

Substation Design Instruction

ILJIN Electric, Korea 12kV/24kV enclosed SF₆ gas load break switch - IJ-W1S (630 M)/IJ-W2S (630 M)

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Substation Design Instruction

ASSETS STANDARDS & DESIGN	Document No. Amendment No. Approved By Approval Date	SDI 215 4 MASD 01/08/2018
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SDI 215 **ILJIN Electric, Korea 12kV/24kV enclosed SF₆ gas load break switch - IJ-W1S (630-M)/IJ-W2S (630-M)**

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1.0 PURPOSE

To provide the technical and reference information to assist with the safe design, installation, commissioning, operation and decommissioning of 12kV/24kV SF₆ gas enclosed load break switch IJ-W1S (630-M)/IJ-W2S (630-M), manufactured by ILJIN Electric, Korea. The product is supplied and serviced in Australia by Insulect Australia Pty Ltd. (previously known as AK Power Solutions Pty. Ltd).

2.0 SCOPE

This instruction provides information and reference documentation to assist in the safe design, installation, commissioning, operation and decommissioning of the approved Iljin load break switch manufactured and supplied by ILJIN Electric, Korea. This instruction is applicable only with the standard units approved for use by Endeavour Energy for use in the distribution network as detailed in 5.1.3.

The scope of this document provides reference to the various lifecycle stages of the switchgear and therefore should be read in conjunction with:

- Mounting and construction requirements: Mains Construction Instruction MCI 0005 – Overhead construction standards manual;
- Location of isolation points on the network: Mains Design Instruction MDI 0026 – Location of isolation points on the high voltage distribution network, Earthing design, construction and testing: Earthing Design Instruction EDI 100 – Distribution Earthing Design;
- Specification for new equipment: Equipment Technical Specification ETS 0067 – 11kV and 22kV enclosed load break switches;
- General details and minimum design requirements: Mains Design Instruction MDI 0028 – Underground distribution network design;
- Testing and commissioning: Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems and Division Procedure GNV 1044 – Commissioning network electrical assets;
- Ongoing maintenance requirements: Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment;
- Standard drawing requirements: Standard Asset Data SAD 0001 – Project drawings standards;
- SF₆ Management: Environmental Management Standard EMS 0007 – Waste management; and
- Disposal: Company Procedure GSU 0012 – Selection and approval of a disposal method.

This document should be read in conjunction with the manufacturer's installation instructions: IJ-WS-04-AUI003 – Installation, Operation and Maintenance Instructions for 24kV SF₆ Gas Insulated Load Break Switch (Manual type).

3.0 REFERENCES

Internal

Company Policy (Network) 9.1.7 – Commissioning Network Electrical Assets
Company Policy (Network) 9.2.5 – Network Asset Design
Company Policy (Network) 9.7.1 – Network Asset Construction
Company Policy (Network) 9.8.3 – Network Operations
Company Policy (Network) 9.9.1 – Network Asset Maintenance
Company Procedure (Network) GAM 0114 – Granting dispensations for engineering documents

Company Procedure (Procurement & Logistics) GSU 0012 – Selection and Approval of a Disposal Method

Division Procedure (Network) GNV 1026 – Equipment Register

Division Procedure (Network) GNV 1044 – Commissioning Network Electrical Assets

Division Procedure (Network) GNV 1061 – Transmission and High Voltage Distribution Network Switching

Branch Workplace Instruction (System Control) WCB 2085 – ILJIN Electric (Korea) 12kV enclosed SF₆ Gas Load Break Switch Type IJ-W1S (630 M)

Earthing Design Instruction EDI 100 - Distribution Earthing Design

Environmental Management Standards EMS 0007 – Waste Management

Equipment Technical Specification ETS 0067 – 11kV and 22kV enclosed load break switches

Mains Construction Instruction MCI 0005 – Overhead construction standards manual

Mains Design Instruction MDI 0026 – Location of isolation points on the high voltage distribution network

