PowerLab Limited

Test Report

DATE ISSUED: 15 December 2022

DEVICE TESTED: AusProof 25 kV 800 A Coupler

RANGE NUMBERS: 25KA, 25KAFO, 25KAMT, 25KAMTE, 25KAE, 25KAFO

CLIENT'S NAME:
AusProof Pty Ltd
6 Shona Avenue
Gladstone
Queensland 4680
Australia

CLIENT'S REFERENCE: Email: Clinton Taylor

TEST SPECIFICATION: Client specification including references to AS/NZS 1300, AS/NZS 1299, C22.2 No 298, IEEE 386 and IEEE 404

DATE OF TEST COMPLETION: 22 November 2022

SUMMARY OF RESULTS: The sample device tested complied with the requirements of the above test specification.

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ilac-MRA ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the Laboratory's scope of accreditation, Accreditation Number: 42

Approved Signatory: K Manson

Checked By: G I Dix

International Accreditation New Zealand (IANZ) has a Mutual Recognition Arrangement (MRA) with the National Association of Testing Authorities (NATA), Australia, such that both organizations recognize accreditations by IANZ and NATA as being equivalent. Users of inspection reports / certificates are recommended to accept inspection reports / certificates in the name of either accrediting body.

Testing notes

The following personnel were present during testing:

Laboratory staff: K Manson and G I Dix

Tests Performed

Test number	Test	Standard/Clause	Test value
1	Phase to phase + earth AC 50 Hz 1 minute	AS/NZS 1299 AS/NZS 1300 C22.2 No. 298 IEEE 386	52 kV for 1 minute
2	Phase to phase + earth AC 50 Hz 4 hours	AS/NZS 1299 AS/NZS 1300	40 kV for 4 hours
3	Pilot to earth 50 Hz	AS/NZS 1300 AS/NZS 1299	1000 V for 1 minute
4	Impulse	AS/NZS 1300 AS/NZS 1299 AS/NZS 2802 C22.2 No. 298 IEEE 386	125 kV and 150 kV
5	Partial Discharge	AS/NZS 1300 AS/NZS 1299 C22.2 No. 298	Inception and extinction 10% greater than 14.44 kV, Max 100 pC
6	Ingress protection	AS 60529	IP68
7	Short circuit test (phase)	AS/NZS 1300 AS/NZS 1299 C22.2 No. 298	20 kA for 1.0 s
8	Bonding (earth) path current test	C22.2 No. 298	5.01 kA for 9 s
9	Temperature rise	ASNZS1300 ASNZS1299 C22.2 No. 298	800 A

Test Laboratory Atmospheric Conditions

Temperature 12 (±5)°C.
Pressure 100 (±5) kPa
(Approximate height above local sea level is 30 m).

Laboratory Equipment

Ferranti inverted Marx impulse generator configured with 3 stages rated at 100 kV, 0.24 µF per stage;
Laboratory manufactured adjustable transfer, tail and front resistors;

Laboratory manufactured impulse generator control and firing equipment;
Haefely 600 kV peak capacitor voltage divider/chopping gap;
Haefely 64M Impulse Peak Voltmeter;
Manually set 25cm sphere-gap;
Biddle balanced partial discharge detector 665700 (Zm, PDS)
Biddle partial discharge system master calibrator 6617250
Oscilloscope
Heafely 2000 pF discharge free 200 kV capacitor (Ck).
Hipotronics 150 kV 150 kVA ac dielectric test set
Resistive voltage divider and true RMS indicator (Hipotronics KVM300)
Fluke 287 DVM
Tektronix TDS3034 Four Channel digitizing oscilloscope;
11 kV/440 V short circuit transformer
20,000/5 CT
Laboratory constructed point on wave switch
Inductors and Resistors
Laboratory manufactured current viewing resistor; and
Miscellaneous laboratory equipment including: assman hygrometer, barometer, and a mercury-in-glass thermometer.
Agilent 34970A data acquisition system

Measurement Uncertainties

Refer to the Laboratory accreditation details at www.ianz.govt.nz for information on measurement uncertainty.

Coupler test connection, terminations and fittings

The sample coupler assemblies tested were terminated with Client supplied cables, potting compound and fittings

Although these are required for testing, they are not considered to be part of the sample device tested.

Test procedures, Results

1. AC Voltage withstand test (phase conductors)

The specified test voltage was applied between the specified conductors and the coupler body using a Hipotronics 150 kV 150 kVA ac dielectric test set operated from the laboratory mains supply. The voltage was measured using a resistive voltage divider and true RMS indicator (Hipotronics KVM300). A stopwatch was used to monitor time of application.

52 kV rms was applied between the conductors and the coupler body for a period of 1 minute.

During the high voltage test no disruptive discharges, - flashovers or insulation punctures were noted.

The insulation resistance was greater than 1 GΩ, each phase to earth.

Result: **Complies**

2. AC Voltage withstand test (phase conductors)

The specified test voltage was applied between the specified conductors and the coupler body using a Hipotronics 150 kV 150 kVA ac dielectric test set operated from the laboratory mains supply. The voltage was measured using a resistive voltage divider and true RMS indicator (Hipotronics KVM300). A stopwatch was used to monitor time of application.

40 kV rms was applied between the conductors and the coupler body for a period of 4 hours.

During the high voltage test no disruptive discharges, - flashovers or insulation punctures were noted.

The insulation resistance was greater than 1 GΩ, each phase to earth.

Result: **Complies**

3. AC Voltage withstand test (pilot conductors)

The specified test voltage was applied between the specified conductors and the coupler body using a Hipotronics 150 kV 150 kVA ac dielectric test set operated from the laboratory mains supply. The voltage was measured using a resistive voltage divider and true RMS indicator (Hipotronics KVM300). A stopwatch was used to monitor time of application.

1 kV rms was applied between the pilot conductor and the coupler body for a period of 1 minute.

During the high voltage test no disruptive discharges, - flashovers or insulation punctures were noted.

Result: **Complies**

4. Impulse test

A Ferranti impulse generator with a Haefley voltage divider and peak voltmeter was used. The wave shape was adjusted by means of interchangeable front and tail resistors to be within the allowed tolerances.

Ten impulses of each polarity were applied as specified in the Standard.
Each impulse was monitored by digital comparison with a stored reference.

The applied impulse was monitored using a Tektronix digitising oscilloscope.

