## **Solution**

### 6.6kV / 8.7kV 800AMP Coupler and Adaptor Test Report

Pioneering the Difference.

	Developed by	Philip Marks		
Theory 1.9.1	DIN	RD_974		
	Version	3		
	Version 1 27/08/2021			

Páwarlab



#### **Test Report**

DATE ISSUED: 12 January 2024 DEVICE TESTED: AusProof 6.6 kV / 8.7 kV 800 A Coupler **RANGE NUUMBERS:** 64BKA, 64BKAFO, 64BKAE, 8BU, 8BUFO, 8KA, 8KAFO, 8KAKEY, 8KAMT 8KAMTE, 8KAE **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, AS/NZS 1802, AS/NZS 2802 and IEEE 404 DATE OF TEST COMPLETION: 23 December 2022 SUMMARY OF RESULTS: The sample device tested complied with the

All tests report have been per accordance w Laboratory's ca carcelitation, Number: 42

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

requirements of the above test specification.

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.

PowerLab Limited, PO Box 31034 Christchurch 8444 New Zealand, 5 Sheffield Crescent Christchurch New Zealand, Info@powerlab.co.nz. This Report must not be quoted except in full.

#### **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 6 hours	C22.2 No. 298 AS/NZS 1299 AS/NZS 1300 AS/NZS 1802 AS/NZS 2802 IEEE 404	22 kV for 6 hours
2	Pilot to earth 50 Hz	AS/NZS 1300 AS/NZS 1299	1000 V for 1 minute
3	Impulse	AS/NZS 1300 AS/NZS 1299 AS/NZS 2802 IEEE 404 C22.2 No. 298	75 kV and 95 kV
4	Partial Discharge	AS/NZS 1300 AS/NZS 1299 C22.2 No. 298	Inception and extinction 10% greater than 5.03 kV, Max 100 pC
5	Ingress protection	AS 60529	IP68
6	Short circuit test (phase)	AS/NZS 1300 AS/NZS 1299 C22.2 No. 298	20 kA for 1.0 s
7	Bonding (earth) path current test	C22.2 No. 298	5.01 kA for 9 s
8	Temperature rise	ASNZS1300 ASNZS1299 C22.2 No. 298	800 A

#### **Test Laboratory Atmospheric Conditions**

Temperature 20  $(\pm 4)^{\circ}$ C. Pressure 100  $(\pm 5)$  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  $\mu\text{F}$  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 <u>www.ianz.govt.nz</u> for information on measurement uncertainty.

#### Coupler test connection, terminations and fittings

The sample coupler assemblies tested were terminated with Client supplied cables 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.

22 kV rms was applied between the conductors and the coupler body for a period of 6 hours.

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

The insulation resistance was greater than 1 G $\Omega$ , each phase to earth.

#### **Result:**

#### Complies

#### 2. 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

#### 3. 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.

> Page 4 of 29 Pages 12 January 2024



Background discharge level was less than 1 pC

	Voltage (kV)	Discharge Level
Inception	8.5	30 pC after inception
Extinction	8.2	< 1 pC after extinction

#### **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 1.0/43 µs. Refer to oscillogram included in this report

The test voltage was 75 kV peak.

The test was then repeated with a test voltage of 95 kV peak

During the application the 75 kV impulses no disruptive discharges, flashovers or insulation punctures were noted.

#### Result (75 kV):

#### Complies

During the application the 95 kV impulses no disruptive discharges, flashovers or insulation punctures were noted. Refer to Figure 1.

#### Result (95 kV):

Complies



#### **5. Ingress Protection**

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

CI 13.3	Ingress of Solid Objects Test (AS 60529)			Р
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	Р
IP2X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	30	No entry/damage	Р
IP3X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	3	No entry/damage	Р
IP4X	Enclosure Ends, Cable Rubber Entry, Bungs, Cover Cap.	1	No entry/damage	Р
	Unit 1			·
IP1X	Enclosure Ends, Cable Rubber Entry, Bungs.	50	No entry/damage	Р
IP2X	Enclosure Ends, Cable Rubber Entry, Bungs.		No entry/damage	Р
IP3X	Enclosure Ends, Cable Rubber Entry, Bungs.	3	No entry/damage	Р
IP4X	Enclosure Ends, Cable Rubber Entry, Bungs.	1	No entry/damage	Р

CI 13.6	Ingress of Dust Test (AS 60529)						
EUT Degree of protection (Dust)		Duration of test (hr)	Ambient temperature (°C)	EUT ambient (°C)	Verdict		
Unit 1		IP6X	2.6	24.6	31.9	Р	
Unit 2		IP6X	2.6	22.6	29.6	Р	

CI 14.3	Ingre	Ingress of Water Test (AS 60529)							
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	1.0	60.0	23.8	22.2	Р		
Unit 2		IPX8	1.0	60.0	23.0	22.8	Р		

#### Result

#### Complies



#### 6. 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: 0.22 s, 21.8 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, 20.8 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

#### 7. 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: 9.3 s, 5.0 kA, n=1.9, 50 Hz. Refer to Figure 4.

The earth continuity was measured on test completion.