Standard Asset Data SAD 0001 – Project drawing standards

Substation Design Instruction SDI 120 – Testing and commissioning for distribution systems

Substation Maintenance Instruction SMI 101 – Minimum requirements for maintenance of distribution equipment

Substation Maintenance Instruction SMI 122 – Use and handling of sulphur hexafluoride (SF₆)

Drawing no. 332021 – Overhead 11-22kV construction no. HLBS – Termination to load break switch with or without remote control

Annexure 1 – Bushing Details

Annexure 2 – Terminal Palm Details

Annexure 3 – Bushing Clamp Installation Instruction

Annexure 4 – Instruction for the Replacement of Cover Plate

External

ENA Doc 001-2008 National Electricity Network Safety Code

Work Health and Safety Act 2011 (NSW)

Work Health and Safety Regulation 2017 (NSW)

Electricity Supply (Safety and Network Management) Regulation 2014

AS 5577:2013 – Electricity network safety management systems

AS/NZS 60265.1: 2001 - Switches for rated voltages above 1kV and less than 52kV

Cat ILJIN 0106 - SF₆ Gas Load Break Switch 15 – 36kV, 400A – 630A

IJ-WS-04-AUI003 – Installation, Operation and Maintenance Instructions for 24kV SF₆ Gas Insulated Load Break Switch (Manual type).

4.0 DEFINITIONS AND ABBREVIATIONS

ASP

Accredited Service Provider, a person authorised to work in the system and includes authorised external contractors and Endeavour Energy employees.

BIL

Basic Impulse Level, insulation level designed to withstand surge voltage

CCT

Covered conductor thick

LBS

Load break switch

RMS

Root mean square

SF₆

Sulphur hexafluoride

XLPE

Cross linked polyethylene

5.0 ACTIONS

5.1 General

5.1.1 Introduction

The ILJIN IJ-W1S (630-M)/IJ-W2S (630-M) enclosed switches are used to improve power supply reliability. They are designed for use on overhead distribution lines. This switchgear complies with the technical requirements of Equipment Technical Specification ETS 0067 - 11kV and 22kV enclosed load break switches.

AK Power Solutions Pty. Ltd. has supplied 36 units of 12kV rated enclosed switches from ILJIN Electric, Korea to Endeavour Energy since October 2004.

Since 2008, AK Power Solutions Pty. Ltd. has delivered 24kV rated enclosed switches from ILJIN Electric, Korea.

5.1.2 Issues

In May 2010, field employees reported that the bushing terminal palm turns while dressing the cable or installing the LBS on the pole.

In August 2010, a LBS had locked out due to gas leak from the burst disc due to corrosion.

In October 2010, some metal pieces fell off from the cast aluminum gas lock out housing due to corrosion, when the switch was operated.

Iljin Electric, Korea had taken the following actions:

- i. bushing clamps were installed on 137 LBSs which were already supplied to Endeavour Energy but were not yet installed.
- ii. 144 LBSs marked **MK1** are supplied with keyway lock bushing and 316 stainless steel burst disc.
- iii. All LBSs supplied after April 2011 are marked **MK2**, are supplied with keyway lock bushing (see Annexure 1 and 2), 316 stainless steel burst disc and 304 stainless steel gas lock out housing.

There were two catastrophic failures while commissioning new Iljin manual LBS in November 2012 and April 2013. These two LBSs were from the same batch manufactured in August 2012. A ban restricting the installation of Iljin LBSs was implemented effective May 2013.

Iljin had agreed to re-test all uninstalled units at Iljin's manufacturing plant in South Korea. These switchgears underwent routine testing (inclusive of partial discharge) in

December 2015. Please note some LBSs that had been in service and dismantled from the network were also re-tested. The LBSs were allowed to be installed in the distribution network effective April 2016.

5.1.3 Product approval

Endeavour Energy has approved the following enclosed switch assemblies from ILJIN Electric, for use in 11kV and 22kV networks.

