



**LIGO LABORATORY**  
California Institute of Technology  
1200 E. California Blvd.  
Pasadena, CA 91125

## Statement of Work In-vacuum cables

### 1.0 Scope

This SOW is for the fabrication of various individual parts detailed in the drawings included in this package. These parts will be assembled by the Supplier to create in-vacuum cables for use in several Advanced LIGO subsystems. These cables (and their individual parts) will be in contact with an Ultra High Vacuum (UHV) environment. **Please note that most of the parts for the assembly of the cables will be supplied by LIGO (exclusions are noted in Section 6.5).**

### 2.0 Document Access

Many supplemental documents and specifications are incorporated into and made a part this Statement of Work. Click on the document links to access these documents from the LIGO Document Control Center (DCC) or go online to the LIGO Public DCC at <https://dcc.ligo.org/> to access the DCC#.

### 3.0 Commercial Terms and Applicable LIGO Specifications:

**Note: The documents listed below are invoked for this Statement of Work and comprise additional requirements which are integral to this Statement of Work.**

- [LIGO-C080185-v1](#) LIGO Commercial Items or Services Contract General Provisions
- [LIGO-Q0900001-v5](#) Advanced LIGO Supplier Quality Requirements
- [LIGO-Q1100003-v1](#) Acceptable Quality Level (AQL) for Inspection of LIGO Components

### 4.0 Quality System:

Referring to the above referenced LIGO Specification Q0900001, Suppliers should include a copy of their current ISO 9001, AS9100, or TS16949 certification in their bid package. Suppliers lacking current certification should send a copy of their Quality Manual with their bid package.

### 4.1 Manufacturing process

Suppliers are to provide an assembly approach on the process that will be used. For example:

- Which cable clamping method will be used.
- Proposed design change recommendations that would improve the manufacturing process.

## 5.0 Parts/Assemblies to be manufactured, Quantity Required, and Inspection requirements:

Note: refer to Section 8.0 for delivery schedule and location.

All cable lengths are to be measured, and found to comply with drawing tolerances. All other dimensions on the drawing should be checked on the first article.

A hipot electrical test shall be performed to verify the insulation integrity of each insulated conductor. The test shall certify the measured insulation resistance of any conductor to adjacent conductors in a bundle AND the overall cable shield. The measured insulation resistance at a test voltage of greater than or equal to 500 VDC shall be greater than or equal to 500 mega-Ohms. It is not necessary to record each measurement, but a record of satisfactory test completion must be available upon request. LIGO will provide mating ends to be used for testing.

Drawing #	Length (in)	Description	Quantity
D1000223	216	DB25 F - DB25 F	20
D1000227	36	DB25 M - DB9 F, DB9 F Right Angle	4
D1000234	66	DB25 M - x4 microD9 F	10
D1000234	78	DB25 M - x4 microD9 F	9
D1000234	88	DB25 M - x4 microD9 F	21
D1000234	96	DB25 M - x4 microD9 F	13
D1000237	36	DB25 M - Mighty Mouse 7pin F	15
D1000568	143	DB25 M - DB25 F	8
D1000921	143	DB25 M - DB25 F	7
D1000924	216	DB25 F - DB25 F	8
D1002522	110	DB25 M - microD25 F	8
D1100148	80	DB3 F - DB3 M	6
D1100150	40	DB3 F - x2 Pin	4
D1100151	60	DB3 F - x2 Pin	6
D1100152	110	DB25 F - DB25 F	1
D1101658	108	DB25 F - DB25 F	2
D1101659	108	DB25 F - DB25 F	12
<b>TOTAL</b>			<b>154</b>

Note: refer to LIGO-L1100003 (Sec 3.0) for the AQL table.

## 6.0 Manufacturing:

### 6.1 Requirements:

Suppliers must refer to the LIGO specifications referenced in Section 3.0 for additional, and in some cases, non-industry standard requirements.

## **6.2 Sub-Contracted Work:**

The drawings typically represent the finished part as needed for use in service. Suppliers should always contact a LIGO representative to resolve any discrepancies or uncertainties in the documentation or instructions.

## **6.3 Precedence:**

The drawings typically represent the finished part as needed for use in service. Suppliers should always contact a LIGO representative to resolve any discrepancies or uncertainties in the documentation or instructions.

## **6.4 Special Instructions:**

### **6.4.1 Restrictions:**

#### Cleanliness Requirements for Cable Assembly/Manufacture:

- These cables will be used in an Ultra-High Vacuum (UHV) system. Care must be taken to maintain cleanliness while handling and machining these parts. All machines, tools, fixtures and storage containers which come into contact with the cable parts or cable assemblies should be clean, and kept clean from oxides, oils, etc. This is to avoid cross contamination before any winding/assembly takes place.
- All parts/components of the cable assembly must be as clean as possible before assembly. This can be discussed with LIGO personnel at the time of procurement.

### **6.4.2 Materials:**

LIGO will provide all parts required to manufacture the cables with the exception noted in Section 6.5

### **6.4.3 Finishing:**

Any required surface finish is defined in the drawings. Localized scratches, digs and blemishes should be minimized.

### **6.4.4 Markings:**

All cables shall be serialized. Serial numbers will be provided by LIGO when needed. Each connector must be laser etched or engraved by the Supplier as outlined on the subsequent page. Arrows on pictures indicate areas where connectors should be labeled if they have not already been scribed. If the parts supplied by LIGO have existing serial numbers, they should be removed. The scribing method should result in a legible set of numbers without using any dyes or inks.

Length and position are special cases. Length is scribed only if a drawing number has multiple lengths. Position (V for vertical, H for horizontal) is scribed only if connectors are set at different angles from each other.



**DB25**

D# – version – length\* – s/n

Example:

D1000234–v2–88–S1101234

Length required for:

D1000234

D1002522



**DB9**

D# – version – s/n – position\*

Example:

D1000228–v2–S1000000 V

Position required for:

D1000227

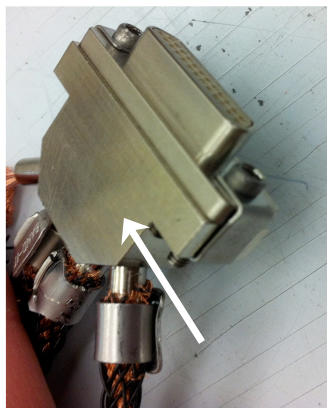


**DB3**

D# – version – s/n

Example:

D1100150–v1–S1107134



**MicroD25**

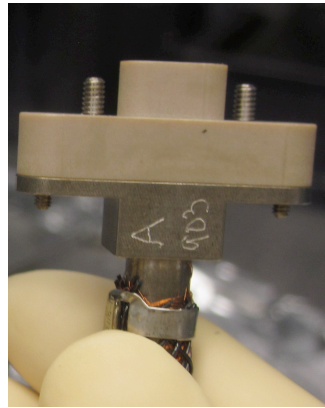
D# – version – length\* – s/n

Example:

D1002522–v4–110–S1000001

Length required for:

D1002522



**MicroD9**

Leg (A, B, C, D) – last 3 digits of s/n

Example:

A 903



**Mighty Mouse**

Leg (A, B, C, D)

## 6.5 Exclusions:

- Supplier is not responsible for supplying or installing the helicoils.
- All microD9 and microD25 connectors require potting compound and LIGO WILL NOT supply the potting compound used in the assembly. LIGO requires that only the following epoxy be used:  
EP-1730-1  
CHEMICAL NAMES: Modified Epoxy  
MANUFACTURER'S NAME: EPOXY PAX  
ADDRESS: 711 W. 17<sup>th</sup> Street B-5, Costa Mesa, CA 92627 (949) 646-2522

## 7.0 End Item Data Package:

Before delivery of the parts, the Supplier shall provide the following data, as a minimum:

- Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the drawings
- Material certifications
- Inspection reports of all dimensional features for the number of parts specified per the AQL number and referenced in the AQL table LIGO-L1100003 (Sec 3.0) and any other inspection requirements detailed in Section 5.0 of this SOW
- Certificate of compliance for each part number stating conformance to contract and drawing requirements

## 8.0 Delivery Requirements:

### 8.1 Shipping Containers and Packaging:

The Supplier is responsible for providing shipping containers and transportation which protect these parts from damage from the transportation environment (weather, handling, accidents, etc.). Mating edges of parts should be especially protected from damage during shipping.

### 8.2 Shipping Destination(s):

The deliveries are FOB at these destinations, i.e. the Supplier has the responsibility for shipping title and control of goods until they are delivered and the transportation has been completed. The Supplier selects the carrier and is responsible for the risk of transportation and for filing claims for loss or damage.

These items will be shipped to:

California Institute of Technology (CIT)  
LIGO Project MS 100-36  
391 S. Holliston Ave.  
Pasadena, CA 91125  
Attn: Kate Gushwa

### 8.3 Delivery Schedule:

Cables should be shipped within 8 weeks after receipt of materials. First Articles for the following drawing numbers are due **2 weeks after receipt of materials**:

- D1000227
- D1000234 66"

- D1000237
- D1002522 110"
- D1100148
- D1100150
- D1101659

Please provide separate pricing for expedited delivery according to the due dates (following First Article approval) outlined in the following table.

Drawing #	Length (in)	Description	Quantity	Due (weeks)
D1000223	216	DB25 F - DB25 F	20	2
D1000227	36	DB25 M - DB9 F, DB9 F Right Angle	4	4
D1000234	66	DB25 M - x4 microD9 F	10	2
D1000234	78	DB25 M - x4 microD9 F	9	3
D1000234	88	DB25 M - x4 microD9 F	21	5
D1000234	96	DB25 M - x4 microD9 F	13	5
D1000237	36	DB25 M - Mighty Mouse 7pin F	15	1
D1000568	143	DB25 M - DB25 F	8	3
D1000921	143	DB25 M - DB25 F	7	6
D1000924	216	DB25 F - DB25 F	8	3
D1002522	110	DB25 M - microD25 F	8	6
D1100148	80	DB3 F - DB3 M	6	4
D1100150	40	DB3 F - x2 Pin	4	4
D1100151	60	DB3 F - x2 Pin	6	4
D1100152	110	DB25 F - DB25 F	1	4
D1101658	108	DB25 F - DB25 F	2	2
D1101659	108	DB25 F - DB25 F	12	1

Please suggest an alternative delivery schedule if this is not possible. Early and/or partial deliveries are acceptable.

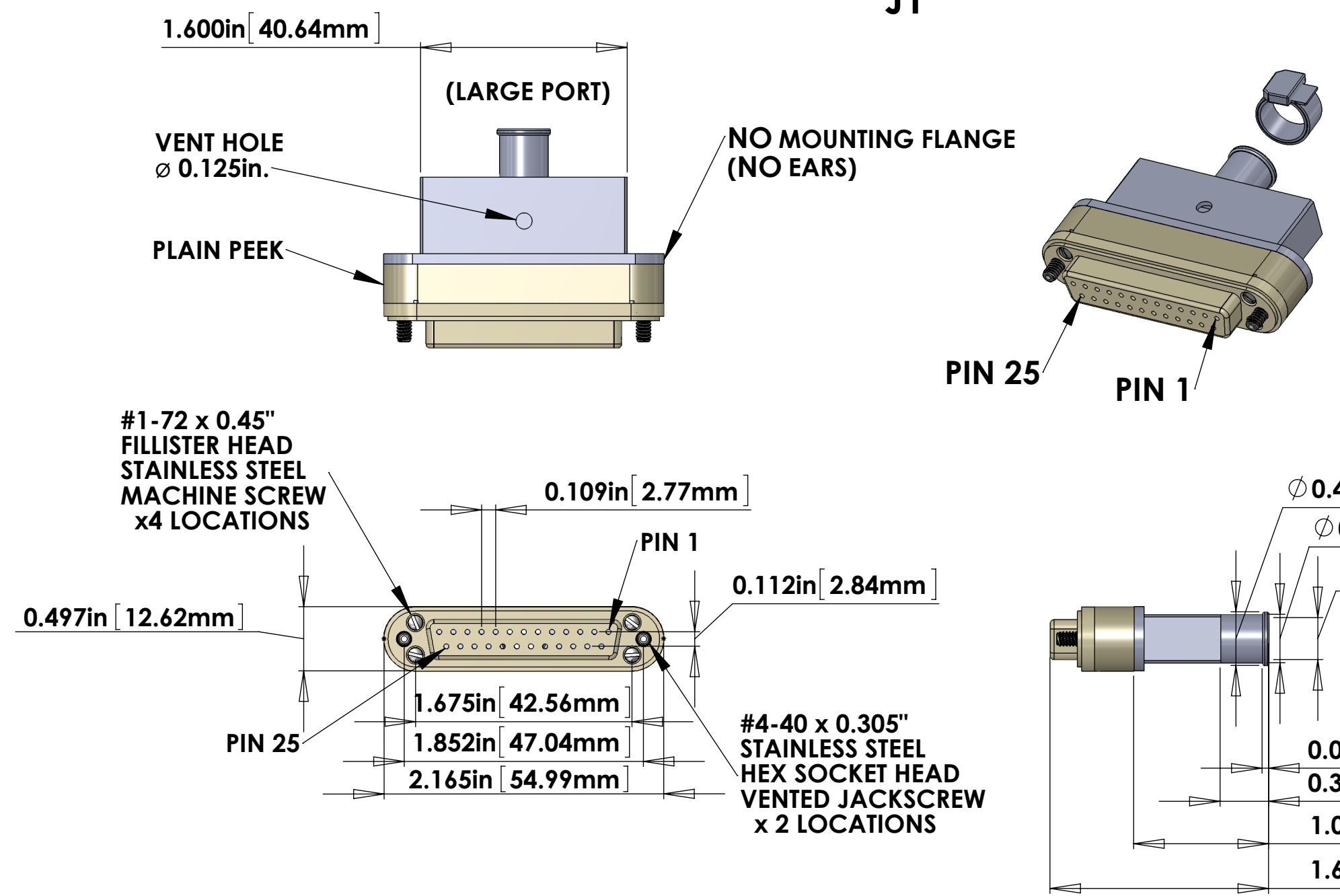
- NOTES CONTINUED:
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXX-VV, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV.4
  - ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.

- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
- DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

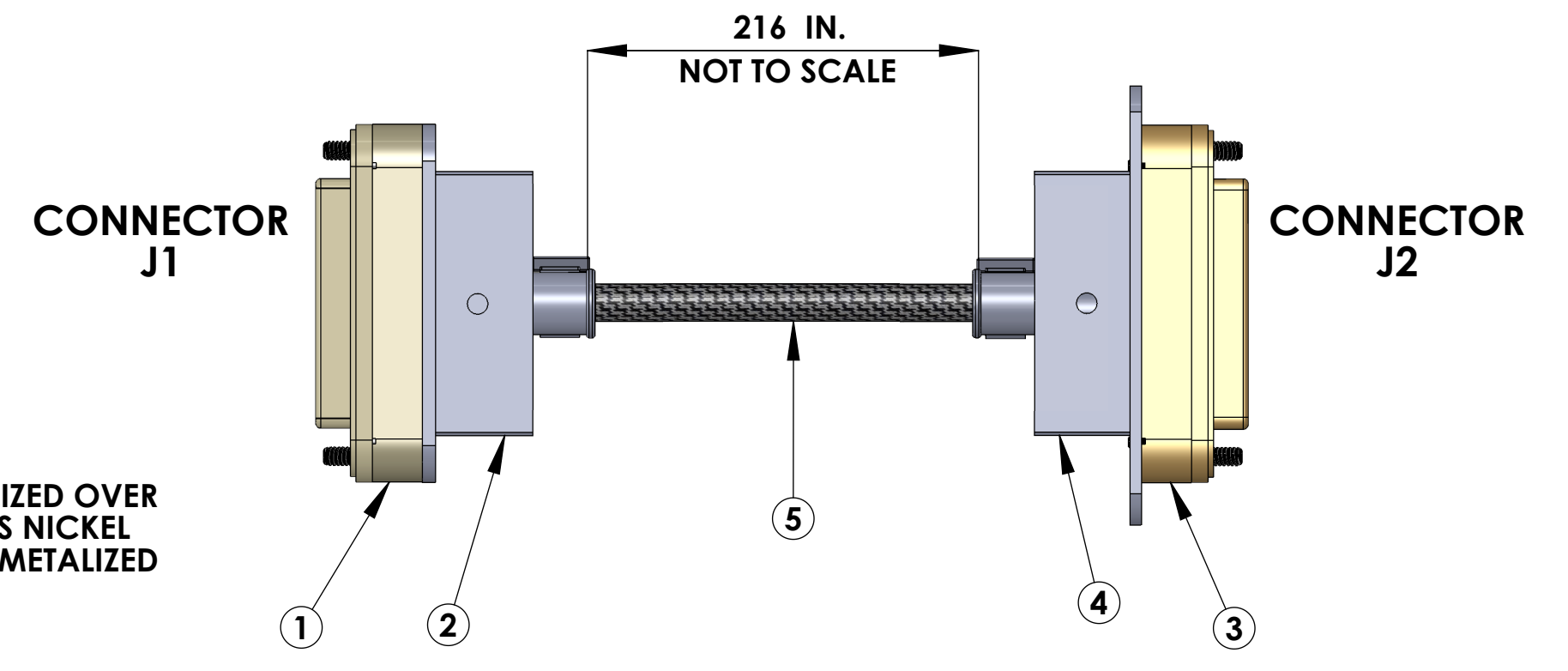
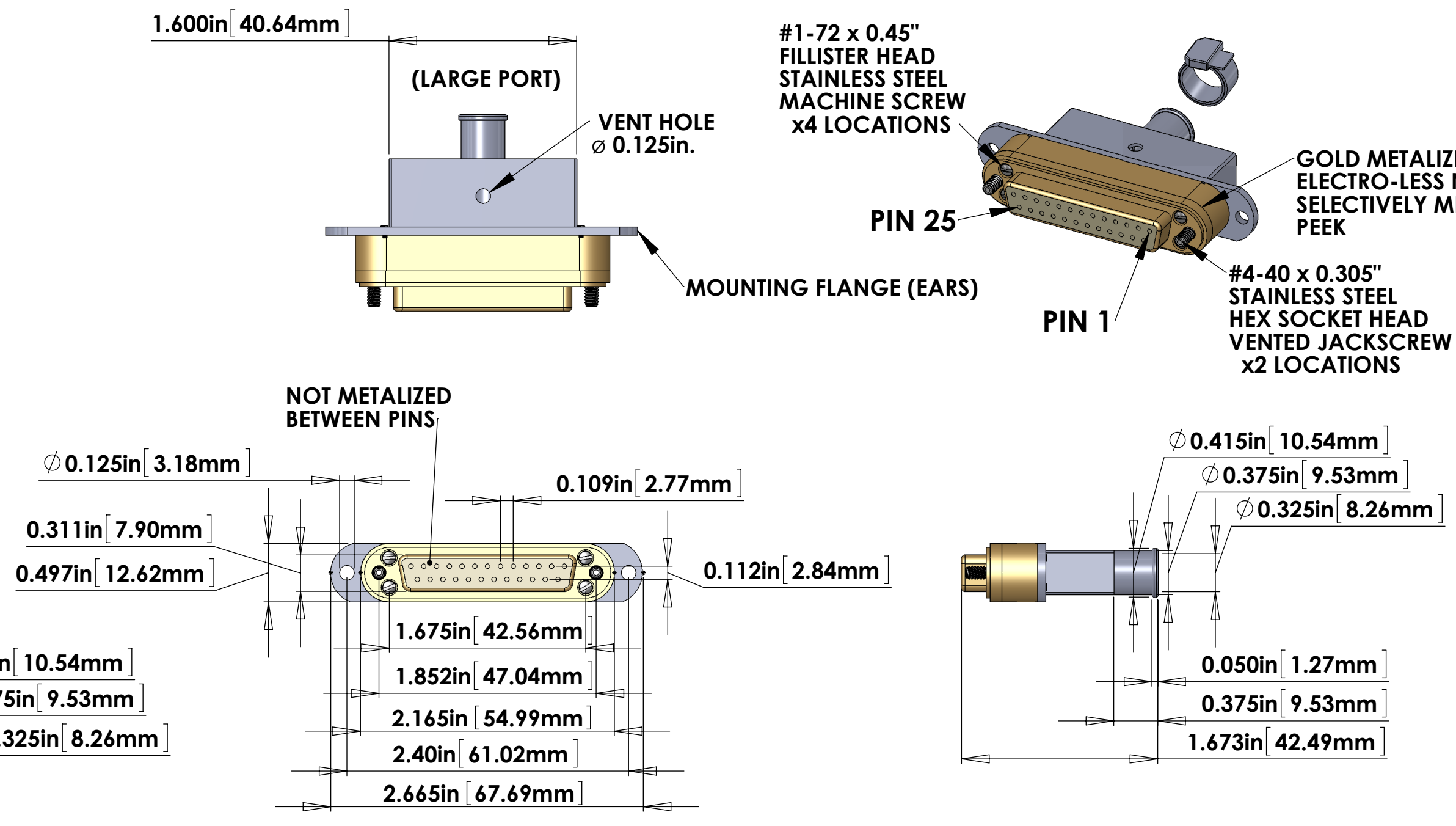
NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART.

REV.	DATE	DCN #	DRAWING TREE #

### CONNECTOR J1



### CONNECTOR J2



### V25B-216 CABLE ASSEMBLY CIRCUIT SUMMARY V-DB25HD F/S1-216-DB25HD F/S1

CABLE NAME	COND.- WIRE ID	DOUBLE TWISTED PAIR	LENGTH *	FROM	TO
V25B-216	16 COND. CABLE	(12 TOTAL)	216 in.	Conn. J1	Conn. J2
	SHIELD		216 in	PIN 1, SHELL	PIN 1, SHELL
	W13	TP-1	216 in	PIN 13	PIN 13
	W25		216 in	PIN 25	PIN 25
	W12	TP-2	216 in	PIN 12	PIN 12
	W24		216 in	PIN 24	PIN 24
	W11	TP-3	216 in	PIN 11	PIN 11
	W23		216 in	PIN 23	PIN 23
	W10	TP-4	216 in	PIN 10	PIN 10
	W22		216 in	PIN 22	PIN 22
	W9	TP-5	216 in	PIN 9	PIN 9
	W21		216 in	PIN 21	PIN 21
	W8	TP-6	216 in	PIN 8	PIN 8
	W20		216 in	PIN 20	PIN 20
	W7	TP-7	216 in	PIN 7	PIN 7
	W19		216 in	PIN 19	PIN 19
	W6	TP-8	216 in	PIN 6	PIN 6
	W18		216 in	PIN 18	PIN 18

PIN 14,2,15,3,16,4,17,5 N/C (NOT CONNECTED)

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

SEE REFERENCE DCC# LIGO-D1100670

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0148-25C020BS1-325) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J1) FOR UHV (PLAIN PEEK)	1	216in *
2		DB25 CONNECTOR BACKSHELL (NO EARS) FOR UHV (STAINLESS) WITH $\varnothing$ 0.325" i.d. PORT	1	
3	TICOR # (TS0148-25C020BS1-325F) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS) WITH $\varnothing$ 0.325" i.d. PORT	1	
5	COONER WIRE # CZ2205 22GA PFA INSULATED BIOMEDICAL WIRE	16 COND. (8 TW PAIR) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	216in *
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
7	PART # 6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT - SUPPLIED BY LIGO	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	

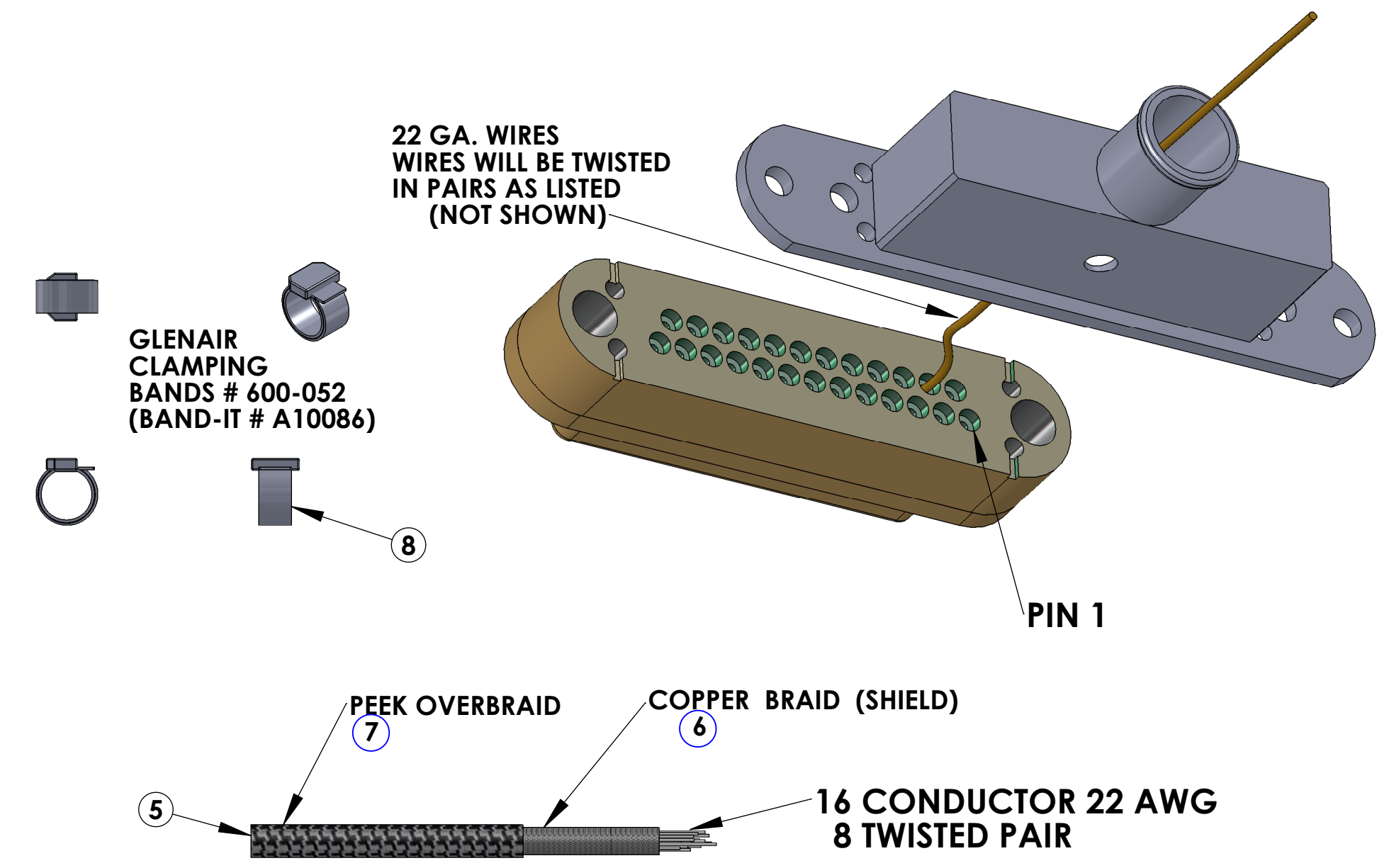
\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

