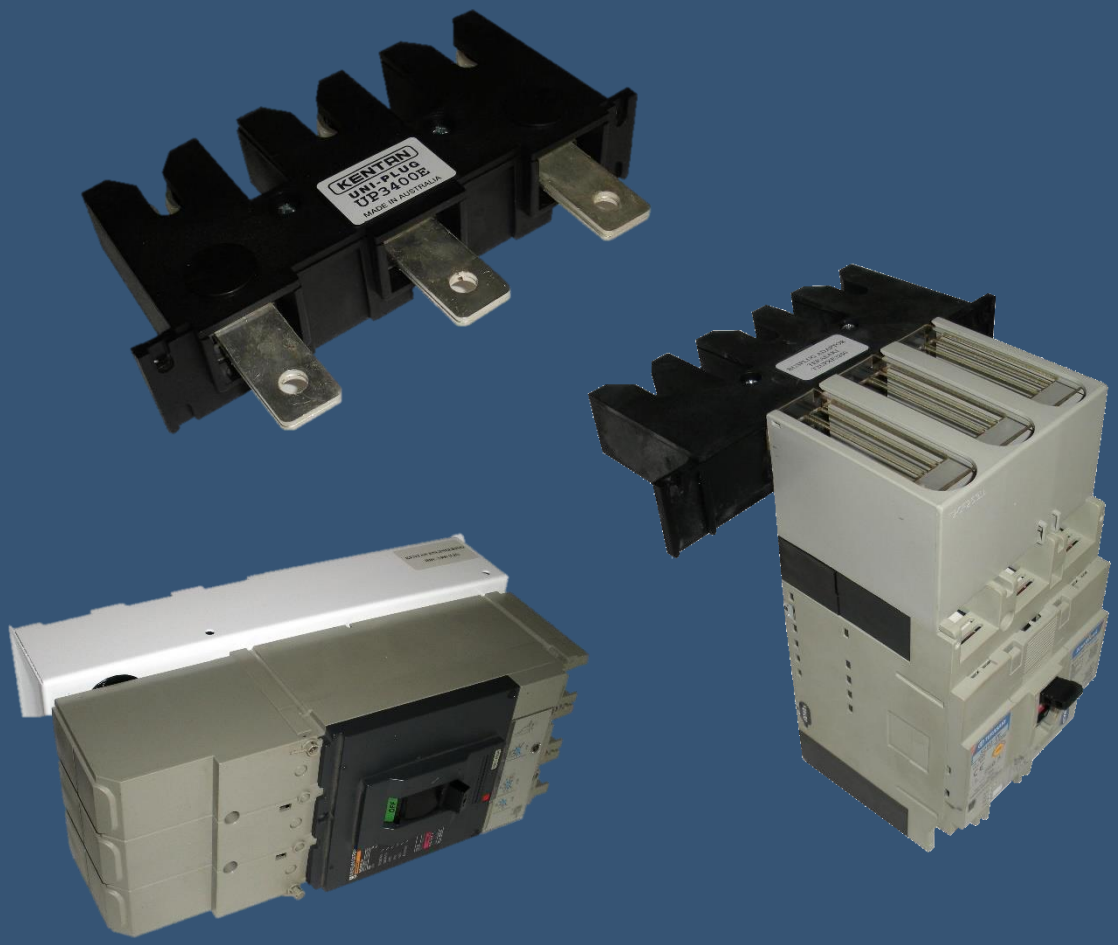
KENTAN

SWITCHBOARD EQUIPMENT AND AUTOMATION

Maintenance of Type UP Busplugs

Low Voltage Switchboard Equipment



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Since product improvement is a continuing policy, we reserve the right to change specifications without notice.

Contents

Descriptive

Scope

This applies to all variations of type UP BUSPLUGS.

These are:
- Separate Busplugs Pub. UP2020
- HBC Pub. HBC2020
- Busplug Adaptors Pub. BA2020

Normal service conditions as defined in clause 7.1 of AS/NZS 61439.1 : 2018 is presumed.

Models of Busplugs

The UP busplugs have been manufactured since 1988, and have seen a number of modifications. This list shows the changes and their approximate time. This is useful in determining the age of the device. Stickers, showing the assembler (by code no.) and the date of assembly have been attached to the underside of the bus-plug housing since 1996.

1988 Original device (250-400A)
Wire spring
Contact surfaces of the finger against the busbar are flat
Contacts held in place by the contact spring
Contact finger made from phosphor bronze
Provision for M6 or M8 (5/16 " UNF) termination hardware

1989 800A busplug added

1993 Contact fingers curved at the busbar contact end
Contact fingers now made from copper strip
Contact fingers secured by screws
M6 termination hardware deleted

1999 Contact fingers reduced from 2.5 to 2.0 mm copper
Circlip type springs replaced 2.8 mm wire spring

2001 1000 and 1200A busplugs added

2002 Optional contacts/springs for 10mm thick bars

Nickel plated contacts are available to order. These are generally specified when the switchgear is in an adverse atmosphere such as sewerage plants, paper mills, etc.