ILJIN model no.	ILJIN ref. no.	Part no.	Description	Approval no.
IJ-W1S (630-M)	IJ-W1S - K002	—	12kV manually operated enclosed switch	340 021
ILJIN model no.	ILJIN ref. no.	Part no.	Description	Approval no.
IJ-W2S (630-M)	IJ-W2S - 003/IT	80796	24kV manually operated enclosed switch	O20028A
IJ-W2S (630-M)	IJ-W2S - 003/IT MK2	80796	24kV manually operated enclosed switch	O20028B

The enclosed switch can be used in an indoor or an outdoor substation, subject to Endeavour Energy approval, as an isolator or a load break switch, provided that the enclosed switch specification meets the situational requirements.

5.1.4 Technical features

The main technical features of the enclosed switch are:

- Tank made from stainless steel and powder coated;
- SF₆ gas used as insulation and interruption medium;
- SF₆ gas tank is sealed for life;
- Manually operated mechanism by a hook stick;
- Two operations are required to open or close the switch to prevent fraudulent operation;
- Can be padlocked;
- Open and closed position is indicated by green and red indicators, respectively;
- Low gas pressure locks the switch and prevents further operation;
- Low gas pressure indication is visible from the ground; and
- Porcelain bushings.

Further description, operation and maintenance instructions on the enclosed switch are set out in manuals, guides and instructions provided by ILJIN.

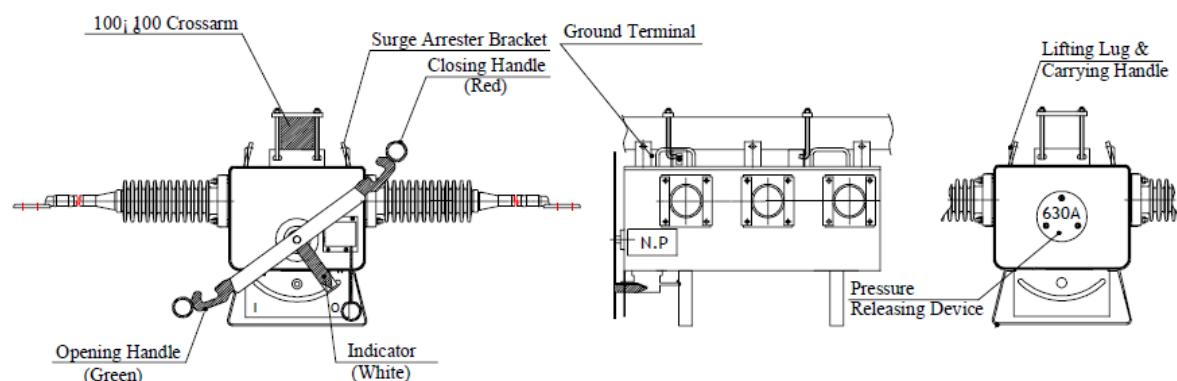


Figure 1 – Arrangement diagram

5.1.5 Technical specifications

The specifications of the enclosed LBS switch are as follows:

Applicable standards	AS/NZS 60265	
Rated maximum voltage	17.5kV	25.8kV
Rated continuous current	630A	
Fault make capacity RMS	16kA	
Fault make capacity, peak	41.6kA	
Mainly active load breaking capacity	630A	
Mechanical operations	5,000	
Full load operations	400	
Short time current withstand	16kA/1s	
Transformer magnetising current	21A	
Cable charging breaking current	40A	
Line charging breaking current	2.5A	
Power frequency withstand phase to earth dry	50kV rms	70kV rms
Power frequency withstand across the interrupter	55kV rms	77kV rms
Impulse withstand voltage phase to earth and phase to phase	110kVp	150kVp
Impulse withstand voltage across the interrupter	125kVp	165kVp
Insulation medium	SF ₆ gas	
Weight of SF6 gas	1.507kg	
Bushings	Porcelain	
Creepage distance	600 mm min.	900 mm min.
Maximum ambient temperature	55 deg. C	
Humidity	0-100%	
Altitude	1000m	
Weight of the tank	165kg	185kg

5.1.6 Gas leak indication

The normal operating pressure of the SF₆ gas is 2.6kgf/cm² Gauge at 20⁰C.

