



**TEST REPORT
(READ)**

Copper ShearBolt Connector

Catalogue Number CSBS 2-250

P/N 1974136-1

502-47404(I)
REV. A

ACT No.: ACT4101
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**Markham Energy
Utility Products
Test Laboratory**

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Engineering Test Report
COPPER SHEARBOLT CONNECTOR

1. Introduction

1.1 Purpose

Testing was performed on the Copper ShearBolt Connectors, Catalogue # CSBS 2-250, P/N 1974136-1 to determine their compliance to the 'Ten-Severe Heat Cycle Test' in accordance with Con-Edison document, EO-5407-2, dated 11/1/85 using 250 kcmil Copper bare (19 str.) conductor. Four Copper ShearBolt Connectors were considered for testing.

1.2 Scope

This report covers the electrical performance of the Copper ShearBolt Connectors, Catalogue # CSBS 2-250, P/N 1974136-1.

The testing was performed between 9th December and 14th December 2011.

1.3 Conclusion

The Copper ShearBolt Connectors, Catalogue # CSBS 2-250, P/N 1974136-1 complied with the 'Ten-Severe Heat Cycle Test' requirements in accordance with Con-Edison document, EO-5407-2, dated 11/1/85 incorporating 250 kcmil Copper bare (19 str.) conductor.

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1.4 Product Description

The Copper ShearBolt Connectors, Catalogue # CSBS 2-250, P/N 1974136-1 gets its name from the four shear head bolts that come with it and from the application it is used on. The material used to manufacture the connector is electrolytic tough pitch (ETP) copper, C 11000. Its inner surface is grooved to provide best electrical contact with the conductor strands to be connected. The center stop inside the connector ensures proper conductor insertion with cable entries chamfered to provide easy cable access.

The connector is supplied with 2 copper inserts assembled to the connector body to centralize position on small conductor sizes. For sizes equal to or greater than 4/0 AWG compressed, inserts are not required and therefore must be removed. A copper-to-copper oxide inhibiting joint compound (neutral grease) will also be found in the connector barrels. CSBS 2-250 is a range taking connector that will accommodate a wide range of copper cables, from #2 AWG Compact Copper Conductor to 250 kcmil compact stranded.

Each connector is installed with 4 brass alloy shear head bolts for one time installation, two on each side of the center stop.

1.5 Test Specimens

The test specimen was supplied to the lab by New Product Development Engineering, Energy Division, Tyco Electronics, Canada ULC and the following part number and quantities were used:

Group	Copper ShearBolt Sleeve Connector, Catalogue Number	Copper ShearBolt Sleeve Connector, P/N	Quantity	Insert	Conductor Combination
1	CSBS 2-250	1974136-1	4	None	250 kcmil Cu. Bare (19 str.) cable – 250 kcmil Cu. Bare (19 str.) cable

1.6 Test Sequence

TEST OR EXAMINATION	TEST GROUP
	1
Examination of Product	1, 5
Installation Torque	2
Termination Resistance – Specified Current	3
Ten-Severe Heat Cycles	4

Note: Number indicates sequence in which tests were performed.

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2. Summary of Testing

2.1 Examination of Product

All specimens submitted for testing were inspected and accepted as being representative of a standard production unit. They were supplied to the Test Lab. by New Product Development Engineering, Energy Division, Tyco Electronics, Canada ULC.

2.2 Installation Torque

The installation torque ranged between 16.7 – 18.5 ft-lbs.

2.3 Termination Resistance – Specified Current

All termination resistance measurements taken initially and during the ten-severe heat cycles met the Con-Edison document requirement by not varying more than +/- 5% from the average of the measured values taken between the 1st to the 10th cycle interval. All measurements were corrected to the resistance at 20°C.

2.4 Ten-Severe Heat Cycle Test

There was no evidence of physical damage to the test specimens after Ten-Severe Heat Cycles. The temperatures of the specimens did not exceed the temperature of the control conductor and the temperature difference between the control conductor and the specimens was stable between the 7th and 10th cycle. Stability was achieved when the temperature difference between the control conductor and the specimen, including allowance for measurement error, is not more than 15°C from the average of the measured temperature differences in this interval. (Representative photographs of a typical connector before and after the test can be seen in figs.2 – 3).

