - (f) Statement of discharge device;
 - (g) Short-circuit current;
 - (h) Name of the manufacturer and contact details.
- 8 Capacitor and related components such as regulators, indicating instruments, contactors etc. shall be capable of withstanding local environmental condition.
- 9 Contactors shall be suitably rated and designed for capacitive back to back switching with pre-insertion resistors and be able to withstand switching surges. Contactors shall isolate all three phases on switch off of the capacitor bank or on loss of supply voltage.
- 10 Each capacitor step shall be protected against conditions of overload and short circuit by means of suitably rated overcurrent relays and suitably rated HRC fuses (current limiting type) respectively.
- 11 The capacitor panel must be provided with a suitably rated main incomer isolating switch. This shall be a three-pole isolator or MCCB. The handle of the incomer isolator or MCCB shall be interlocked with the door to ensure that the capacitor bank is de-energised when the door is open.

- 12 The cooling requirement of the capacitor banks shall be as per the project specification and manufacture's requirements. Where forced ventilation equipment is used for cooling, a thermoset is required to be installed to sense the ambient surrounding temperature and to switch off the capacitor in the temperature rise.

24.1.2 Specification for series reactors to prevent amplification of system harmonics

- 1 Employing variable speed drives, welding machines or similar device in circuit leads to occurrence of harmonics while can lead to disturbance in the system and may cause capacitor failure. To minimise this risk, harmonic filter reactors must be employed in series with capacitors. The three phase series reactors to be connected in series with each capacitors unit for harmonic current suppression and to prevent resonance shall be iron cored type with copper windings. The reactor shall comply with the IEC 60076-6. The capacitor and the Reactor combination shall be tuned below the lowest harmonic present in particular distribution system.

24.1.3 Automatic Power factor controllers

- 1 Wherever automatic power factor controllers are installed the target minimum power factor shall be 0.99 lagging. The controller shall be programmed to have appropriate switching sequence. The method of switching for capacitor shall be as per manufacture's recommendation.

24.1.4 Capacitor Bank enclosure

- 1 In large Installation where large capacitor bank is installed for both indoor and outdoor application, the capacitor bank and allied components shall be housed in suitable enclosure of rust proof materials like GI, Stainless steel or GRP of suitable thickness having front access with provision for lock arrangements. The degree of ingress protection shall suit the site requirements as per IEC 60529.

24.1.5 Installation

- 1 The installation of Capacitor banks shall be generally in accordance with the manufacturer's recommendation, clearance shall be provided around the capacitor banks as per the manufacturer's recommendation. Where a capacitor is installed for power factor correction it must be provided with means for its prompt automatic discharge immediately the supply is disconnected. This requirement shall not apply to a small capacitor, such as that integral with a fluorescent light fitting.

Note: A capacitor bank shall not be part of the motor control centre, main LV panel (MDB) or sub-main panel, but it shall be accommodated in a separate cubicle with appropriate clearance as per manufacturer recommendations and safety aspects.

24.1.6 Routine test and Type tests for capacitors

- 1 Each capacitor unit shall be routine tested by the manufacturer as per IEC 60831 part 1 and 2. Each capacitor bank shall be subject to routine test by the manufacturer as per IEC 60439.
- (a) Inspection, including checking of clearance, dimensions etc.
 - (b) Di-electric test.
- 2 Type tests for capacitor unit and capacitor banks shall be carried out as per IEC 60831 part 1, 2 and IEC 60439-1 respectively.

- 3 All site tests/ commissioning test (Electrical and Mechanical) shall be conducted by the contractor's representative to ensure quality and functional properties of device.
- 4 All manufactures test certificate shall be submitted to KAHRAMAA for approval as a part of MDB(s) submittal prior to installation of equipment.

24.1.7 References and Applicable Standards for capacitor banks

- 1 The capacitor banks shall conform in design, material, construction and performance to the latest edition of the IEC standards, in particular to the following standards Relevant international standards for capacitor banks

IEC 60076-6	Power transformers - Part 6: Reactors
IEC 60085	Electrical insulation - Thermal evaluation and designation.
IEC 60439	Low-voltage switchgear and controlgear assemblies; (IEC 61439-1 Low-voltage switchgear and controlgear assemblies)
IEC 60439 -1	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies; (IEC 61439-1 Low-voltage switchgear and controlgear assemblies - Part 1: General rules).
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60831-1	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation
IEC 60831-2	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V - Part 2: Ageing test, self-healing test and destruction test
IEC 60947-1	Low-voltage switchgear and controlgear - Part 1: General rules.
IEC 60947-2	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers.
IEC 60947-4	Low voltage switch gear and control gear – ; (IEC 60947-4-1 Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters; IEC 60947-4-2 Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – Semiconductor motor controllers, starters and soft-starters; IEC 60947-4-3 Low-voltage switchgear and controlgear - Part 4-3: Contactors and motor-starters - Semiconductor controllers and semiconductor contactors for non-motor loads)
IEC 61921	Power capacitors - Low-voltage power factor correction banks.

END OF PART