After the current application the measured continuity was 0.0001  $\Omega$ .

#### Result

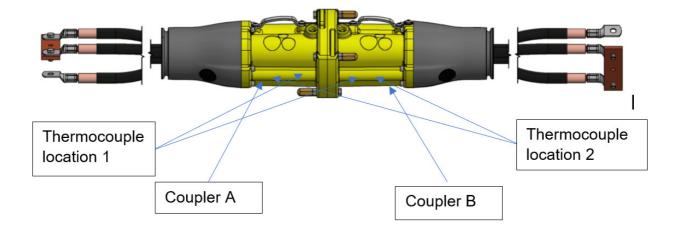
#### Complies

#### 8 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
А	А	1	White
В	А	2	White
С	А	1	Blue
D	А	2	Blue
E	А	1	Red
F	А	2	Red
G	В	1	Blue
Н	В	2	Blue
1	В	1	Red
J	В	2	Red
K	В	1	White
L	В	2	White

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

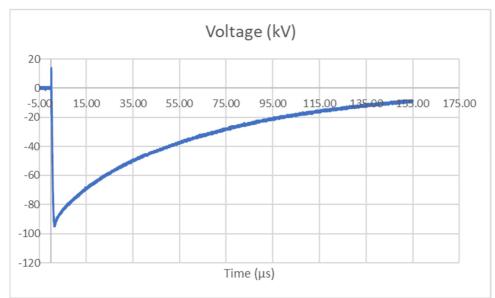
Location	A	В	С	D	E	F	G	Н	I	J	K	L
Rise	40	38	40	36	37	39	37	38	37	37	42	39
Difference from cable	9	7	8	5	5	8	6	7	6	5	10	8

(Values are degrees Kelvin)

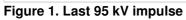
#### Result

#### Complies





#### Oscillograms



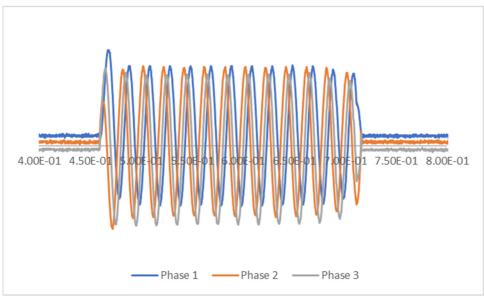


Figure 2. 20 kA for 0.2 s short circuit test number 3



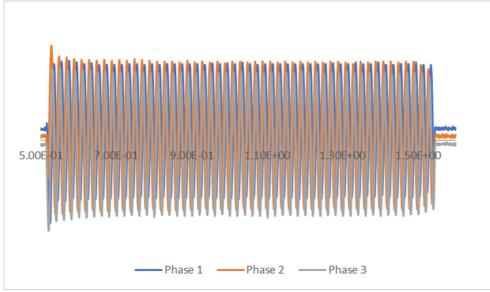


Figure 3. 20 kA for 1 s short circuit test



Figure 4. 5 kA for 9 s short circuit test



# 03 EARTH JUMP

#### Pictures:

Picture 1 General view of coupler

Page 11 of 29 Pages 12 January 2024





Picture 2 View of main contacts

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Picture 3 Coupler in dust test





