

## **GUIDE FORM SPECIFICATION**

### **HIGH VOLTAGE CAPACITORS - AC ROTATING MACHINE PROTECTION**

#### **SCOPE**

This specification covers the requirements for individual capacitors rated up to 24 kV, 50 Hz or 60 Hz used indoors or outdoors for surge protection of ac rotating machines. Specifications referenced are based on the IEEE standard.

#### **STANDARDS**

Where applicable, the capacitor unit shall conform to the following standards:  
NEMA standards publication CP-1 - 1988 (Shunt Capacitor) or latest revision.  
IEEE Standard for Shunt Power Capacitors, Std 18 - 1992, or latest revision.  
IEC Publication 871-1 (1987) or latest revision.

#### **CAPACITOR CONSTRUCTION**

Capacitor case material shall be type AISI# 409 stainless steel suitable for outdoor service.

Capacitor bushings shall be wet processed porcelain and shall be welded to the top of the case with a weldable flange to provide a strong, hermetically sealed system. Capacitor bushing color shall be light gray. The creep shall be a minimum of 12" for 75 or 95 kV BIL and 18" for 125 and 150 kV BIL.

The capacitor case shall be painted ANSI #70 sky gray. The paint system shall be a durable Epoxy/Urethane composition which meets the requirements of ANSI C57.12.31 (Pole Mounted Transformer Enclosure Coating Integrity). A portion of the bottom of the mounting bracket shall be left unpainted to allow proper grounding of unit to the capacitor bank.

The bushing terminal(s) and ground lug shall be stainless steel and be equipped with a clamp-type terminal connector to accommodate copper or aluminum conductors from number 10 solid to number 1 stranded. The nut shall be plated soft brass to strip, if excess torque is applied, before damage to the bushing or stud.

The nameplate shall be anodized aluminum and shall be located on the narrow side of the capacitor and contain the following information:

- a) Name of manufacturer
- b) Unique serial number
- c) Catalog number
- d) Year of manufacture
- e) Rated capacitance
- f) Rated rms voltage
- g) Number of poles
- h) Rated frequency
- i) Rated BIL
- j) Amount of fluid, indicate flammable or not flammable
- k) Statement that the capacitor contains an internal discharge device

In addition, the capacitor shall be identified as containing NO PCB's by means of a BLUE colored label.

#### **INTERNAL CONSTRUCTION AND PROCESSING**

Capacitor units shall be of the "all-film" design using 2 sheets of Hazy Polypropylene Film as the solid dielectric material.

Connection to capacitor elements shall be by means of mechanical crimps. For designs with extended aluminum foil, the inter-element connections shall be made by means of ultrasonic welds.

Each capacitor shall be provided with a discharge resistor assembly to reduce the residual voltage to 50 volts or less within 5 minutes after the capacitor is disconnected from rated voltage (for capacitors rated over 600 volts).

Prior to fluid impregnation, each capacitor shall pass a helium mass spectrometer leak test sensitive to a rate of  $1 \times 10^{-6}$  cc per second.

The capacitor unit shall be filled and sealed under positive pressure to insure full impregnation and improved performance.

Insulating fluid shall be a Non-PCB Synthetic Aromatic Hydrocarbon suitable for use in outdoor shunt capacitors and shall comply with all current environmental standards.

## **ELECTRICAL REQUIREMENTS**

Capacitors shall be rated for line-to-line voltage in the event they are applied on ungrounded or poorly grounded systems.

Capacitor units shall be capable of continuous operation over an ambient range of -50 to +55 C provided that the following limitations are not exceeded:

- a) 135% of nameplate kVAR
- b) 110% of rated voltage rms, including harmonics
- c) 180% of rated current rms, including fundamental and harmonic currents

Capacitor units shall be capable of meeting the permissible overload operating conditions as specified in the applicable Standards.

## **TESTS**

The capacitors shall be of design and construction which have been validated by the type tests specified in the applicable Standards. Additional tests may be required to verify adequate over-voltage endurance and life for which the manufacturer may supply a certified test report.

## **PRODUCTION TESTS**

Each capacitor shall be subjected to the routine production tests as specified in the applicable standard, except that the **Terminal-to-Terminal Test shall be increased to a DC voltage that is 6.25 x rated AC (line-to-line voltage) to verify the high overvoltage-withstand capability required of these protection capacitors.** Production tests shall include:

- a) Short-time overvoltage test:
  - Terminal-to-terminal test : DC at 6.25 x rated AC voltage (line-to-line)
- b) Capacitance test at rated voltage (-0%, +15%)
- c) Loss determination test at rated voltage
- d) Discharge resistor test
- e) Leak test

## DESIGN TESTS

**Design tests shall be performed by the manufacturer on a sufficient number of capacitors to demonstrate that the design meets industry standards. Capacitors shall first meet production tests before being subjected to design tests. Design tests shall include:**

- a) Impulse withstand test (\*)**
- b) Bushing test**
- c) Radio influence voltage test (\*)**
- d) Voltage decay test**

**\* These tests to be performed on a 2-bushing unit with similar terminal-to-case insulation.**

## Bid Documentation

Each proposal shall include the following documentation for evaluation purposes:

1. Description of capacitor units, including:
  - a) Number of series sections
  - b) Voltage per section
  - c) Average dielectric stress in volts per mil including both film & fluid thicknesses
  - d) Film thickness
  - e) Number of sheets of film
2. Outline drawings of capacitor units.
3. Material Safety Data Sheet and quantity of insulating fluid per unit.
4. Manufacturer's failure data on previous three years' shipments for year of manufacture and following year.
5. Certification of ability to pass capacitor design tests including over-voltage endurance as well as long-term life.
6. Certification that paint meets requirements of ANSI C57. 12.31 (Pole-Mounted Transformer Enclosure Coating Integrity)