#### NOTES: ( UNLESS OTHERWISE SPECIFIED )

- MATERIAL:
  - J1 CONNECTOR SHELL - PEEK VICTREX 450G130.
  - J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450G130.
  - BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
  - CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.00050 MIN. GOLD OVER NICKEL.
  - HARDWARE: STAINLESS STEEL, PASSIVATED.
  - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.
- CABLE 16 COND. 22 AWG (150/44), WITH PFA INSULATION COONER WIRE #CZ2205. 8 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ). OVERALL 40AWG COPPER BRAID SHIELD MIN. 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. ~ 0.260 IN.
- CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.

#### INTERNAL WIRING ONLY ONE WIRE SHOWN FOR CLARITY



#### NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

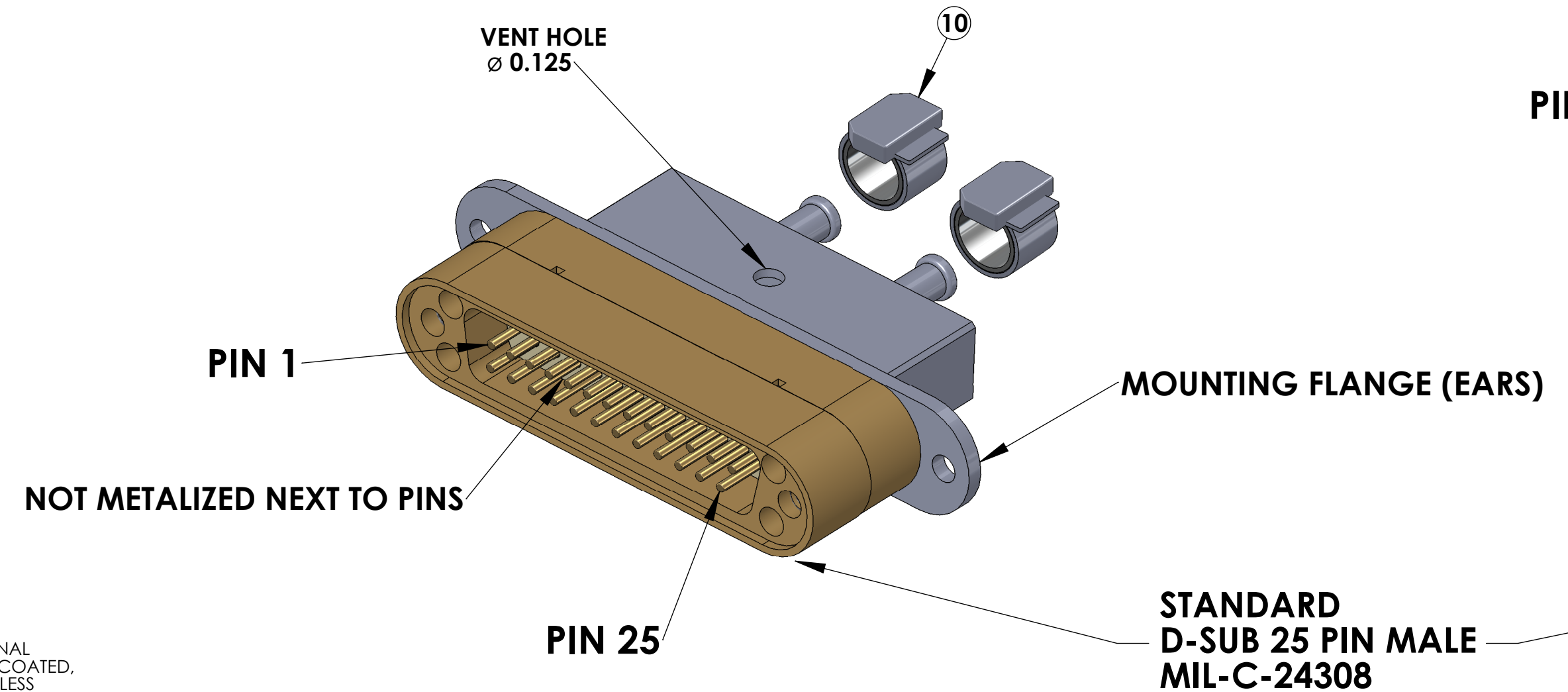
DIMENSIONS ARE IN	1. INTERPRET DRAWING PER ASME Y14.5-1994.	LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY	PART NAME
TOLERANCES:	2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.	SYSTEM LIGO	CUSTOM CABLE SPECIFICATION V25B-216
ANGULAR $\pm$ °	3. DO NOT SCALE FROM DRAWING.	NEXT ASSY	DESIGNER R. ABBOTT JUL/02/2012
	4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.		SIZE DWG. NO. D D1000223
			CHECKER E. BROWN JUL/02/2012
			APPROVAL
			SCALE: 1:1 PROJECTION: SHEET 1 OF 1

ISC TRANSMON PICOMOTOR CABLE VACUUM FLANGE TO SEISMIC TABLE		
V-DB25HD F/S1-216-DB25HD F/S1		
STANDARD USE FOR THIS CABLE		
SUBSYSTEM	AIR/VAC	STANDARD USE
ISC & ISC(TMS)	IN-VAC	PICOMOTORS - FLANGE TO TOP

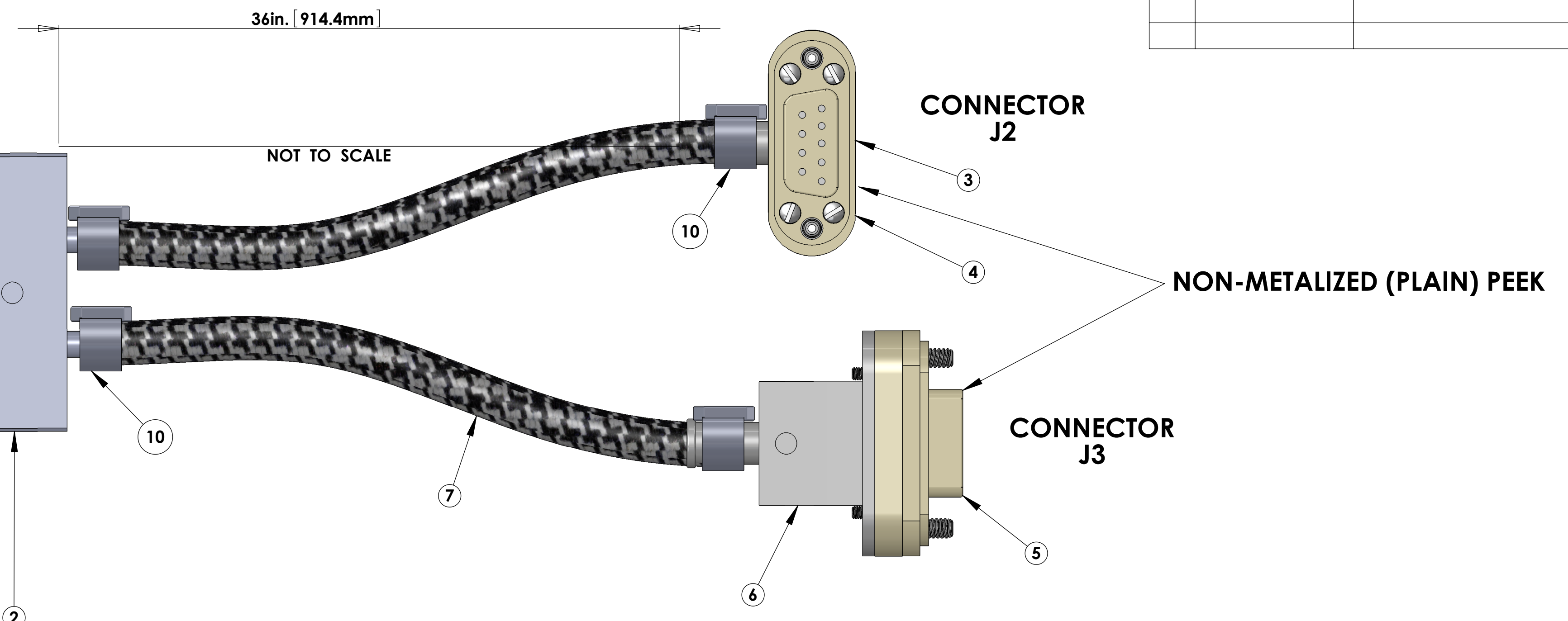
D1000223-46.cdw V25B-216 PART PDM REV. DRAWING PDM REV. A-001

NOTES CONTINUED:  
 3. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE 07" HIGH CHARACTERS. DXXXXXX.YY, S/N 001. EXAMPLE: A VIBRATORY TOOL MAY BE USED.  
 6. APPROXIMATE WEIGHT = X.XXXX LB.  
 7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-ED900364.  
 8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E9900364.  
 9. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV. 4  
 10. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.  
 11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS, FLOPS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-ED900364.  
 12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.  
 13. PARTS WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E9000364 AFTER FABRICATION. THE INDICATED HIGLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.  
 14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.  
 15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF 1/2 OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.  
 NOTES 13 and 14 DO NOT APPLY TO THIS PART

