

# Lightning/Surge Protection

ESA-09-08

## Applicability

Network Wide

## Publication Requirement

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1.0	Jun25		Specification SPS34 to SPS 38 are merged into this document with some minor changes. The document has been renumbered from SPS 34 as per EGP-01-02.

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## **1 Introduction**

### **1.1 Purpose**

The Purpose of this Specification is to provide requirements for Inductor/Varistor Panels, Varistor/Arrestor Panel, Varistor Panel, Power Inductors, and Line Protection Unit for the ARTC network.

### **1.2 Scope**

This document covers the general, design, rating, and construction requirements for Inductor/Varistor Panels, Varistor/Arrestor Panel, Varistor Panel, Power Inductors, and Line Protection Unit.

### **1.3 Document Owner**

The Manager Engineering Services is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

## **2 Referenced Documents**

### **2.1 ARTC Specifications**

This Specification refers to the following ARTC Specifications and Standards:

ESC-09-02 – Lightning and Surged Protection Requirements

### **2.2 Australian Standards**

AS 3000 - Electrical Installations

## **3 Inductor/Varistor Panel**

### **3.1 General**

Inductor/Varistor Panel shall be required to provide lightning surge suppression on AC and DC power supply mains.

The panel shall be referred to as the IVAP-50-300A, ISGT 50-300A as appropriate.

Panels with higher current ratings shall comply with this Specification as far as practicable considering the following factors:

1. Voltage drop across the IVAP shall not exceed 2.0V at full load
2. Temperature rise at full rated current shall not be above 40°C at ambient temperature of 70°C.

### **3.2 Operation Conditions**

The equipment shall be capable of operating satisfactorily under the following conditions:

- a. Ambient temperature range -10°C to 70°C
- b. Relative humidity 0 to 95%.

### 3.3 Design Requirements

#### 3.3.1 Ratings

50, 100 amperes AC or DC for IVAP or ISGT 50-300A respectively.

#### 3.3.2 Construction

1. All components shall be securely mounted on nominal 10mm panel. The panel shall be made of either paper-based Phenolic or ABS
2. All components shall be readily and individually replaceable in case of failure.
3. All material fittings, bolts, nuts should be zinc-plated steel. In the case of electrical connections of the main terminals, they should be stainless steel bolts with nickel-plated brass nuts and washers.

#### 3.3.3 Components

1. The varistors shall be SIOV-B32K150 or equivalent in voltage and power ratings.

#### 3.3.4 Wiring

1. All conductors shall be multi-stranded, with sizes and current ratings in accordance with AS 3000.
2. Minimum insulation shall be 0.6KV, V105 grade PVC
3. All conductors shall be as short and as direct as possible with smooth curves of maximum practical radius.
4. All conductors shall be terminated with suitable crimp lugs either pre-insulated double-grip type for smaller conductors, or in the case of larger conductors, non-insulated lugs with a heat-shrink sleeve applied after crimping. The heat shrink sleeve shall cover the body of the crimp lug and extend at least 15mm over the conductor insulation.

#### 3.3.5 Terminals

The Earth Terminal shall be a 40mm long M6 Nickel plated stainless steel stud provided with 3 washers, two nuts and one lock nut which are to be nickel-plated brass.

Terminals labelled as "Line" and "Equipment" form part of the inductor and shall be as described in Specification SPS 37.

#### 3.3.6 Labelling

1. All labelling shall be permanently affixed with rivets or screws, clearly legible, and of a material which will not fade due to weathering over time or repeated handling.
2. Input and Output terminals shall be labelled "Line 1", "Line 2", "Equipment 1" and "Equipment 2" respectively. The Earth terminal shall be labelled "Signalling Earth".
3. In addition, the unit must be fitted with a readily visible label stating IVAP OR ISGT 50-300A as appropriate, the manufacturer's identification and date of manufacture, voltage and current rating should be included.