Low gas pressure (<1.6kgf/cm² Gauge) in the switch tank will inhibit operation of the switch. Low gas pressure is indicated by a red mechanical indicator. This can be read from ground level. (Refer to Figure 2 – LBS lock out position).

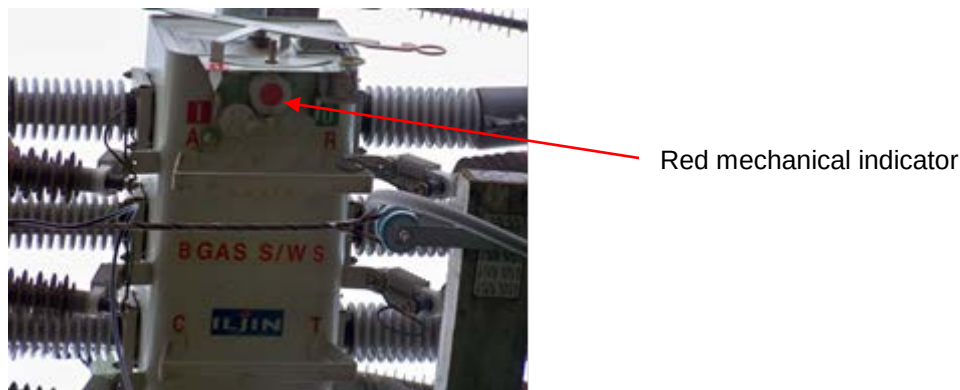


Figure 2 - LBS lock out position

5.1.7 Pressure relief device

The LBS includes a pressure relief device that operates when the gas pressure exceeds 4kgf/cm² Gauge.

If a LBS has failed and all the SF₆ gas has been depleted, and is beyond repair, the LBS **must** be disposed through the normal disposal methods in accordance with Company Procedure GSU 0012 – Selection and Approval of a Disposal Method. Where the SF₆ gas is still intact, the SF₆ gas must be removed prior to disposal in accordance with Substation Maintenance Instruction SMI 122 - Use and handling of sulphur hexafluoride (SF₆).

5.2 Installation

5.2.1 General

The Iljin LBS's are designed for pole mounted installation in accordance with Mains Construction Instruction MCI 0005 – Overhead distribution: Construction standards manual and Drawing no. 332021. The LBS is built in accordance with Equipment Technical Specification ETS 0067 -11kV and 22kV enclosed load break switch. Earthing of the LBS **must** be performed in accordance with Earthing Design Instruction EDI 100 - Distribution earthing design, construct and test, and commissioning performed in accordance with Substation Design Instruction SDI 120 - Testing and commissioning for distribution systems. Installation should be performed safely with all relevant authorisations, training, safe work method statements and all relevant Safe Work and WorkCover codes of practice.

5.2.2 Supplied manufacturer items

The supply from the manufacturer includes the following items:

Description	Qty
IJ-W2S (630-M) enclosed switch in a stainless steel tank (Type 304) with six bare terminals.	1
Pole mounting bracket for enclosed switch, hot dip galvanised, palm connectors	1
Silicon rubber enclosed switch bushing covers	6
11kV XLPE-CCT cable 19/3.5, 180 sq. mm in three metre length	6
Earth stirrup	6
Description	Qty
Hardware (set for installation)	1

The manufacturer does **not** supply the following items:

- Pole mounting hardware.
- HV connectors for connection of enclosed switch to line.
- Surge arresters with earth lead disconnect device, including HV connections and hardware.
- Earthing conductor from surge arresters to tank and to ground rods.

Reference **must** be made to Mains Construction Instruction MCI 0005 – Overhead distribution: Construction standards manual, for complete list of materials required for construction of pole mounted LBS. Refer to Drawing no: 332021 for termination to LBS.