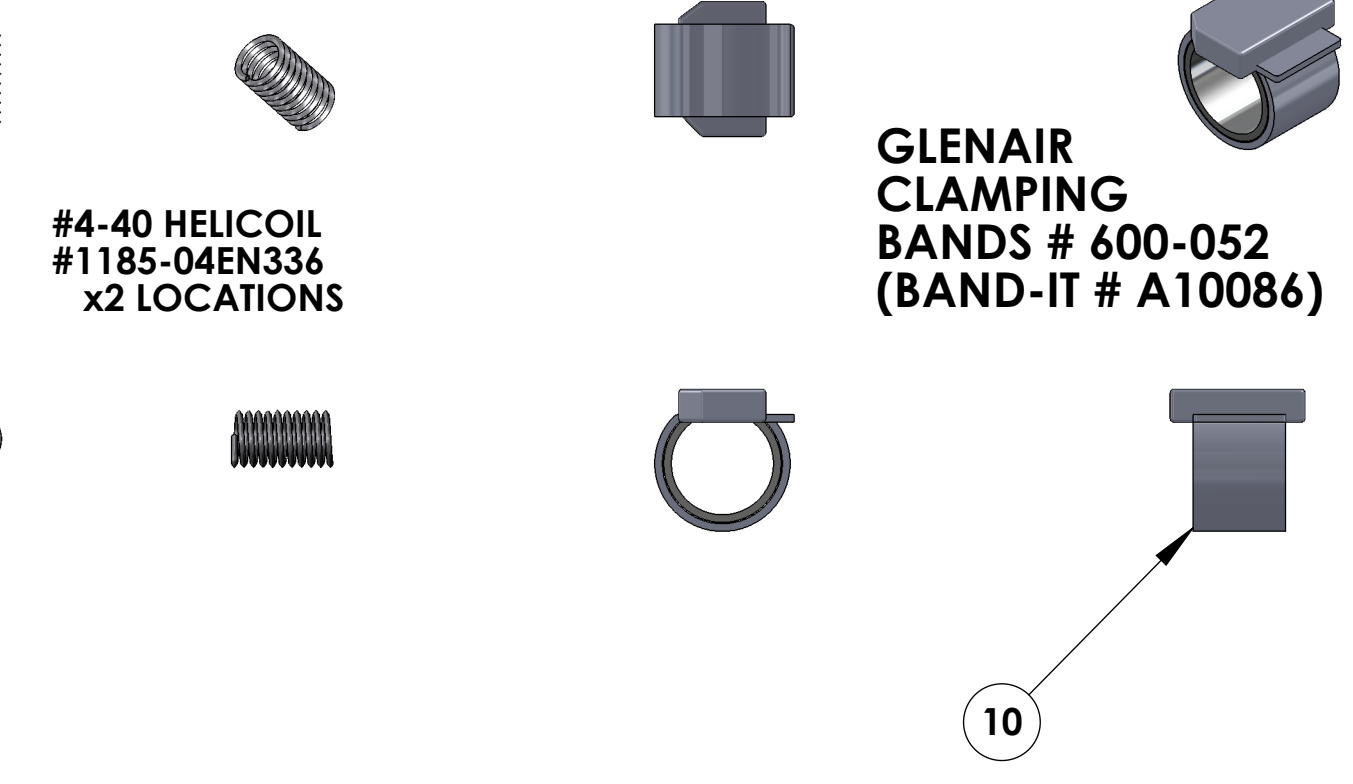
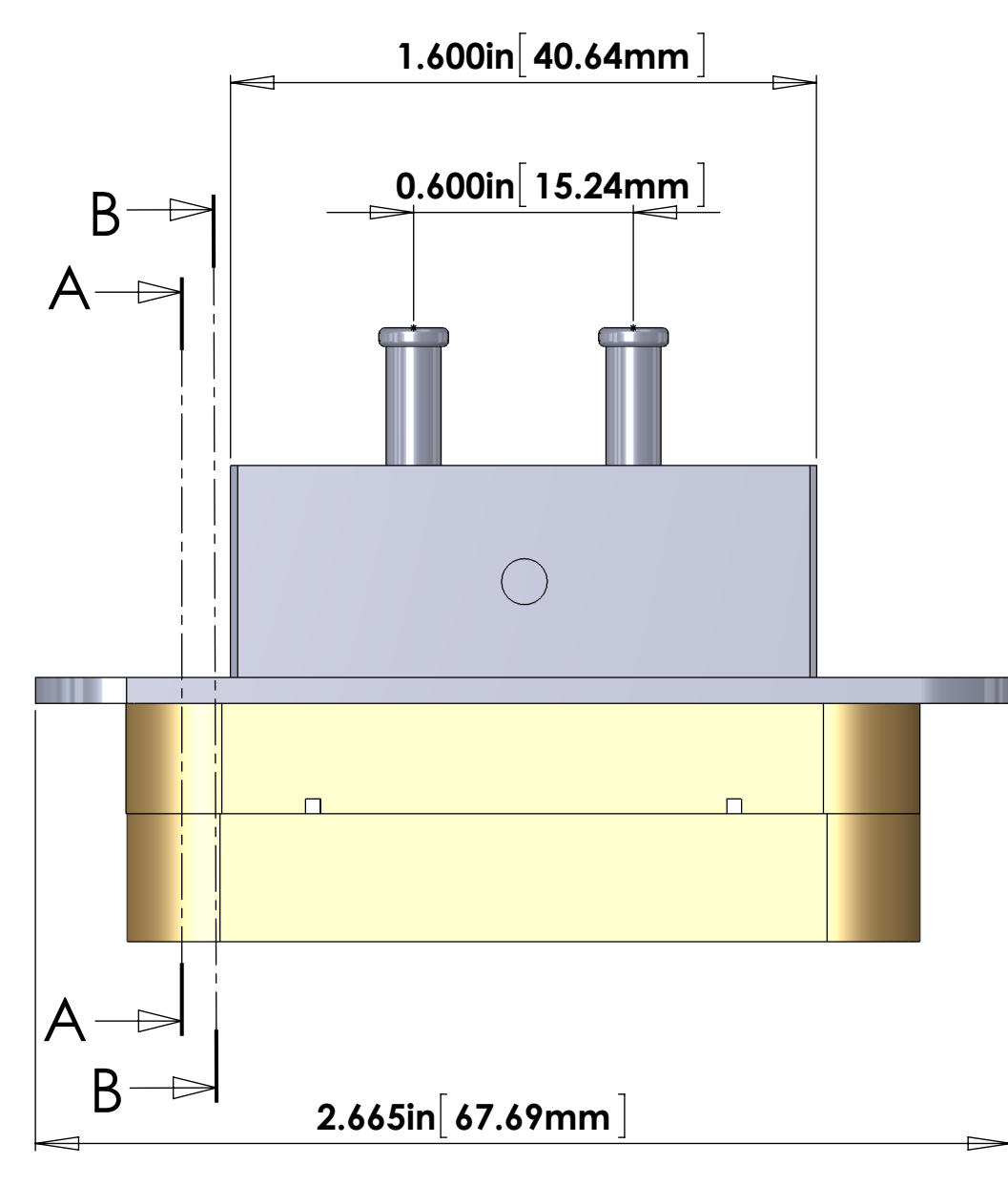
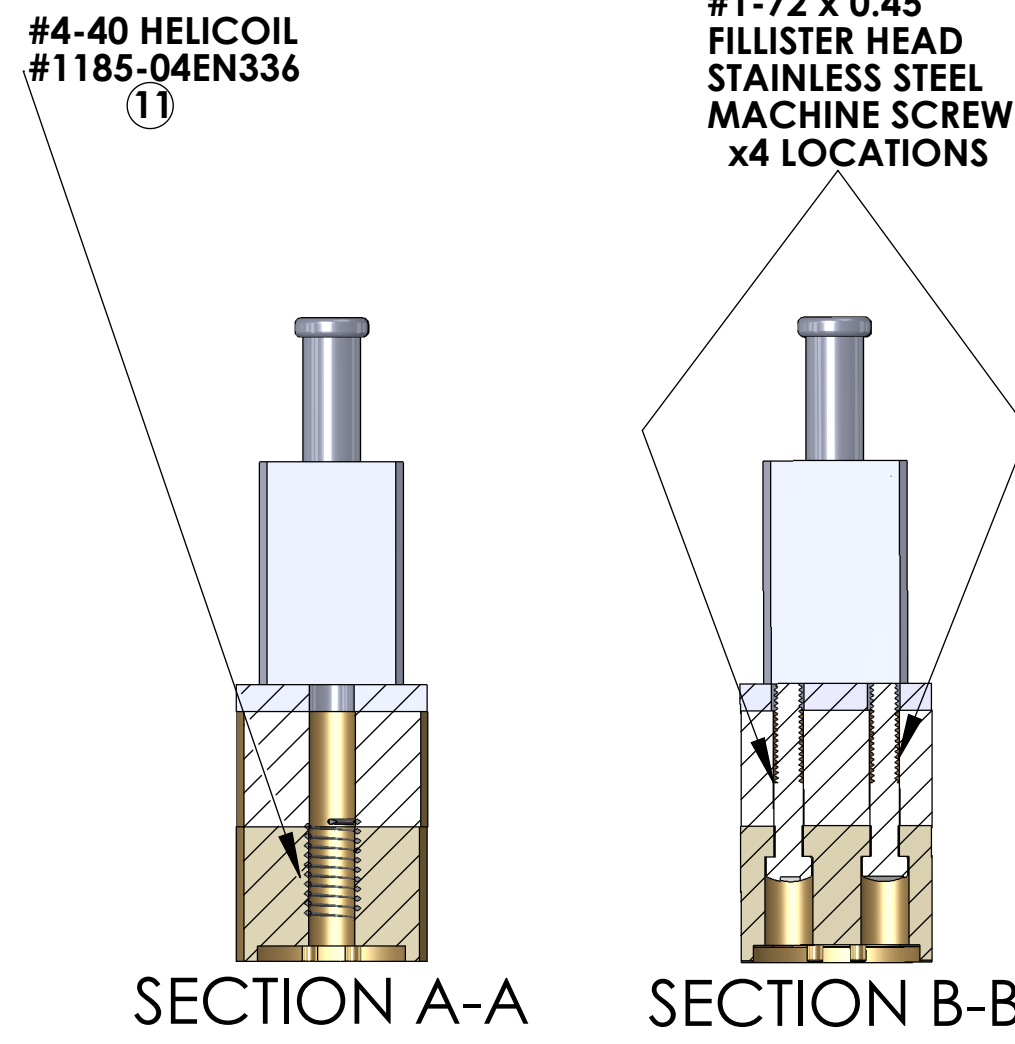
**CONNECTOR J1**