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3. Test Methods

3.1 Examination of Product

The specimens were supplied for testing by New Product Development Department at Tyco Electronics Canada ULC.

They were examined visually for physical damage and functionally for conductor accommodation.

3.2 Installation Torque

Each Copper ShearBolt Connector, Catalogue # CSBS 2-250, P/N 1974136-1 was installed onto bare 250 kcmil copper, bare (19 str.) cable as per IS 408-10327. Each 'ShearBolt' was initially tightened by hand, and then a digital torque wrench with appropriate sized socket was applied to each bolt head until it sheared off. This process was repeated for each bolt.

3.3 Termination Resistance - Specified Current

Termination resistance was measured using a test current of approximately 12 amperes dc. Measurements were taken initially and after each cycle until 10 cycles were completed.

3.4 Ten-Severe Heat Cycle Test

Four Copper ShearBolt Connectors, Catalogue # CSBS 2-250, P/N 1974136-1 were installed in a series circuit using approximately 2 ½ feet lengths of bare 250 kcmil copper bare (19 str.) cable between any equalization point and connector. The control conductor was of the same size and was 4 feet in length. Bolted Terminal Lugs were used to connect the conductor to the power supply, with a minimum of 6 feet between the equalization point and the power supply. Prior to installation into either the connector or bolted termination lug, the end of each length of conductor was prepared by brushing with a dry stainless-steel brush to remove surface oxidation.

The equalizers were comprised of the same material as the conductor. Each one was 2" x 4 ¼" x ½" with a hole drilled to accommodate the conductor. In each case a pair of conductor's was brazed to an equalizer. The conductor was inserted into the connector and the 'ShearBolt' was tightened until the bolt head sheared off. Thermocouples were applied to each connector and in the middle of the control conductor. Voltdrop leads in order to determine the resistances were applied to each connector and to each equalizer either side of each connector.

The connectors were energized with a current of approximately 820 amps, which raised the temperature of the control conductor to approximately 250°C. The cycle time throughout the test was 4 hours 'CURRENT ON' and 4 hours 'CURRENT OFF'. The connectors were subjected to a total of 10 cycles. The temperature of the control conductor and the connectors were taken during the cycles preceding the termination resistance measurements.

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4. Validation

Prepared by:

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Energy Division
Tyco Electronics Canada ULC.

Reviewed by:

Alex Bulza Nov 26, 2013

Alex Bulza
Product Engineer
Product Development Engineering
Energy Division
Tyco Electronics Canada ULC.