## **4 Varistor/Arrestor Panel (VAP)**

### **4.1 General**

Varistor/Arrestor Panel which shall be termed as the "VAP" shall provide Lightning/Surge suppression on AC and DC power supply feeders.

### **4.2 Operation Conditions**

The equipment shall be capable of operating satisfactorily under the following conditions:

- a. Ambient temperature range -10° C to 70° C
- b. Relative humidity 0 to 95%

### **4.3 Design Requirements**

#### **4.3.1 Construction**

All components shall be securely mounted on a 6mm panel. The panel shall be made of either paper-based Phenolic or ABS.

All components shall be readily and individually replaceable in case of failure. All material fittings, bolts, nuts, etc. shall be made of Nickel plated Brass.

#### **4.3.2 Components**

Surface mounting Octal socket shall be used to take Arrestor "Sankosha" type 3Y20 - 290 GT. The terminals 1-2, 3-4 and 5-6-7-8 shall be bridged if these terminals are not already bridged internally within the socket.

The Varistor shall be SIOVB32K150 or equivalent in voltage and power ratings or similar.

#### **4.3.3 Wiring**

All conductors shall be multi-stranded, with sizes and current ratings in accordance with AS3000-1986, Table B4.

Minimum insulation shall be 0.6KV, V105 grade PVC.

All conductors shall be as short and as direct as possible with smooth curves of maximum practical radius.

All conductors shall be terminated with suitable crimp lugs either pre-insulated double grip type for smaller conductors, or in the case of larger conductors, non-insulated lugs with a heat shrink sleeve applied after crimping. The heat shrink sleeve shall cover the body of the crimp lug and extend at least 15mm over the conductor insulation.

#### **4.3.4 Terminals**

The Earth terminal shall be M6 and 40mm long stainless steel stud provided with, Nickel Plated, 3 washers, 2 nuts and one lock nut for each stud. The other terminals shall be SAK10 or suitably sized for higher ratings and cables.

#### **4.3.5 Labelling**

All labelling shall be permanently affixed, clearly legible, and of a material which will not fade due to weathering over time or repeated handling.

Input and Output terminals shall be labelled "Line 1", "Line 2", "Equipment 1" and "Equipment 2" respectively. The Earth terminal shall be labelled "Signalling Earth".

In addition the unit must be fitted with a readily visible label stating "VAP", the manufacturer's identification and date of manufacture.

## **5 Varistor Panel**

### **5.1 General**

Varistor Panel shall be required to provide lightning/surge suppression on AC and DC power supply mains. The panel shall be referred to as VP-25KA or VP-60KA as appropriate.

### **5.2 Operation Conditions**

The equipment shall be capable of operating satisfactorily under the following conditions:

- a. ambient temperature range -10°C to 70°C
- b. relative humidity 0 to 95%

### **5.3 Design Requirements**

#### **5.3.1 Construction**

1. All components shall be securely mounted on a 6mm panel. The panel shall be made of either paper-based Phenolic or ABS.
2. All components shall be readily and individually replaceable in case of a failure.
3. All material fittings, bolts, nuts, etc shall be Nickel plated Brass.

#### **5.3.2 Components**

The VP panel should use Leutron IP B25 for the VP-25KA and shall use Leutron IP B60 for the VP-60KA or similar.

#### **5.3.3 Wiring**

1. All conductors shall be multi-stranded, with sizes and current ratings in accordance with AS3000-1991.
2. Minimum insulation shall be 0.6KV, V75 grade PVC.
3. All conductors shall be as short and as straight as practicable with smooth curves of maximum radius.
4. All conductors shall be terminated with suitable crimp lugs either pre-insulated double-grip type for smaller conductors, or in the case of larger conductors, non-insulated lugs with a heat-shrink sleeve applied after crimping. The heat shrink sleeve shall cover the body of the crimp lug and extend at least 15mm over the conductor insulation.