GOLD METALIZED OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK



REV.	DATE	DCN #	DRAWING TREE #



**V25M CABLE ASSEMBLY CIRCUIT SUMMARY**  
 V-DB25 M/S1,9-36-DB9 F/S5,DB9 F/S5 RA

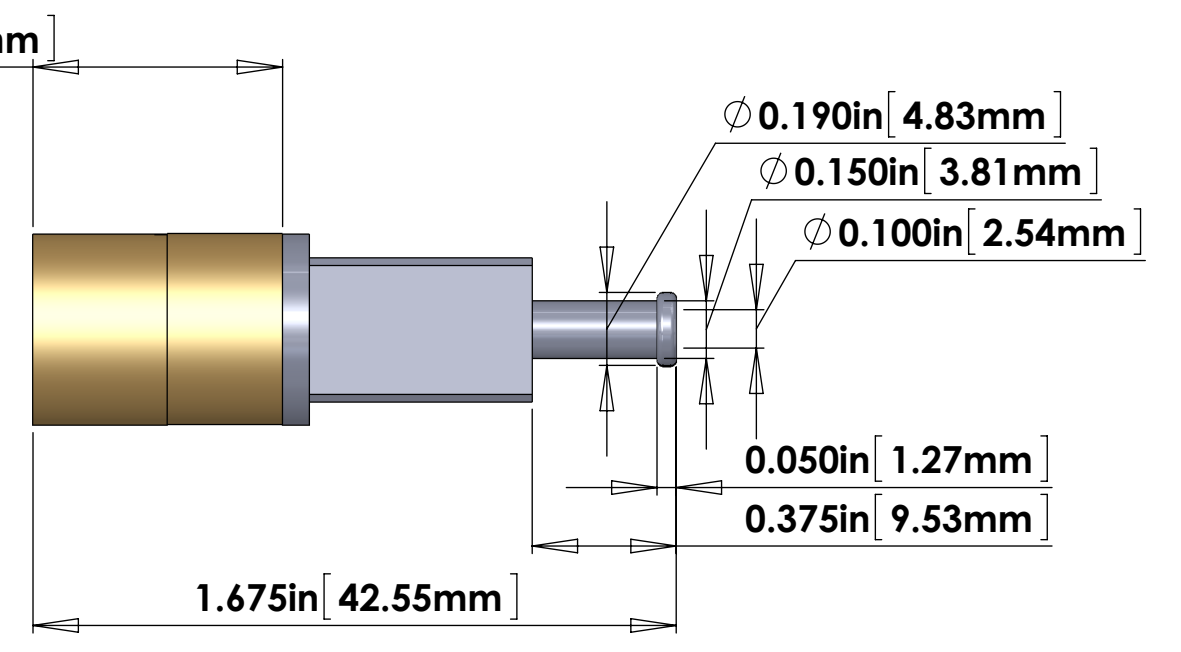
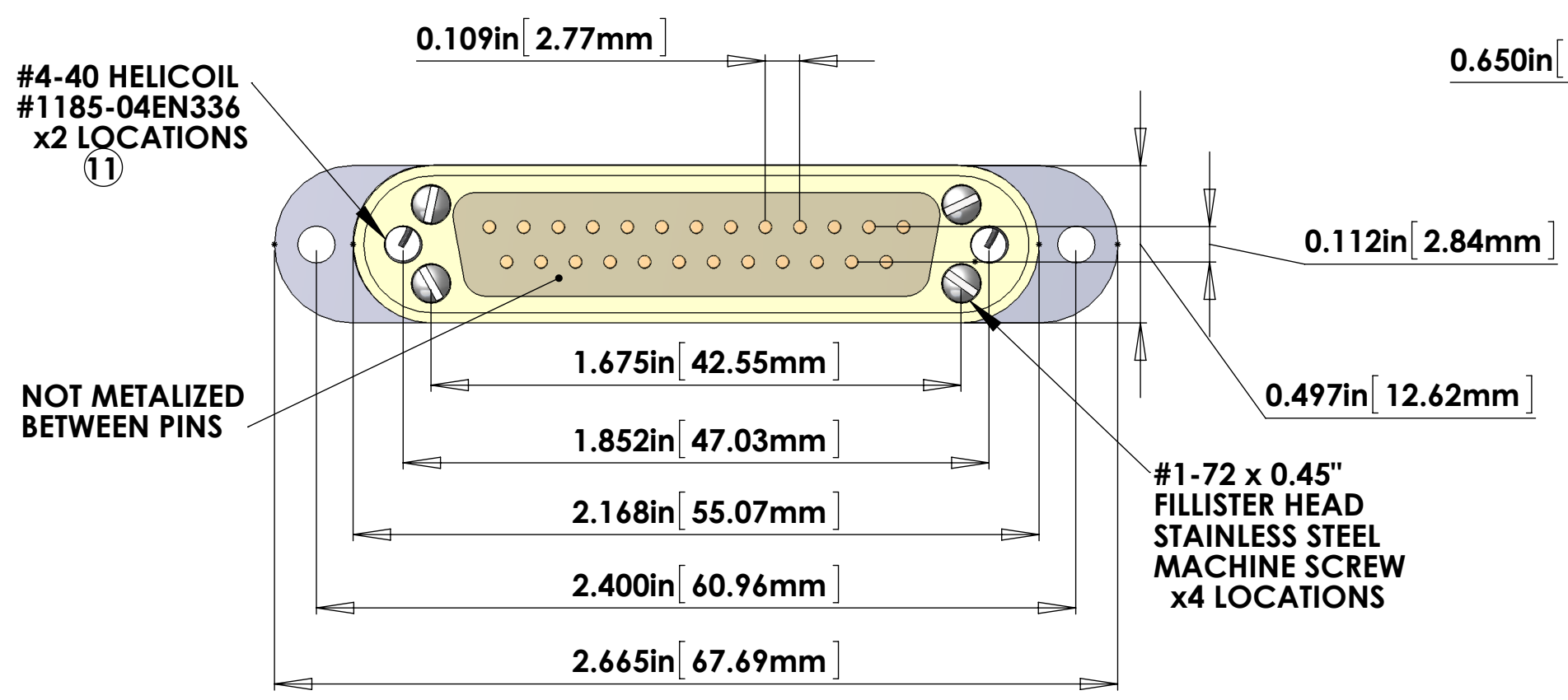
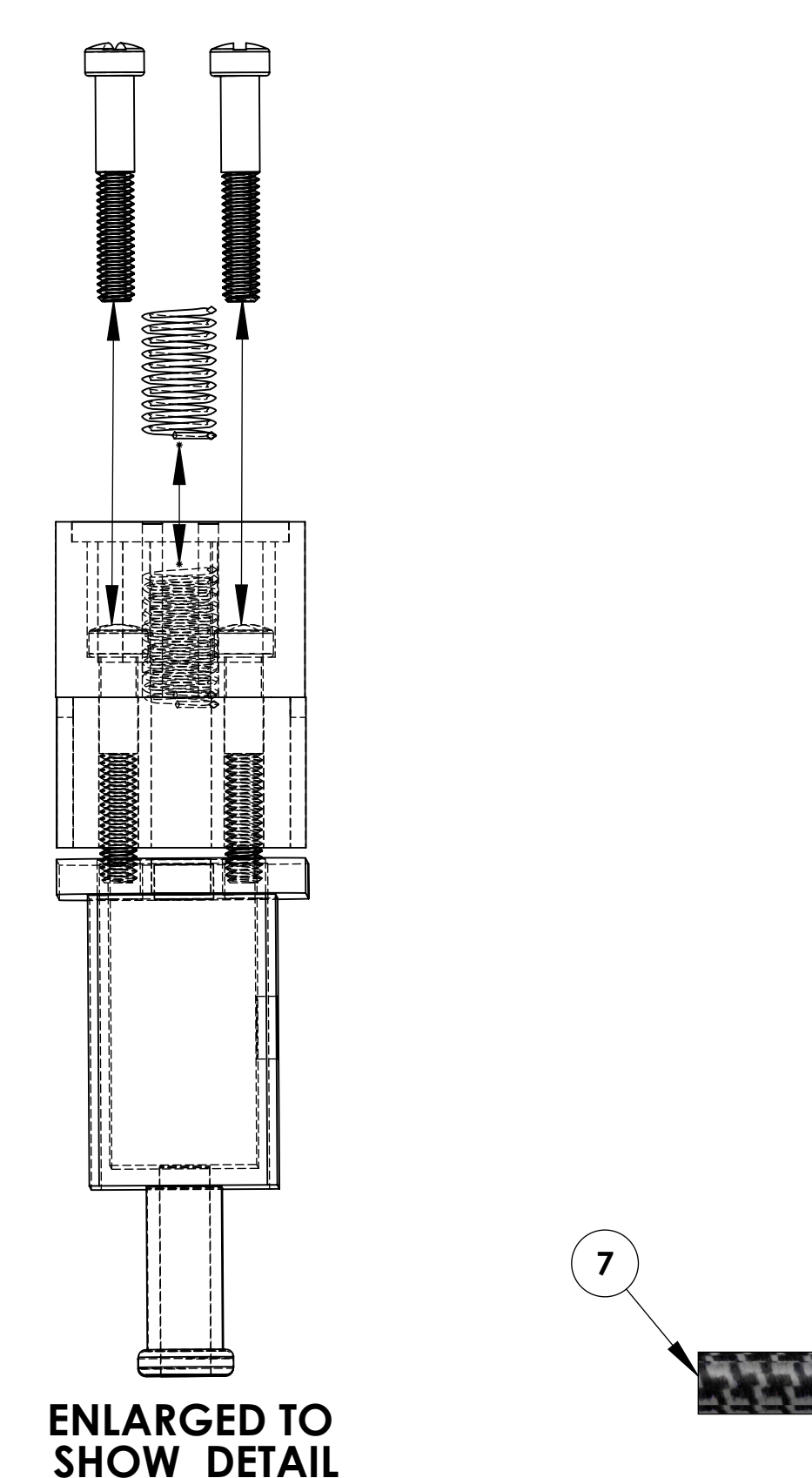
FROM				TO			
CONNECTOR J1 - 25 PIN SUBMINI D MALE CONNECTOR (GOLD METALIZED PEEK)				CONNECTOR J2 - 9 PIN SUBMINI D RIGHT ANGLE FEMALE CONNECTOR (PEEK)			
PIN	WIRE NAME	COLOR	LENGTH	TWISTED PAIR	PIN	WIRE NAME	SIGNAL
1,9,SHELL	SHIELD (BRAID)		36in.		5, SHELL	SHIELD (BRAID)	SHIELD
1,9,SHELL	(CABLE 1) WIRE 1	White	36in.		5, SHELL	(CABLE 1) WIRE 1	SHIELD
2	(CABLE 1) WIRE 2	White	36in.	TP-1	4	(CABLE 1) WIRE 2	POWER -
14	(CABLE 1) WIRE 14	White	36in.	TP-1	9	(CABLE 1) WIRE 14	POWER - RTN
3	(CABLE 1) WIRE 3	White	36in.	TP-2	3	(CABLE 1) WIRE 3	POWER +
15	(CABLE 1) WIRE 15	White	36in.	TP-2	8	(CABLE 1) WIRE 15	POWER + RTN
4	(CABLE 1) WIRE 4	White	36in.	TP-3	2	(CABLE 1) WIRE 4	LOCK -
16	(CABLE 1) WIRE 16	White	36in.	TP-3	7	(CABLE 1) WIRE 16	LOCK -
5	(CABLE 1) WIRE 5	White	36in.	TP-4	1	(CABLE 1) WIRE 5	SIG -
17	(CABLE 1) WIRE 17	White	36in.	TP-4	6	(CABLE 1) WIRE 17	SIG -

CONNECTOR J3 - 9 PIN SUBMINI D FEMALE CONNECTOR (PEEK)							
PIN	WIRE NAME	COLOR	LENGTH	TWISTED PAIR	PIN	WIRE NAME	SIGNAL
1,9,SHELL	SHIELD (BRAID)		36in.		5, SHELL	SHIELD (BRAID)	SHIELD
1,9,SHELL	(CABLE 2) WIRE 9	White	36in.		5, SHELL	(CABLE 2) WIRE 9	SHIELD
10	(CABLE 2) WIRE 10	White	36in.	TP-5	4	(CABLE 2) WIRE 10	POWER -
22	(CABLE 2) WIRE 22	White	36in.	TP-5	9	(CABLE 2) WIRE 22	POWER - RTN
11	(CABLE 2) WIRE 11	White	36in.	TP-6	3	(CABLE 2) WIRE 11	POWER +
23	(CABLE 2) WIRE 23	White	36in.	TP-6	8	(CABLE 2) WIRE 23	POWER + RTN
12	(CABLE 2) WIRE 12	White	36in.	TP-7	2	(CABLE 2) WIRE 12	LOCK -
24	(CABLE 2) WIRE 24	White	36in.	TP-7	7	(CABLE 2) WIRE 24	LOCK -
13	(CABLE 2) WIRE 13	White	36in.	TP-8	1	(CABLE 2) WIRE 13	SIG -
25	(CABLE 2) WIRE 25	White	36in.	TP-8	6	(CABLE 2) WIRE 25	SIG -

**TEST LIST**

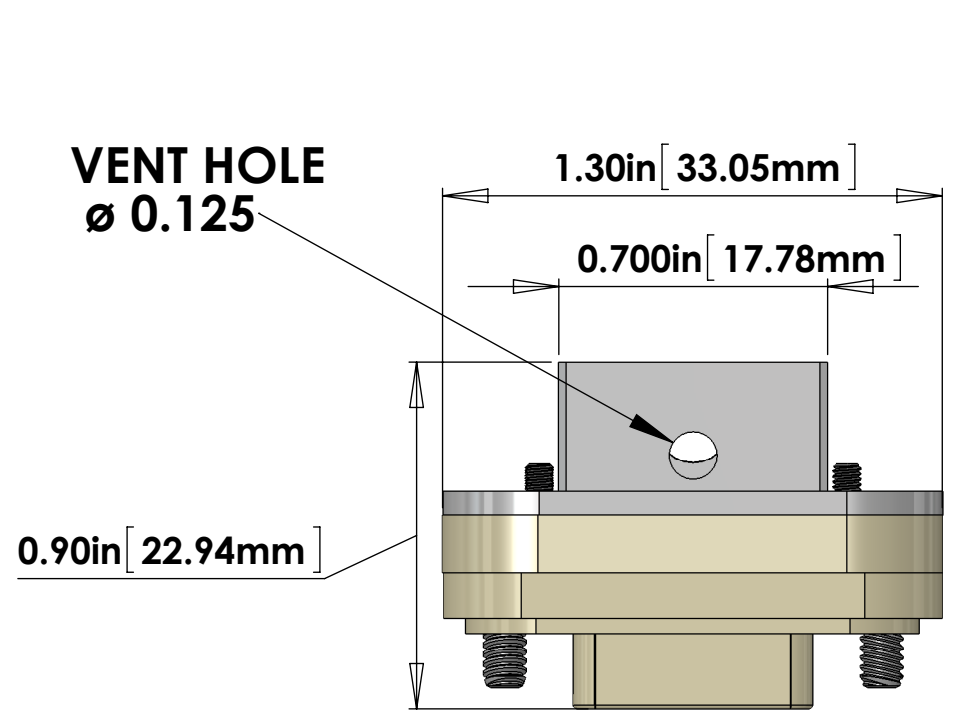
FROM	TO
J1	J2
J1 - 1,9,SHELL	J2 - 5, SHELL
J1 - 1,9,SHELL	J2 - 5, SHELL
J1 - 2	J2 - 4
J1 - 14	J2 - 9
J1 - 3	J2 - 3
J1 - 15	J2 - 8
J1 - 4	J2 - 2
J1 - 16	J2 - 7
J1 - 5	J2 - 1
J1 - 17	J2 - 6
J1	J3
J1 - 1,9,SHELL	J3 - 5, SHELL
J1 - 1,9,SHELL	J3 - 5, SHELL
J1 - 10	J3 - 4
J1 - 22	J3 - 9
J1 - 11	J3 - 3
J1 - 23	J3 - 8
J1 - 12	J3 - 2
J1 - 24	J3 - 7
J1 - 13	J3 - 1
J1 - 25	J3 - 6