Wave shape was 1.0/44 µs. Refer to Figure 1.

The test voltage was 125 kV peak.

The test was then repeated with a test voltage of 150 kV peak

During the application the 125 kV impulses no disruptive discharges, flashovers or insulation punctures were noted.

Result (125 kV): **Complies**

During the application the 150 kV impulses no disruptive discharges, flashovers or insulation punctures were noted.
Refer to Figure 1.

Result (150 kV): **Complies**

5. Partial discharge test

The specified test voltage was applied between the conductors and the coupler body using a Hipotronics 150 kV 150 kVA ac dielectric test set operated from the laboratory

mains supply. The voltage was measured using a resistive voltage divider and true RMS indicator (Hipotronics KVM300).

Discharge levels were measured using a Biddle balanced bridge discharge detector. The bridge was balanced according to the bridge manufacturer's instructions. The measurements system was calibrated by injecting a known discharge between the conductor and the cable sheath. The system calibration was checked at 10 pC and at 100 pC. Background discharge levels were recorded. Discharge levels were measured using an oscilloscope and the bridge meter.

Background discharge level was less than 1 pC

	Voltage (kV)	Discharge Level
Inception	17.1	500 pC after inception
Extinction	16.2	< 2 pC after extinction

Result: **Complies**

6. Ingress Protection

Two sample couplers were assessed according to AS 60529 to determine compliance with IP 68.

Cl 13.3	**Ingress of Solid Objects Test (AS 60529)**			**P**
Ingress Test Performed	Location of probe applied	Force applied (N)	Clearance measured	Verdict
Unit 1				
IP1X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	50	No entry/damage	P
IP2X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	30	No entry/damage	P
IP3X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	3	No entry/damage	P
IP4X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	1	No entry/damage	P
Unit 2				
IP1X	Enclosure Ends, Cable Rubber Entry, Bungs.	50	No entry/damage	P
IP2X	Enclosure Ends, Cable Rubber Entry, Bungs.	30	No entry/damage	P
IP3X	Enclosure Ends, Cable Rubber Entry, Bungs.	3	No entry/damage	P
IP4X	Enclosure Ends, Cable Rubber Entry, Bungs.	1	No entry/damage	P

Cl 13.6	**Ingress of Dust Test (AS 60529)**				**P**
EUT identification	Degree of protection (Dust)	Duration of test (hr)	Ambient temperature (°C)	EUT ambient (°C)	Verdict
Unit 1	IP6X	6.1	15.1	24.4	P
Unit 2	IP6X	6.1	15.0	20.9	P

Cl 14.3	**Ingress of Water Test (AS 60529)**					**P**
EUT identification	Degree of protection (Water)	Depth of EUT from surface (m)	Duration of test (min)	Ambient temperature (°C)	Water Ambient temperature (°C)	Verdict
Unit 1	IPX8	1.1	60.0	15.0	17.4	P
Unit 2	IPX8	1.1	60.0	15.4	16.4	P

Result **Complies**

7. Short-circuit (though-fault) test

The device was subjected to the test currents by use of a step down three phase transformer and inductors from an 11 kV supply and a phase controlled on switch and time controlled off circuit breaker:

Test 20 kA 0.2 s
Results: 0.234 s, 19.8 kA, n=2.0 (power factor = 0.3), 50 Hz, mean of 3 tests applied with 10 minutes between. Refer to Figure 2.

Test 20 kA 1.0 s
Results: 1.03 s, 19.7 kA, n=2.0 (power factor = 0.3), 50 Hz. Refer to Figure 3.

After current applications, there were no visible disturbance, pitting or burning.

Result **Complies**

8. Bonding (earth) path current test

The earth continuity circuit was subjected to the following current waveform by use of a step down transformer and inductors from an 11kV supply and a phase controlled on switch and time controlled off circuit breaker:

Test 5.01 kA for 9 s
Results: 9.08 s, 5.13 kA, n=2.0, 50 Hz. Refer to Figure 4.

The earth continuity was measured on test completion.

After the current application the measured continuity was 0.0006 Ω.

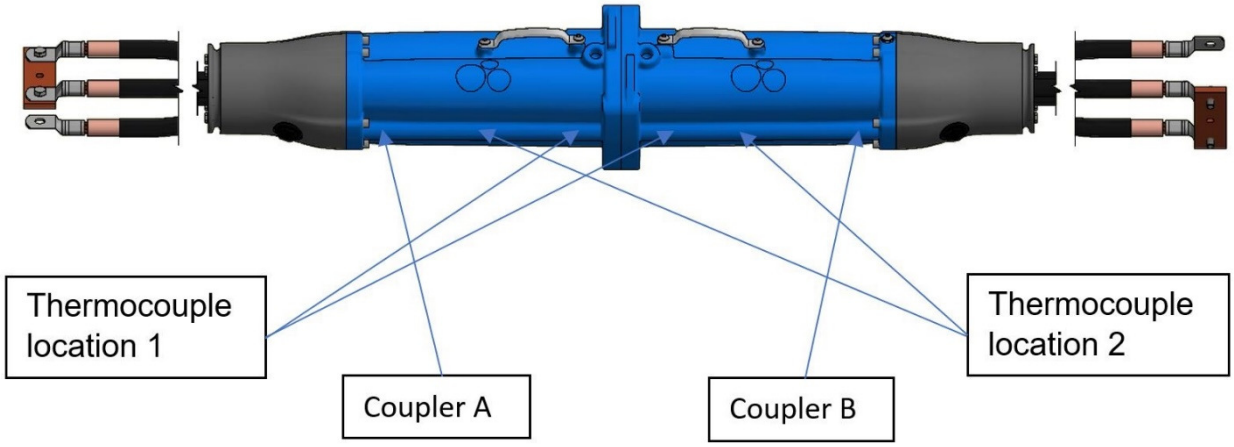
Result **Complies**

9. Temperature rise

All conductors were connected in series and thermocouples were placed as required by Clause 3.3.8.4 of ASNZS 1300.

Thermocouple locations included:

(a) Main contact adjacent to connecting device (1)
(b) Main contact adjacent to cable conductor (2)
(c) Cable conductor 1 m from cable gland



Location	Coupler	Thermocouple location	Phase ID
A	A	1	White
B	A	2	White
C	A	1	Blue
D	A	2	Blue
E	A	1	Red
F	A	2	Red
G	B	1	Blue
H	B	2	Blue
I	B	1	Red
J	B	2	Red
K	B	1	White
L	B	2	White

A current of 800A was passed through the test object until the temperature variation did not exceed 2 K/h.