#### 5.3.4 Terminals

The Earth terminal shall be M6 and 40 mm long Nickel plated Brass stud provided with 3 washers, 2 nuts and one lock nut.

#### 5.3.5 Labelling

1. All labelling shall be permanently affixed, clearly legible, and of a material which will not deteriorate on ageing.
2. The terminals shall be labelled "E1 ", "E2", "L1" and "L2", and the Earth terminal shall be labelled "Signalling Earth" as shown in the drawing.
3. In addition the unit must be fitted with a readily visible label stating "VP-20KA or "VP-60KA" as appropriate, the manufacturer's identification and date of manufacture.

## 6 Power Inductors

### 6.1 General

This Specification describes the design requirements for Power Inductors with ratings from 15A to 300 Amperes to be used on the ARTC network.

The Inductor shall form part of the following equipment, which shall provide lightning/surge suppression on AC and DC power supply mains.

- a. Inductor/Varistor Panel (IVP – known as VAP panel)
- b. Inductor/Varistor/Arrestor Panel (IVAP and ISGT)

The Inductor shall be referred to as PI-15A, PI-50A, PI-100A or PI-300A depending on the current rating of the Inductor

### 6.2 Operation Conditions

The inductor shall be capable of operating satisfactorily under the following conditions:

- a. Ambient Temperature range: -10°C to +70°C.
- b. Humidity: Relative Humidity 0 to 95%

### 6.3 Design Requirements

#### 6.3.1 Electrical Specifications

The inductor is an air-cored inductor with the following ratings.

Power Inductor	Operating Voltage	L	R	Max Continuous Current
PI - 50	120V	25 Micro-H	7 m ohm	100A
PI - 100	120V	25 Micro-H	2 m ohm	200A
PI - 200	120V	25 Micro-H	1.12 m ohm	400A



Inductors designed for higher current ratings than shown above, the values of L & R shall be selected such that the heat rise at full load for an ambient temperature of 70 C shall not exceed 40 C and Voltage drop across the inductor shall not exceed 2.0 Volts at maximum continuous current rating.

### **6.3.2 Design Considerations**

The cross section area of the conductor shall be based on the continuous current of 100 Amperes for PI-50, 200 Amperes in the case of PI-100 and 400 Amperes in case of PI-200.

The spacing of the windings and the insulation of the conductor shall be such that the voltage produced by a surge current of 20KA, 8/20 microseconds shall not breakdown the insulation.

The spacing of the windings and the insulation of the conductor shall be such that the coil should be able to withstand a voltage of 100KV generated internally (current flow x impedance of the coil). The beginning and end of the coil should be at the two ends of the coil former or at least separated by 90mm if ended at one end of the former. Plastic formers are prone to fatigue and all inductors should be air cored.

The progressive voltage between the turns and the layers of windings (if more than one layer of winding is required) should be carefully considered to provide proper separation and insulating material to withstand the breakdown voltage.

### **6.3.3 Impregnation**

The coil should be vacuum Impregnated or dipped and baked with fiberglass insulation over enameled winding wire.

### **6.3.4 Insulation Resistance**

The insulation resistance shall be greater than 100 M-Ohms when measured using an Insulation tester with an injected voltage of 500 V. The test shall be conducted for 1 minute with the body of the inductor immersed in water. The water shall be in a metal tank and the insulation tester applied from either inductor terminal to the water tank.

### **6.3.5 Terminals**

Terminals shall be M6X50 for 50A, M8x55 for 100A, M10x65 for 200A, 316-grade stainless steel. Nickel plated Brass studs provided with 2 washers, a nut and a lock nut for each stud. Appropriate terminals shall be selected for higher current ratings.

### **6.3.6 Dimensions**

The maximum height of the inductor rated up to 100A, shall not exceed 100mm from the mounting surface.

### **6.3.7 Labelling**

All labelling shall be permanently affixed, clearly legible, and of a material which shall not fade or deteriorate due to handling, environmental conditions or ageing.