Picture 4 Coupler in 1 m water





Picture 5 Contacts after short circuit test



Picture 6 Contacts after short circuit test

Page 15 of 29 Pages 12 January 2024

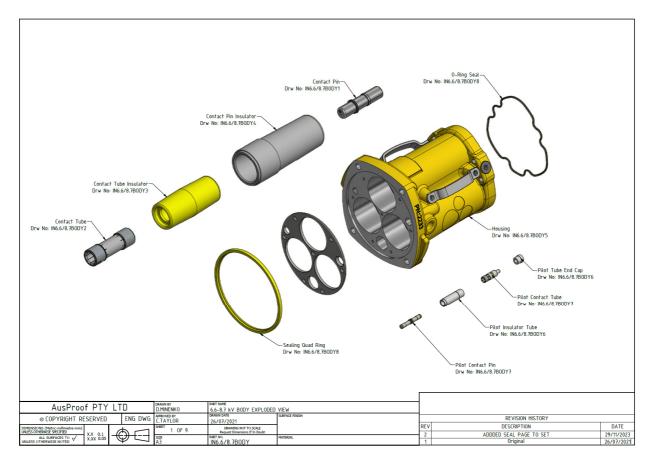


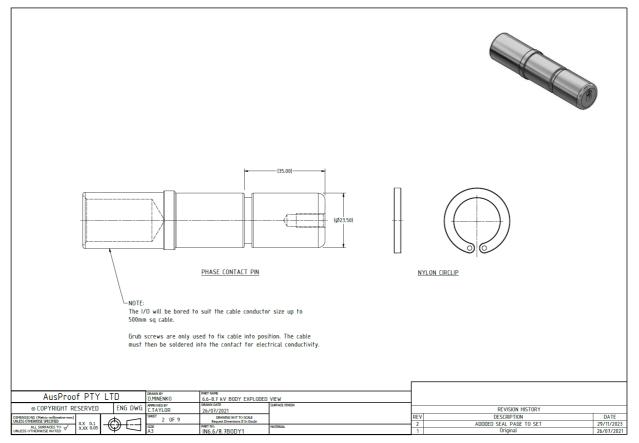
#### Drawings:

List of drawings:

No	Drawing No.	Title	Revision	Date
1	IN6.6/8.7BODY	Cable coupler & components	2	29/11/2023
2	IN6.6/8.7BODY1	Phase contact pin	2	29/11/2023
3	IN6.6/8.7BODY2	Phase contact tube	2	29/11/2023
4	IN6.6/8.7BODY3	Phase Tube insulator	2	29/11/2023
5	IN6.6/8.7BODY4	Phase Pin insulator	2	29/11/2023
6	IN6.6/8.7BODY5	Housing	2	29/11/2023
7	IN6.6/8.7BODY6	Pilot Insulator tube	2	29/11/2023
8	IN6.6/8.7BODY7	Pilot Pin/Tube	2	29/11/2023
9	IN6.6/8.7BODY8	Sealing quad ring/O-ring seal	2	29/11/2023
10	IN6.6/8.7COVER	End covers & components	1	29/11/2023
11	IN6.6/8.7COVER1	Cast pro cover	1	29/11/2023
12	IN6.6/8.7COVER2	Insulated end cover	1	29/11/2023
13	IN6.6/8.7COVER3	Universal End Cover Cast Box	1	29/11/2023
14	IN6.6/8.7COVER4	Sealing quad ring/O-Ring Seal	1	29/11/2023
15	IN6.6/8.7COVER5	End cover plug	1	29/11/2023
16	IN6.6/8.7GLANDKA	KA Glands & components	1	29/11/2023
17	IN6.6/8.7GLANDKA1	KA Small/KA Large	1	29/11/2023
18	IN6.6/8.7GLANDKA2	KA OCS Comp ring/KA OCL Comp ring	1	29/11/2023
19	IN6.6/8.7GLANDKA3	KA OCS Pressure ring/KA OCL Pressure ring	1	29/11/2023
20	IN6.6/8.7GLANDKA4	Filler bung/O-ring	1	29/11/2023
21	IN6.6/8.7GLANDKAN	KAN Glands & components	1	29/11/2023
22	IN6.6/8.7GLANDKAN1	KAN Small Housing/KAN Large Housing	1	29/11/2023
23	IN6.6/8.7GLANDKAN2	KAN Small Comp washer/KAN Large Comp washer	1	29/11/2023
24	IN6.6/8.7GLANDKAN3	KAN OCS Comp ring/KAN OCL Comp ring	1	29/11/2023
25	IN6.6/8.7GLANDKAN4	KAN Small ss comp ring/KAN Large ss comp ring	1	29/11/2023
26	IN6.6/8.7GLANDKAN5	Filler bung/O-ring	1	29/11/2023