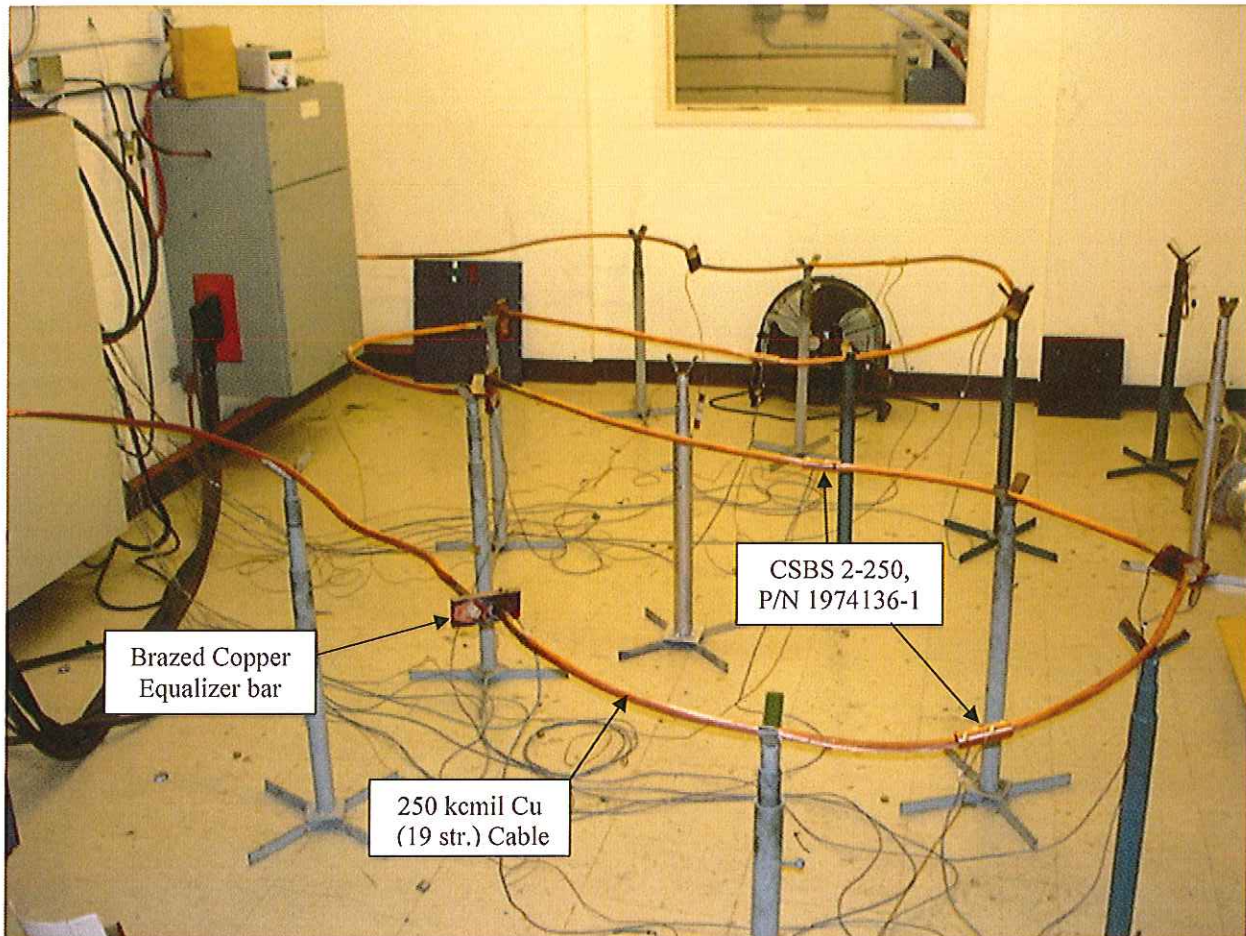
Approved by:

Barry Johnson Nov 26, 13

Barry Johnson
Manager, Product Development
Product Development Engineering
Energy Division
Tyco Electronics Canada ULC.