Figure 3 – Photos of an installed Iljin LBS

5.3 Operation

5.3.1 Manual operation

The enclosed switch is manually operated from ground level using an insulated hook stick. To open or close the switch, two operations must be carried out.

- First Operation:

Release the mechanical interlock which allows the switch to be open or close. This operation is performed by pulling an auxiliary eye lever (manual lock out lever) using the insulated hook stick from ground level.

- Second operation:

Operation performed on the main arm (manual operating arm) of the switch to open or close function. Facilities are provided to padlock the mechanism in the open position or closed position

For detailed instructions on the operation of the enclosed switch, refer to the manuals provided by the manufacturer.

5.3.2 Position indicators

The enclosed switch provides open/close indication. Indication is directly linked to the operating mechanism. The indication is clearly visible from the ground to provide a clear indication of the position of the enclosed switch.

5.3.3 Switching operations

Switching operations must be carried out by authorised personnel only. Refer to Division Procedure GNV 1061 - Transmission and High Voltage Distribution Network Switching.

5.4 Accessories

The LBSs can be converted to pole top mount with mid pole operation by purchasing the following part from Insulect Australia Pty Ltd:

Part no.	Description
GSV80939	Pole top mounting assembly (mounting bracket, connection plate, down rod assembly and actuator)

Other accessories that can be purchased from Insulect Australia Pty Ltd are as follows:

Part no.	Description
06593	Support bracket assemblies
80790	Buckarm mounting bracket

Accessories that are available in Endeavour Energy stores are as follows:

Stock code	Description
1509462	Earth stirrup
1116540	11kV CCT Al. 180mm ²
1502020	22kV CCT Al. 120mm ²
SL17257	2 hole compression lug 185mm ²
SL15459	2 hole compression lug 150mm ²
1550086	HV bushing cover

5.5 Maintenance

All routine maintenance must be carried out in accordance with SMI 101 – Minimum requirements for maintenance of distribution equipment.

5.6 Bushing clamp installation

All LBSs installed prior to January 2011 need to be installed with the bushing clamp. This can be done when maintenance work or any other related work is being conducted on or near the LBS pole. Installation instructions are set out in Annexure 3.

5.7 Replacement of cover plate of the low gas indicator

There have been two incidents of the cover plate of the low gas indicator falling off due to corrosion in the coastal locations. The replacement of these cover plate could be done based on a defect report. The replacement instructions are set out in Annexure 4. The stock code for the cover plate is 1565985. (Refer to figure 4 – Replacement Cover Plate).



Figure 4 – Replacement Cover plate

5.8 Decommissioning

Disposal of equipment must be registered onto the equipment register (refer to GNV 1026 - Equipment Register) and disposed with an approved method (refer to GSU 0012 - Selection and Approval of a Disposal Method).

6.0 AUTHORITIES AND RESPONSIBILITIES

The **Manager Asset Standards & Design** has the authority and responsibility for approving this instruction and approving variations to the requirements of this instruction.

The **Substation Assets Manager** has the responsibility for revising and updating this instruction in accordance with Company Policy and Procedures.

Regional Managers have the responsibility for determining that all designs carried out by Regional employees conform to the requirements of this instruction.

The **Manager Network Connections** has the responsibility for determining that all designs carried out by Level 3 ASPs conform to the requirements of this instruction.