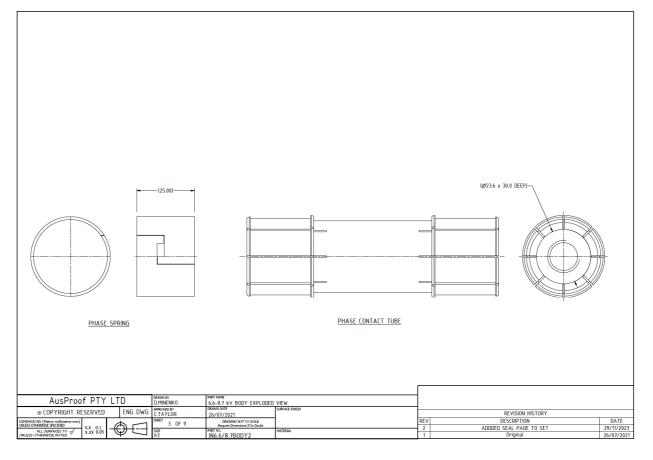


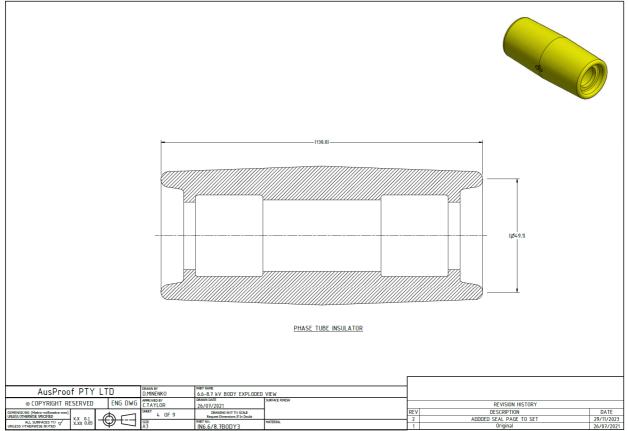




Page 17 of 29 Pages 12 January 2024

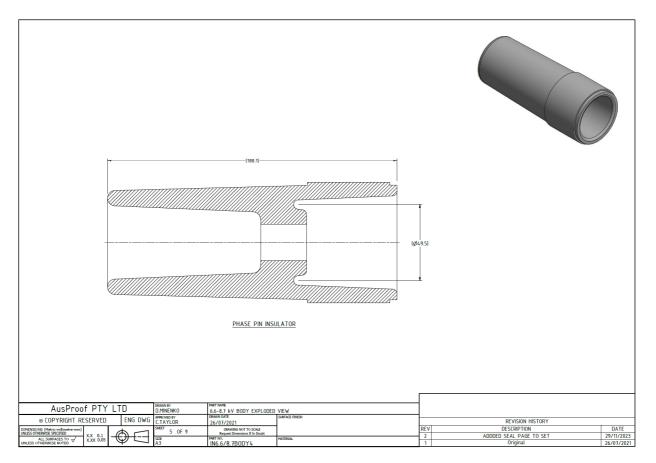


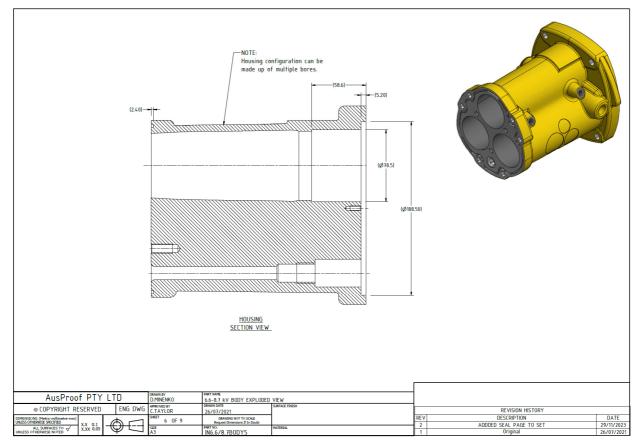




Page 18 of 29 Pages 12 January 2024

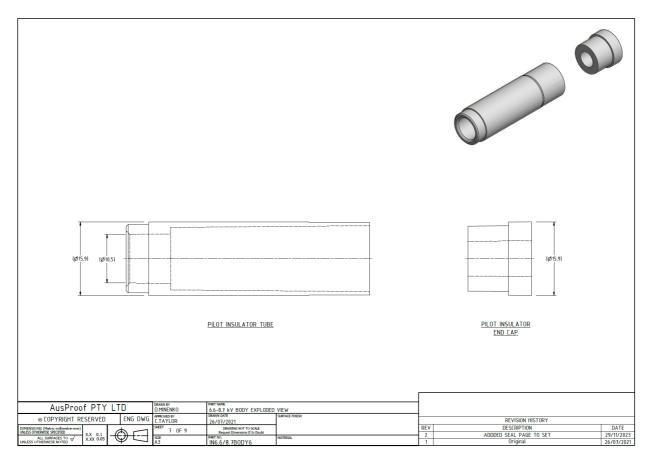