Location	A	B	C	D	E	F	G	H	I	J	K	L
Rise	34	39	40	36	34	38	41	40	37	38	38	35
Difference from cable	-2	3	4	0	-2	2	5	4	1	2	2	-1

(Values are degrees Kelvin)

Result **Complies**

Oscillograms

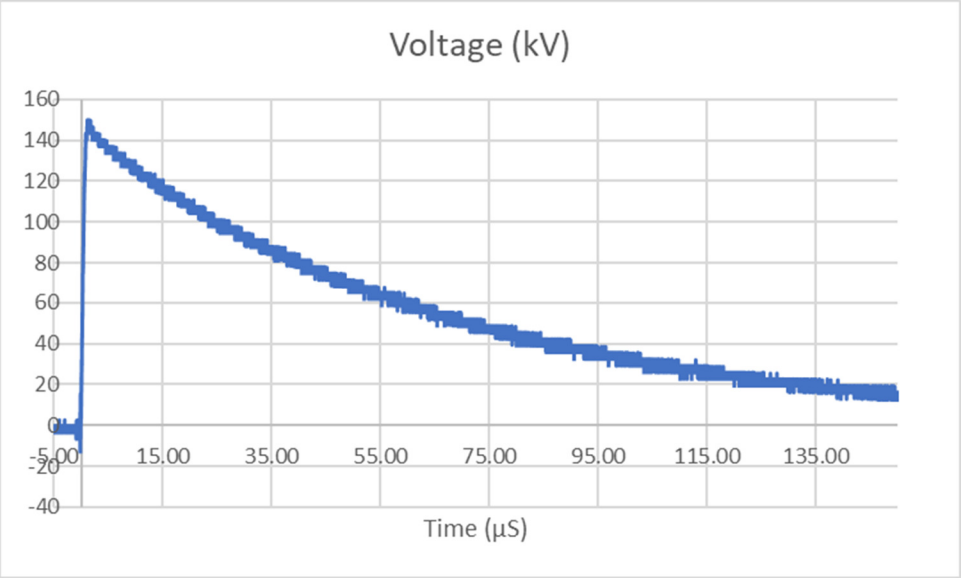


Figure 1. Last 150 kV impulse

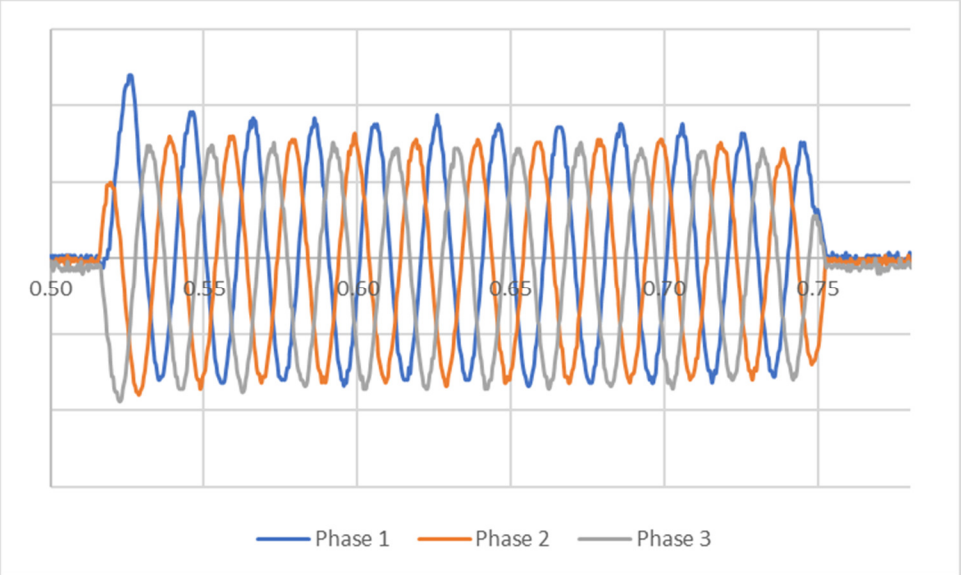