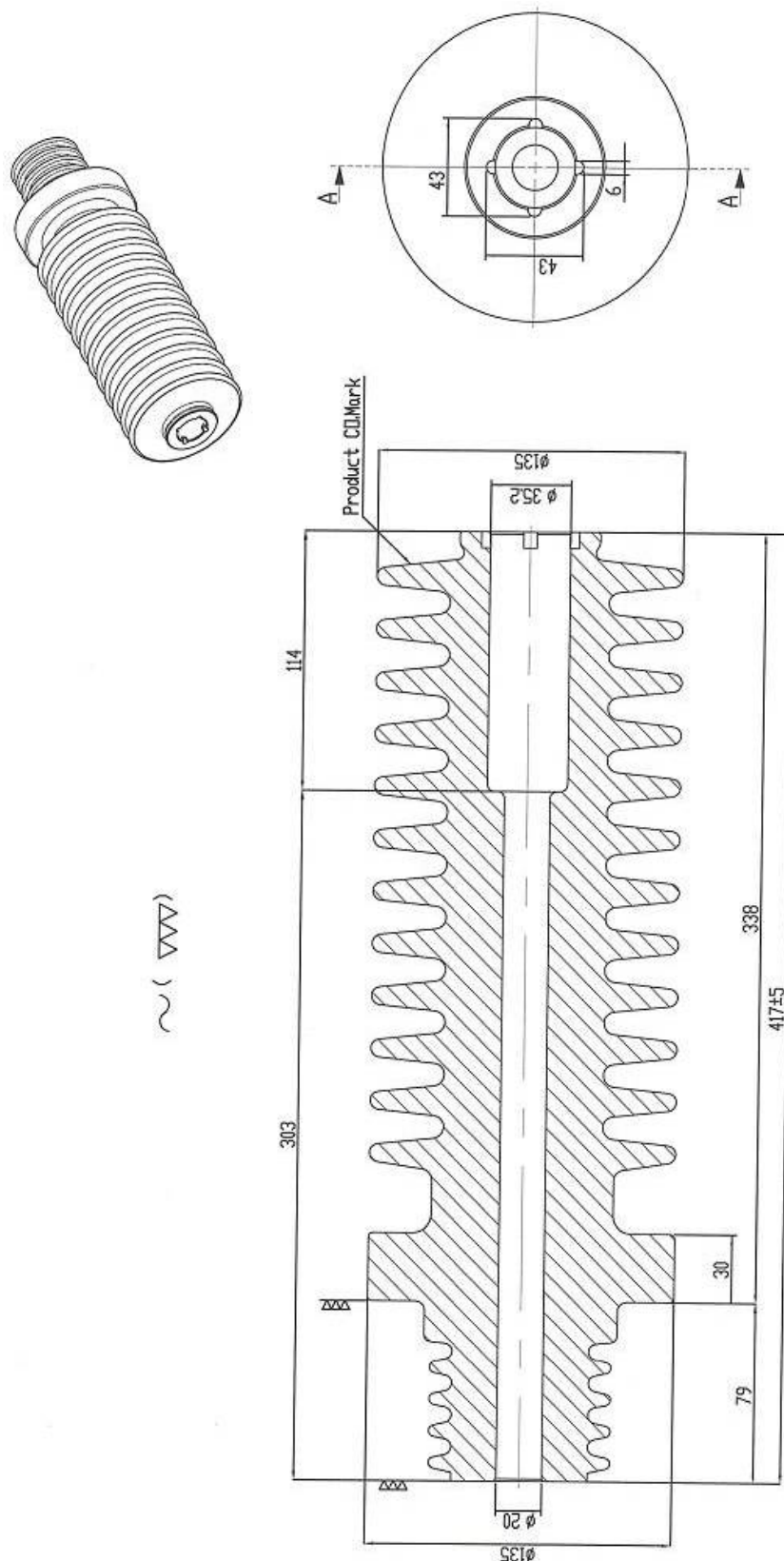
Accredited Service Providers have the responsibility to determine that the latest issue of any instruction or drawing relevant to or listed in this manual is available and used during the design of any project.