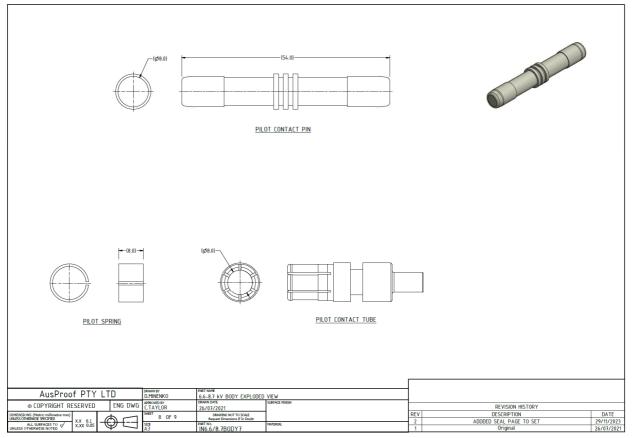




Page 19 of 29 Pages 12 January 2024

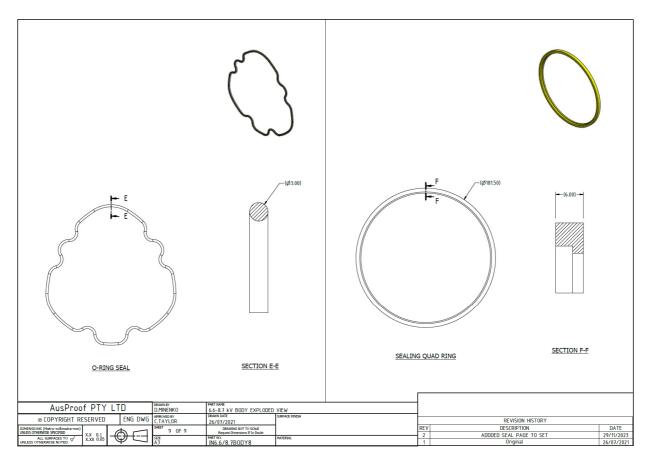


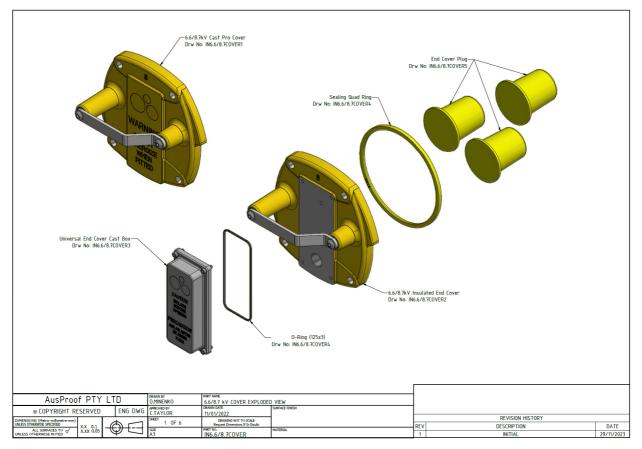




Page 20 of 29 Pages 12 January 2024

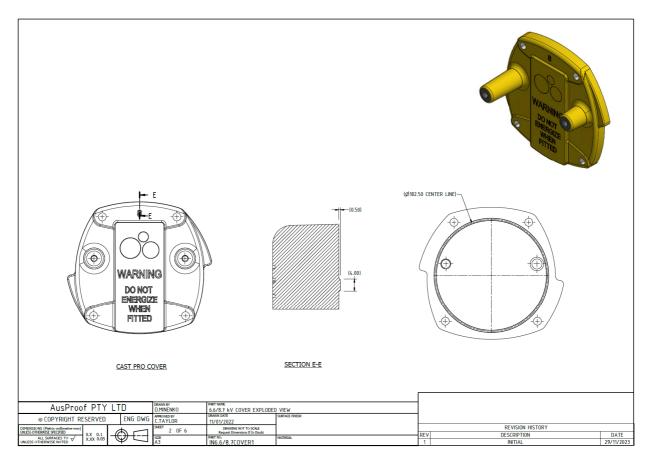


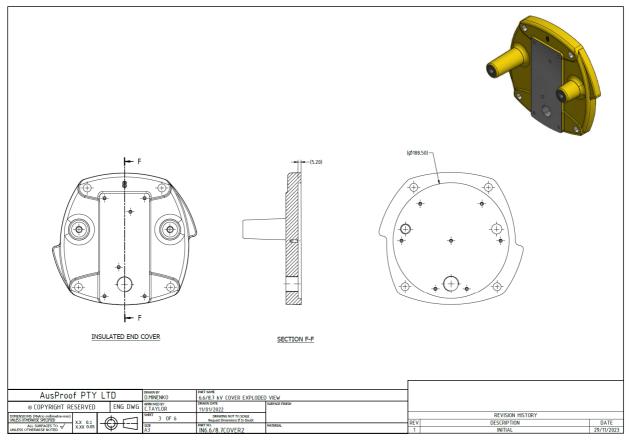