Figure 2. 20 kA for 0.2 s short circuit test number 3

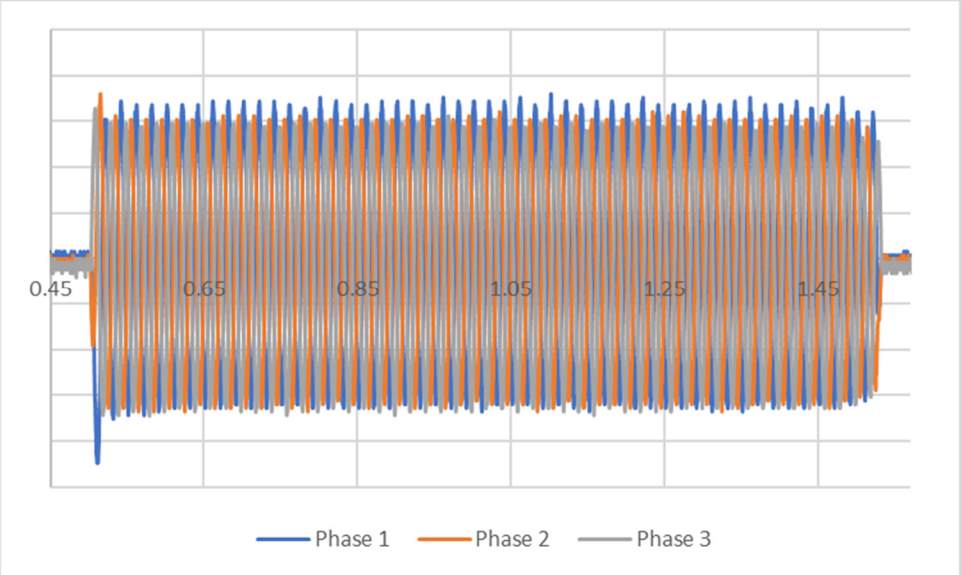


Figure 3. 20 kA for 1 s short circuit test

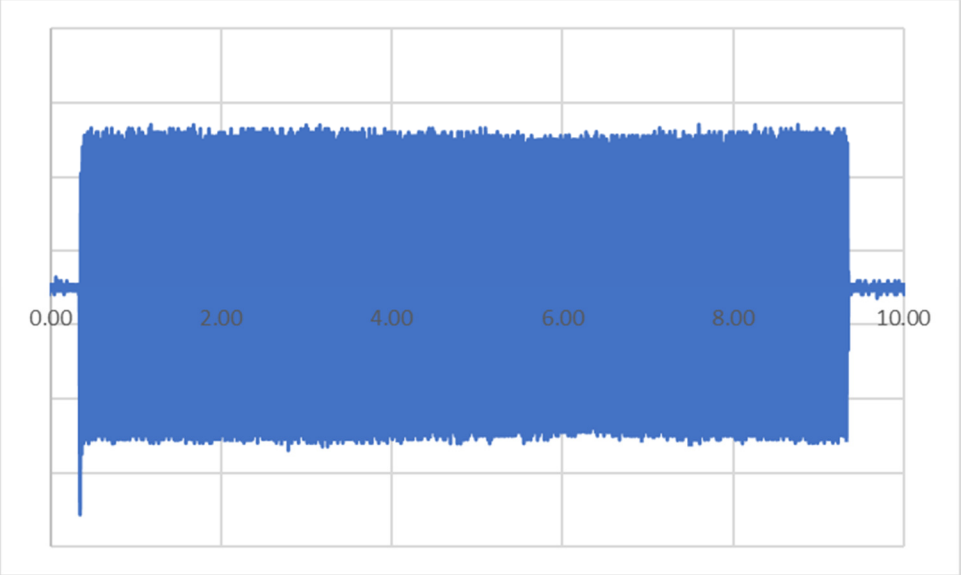
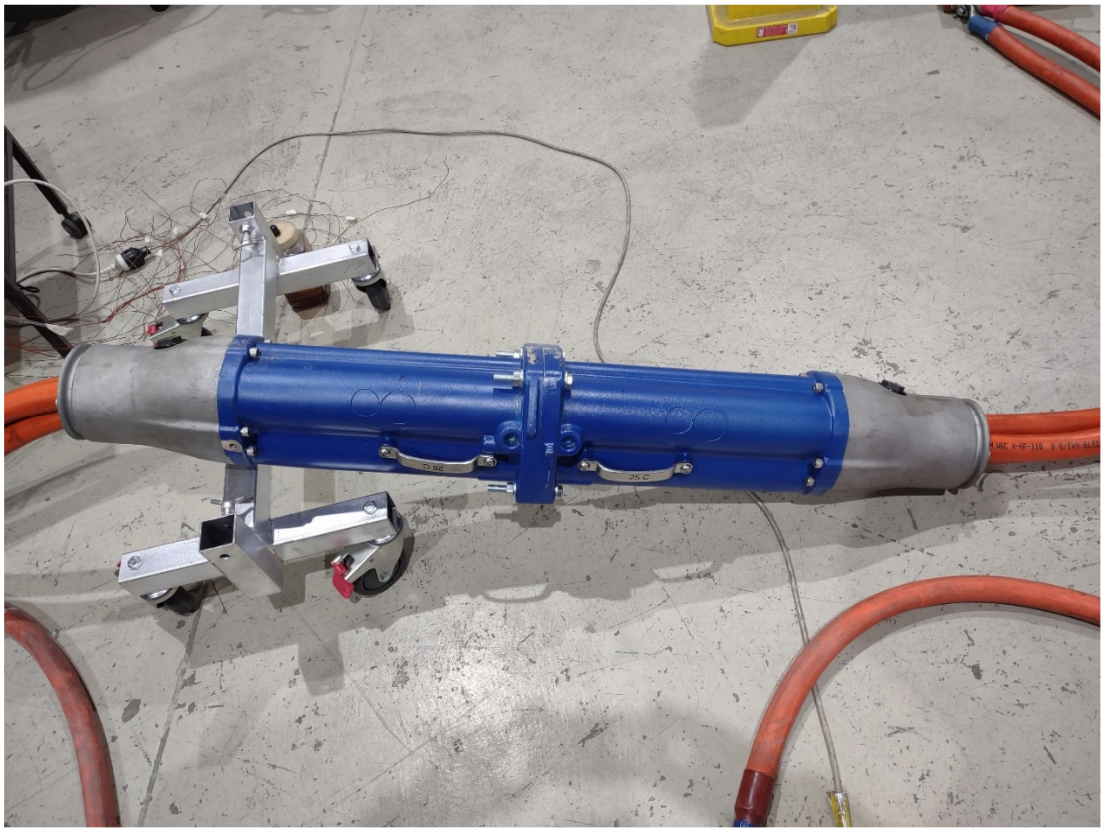


Figure 4. 5 kA for 9 s short circuit test

Pictures:

