

Automatic Harmonic filter / Power Factor Correction Capacitor

Standard specification - 600v and below

Section 16---

PART I GENERAL:

1.1 Scope of work

- 1.1.1 This specification contains the minimum requirements for the design, manufacture and testing of automatic, polyphase, harmonic filter / power factor correction capacitors rated ____ volts.
- 1.1.2 This specification shall apply if the harmonic filter / power factor correction equipment is supplied to this purchaser, or as part of other equipment.
- 1.1.3 Should the vendor take exception to any part of this specification, he shall so state in his bid, by reference to each item number.

1.2 Related work

1.3 Standards

- 1.3.1 The equipment covered by these specifications shall be designed and tested in accordance with the latest standards of EEMAC, CEC, CSA, IEC, IEEE and ANSI.
- 1.3.2 The equipment shall be CSA approved and/or UL Listed.
- 1.3.3 The capacitor shall be rated for continuous duty between -40°C/-40°F and +46°C/+115°F ambient at 3300 ft. (1,000 meters) and below.
- 1.3.4 Total Harmonic Distortion (THD) of 5% on the voltage and 25% on current waveforms shall not affect the life of capacitors, contactors or controller.
- 1.3.5 A +/- 10% variation in line voltage shall not effect the life of the capacitor.

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1.3.6 References:

- IEEE 519, ANSI C37.20, ANSI C55.1, ANSI C57-16, ANSI C57-99, CSA C22.2 No 31

1.4 Submittals

1.4.1 Submit the following information when contract is awarded:

- Outline dimension drawings including weights
- Sectional view of equipment of the different cubicle
- Single line diagram of capacitor / filter bank
- Descriptive literature
- List of factory tests and type tests
- List of exceptions and clarifications

1.5 Commissioning and start-up (Optional)

Submit commissioning and start-up procedures and make allowance for necessary assistance by a qualified field service representative. Associated costs should be identified separately.

1.6 Quality assurance: testing

1.6.1 All capacitor cells shall be traceable through construction and testing.

2.11.1 The automatic filter bank shall be tested for proper operation prior to leaving the factory. The Following checks, measurements, and operations must be confirmed and recorded for each stage.

1.6.3 The certified record of these tests shall become part of the permanent documentation package that travels with the automatic capacitor bank.

- Wire connections
- Torque connections
- Phase to phase, resistance checks
- Phase to phase, capacitance checks
- Controller operation, manual operation
- Controller operation, automatic operation

1.6.4 All other tests as prescribed by the applicable standard namely:

- High potential test
- Control wiring checks
- Etc

1.6.5 Submit design calculations including losses calculations

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PART II PRODUCTS:

2.1 Manufacturers

2.1.1 Acceptable manufacturers: Power Survey International

2.2 Ratings

2.2.1 Systems

| | | |
|---------------------------------|-------|-------|
| Nominal voltage: | _____ | volts |
| Maximum voltage: | _____ | volts |
| Frequency: | _____ | Hz |
| Symmetrical fault level: | _____ | kA |
| Grounding type: | _____ | |
| BIL: | _____ | kV |
| 60 Hz insulation level: | _____ | kV |
| Source symmetrical fault level: | _____ | MVA |

2.2.2 Capacitor / filter

| | | |
|--------------------------------|------------|-----------------|
| Total capacity: | _____ | kvar |
| Capacity of each step: | _____ | kvar |
| Capacity of fixed capacitor: | _____ | kvar |
| Capacity for future expansion: | _____ | step(s) or kvar |
| Filter tuned to: | <u>227</u> | Hz |

2.3 Reactor

2.3.1 The reactor/capacitor system shall be tuned to the 3.8th harmonic

2.3.2 Reactor should be designed for: $V_{h3} = 0.5\%$, $V_{h5} = V_{h7} = 5\%$ based on V_n

2.3.3 The reactor shall have aluminium bands coil windings for better heat dissipation with copper bus bar termination. Bus bars coil windings are not acceptable due to low heat dissipation.