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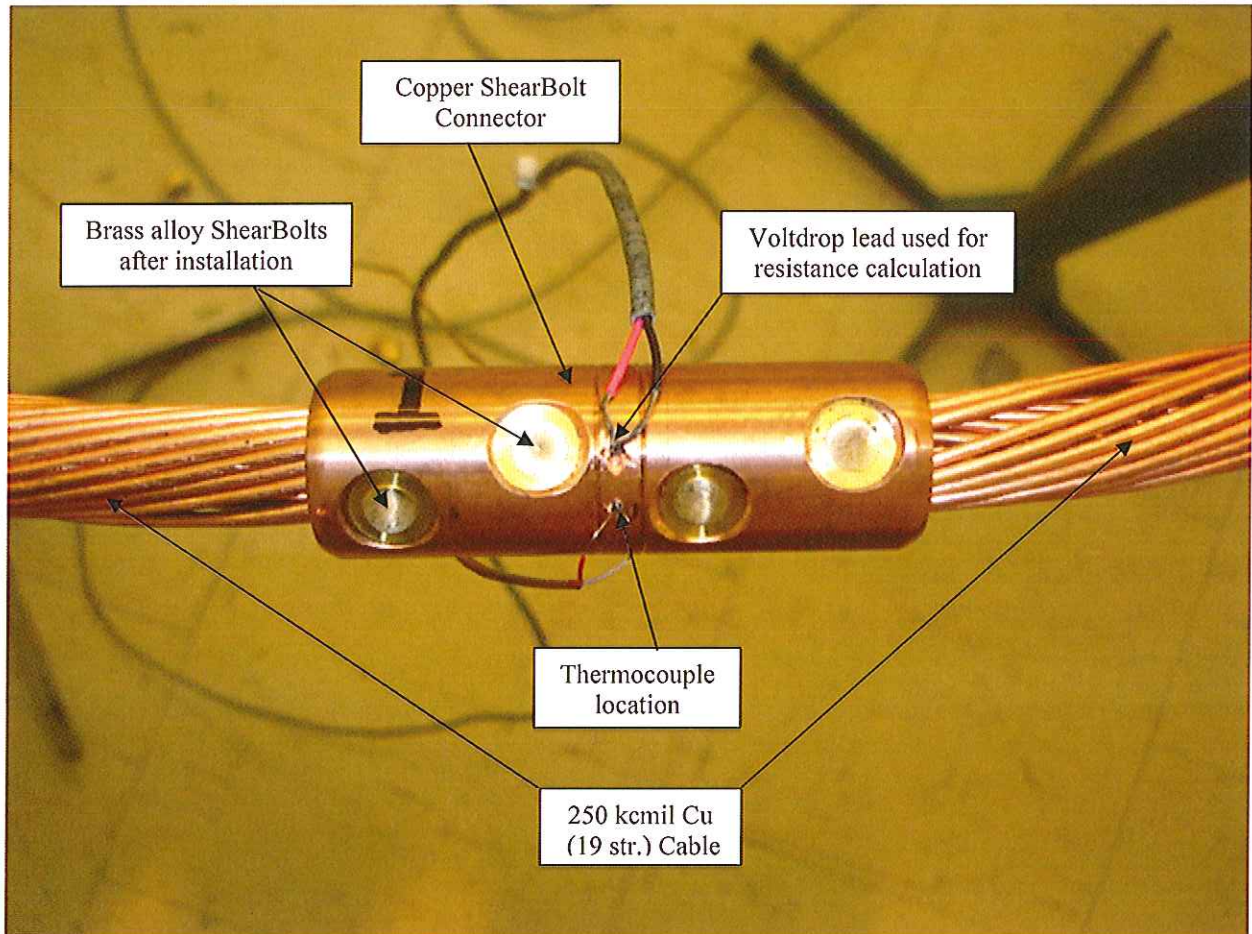
Fig. 1



Representative photograph of the Copper Shear Bolt Connector, Cat # CSBS 2-250, P/N 1974136-1, test loop set-up, before the Ten-Severe Heat Cycle Test as per Con-Edison document, EO-5407-2, dated 11/1/85.