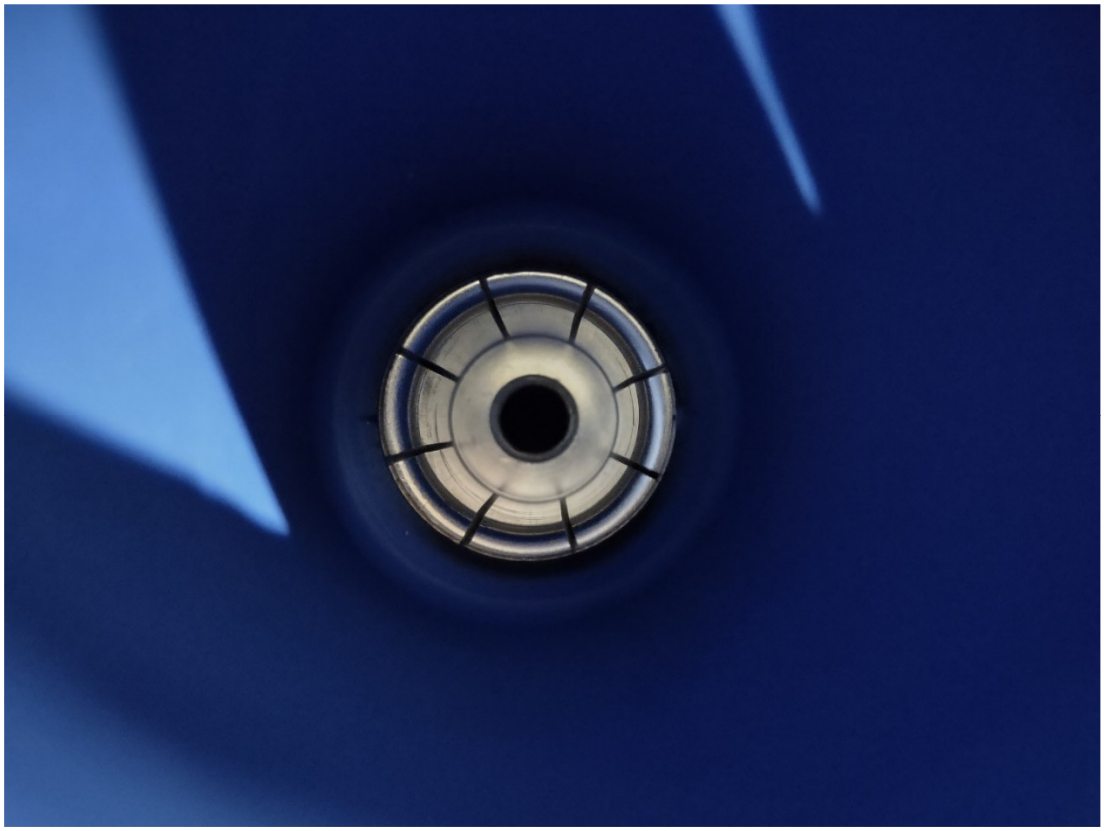


Picture 1 General view of coupler

Picture 2 Coupler in dust test

Picture 3 Coupler in 1 m water

Picture 4 Contacts after short circuit test

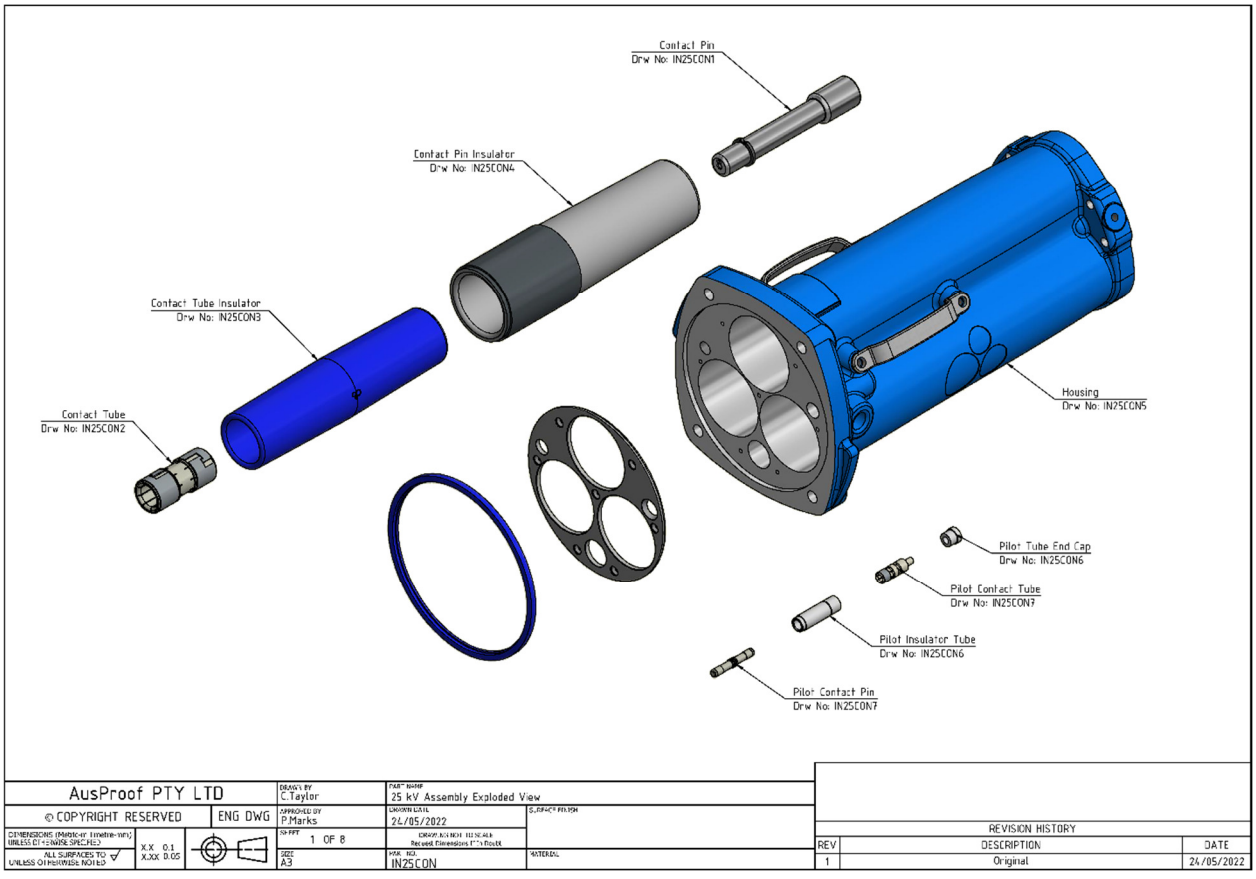


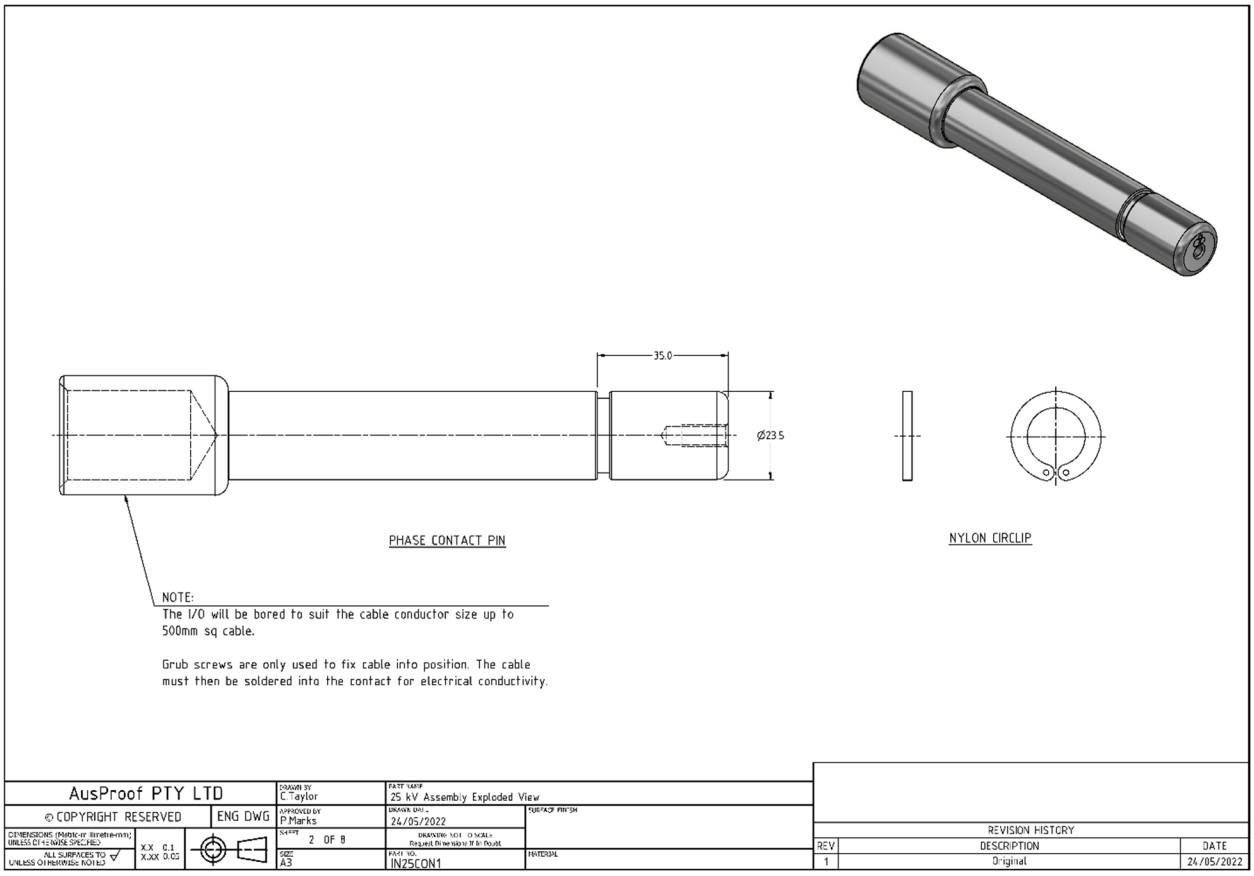
Picture 5 Contacts after short circuit test

Drawings:

List of drawings:

No	Drawing No.	Title	Revision	Date
1	IN25CON	Cable coupler and components	1	24/05/2022
2	IN25CON1	Contact Pin	1	24/05/2022
3	IN25CON2	Contact Tube	1	24/05/2022
4	IN25CON3	Contact Tube Insulator	1	24/05/2022
5	IN25CON4	Contact Pin Insulator	1	24/05/2022
6	IN25CON5	Housing	1	24/05/2022