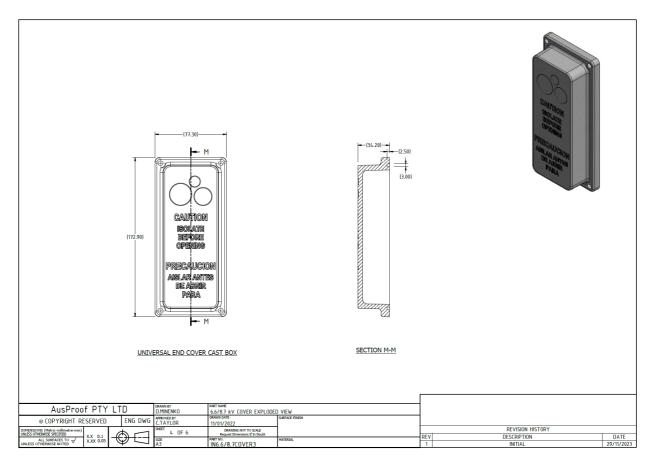
Page 21 of 29 Pages 12 January 2024

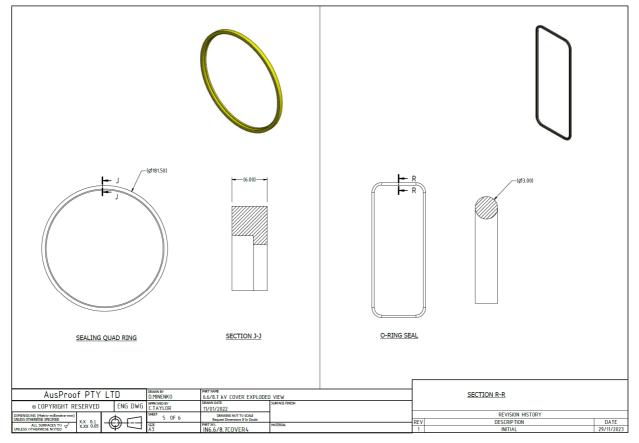






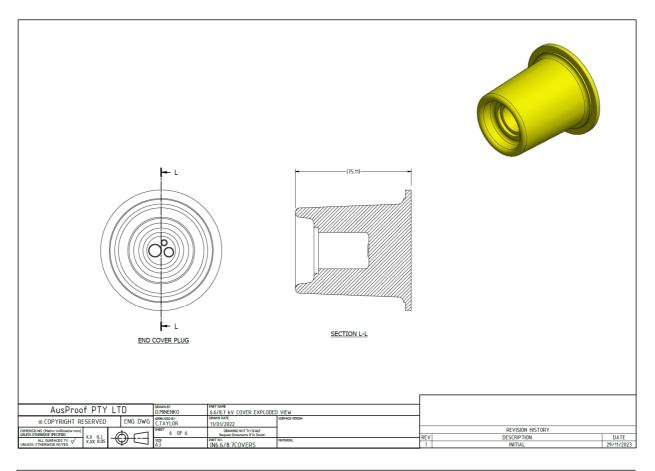


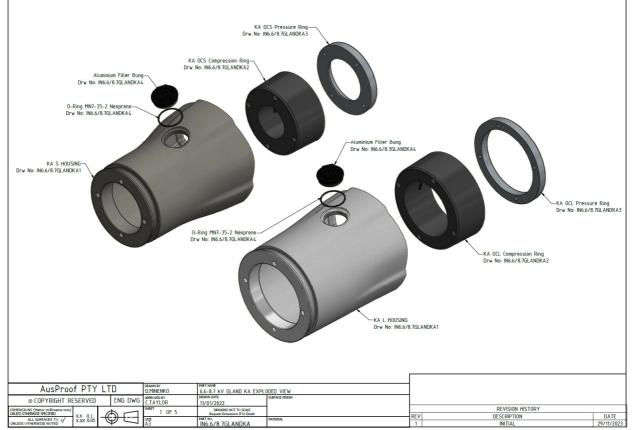




Page 23 of 29 Pages 12 January 2024