Relevant Standards

Maintenance

Maintenance AS2467-2008 Maintenance of electrical switchgear.

Switchgear

The busplugs have been tested to the relevant requirements of AS/NZS 61439.1 : 2016 (Low Voltage Switchgear and Controlgear Assemblies, and AS/NZS 60947.3 : 2015 (Low Voltage Switchgear and Controlgear. Part 3: Switches)

These tests include:

- Temperature rise
- Dielectric properties
- Clearance and Creepage distances
- Short-circuit strength
- Fault containment
- Mechanical endurance

Effect of Temperature on Contact Life

AS 3768-1995 is a guide to the effects of temperature on electrical equipment.

When two conductors are applied against each other, the contact is made only in a number of points. The current flows at these points of contact. This current constriction introduces additional resistance around these points of contact causing heat.

This heating leads to oxidation of the conductors, further leading to resistance, more heat and so on. The relatively rapid increase in this cycle signifies the end of the useful life of the contact.
In order to reduce oxidation and therefore allow the contact to operate at higher temperatures, all contact surfaces should be silver plated.

It is highly recommended that the busbars onto which the bus-plugs are connected are at least tin-plated. The condition of these busbars have a great bearing on the performance and life of the busplug.

Maintenance Criteria

The establishment of a maintenance schedule should take into account:

- Service history of the product
- The complexity of the device
- The environment in which it operates
- Frequency of operation
- The likelihood and consequences of failure

Service History

KENTAN busplugs have been manufactured since 1987. In that time, approximately 350,000 have been produced and are in service in Australia, New Zealand and many other parts of the world. They are mainly installed in switchboards for industrial and large commercial facilities.

It can be reasonably assumed that inspection and maintenance of these plugs has been the exception rather than the rule. Reported failures have been extremely rare, and have been mostly related to incorrect installation such as insufficient penetration onto the busbars.

Description of Busplugs

The KENTAN busplugs are designed to provide a disconnectable link between the busbars and the short-circuit protective device (SCPD). They have no moving parts and are only operated (inserted or withdrawn from the supply busbars) in an off-load situation.

Environment

Cleanliness

In common with all electrical devices, the busplugs should be protected from excessive dust and other pollutants that are likely to corrode the metal components (copper, silver and steel) or lead to loss of insulation of the plastic housing etc.

Ambient Temperature

This is defined in AS/NZS 61439.1 : 2016 as the ambient air temperature does not exceed +40°C and its average over a period of 24 hours does not exceed +35°C. However, it is not uncommon for the switchboard to be specified to operate in temperatures of +50°C. The busplugs are rated to operate in temperatures ranging from -20°C to +70°C. The upper limit is a realistic temperature for the inside of a switchboard enclosure.

Maintenance Criteria

Vibration

Constant vibration may lead to a reduced contact life by wearing away the silver coating on the contacts, or loosening the connections.

Frequency of Operation

This refers to the frequency of insertion and removal onto the busbars.

The Likelihood & Consequences of Failure

Provided that the plug had made sufficient penetration onto the busbars, the connections are tight and the operating conditions are normal, there is little reason why the device should fail. This is borne out by the service history. However the consequences of failure (e.g. Overheating leading to an arcing fault) can be catastrophic.

Methods of Inspection / Examination

AS2467 - 2008 defines inspection as an action not requiring any dismantling.

An examination is the addition of removing some parts in order to arrive at a reasonable conclusion as to the condition of the item. For this purpose, it is assumed that, at least, the busplug cover will be removed, or the housings separated in the case of 630A and above.

Access to the busplugs for inspection maintenance purposes requires the withdrawable or demountable cell to be removed from the switchboard or MCC. For demountable units, this is a labour intensive exercise. Where assemblies have rear access, the contact end of the busplugs may be visible by removing partitions etc. This also makes thermographic measurements possible.

Visual Inspection

The busplug should be checked for:

- Cleanliness of the device
- Evidence of overheating by showing discolouration of the conductive or insulated components. (Slight discolouration is not necessarily harmful.) Pollutants in the air may have caused the silver to become blackened but this is still normally acceptable. Overheating would be seen in the melting of adjacent plastic parts or heavy pitting.
- Condition of the section of the busbars onto which the plug makes contact.

Measurements

- Thermographic camera or infrared thermometer. This is ideally carried out with the board in operation.

  The following temperatures show the temp rise on the terminals at the full rating of the busplug when tested in accordance with AS/NZS 61439.1 : 2016 Clause 10.10:

  - UP 3063 10°C
  - UP 3250 26°C
  - UP 3400 17°C
  - UP 3800 23°C

  The following temps show the temp rise at the connections between the busplugs and the incoming terminals of an MCCB:

  - UP 31000 62oC
  - UP 31200 69oC

  The limiting factor is a temperature rise of 70°C at the terminals for the outgoing connections. For a direct connection between busplug adaptor and SCPD, this is the load-side terminals of the SCPD.

  The above figures refer to busplugs with silver plated contacts. Nickel plated contacts may have higher temperatures.