7	IN25CON6	Pilot Insulator	1	24/05/2022
8	IN25CON7	Pilot Pin/Tube	1	24/05/2022




35.0
Ø23.5
PHASE CONTACT PIN
NYLON CIRCLIP
NOTE:
The I/O will be bored to suit the cable conductor size up to 500mm sq cable.
Grub screws are only used to fix cable into position. The cable must then be soldered into the contact for electrical conductivity.
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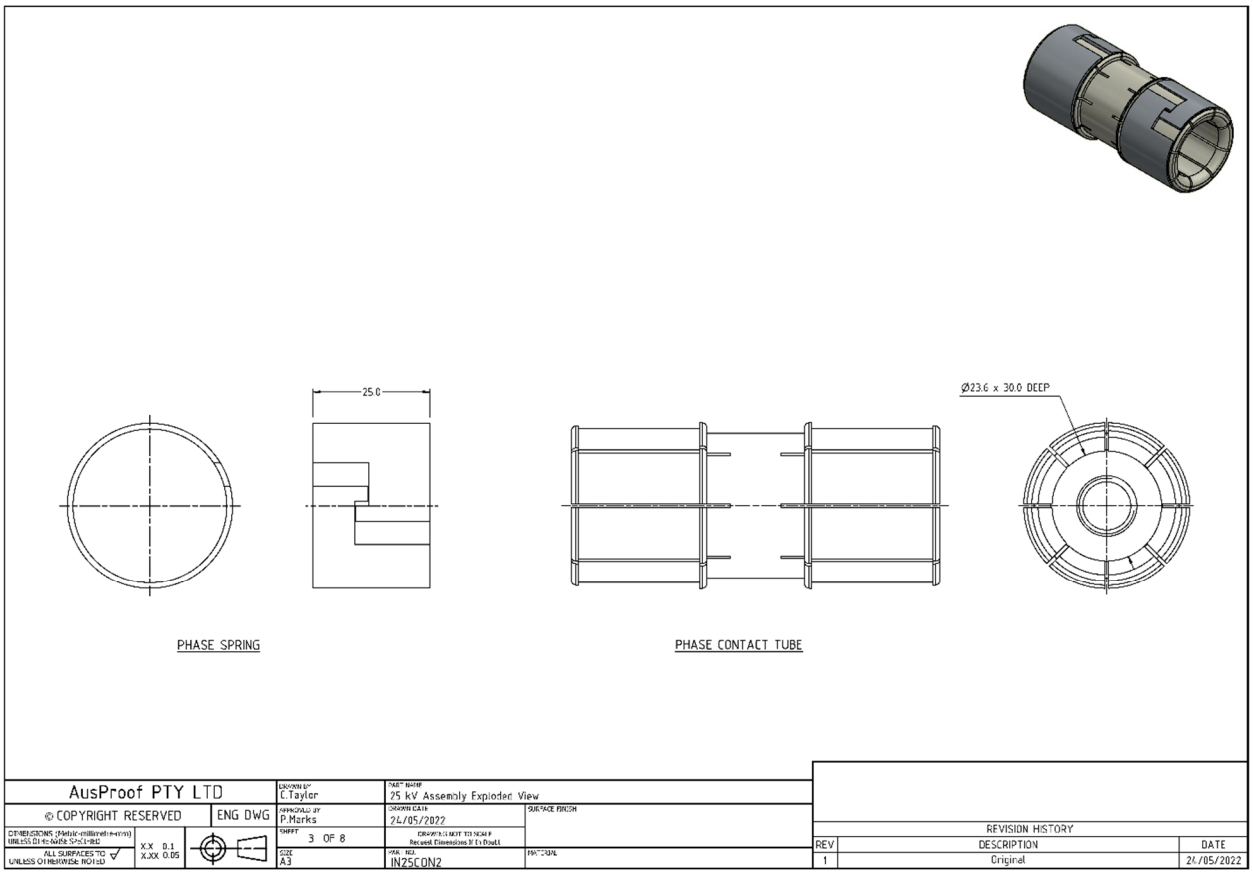
© COPYRIGHT RESERVED
ENG DWG
C.Taylor
P.Marks
2 OF 8
A3
25 kV Assembly Exploded View
24/05/2022
IN25CON1
REVISION HISTORY
REV
DESCRIPTION
DATE
1
Original
24/05/2022