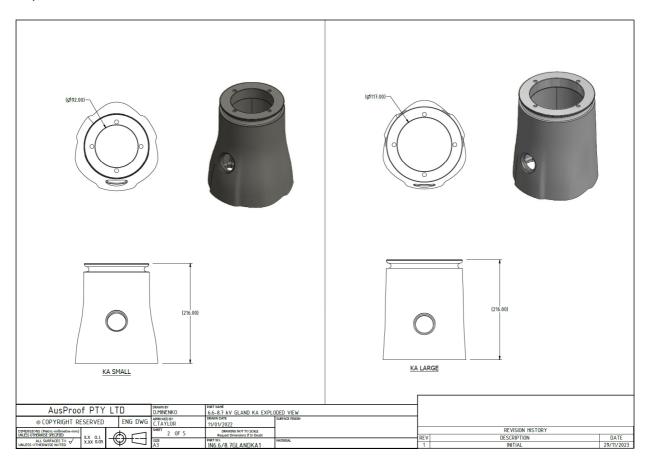


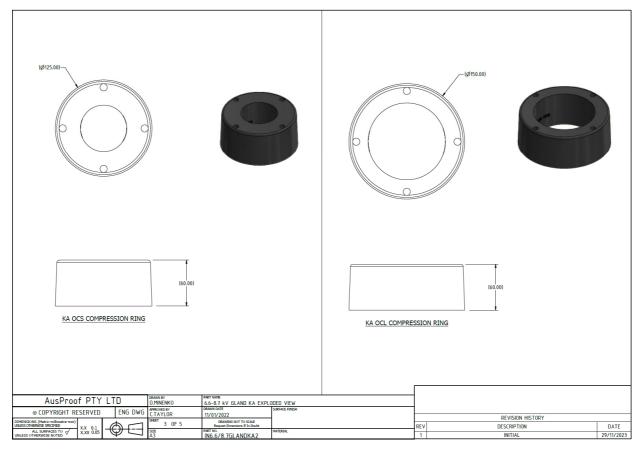




Page 24 of 29 Pages 12 January 2024

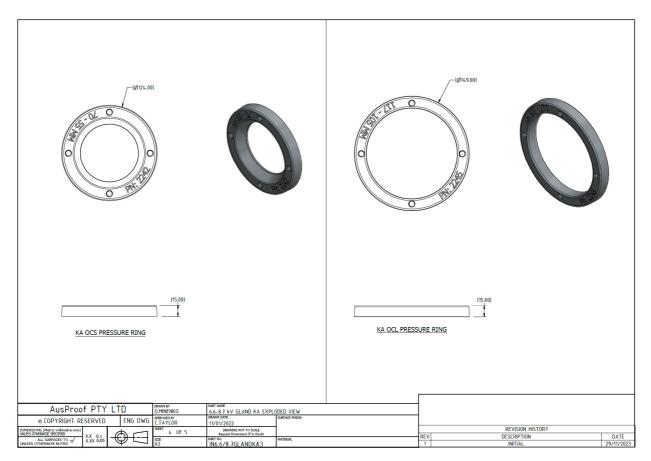


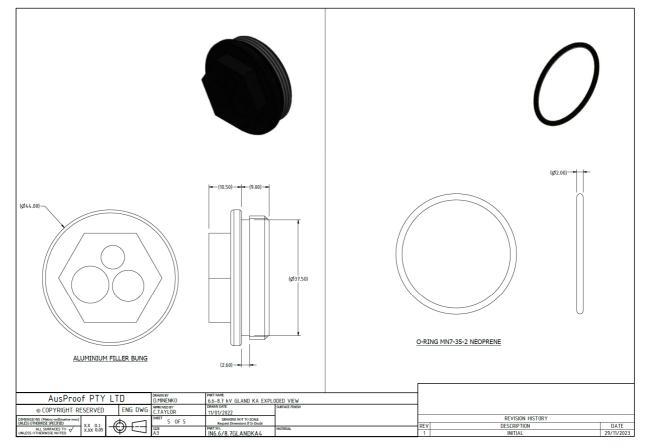




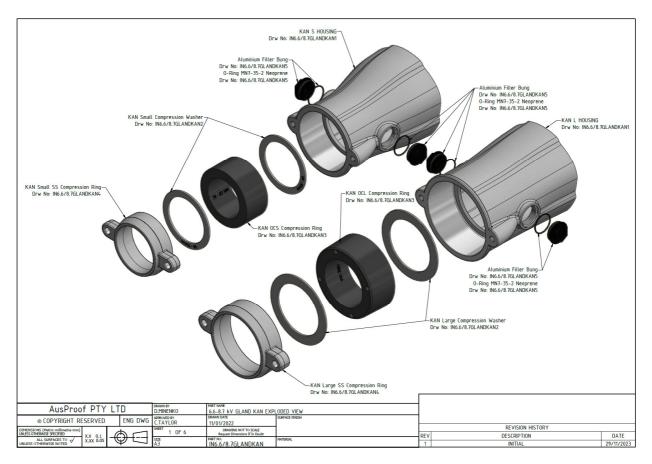
Page 25 of 29 Pages 12 January 2024