7.0 DOCUMENT CONTROL

Documentation content coordinator: Substation Assets Manager

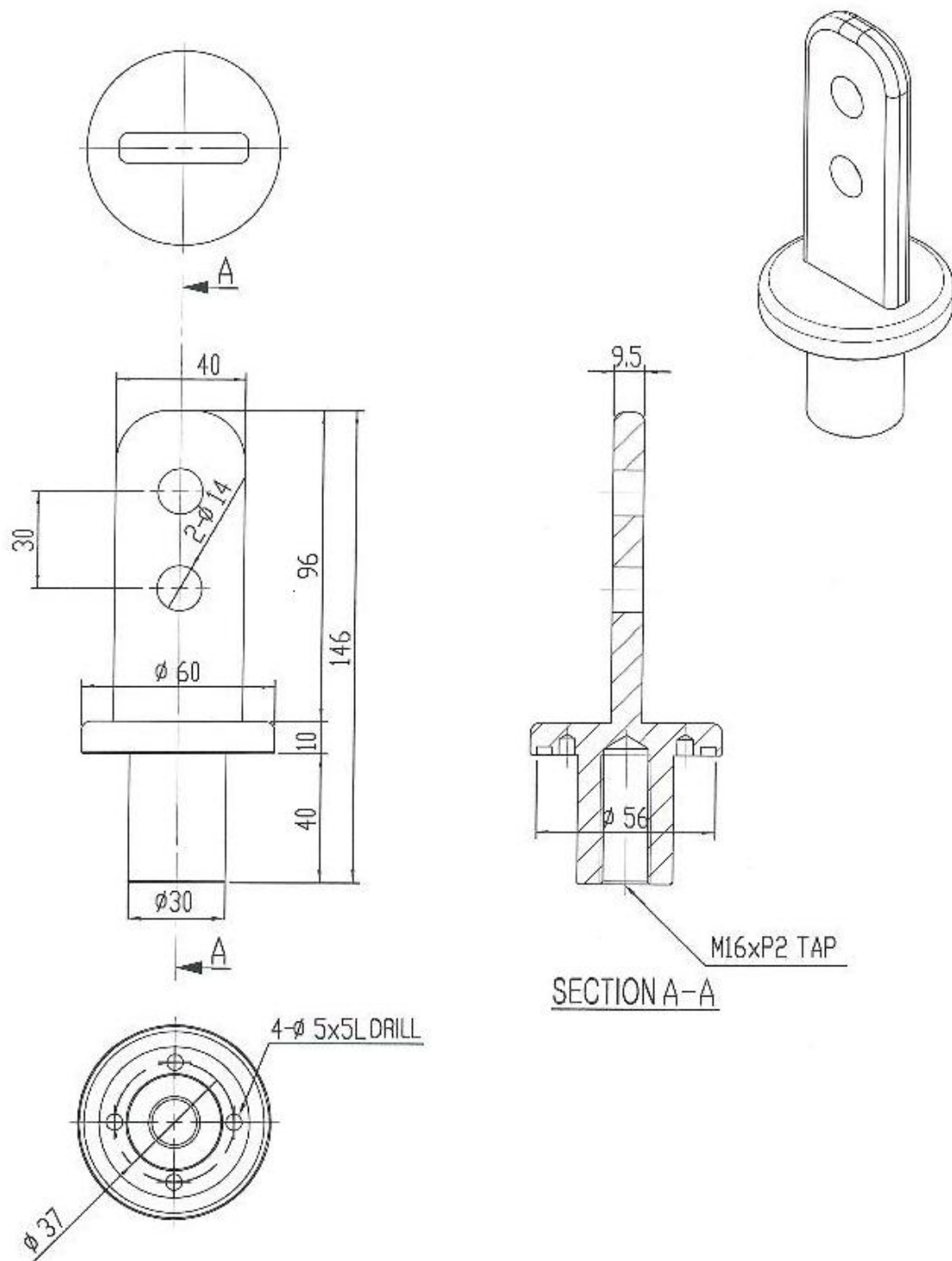
Documentation process coordinator: Standards Process Coordinator