25.0
Ø23.6 x 30.0 DEEP
PHASE SPRING
PHASE CONTACT TUBE
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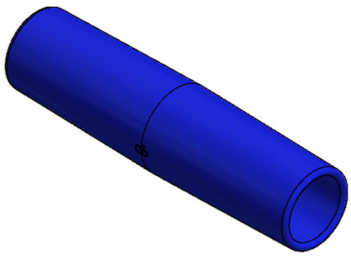
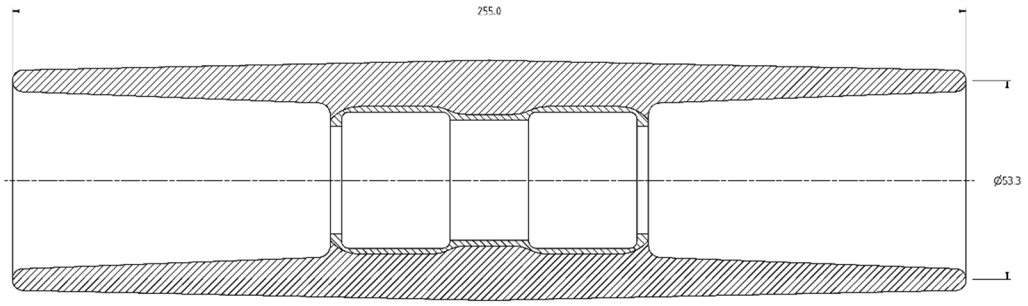
ENG DWG
C.Taylor
P.Marks
3 OF 8
A3
25 kV Assembly Exploded View
24/05/2022
IN25CON2
REVISION HISTORY
REV
DESCRIPTION
DATE
1
Original
24/05/2022





PHASE INSULATOR

AusProof PTY LTD	DRAWN BY C.Taylor	PART NAME 25 kV Assembly Exploded View		
© COPYRIGHT RESERVED ENG DWG	APPROVED BY P.Marks	DRAWN DATE 24/05/2022	SURFACE FINISH	
DIMENSIONS (Metric or linetre-mm) UNLESS OTHERWISE SPECIFIED	SCALE 4 OF 8	DRAWING NOT TO SCALE Request Dimensions If In Doubt		
ALL SURFACES TO UNLESS OTHERWISE NOTED X.X 0.1 X.XX 0.05	SIZE A3	PART NO. IN25CON3	MATERIAL	

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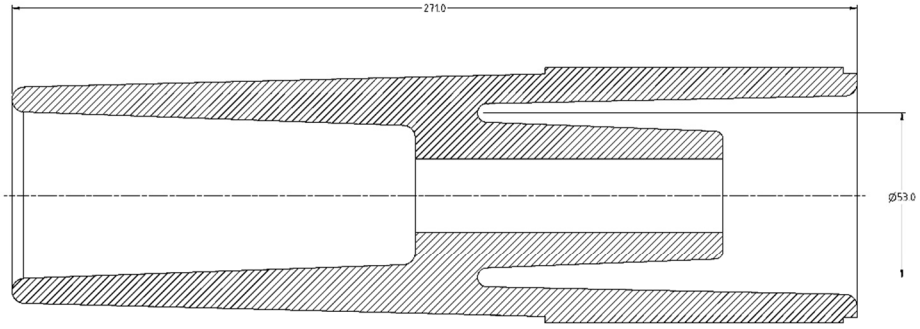

PHASE INSULATOR

AusProof PTY LTD	DRAWN BY C.Taylor	PART NAME 25 kV Assembly Exploded View		
© COPYRIGHT RESERVED ENG DWG	APPROVED BY P.Marks	DRAWN DATE 24/05/2022	SURFACE FINISH	
DIMENSIONS (Metric or linetre-mm) UNLESS OTHERWISE SPECIFIED	SCALE 5 OF 8	DRAWING NOT TO SCALE Request Dimensions If In Doubt		
ALL SURFACES TO UNLESS OTHERWISE NOTED X.X 0.1 X.XX 0.05	SIZE A3	PART NO. IN25CON4	MATERIAL	

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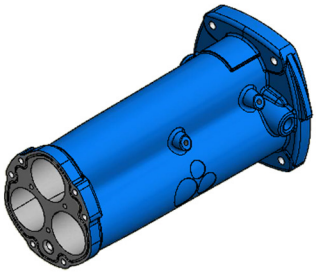

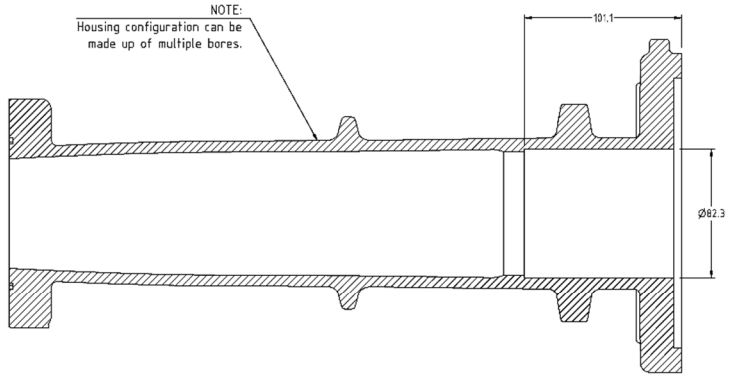

BODY PHASE
SECTION VIEW

AusProof PTY LTD	DRAWN BY C.Taylor	PART NAME 25 kV Assembly Exploded View			
© COPYRIGHT RESERVED	ENG DWG	APPROVED BY P.Marks	DRAWN DATE 24/05/2022	SURFACE FINISH	
DIMENSIONS (Metric or Imetre-mm) UNLESS OTHERWISE SPECIFIED		SHEET 6 OF 8	DRAWING NOT TO SCALE Request Dimensions from Ausproof		
ALL SURFACES TO UNLESS OTHERWISE NOTED	X.X 0.1 X.XX 0.05	SIZE A3	PART NO. IN25CON5	MATERIAL	