Methods of Inspection / Examination

- Ductor test to measure the resistance between the contact fingers and the busbar. (This may be carried out on a similar piece of bar as in the switchboard.)

  Contact resistances per pole for busplugs in new condition are:

  - 63/250A 59 µΩ
  - 400A 34 µΩ
  - 800A 19 µΩ
  - 1000A 16-32 µΩ
  - 1200A 14-28 µΩ

- Contact pressure. The contact should be firm. The earlier contact/springs made up to 1999 with the 2.5 mm copper and wire spring requires a reasonable amount of pressure to engage onto the busbars. Loose contacts would suggest very frequent withdrawal, some degree of mis-alignment, and show pitting and heavy discolouration.

- Insulation Resistance, where suspect, can be checked by a test voltage applicable to the rated insulation voltage of the busplug. These voltages (line to line) are:

  - 690V 1890V rms
  - 800V 2000V rms
  - 1000V 2200V rms

  (Voltages according to AS/NZS 61439:1 : 2016 Table 8)

Cleaning Methods

The following products are recommended as suitable cleaners for the busplugs. All of these are available from RS COMPONENTS in aerosol form.

CCL (non-flammable)	Stock No. 300-8518
SWC (non-flammable)	Stock No. 508-6605
POW-R WASH PR (flammable)	Stock No. 298-7779

All busplugs 630A and above are supplied lubricated with Contact Treatment Grease (Stock No. 566-730) to reduce insertion force. We do not believe this is necessary below this rating.

Maintenance Schedule

The different issues effecting maintenance and its intervals are shown separately. These are:

- Ambient temperature
- Quality of the environment
- Frequency of operation
- Temperature of busplug conductive parts

The most severe circumstances of any of these should be taken as the maximum intervals between inspection and maintenance. If thermographic surveys are possible (the equipment being safely visible) they should be carried out as often as practical.

Degree of Pollution

The busplugs are taken to be installed into switchboards subject to at least pollution degree 3 as per clause 7.2.3 of AS/NZS 61439.1 : 2016.

Initial inspection	10 years
Subsequent Intervals	5 years
Visual Check	Cleanliness of silver plating (if in sulphurous or other adverse atmospheres)
Maintenance	Clean with a non-petroleum or ammonium based cleaner
	Replace entire plug if desirable

For pollution degree 4 (persistent conductive dust etc.) the frequency of inspections should be reduced to every 3-4 years. Note: For sulphurous and ammonia laden atmospheres, nickel plated finger contacts are recommended.

Ambient Temperature

Inspection on the basis of ambient temperature is only suggested if it exceeds 40°C. It is important to note that a high ambient temperature also effects the rated performance of the short-circuit protective device to which the busplug is connected. The SCPD is more likely to supply heat through its proximity and conductors to the busplug than the busplug generates itself. Initial inspection -10 years Subsequent Intervals -5 years Visual Check -evidence of overheating Maintenance -replace entire plug if necessary

Frequency of Operation

Busplugs installed into ‘demountable’ type switchboards/MCC’s (plug on line-side only) are rarely withdrawn. Busplugs used in ‘withdrawable’ type switchboards/MCCs (plugs on line and load-sides of power circuit) may be withdrawn more frequently. The busplugs have been tested for electrical performance to 2000 operations.

Maintenance Schedule

The results suggest that the inspection/maintenance on the basis of mechanical movement need only be considered after about 3000 operations.

Initial inspection	After 3000 operations
Subsequent Intervals	Every 1000 operations
Visual Check	Wear and tear on contacts and busbar
Measurement	For 6.35 busbars the opening gap between contacts should be 4.4 to 4.8mm. For 10mm bars, the measurement should be 8.0 – 8.5mm.
Maintenance	Re-silver plate contacts (or replace contacts) and replace springs Contact resistance should be: - 1 contact/ph 59 µΩ - 2 contact/ph 34 µΩ - 4 contact/ph 19 µΩ - 5 contact/ph 16-32 µΩ - 6 contact/ph 14-28 µΩ

Temperature of Busplug

This is the most indicative measure of the condition of the busplug.

Initial inspection	As frequent as convenient but at least every 2 years for first 10 years of operation
Subsequent Intervals	1 year
Visual Check	Discolouration of contacts and adjacent parts Evidence of pitting or arcing
Measurement	Ductor test. Thermographic camera or infrared thermometer taken while the busplug is in service. The connections end (between busplug and conductors to SCPD should be not more than 70°C above ambient as per table 6 of AS/NZS 61439.1 : 2016 (However, this may be higher if the busplug is considered to be part of the SCPD as in the case of a busplug adaptor. (Designed for direct connection onto the SCPD). Dielectric test to confirm the insulation of the housing if desirable. The value of the test voltage is determined by the rated insulation voltage. Consideration should be given to the rating of the switchboard as a whole. The busplugs are rated at 1000V (63-400A) and 800V for 630-1200A unless marked as 1000V. Refer to AS/NZS 61439.1 : 2016 table 8 for relevant test voltages.
Maintenance	Re-silver plate contacts (or replace contacts) and replace springs Replace complete busplug of desirable or if insulation of housing in suspect

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