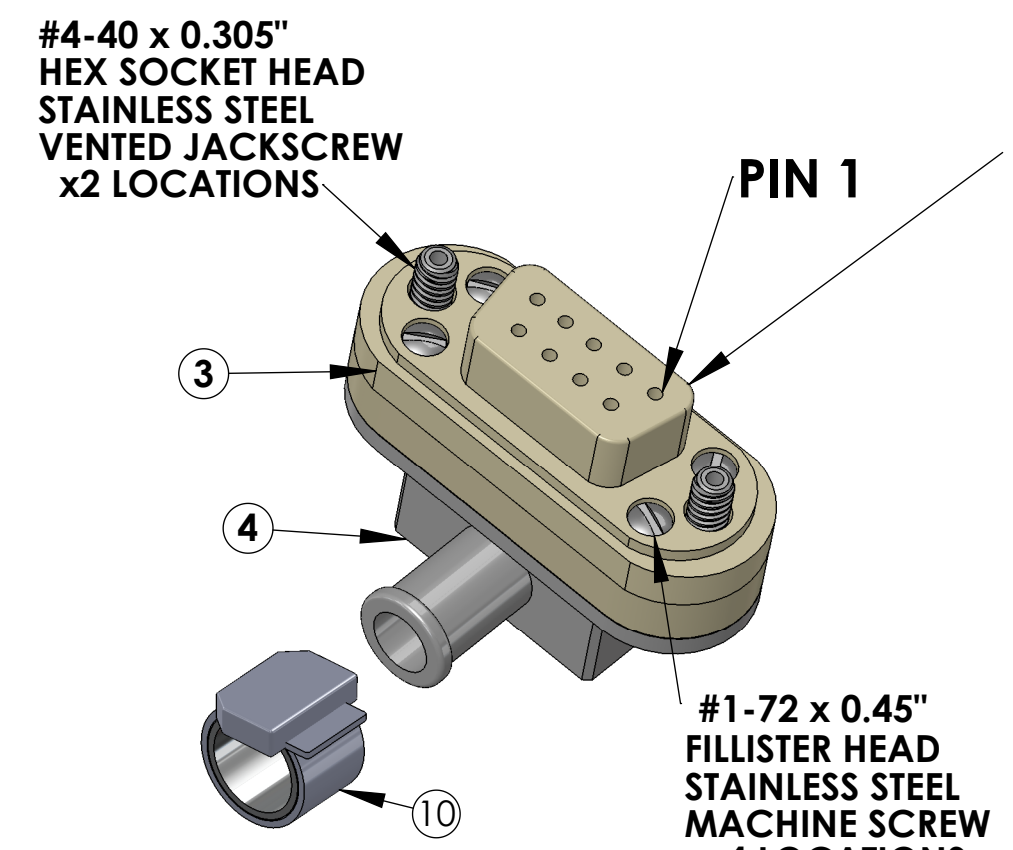
**BILL OF MATERIALS**

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH *
1	TICOR # TS0149-25CG20B32-100F OR EQUIVALENT **	CUSTOM DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2	TICOR # TS0149-9C020B11-188 (TS0122-0901) OR EQUIVALENT **	CUSTOM DB25 CONNECTOR BACKSHELL FOR UHV (STAINLESS) WITH DUAL Ø0.100" i.d. PORTS	1	
3	TICOR # TS0148-9C020B11-188 (TS0122-0901) OR EQUIVALENT **	DB9 RIGHT ANGLE FEMALE CONNECTOR (J2) FOR UHV (PEEK)	1	
4	TICOR # TS0148-9C020B51-188 (TS0122-0902) OR EQUIVALENT **	DB9 CONNECTOR BACKSHELL FOR UHV (STAINLESS) WITH Ø0.188" i.d. PORT	1	
5	TICOR # TS0148-9C020B51-188 (TS0122-0902) OR EQUIVALENT **	DB9 FEMALE CONNECTOR (J3) FOR UHV (PEEK)	1	
6	TICOR # TS0148-9C020B51-188 (TS0122-0902) OR EQUIVALENT **	DB9 CONNECTOR BACKSHELL FOR UHV (STAINLESS) WITH Ø0.188" i.d. PORT	1	
7	C1	9 COND. (4 TW PAIR + 1 WIRE + SHIELD) CABLE WITH (8) COPPER BRAID (SHIELD) AND (9) PEEK OVERBRAID	2	36" *
8	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART # 24x3x40BC	2	
9	PEEK BRAID PART #6759	PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	2	
10	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	4	
11	HELICOIL #1185-04EN336	#4-40 Nitronic 60® HELICOIL 0.336" LENGTH	2	

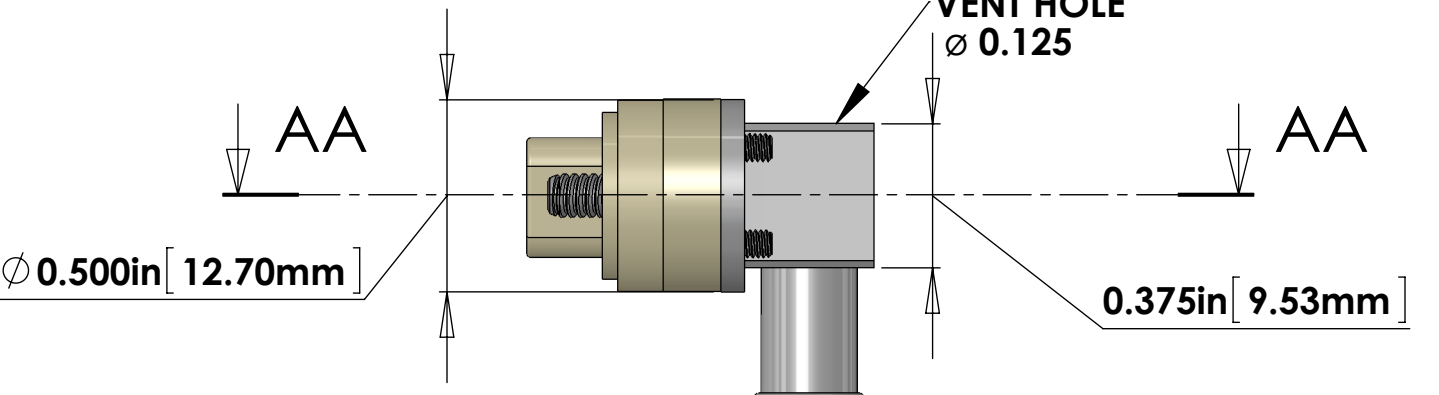
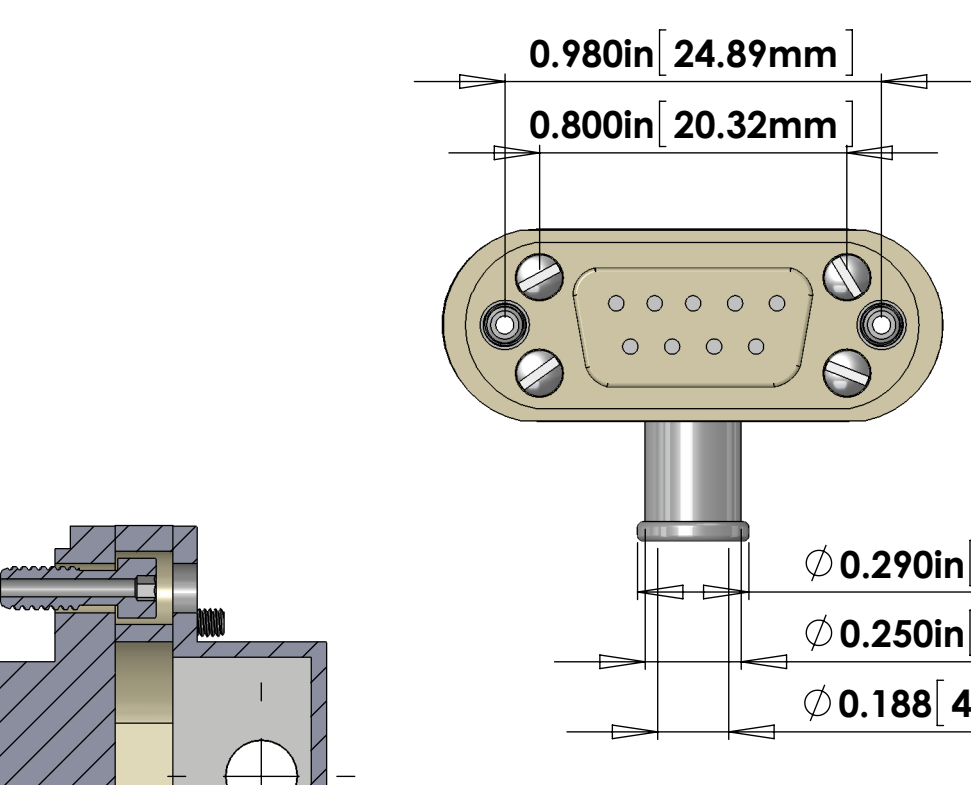
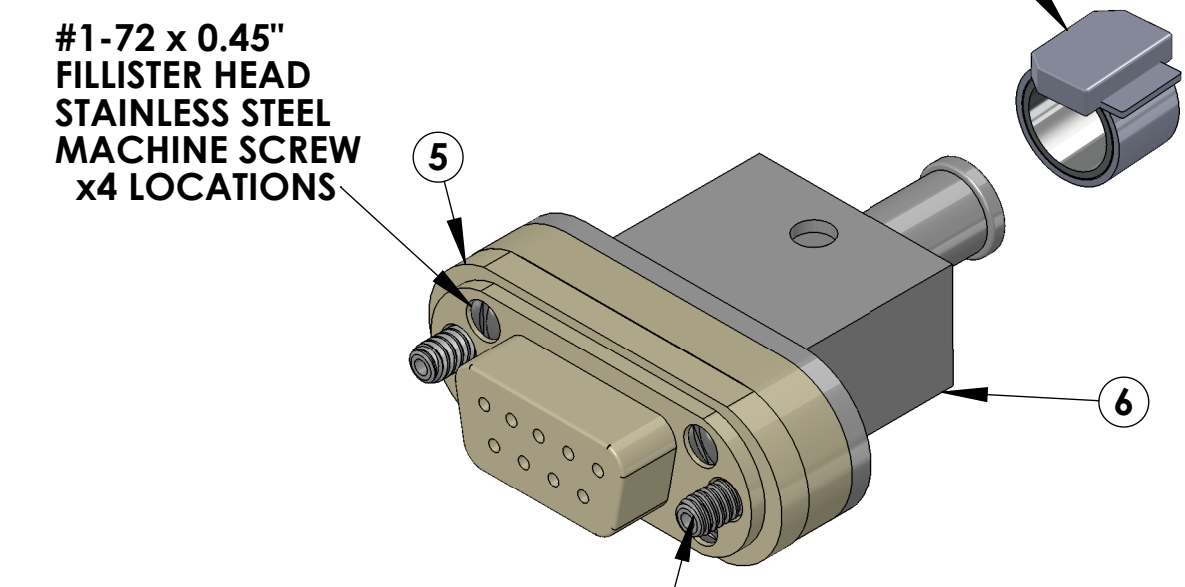
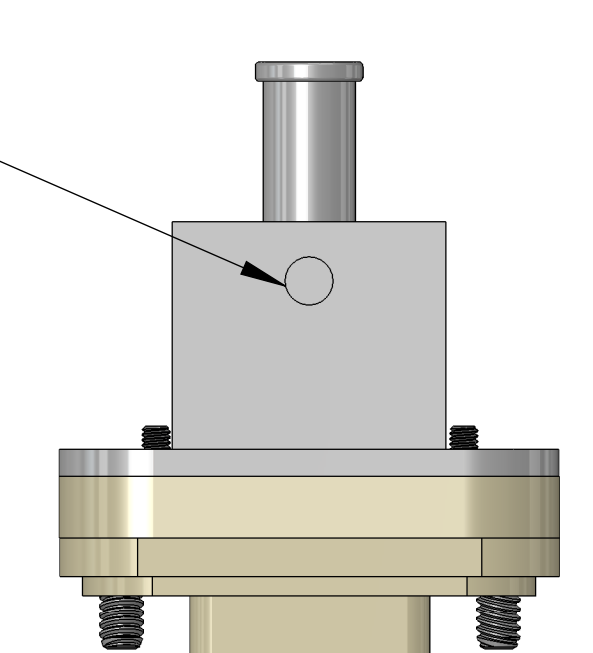
\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.  
 \*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.  
 ELECTRICAL NOTES: ( UNLESS OTHERWISE SPECIFIED )  
 A. MATERIAL: a. J1 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30. b. J2 CONNECTOR SHELL - PEEK VICTREX 450GL30. c. J3 CONNECTOR SHELL - PEEK VICTREX 450GL30. d. BACKSHELL - STAINLESS STEEL WITH VENT HOLE. e. CONTACTS - BERYLLIUM COPPER ALLOY C17300. 0.00050 MIN. GOLD OVER NICKEL. f. HARDWARE: STAINLESS STEEL, PASSIVATED. g. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.  
 B. CABLE 9 COND. 28 AWG ( 40 STRD 44 AWG ) WITH 2 LAYERS OF KAPTON TAPE. (SUPPLIED BY LIGO). 4 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 50% COVERAGE (SUPPLIED BY LIGO). OVERALL PEEK BRAID MIN. 50% COVERAGE (SUPPLIED BY LIGO). OVERALL CABLE O.D. WILL BE APPROX. 0.240 IN.  
 C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. LENGTH OF SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