2.3.4 The insulation construction shall be class H.

2.3.5 The reactor shall be iron core designed with open frame construction

2.3.6 Thermal protection shall be normally closed auto reset thermostats which open at 145°C / 293°F

2.4 Capacitor cells

- 2.4.1 Individual capacitors shall be self-healing utilizing polypropylene as a dielectric with vacuum deposited conductors on the polypropylene as electrodes.
- 2.4.2 Capacitors shall be contained in hermetically sealed metal cans to prevent atmospheric contaminants from shortening the useful life.
- 2.4.3 Dielectric material shall be low loss, less than 0.5 watts per KVAR.
- 2.4.4 Dielectric fluid shall be non-PCB biodegradable with a flash point in excess of 212°C/415°F
- 2.4.5 Terminal bushings shall withstand 2.2 kV AC to ground and be rated 10 kV BIL or greater.
- 2.4.6 Nominal design life of individual capacitor cells shall be 20 years.
- 2.4.7 Individual capacitor cells shall be covered by a one year warranty.
- 2.4.8 All capacitor cells shall have threaded terminals for wire connection.
- 2.4.9 Capacitor cells shall be designed in delta configuration
- 2.4.10 Capacitor cells shall be designed to handle the increase in voltage from the reactor.
- 2.4.11 All three phase capacitors shall be CSA approved or UL listed.

2.5 Capacitor life indicator / Blown fuse pilot lights

- 2.5.1 Three LED, one per phase, door mounted to indicate a low capacitance and/or blown fuse condition
- 2.5.2 Capacitor life indicator will continuously monitor the current drawn from your capacitor. When the current of the capacitor is above 70% of its rated value a LED will stay ON. If the current falls below 70% of its rated value then the LED will switch OFF.

2.6 Controller

- 2.6.1 Controller shall measure the reactive current on every passage of the voltage through zero.
- 2.6.2 A led display shall be provided to indicate the stages that are on.
- 2.6.3 To prevent leading power factor the controller shall be provided with a programmable target cosine selector.
- 2.6.4 The time delay between switching of filtered steps must be field programmable and have a range of 10 seconds to 10 minutes to reduce hunting and allow voltage decay.
- 2.6.5 All output contacts shall be disabled within 15 milliseconds of main power interruption. The controller shall retain its programming after the restoration of supply voltage. The controller shall bring the capacitor bank on line in a step, phased, normal sequence.
- 2.6.6 Controller shall be able to select 1:1:1, 1:1:2 and 1:2:2 switching sequence of filter steps.
- 2.6.7 Controller shall be able to display power factor with indication for an inductive or capacitive power factor.

2.7 Enclosure

- 2.7.1 The enclosure shall be NEMA ____ or EEMAC ____, fabricated from 12 gauge cold rolled steel.
- 2.7.2 An internal grounding lug shall be provided in each cubicle.
- 2.7.3 A dry powder enamel textured finish ANSI 61 switchgear grey color shall be used.
- 2.11.1 Capacitor cells and reactors shall be easily accessible for visual inspection and replacement from the front of the cabinet.
- 2.7.5 Removable lifting eyes shall be provided.
- 2.7.6 The enclosure door shall have a three point latch with key locking handle.

2.8 General construction

- 2.8.1 All power wiring shall have a thermoplastic insulation rated 105°C/221°F at 600 volts.
- 2.8.2 System wiring connections shall be made to copper bus bars braced for 65,000 amps or greater.
- 2.8.3 Contactors shall be rated for switching of reactive current.
- 2.8.4 All wiring connections shall be mechanically fixed with nut or screw.

2.9 Discharge resistors

- 2.9.1 Capacitor cells shall be provided with discharge resistors to reduce residual voltage to less than 50 volts within one minute after de-energization.
- 2.9.2 Resistors shall be chosen to insure a 20 year minimum life.

2.10 Fuses

- 2.10.1 For major fault protection, line fuses shall be provided on all three phases of each switched stage and fixed bank.
- 2.10.2 Line fuses shall be current limiting. Minimum interrupting ratings shall be 200,000 amps for fuses 30 amps and above.
- 2.11.1 Fuses shall be designed for filter applications and shall be rated not less than 150% filter current rating.

2.11 Other elements

- 2.11.1 The system will be equipped with a control transformer, protected at the primary and secondary sides.
- 2.11.2 A current transformer ____ / 5A must be supplied by the capacitor bank manufacturer. The CT will be installed by the contractor or the electrician.
- 2.11.3 The system will be equipped with a testing switch for measurement transformers.