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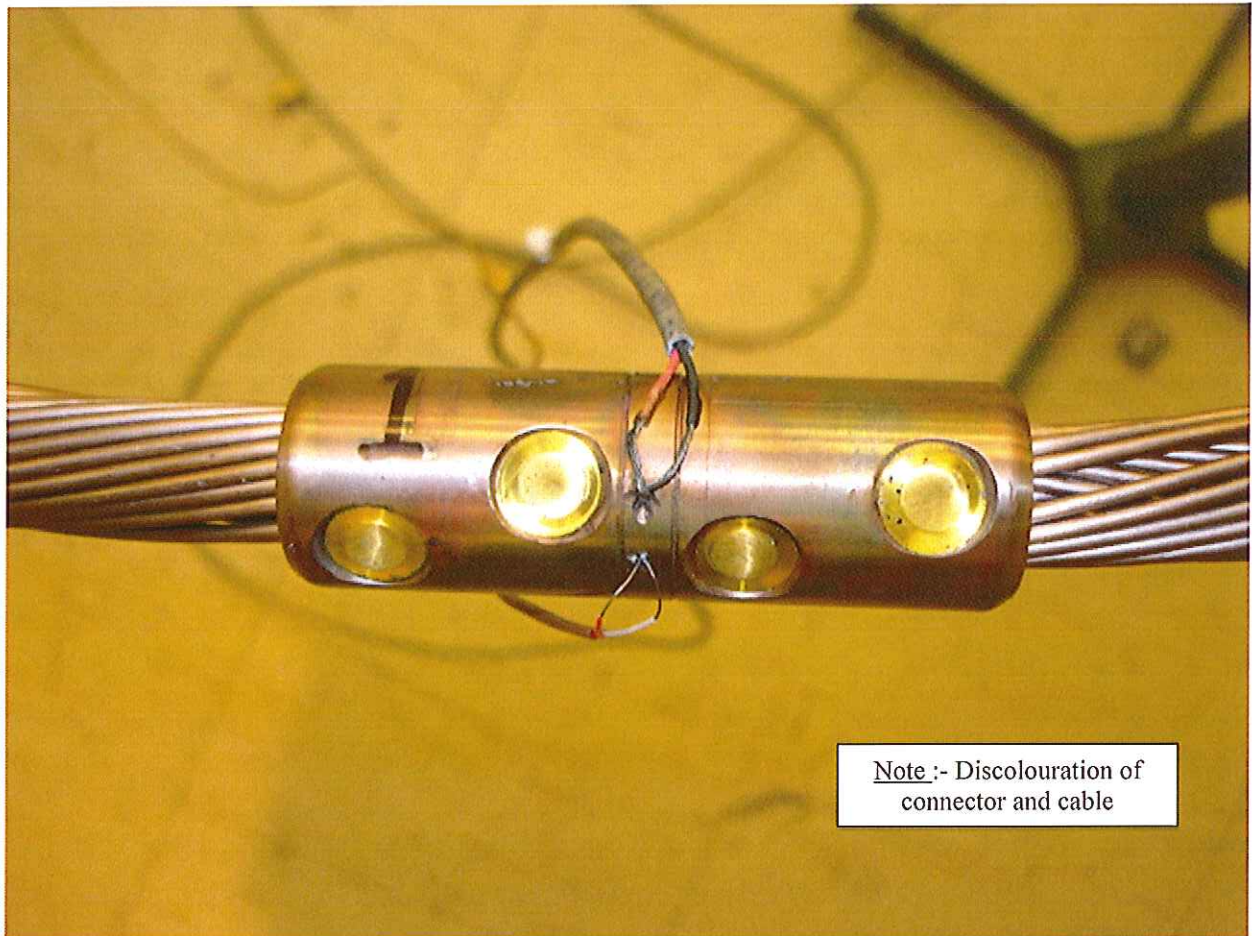
Fig. 2



Representative Close-up photograph of a typical Copper ShearBolt Connector, Cat # CSBS 2-250, P/N 1974136-1, (Specimen # 1) after installation, but before the Ten-Severe Heat Cycle Test as per Con-Edison document, EO-5407-2, dated 11/1/85.

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Fig. 3



Representative Close-up photograph of a typical Copper ShearBolt Connector, Cat # CSBS 2-250, P/N 1974136-1, (Specimen # 1) after the Ten-Severe Heat Cycle Test as per Con-Edison document, EO-5407-2, dated 11/1/85.

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REVISONS		DATE	BY	APP'D
A	INITIAL REL. PER LC20-0053-11	28SEP2011	DM	BJ
B	LC20-0151-11 / ECO-11-024500	05DEC2011	DM	BJ

1. ACCOMMODATES:
#2 AWG COMPACT (Ø6.81 [.268 DIA])
TO 250 KCMIL STD STR (Ø14.61 [.575] DIA))
COPPER CONDUCTORS.

MARKING:
STE
CSBS 2 - 250
[DATE CODE]
MADE IN [COUNTRY OF ORIGIN]

- INSERT SHALL BE REMOVED FOR CONDUCTOR SIZES LARGER THAN OR EQUAL TO 4/0 AWG COMPRESSED COND (Ø13.00 [.512 DIA]).
- ALL DIMENSIONS ARE FOR REFERENCE ONLY.
- INSTALL BOLTS WITH 1/2 INCH HEX. SOCKET.