**CONNECTOR J2**



**CONNECTOR J3**



**SECTION AA-AA**

**SEI GS-13 AND L-4C SEISMOMETER CABLE FROM CONNECTOR MOUNT TO SEISMOMETER**  
 V-DB25 M/S1,9-36-DB9 F/S5,DB9 F/S5 RA  
 STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
SEI	IN-VAC	GS-13,L-4C

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)  
 1. INTERPRET DRAWING PER ASME Y14.5-1994.  
 2. REMOVE ALL SHARP EDGES. 0.05-0.15. FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R/2 FOR SHEET METAL PARTS.  
 3. DO NOT SCALE FROM DRAWING.  
 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN	TOLERANCES:	ANGULAR ± °
	.XX ±	
	.XXX ±	

MATERIAL	FINISH	NEXT ASSY
N/A	N/A µinch	

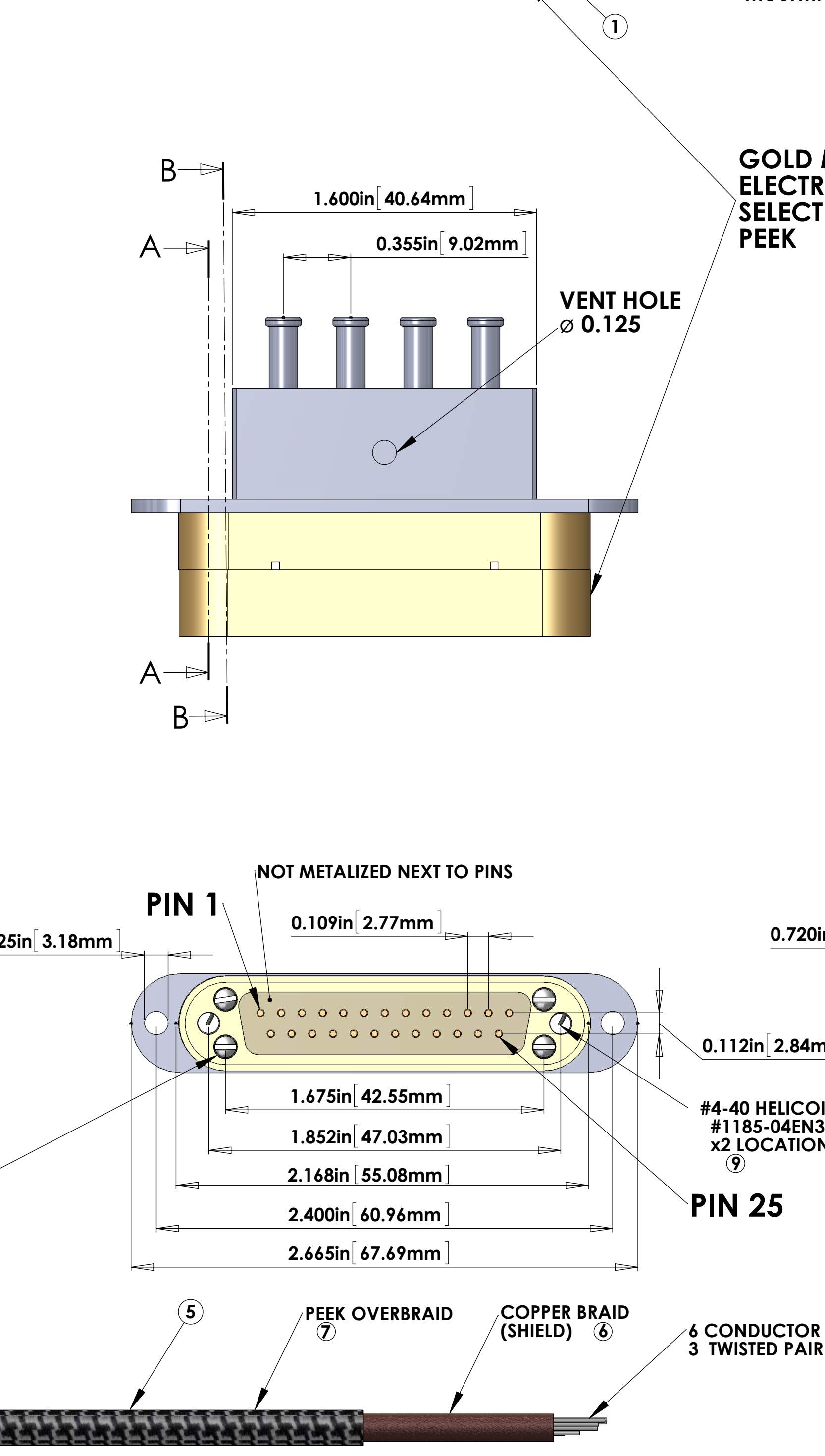
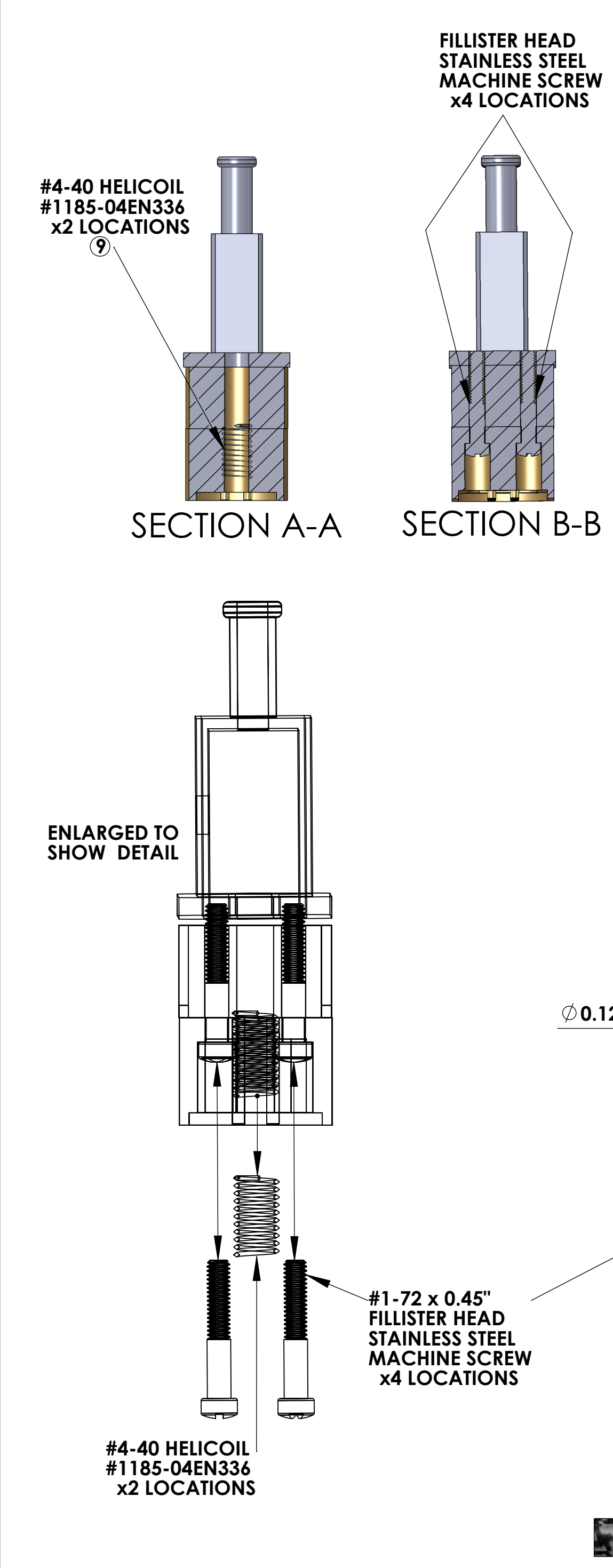
SYSTEM	SUB-SYSTEM	PART NAME
SEI	SEI	CUSTOM CABLE SPECIFICATION V25M-36

DESIGNER	DRAFTER	CHECKER	APPROVAL	DATE	SIZE	DWG. NO.	REV.
B. ABBOTT	E. BROWN			JUN/29/2012	E	D1000227	v9

SCALE: 2:1 PROJECTION: SHEET 1 OF 1



NOTES CONTINUED:  
3. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE OF HIGH CHARACTERS DXXXXXXV, 5/N 001. EXAMPLE: A VIBRATORY TOOL MAY BE USED.  
4. APPROXIMATE WEIGHT = X.XXX LB.  
5. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E090364.  
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E090364.  
7. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO ENHART HELI-COIL PRODUCT CATALOG, HC2000, REV 4.  
8. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.  
9. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED BY ADVANCE. AND IN WRITINGS, BY LIGO LABORATORY. REFER TO LIGO-E090364.  
10. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.  
11. PARTS WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E090364 AFTER FABRICATION. THE INDICATED HOLE SIZE IS CLASSIFIED FOR PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER. DIMENSIONS ON BOTH SIDES OF THE HOLE.  
12. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.  
13. BEND RADIUS UNLESS OTHERWISE NOTED. THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED. THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.  
NOTES 13 and 14 DO NOT APPLY TO THIS PART



### V25X-TBD CABLE ASSEMBLY CIRCUIT SUMMARY

V-DB25 M/1-TBD-4\_μD9 F/5

FROM

PIN	WIRE NAME	COLOR	LENGTH	TWISTED PAIR
N/C	(CONNECTOR SHELL)			
E1	(CABLE 1) WIRE 1	White	TBD in. *	(CABLE 1) SHIELD
E14	(CABLE 1) WIRE 14	White	TBD in. *	TP-1A
E2	(CABLE 1) WIRE 2	White	TBD in. *	TP-2A
E15	(CABLE 1) WIRE 15	White	TBD in. *	TP-2A
E3	(CABLE 1) WIRE 3	White	TBD in. *	TP-2A
E16	(CABLE 1) WIRE 16	White	TBD in. *	TP-3A
E4	(CABLE 1) WIRE 4	White	TBD in. *	TP-3A
E1	(CABLE 2) WIRE 1	White	TBD in. *	(CABLE 2) SHIELD
E17	(CABLE 2) WIRE 17	White	TBD in. *	TP-1B
E5	(CABLE 2) WIRE 5	White	TBD in. *	TP-1B
E18	(CABLE 2) WIRE 18	White	TBD in. *	TP-2B
E6	(CABLE 2) WIRE 6	White	TBD in. *	TP-2B
E19	(CABLE 2) WIRE 19	White	TBD in. *	TP-3B
E7	(CABLE 2) WIRE 7	White	TBD in. *	TP-3B
E1	(CABLE 3) WIRE 1	White	TBD in. *	(CABLE 3) SHIELD
E20	(CABLE 3) WIRE 20	White	TBD in. *	TP-1C
E8	(CABLE 3) WIRE 8	White	TBD in. *	TP-1C
E21	(CABLE 3) WIRE 21	White	TBD in. *	TP-2C
E9	(CABLE 3) WIRE 9	White	TBD in. *	TP-2C
E22	(CABLE 3) WIRE 22	White	TBD in. *	TP-3C
E10	(CABLE 3) WIRE 10	White	TBD in. *	TP-3C
E1	(CABLE 4) WIRE 1	White	TBD in. *	(CABLE 4) SHIELD
E23	(CABLE 4) WIRE 23	White	TBD in. *	TP-1D
E11	(CABLE 4) WIRE 11	White	TBD in. *	TP-1D
E24	(CABLE 4) WIRE 24	White	TBD in. *	TP-2D
E12	(CABLE 4) WIRE 12	White	TBD in. *	TP-2D
E25	(CABLE 4) WIRE 25	White	TBD in. *	TP-3D
E13	(CABLE 4) WIRE 13	White	TBD in. *	TP-3D

TBD in. \* = LENGTH TO BE DETERMINED AT TIME OF ORDER (SEE STANDARD CABLE LENGTH CHART)

### TEST LIST

FROM	TO
J1	J2
J1	J3
J1	J4
J1	J5

### V25X CABLE ASSEMBLY CIRCUIT SUMMARY

TO

PIN	WIRE NAME	SIGNAL
N/C	(CABLE 1) SHIELD	SHIELD
A5	(CABLE 1) WIRE 1	SHIELD
A1	(CABLE 1) WIRE 14	PD1-K
A6	(CABLE 1) WIRE 2	PD1-A
A2	(CABLE 1) WIRE 15	LED1-A
A7	(CABLE 1) WIRE 3	LED1-K
A4	(CABLE 1) WIRE 16	COIL1-FN
A9	(CABLE 1) WIRE 4	COIL1-ST