REVISION HISTORY

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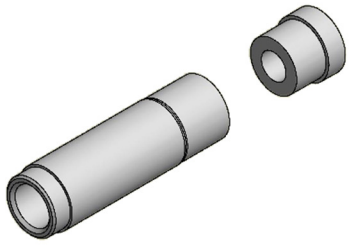
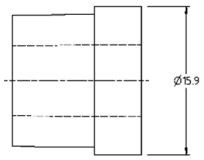


PILOT INSULATOR TUBE



PILOT INSULATOR
END CAP

AusProof PTY LTD	DRAWN BY C.Taylor	PART NAME 25 kV Assembly Exploded View			
© COPYRIGHT RESERVED	ENG DWG	APPROVED BY P.Marks	DRAWN DATE 24/05/2022	SURFACE FINISH	
DIMENSIONS (Metric or Imetre-mm) UNLESS OTHERWISE SPECIFIED		SHEET 7 OF 8	DRAWING NOT TO SCALE Request Dimensions from Ausproof		
ALL SURFACES TO UNLESS OTHERWISE NOTED	X.X 0.1 X.XX 0.05	SIZE A3	PART NO. IN25CON6	MATERIAL	

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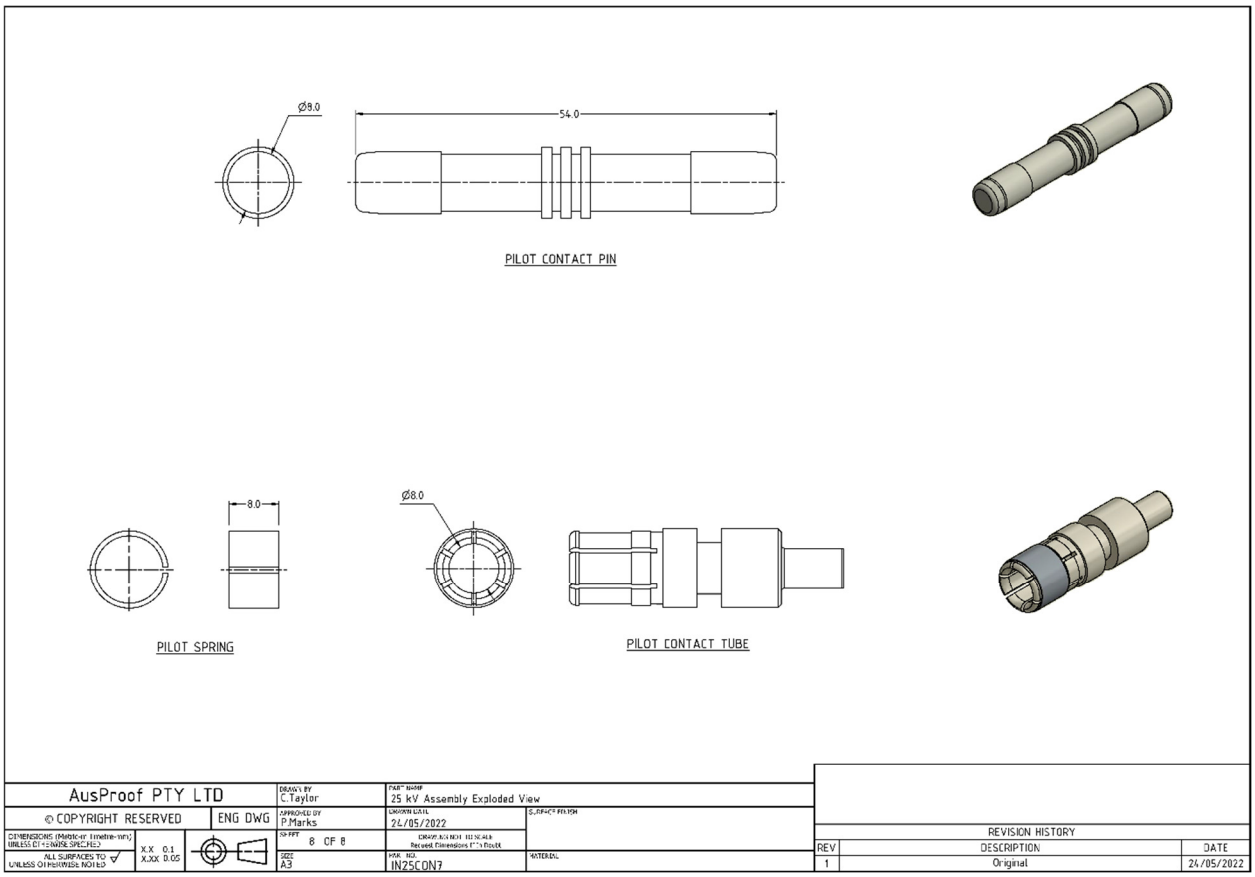
Ø9.0
54.0
PILOT CONTACT PIN
8.0
Ø8.0
PILOT SPRING
PILOT CONTACT TUBE
AusProof PTY LTD
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ENG DWG
DRAWN BY C.Taylor
APPROVED BY P.Marks
DRAWN DATE 24/05/2022
SHEET 8 OF 8
SIZE A3
PART NAME 25 kV Assembly Exploded View
MAT. NO. IN25CON7
DIMENSIONS (Metric or Imetric-inch) UNLESS OTHERWISE SPECIFIED
X.X 0.1
X.XX 0.05
ALL SURFACES TO UNLESS OTHERWISE NOTED
REVISION HISTORY
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DESCRIPTION
DATE
1
Original
24/05/2022