Annexure 1 – Bushing Details



SECTION A-A
SCALE 1:2

Annexure 2 – Terminal Palm Details



Annexure 3 – Bushing Clamp Installation Instruction

Installation of Clamp Assembly



Clamp assembly



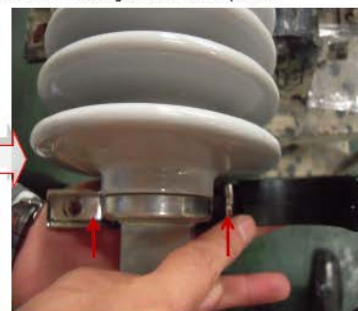
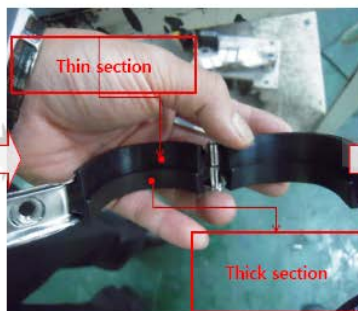
Unscrew the bolt from the clamp so it come open.



Check to ensure the terminal palm is horizontal, if not, gently rotate it to bring it into the horizontal plane. Do not rotate more than about 20-30° to bring it into the correct position.



Rotate the terminal palm, if required to bring into the correct horizontal plane. You will notice there is a thick section and a thin section to the EPDM packing on the clamp assembly



Attached the clamp to the terminal palm and bushing with the thin section of the EPDM packing on the bushing and the thicker section the terminal palm.



Fit clamp to bush and terminal palm



Bring the two sides of the clamp together using multi grips, vice grips or a similar tool. Once the two sides are close enough together insert the bolt and tighten.



Tighten the bolt



Tighten the clamp using the bolt so the top and bottom halves of the clamp come together.



Annexure 4 – Instruction for the Replacement of Cover Plate

1. Purpose

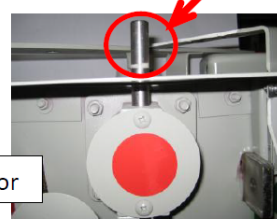
This procedure outlines the actions needed to retrofit semaphore covers on 11 and 22kv Iljin Gas Switches.

2. Confirm the State of the Gas Switch

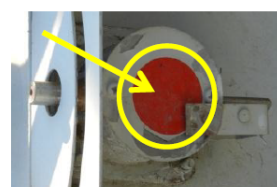
Confirm that the switch **has not locked out due to low gas pressure**. This can be done by:

1. Assessing the position of the rod (circled in red in the adjacent figure). In this example, the rod has protruded by approximately 100mm and is preventing the movement of the operating arm. In this case, the switch **has locked out due to a low gas**.
2. Assessing the position of the bracket that the semaphore cover is normally attached to (circled in yellow in adjacent figure). In this example, the bracket is facing towards the switch indicator and is thus considered to be operational.

If the switch is considered faulty, report this back to the control room and **do not** install the semaphore cover.



If the operating arm of the switch is impeded by the protruding rod (circled in red), the switch **has locked out due to a low gas** and cannot be operated.



If the bracket (circled in yellow) is facing the indicator as shown in this figure, the switch is considered operational.

installING the RETROFIT semaphore cover

The replacement semaphore cover is shown in the picture on the right. Two split pins will be included in the assembly.



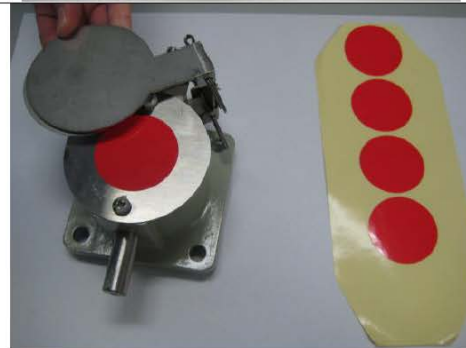
Mount the replacement semaphore cover on the back of the existing semaphore bracket / arm as shown in the adjacent figure.



Place the split pins through the existing holes in the replacement cover as indicated in the adjacent figure.



In the event that the red indicator has come off the device, replacement stickers are provided. Place the red sticker onto the device as shown in the adjacent photo.



Using approved pliers, bend the pointed ends of the split pins to flare them out to ensure they stay in place. This completes the installation.