LOC	QTY	DESCRIPTION
GA	1	

QTY	DESCRIPTION	ITEM NO
1	INSTALLATION INSTRUCTION SHEET, 408-10327	6
1	ABRASIVE TAPE	5
4	MULTI-SHEAR BOLT, BRASS, M12	4
A/R	CONTACT GREASE, NEUTRAL	3
2	INSERT, ETP COPPER	2
1	CONNECTOR BODY, ETP COPPER	1
-1	DESCRIPTION	

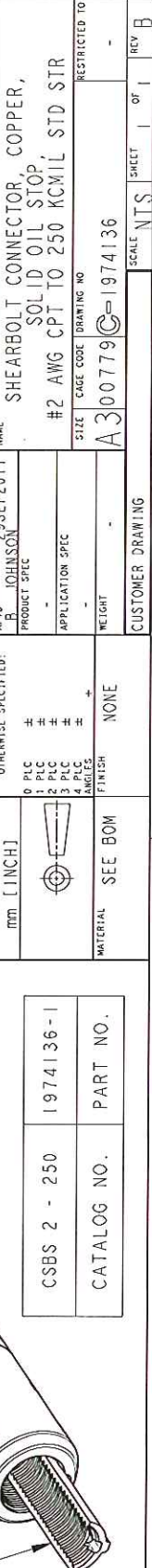
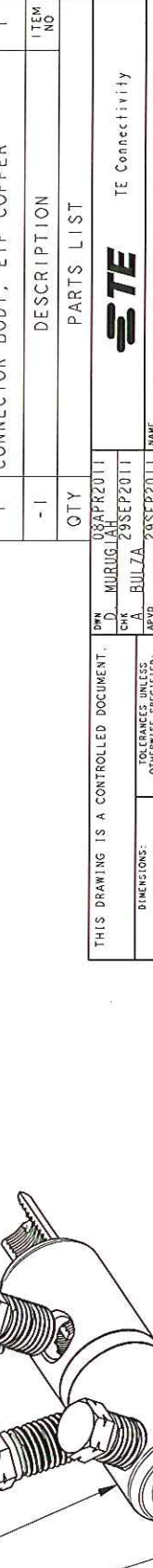
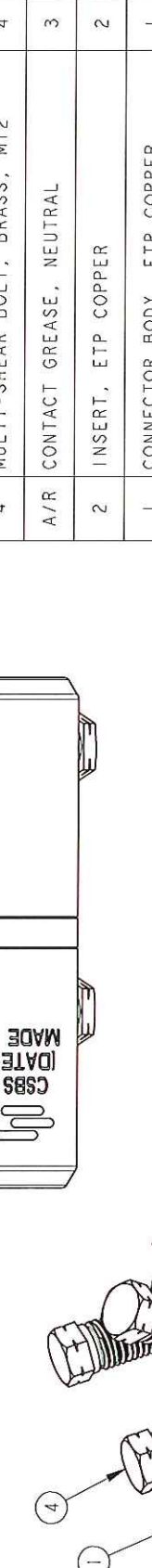
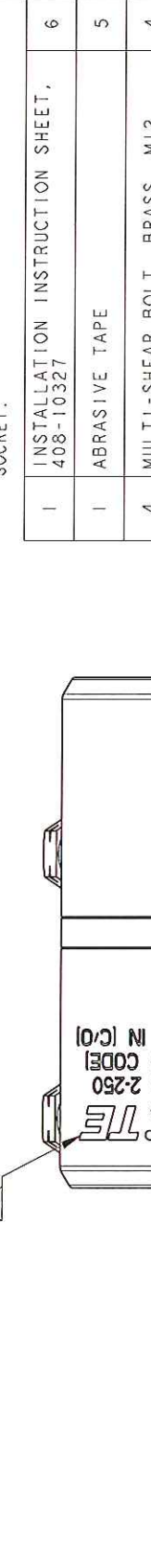
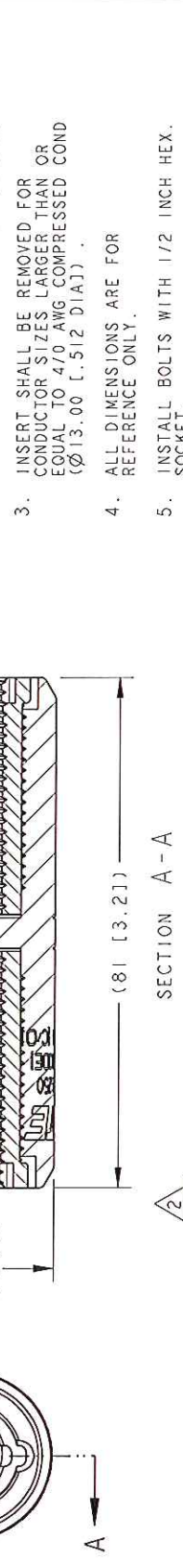
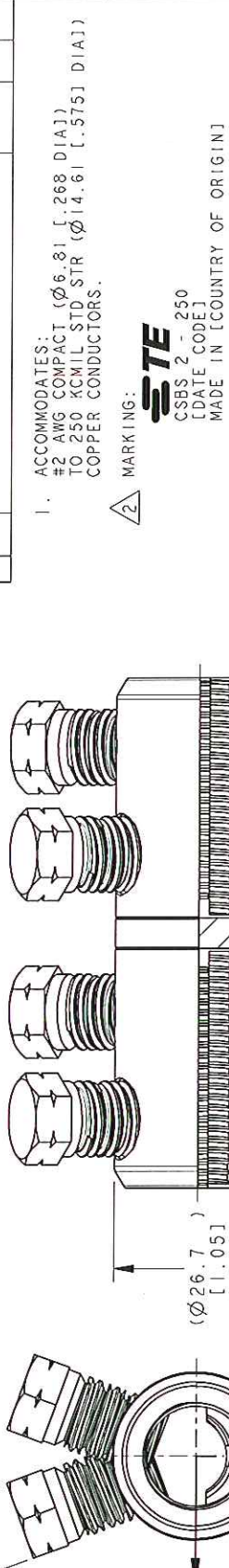
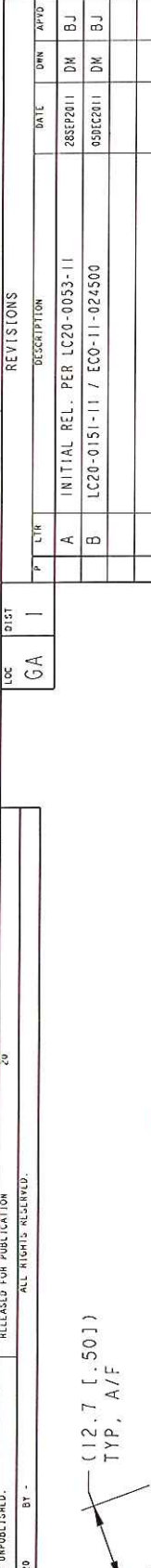
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4	MULTI-SHEAR BOLT, BRASS, M12	4
A/R	CONTACT GREASE, NEUTRAL	3
2	INSERT, ETP COPPER	2
1	CONNECTOR BODY, ETP COPPER	1
-1	DESCRIPTION	



THIS DRAWING IS A CONTROLLED DOCUMENT.

DIMENSIONS:	mm	[INCH]
0 PLC	±	±
1 PLC	±	±
2 PLC	±	±
3 PLC	±	±
4 PLC	±	±
ANGLES	±	±

TOLERANCES UNLESS OTHERWISE SPECIFIED:

FINISH: NONE

MATERIAL: SEE BOM

CSBS 2 - 250 1974136-1

CATALOG NO. PART NO.

STE TE Connectivity

SHEARBOLT CONNECTOR, COPPER, SOLID OIL STOP #2 AWG CPT TO 250 KCMIL STD STR

SIZE: CASE CODE DRAWING NO: A300779 ©1974136 RESTRICTED TO

SCALE: NTS SHEET OF 1 REV B