The unit must be fitted with a readily visible label stating PI-50, PI-100 or PI-200A, the manufacturer's identification and the date of manufacture.

## **7 Line Protection Unit (LPU)**

### **7.1 General**

The equipment shall be required to provide primary and secondary level lightning/surge protection on Communication lines.

The equipment shall be in a non-metallic enclosure made of PVC, ABS or similar plastic material of electrical grade suitable for outdoor installations. The enclosure shall be in conformity with Environmental Protection Class IP56.

### **7.2 Installation**

1. The LPU shall be mounted on the line pole in the case of an open wire line bearer, provided the following conditions are satisfied, otherwise it shall be mounted inside the Relay room at the entry point
2. The Earth resistance of the Earth electrode close to the pole is less than 3 Ohms, and
3. The distance between the Earth electrode at the pole and the Earth electrode at the Relay room is less than 10 metres.

If the LPU is to be mounted on the pole, then the Earth electrode near the pole shall be connected to the Earth electrode of the Relay room Earthing system.

In the case of a cable bearer the LPU shall be mounted inside the Relay room or any other room where the cable terminates.

If a line matching transformer is available at the equipment end, then the LPU shall be installed before the matching transformer on the line side.

### **7.3 Environmental**

The equipment shall be capable of operating satisfactorily under the following conditions:

- a. Ambient temperature range: -40°C to + 55°C.
- b. Relative Humidity: 0 to 95%
- c. Vibration: 0.04cm p-p displacement at 10Hz to 55Hz held for 15 minutes, out of which 3 minutes should be at 55 Hz and applicable in all three axes.

### **7.4 Electrical Specification**

- a. Upper Frequency Limit: 1 MHz
- b. Insertion Loss: Less than 1 dB
- c. Line Impedance: 600 Ohm or 150 Ohm - (To be specified while ordering)
- d. Surge Protection: to withstand 20KA, 8/20 Microsecond impulse
- e. Clamping Voltage: 15 Volts
- f. In accordance with IEC 61643-21:2000 and EN 61643-21:2001

## **7.5 Design**

### **7.5.1 Design Requirements**

All components shall be readily and individually replaceable in case of component failure. All material fittings, bolts, nuts, terminal lugs, etc shall be made of Nickel plated Brass.

### **7.5.2 Components**

Varistors shall be Hakel HDT1/12D for 1 pair and for 2 Pairs HDT2/12D or HDT2/6B or equivalent in voltage and power rating.

Transient Barrier shall be selected in accordance with Line Impedances

600 Ohm - for Open wire line bearer- which has a characteristic impedance of 600 Ohms. 150 Ohm - for Cable bearer which has a characteristic impedance of 150 Ohm

### **7.5.3 Wiring**

Internal wiring leads shall be 70/0.076 with PVC insulation.

For the Earth connections, wiring shall be black in colour and installed with smooth curves avoiding sharp bends

Each wire shall be looped twice before terminating on device unit.

Nickel plated Brass eye lugs shall be provided for 2 Sqmm communication line wire terminations; Similarly, 4 Sqmm lugs shall be provided for the 6 Sqmm multi-stranded Earthing cable.

### **7.5.4 Labelling**

All labelling shall be permanently affixed, clearly legible, and of a material which will not deteriorate

The cable outlets shall be labelled as "Line", "Equipment" and "Signalling Earth"

The "Line" and "Equipment" Terminals shall be labelled as "L1" & "L2" , "Eq1" and "Eq2" on the top base of the box.

The common Earth (Signalling Earth) point on the busbar shall be labelled as "SE" on the top base of the box.

In addition, the unit must be fitted with a readily visible label on the front cover stating "LPU", the Material Identity number, manufacturer's identification and the date of manufacture.

The circuit diagram of the unit shall be displayed on the inner side of the.

All labels to be used within the box should be of electrically non-conductive material.