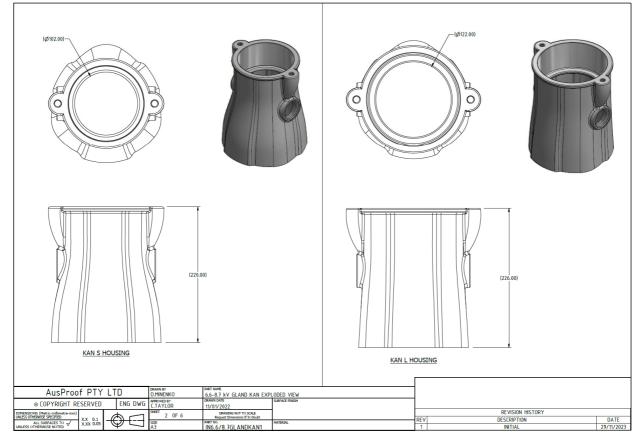




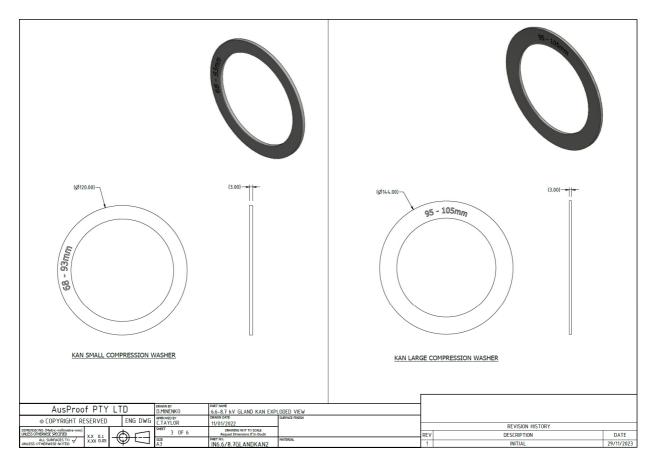


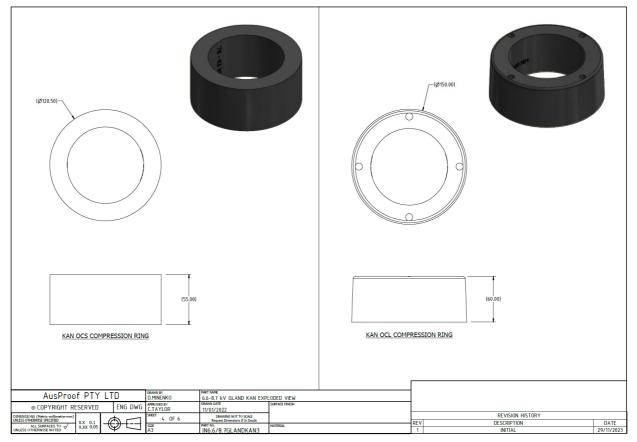






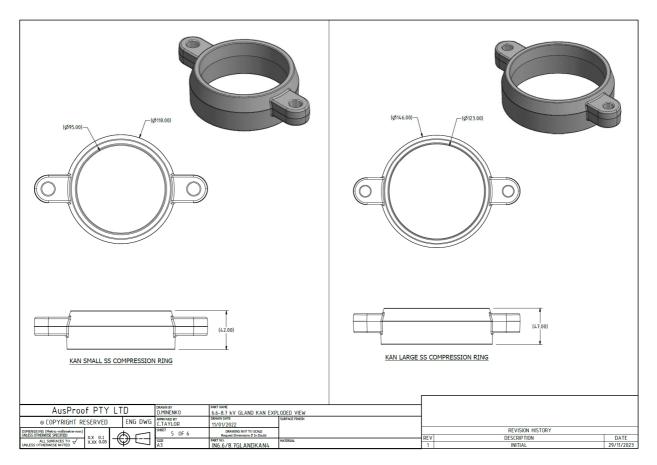


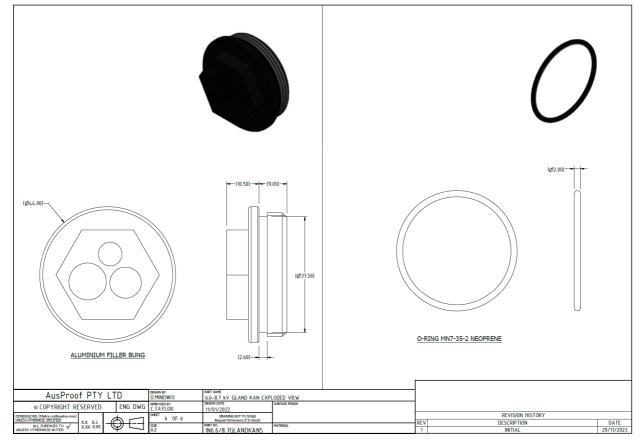




Page 28 of 29 Pages 12 January 2024







Page 29 of 29 Pages 12 January 2024