### V25X CABLE ASSEMBLY CIRCUIT SUMMARY

TO

PIN	WIRE NAME	SIGNAL
N/C	(CABLE 2) SHIELD	SHIELD
B5	(CABLE 2) WIRE 1	SHIELD
B1	(CABLE 2) WIRE 17	PD2-K
B6	(CABLE 2) WIRE 5	PD2-A
B2	(CABLE 2) WIRE 18	LED2-A
B7	(CABLE 2) WIRE 6	LED2-K
B4	(CABLE 2) WIRE 19	COIL2-FN
B9	(CABLE 2) WIRE 7	COIL2-ST

### V25X CABLE ASSEMBLY CIRCUIT SUMMARY

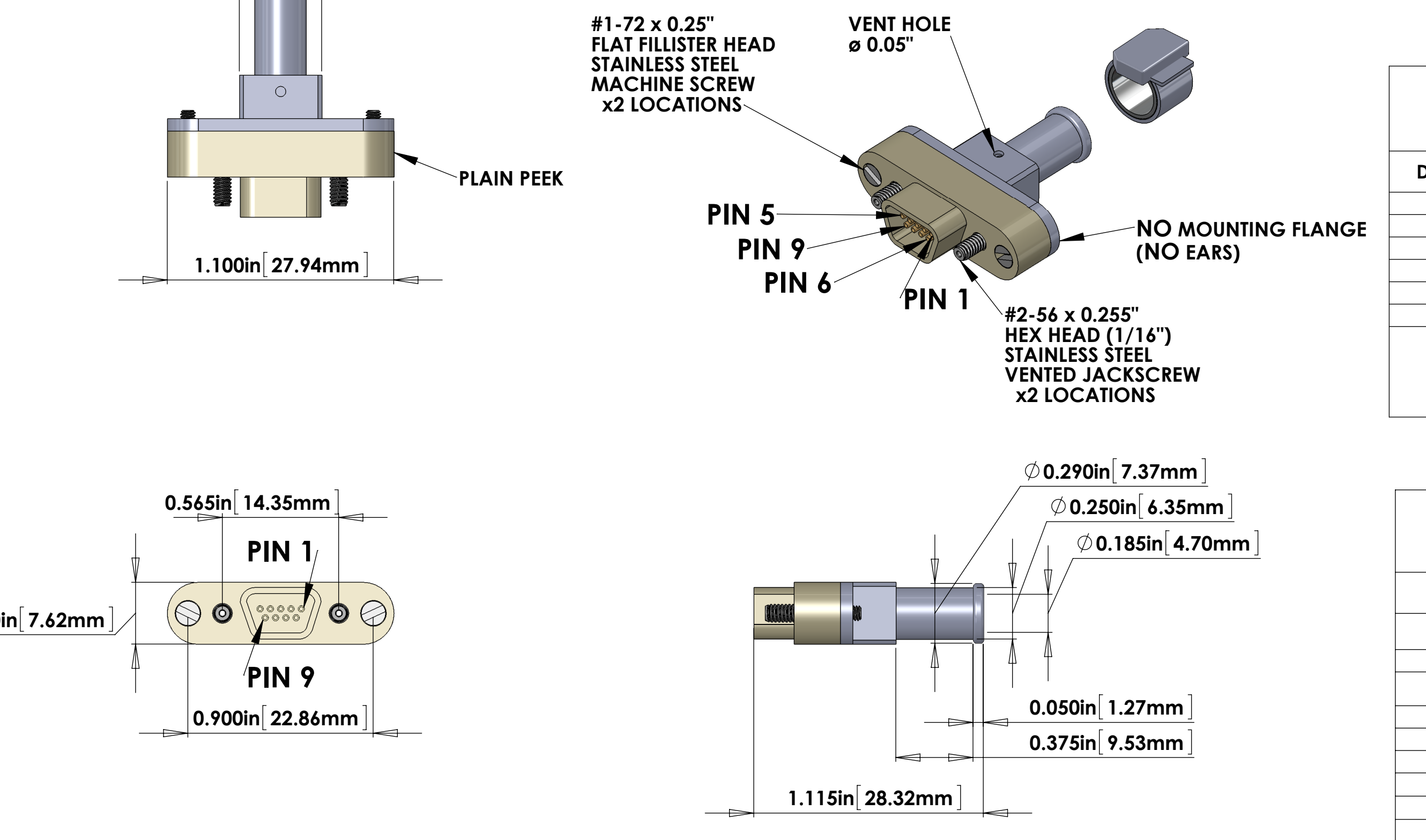
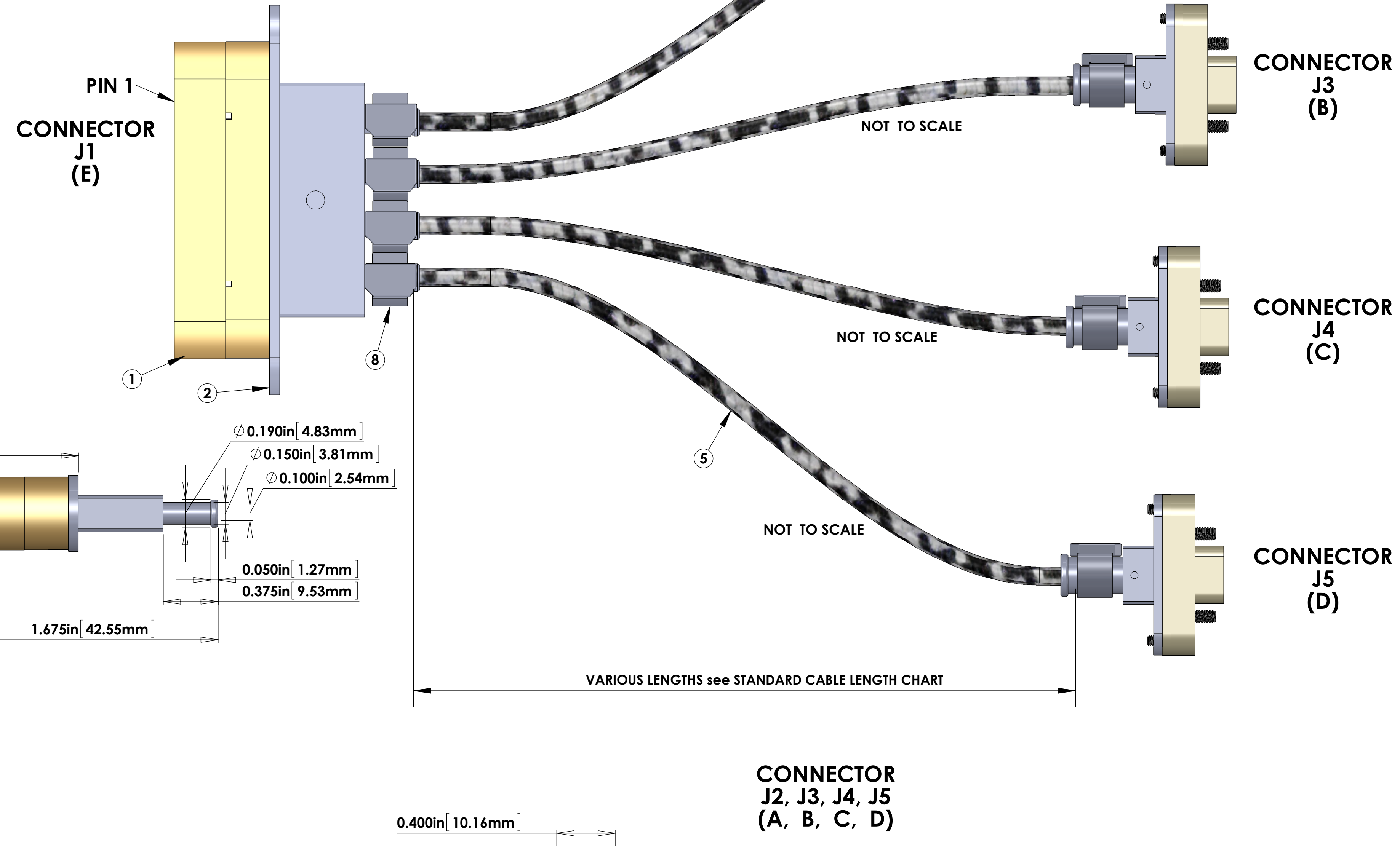
TO

PIN	WIRE NAME	SIGNAL
N/C	(CABLE 3) SHIELD	SHIELD
C5	(CABLE 3) WIRE 1	SHIELD
C1	(CABLE 3) WIRE 20	PD3-K
C6	(CABLE 3) WIRE 8	PD3-A
C2	(CABLE 3) WIRE 21	LED3-A
C7	(CABLE 3) WIRE 9	LED3-K
C4	(CABLE 3) WIRE 22	COIL3-FN
C9	(CABLE 3) WIRE 10	COIL3-ST

### V25X CABLE ASSEMBLY CIRCUIT SUMMARY

TO

PIN	WIRE NAME	SIGNAL
N/C	(CABLE 4) SHIELD	SHIELD
D5	(CABLE 4) WIRE 1	SHIELD
D1	(CABLE 4) WIRE 23	PD4-K
D6	(CABLE 4) WIRE 11	PD4-A
D2	(CABLE 4) WIRE 24	LED4-A
D7	(CABLE 4) WIRE 12	LED2-K
D4	(CABLE 4) WIRE 25	COIL4-FN
D9	(CABLE 4) WIRE 13	COIL4-ST



### BILL OF MATERIALS

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR #T50125-1 (T50149-25CG20854-100F) or EQUIVALENT **	CUSTOM DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2		CUSTOM DB25 CONNECTOR BACKSHELL FOR UHV (STAINLESS) WITH QUAD Ø0.100" i.d. PORTS	1	
3	TICOR #T50094 WITH FLYING LEADS or EQUIVALENT	CUSTOM DB9 (DE9) FEMALE CONNECTOR (J2,J3,J4,J5) FOR UHV (PEEK)	4	
4		CUSTOM DB9 CONNECTOR BACKSHELL FOR UHV (STAINLESS) WITH Ø0.185" i.d. PORT	4	
5	C1	6 COND. (3 TWISTED PAIR) CABLE + 1 WIRE (TO ATTACH SHIELD) WITH (6) COPPER BRAID (SHIELD), AND (7) PEEK OVERBRAID.	4	VARIOUS LENGTHS* see STANDARD CABLE LENGTH CHART
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	4	
7	PART #6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	4	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR #600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" #A10089)	8	
9	HELICOIL #1185-04EN336	#4-40 Nitronic 60® HELICOIL 0.336" LENGTH	2	0.336"

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM BACKSHELL (25 PIN) TO BACKSHELL (9 PIN) OF THE CABLE. USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.  
\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

ELECTRICAL NOTES: (UNLESS OTHERWISE SPECIFIED)

A. MATERIAL: a. J1 - CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.  
b. J2, J3, J4, J5 - CONNECTOR SHELL - PEEK VICTREX 450GL30.  
c. BACKSHELL - STAINLESS STEEL WITH VENT HOLE.  
d. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.00050 MIN. GOLD OVER NICKEL.  
e. HARDWARE: STAINLESS STEEL, PASSIVATED.  
f. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

B. CABLE 6 COND. 28 AWG. (65 STRD 46 AWG) WITH PFA INSULATION COONER WIRE #CZ1105. 3 TWISTED PAIRS (4 TO 5 TWISTS PER INCH). OVERALL 40AWG COPPER BRAID 90% COVERAGE. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE APPROX. 0.240 IN.

C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.

### STANDARD CABLE LENGTH CHART

DESIGNATOR	INCHES	FEET and INCHES
V25X-60	60	5 ft.
V25X-66	66	5 ft. 6 in.
V25X-78	78	6 ft. 6 in.
V25X-88	88	7 ft. 4 in.
V25X-96	96	8 ft.
V25X-125	125	10 ft. 5 in.

V25X-TBD: TBD \* ADDITIONAL CUSTOM LENGTHS

\* LENGTH To Be Determined AT TIME OF ORDER

### SUS, AOS - SUSPENSION CUSTOM CABLE

V-DB25 M/1-TBD-4\_μD9 F/5

STANDARD USE FOR THIS CABLE

SUBSYSTEM	STANDARD USE
SUS	QUAD SUSPENSIONS TOP
SUS	HAM SMALL TRIPLE SUSPENSION (HSTS)
SUS	HAM LARGE TRIPLE SUSPENSION (HLTS)
AOS	TRANSMISSION MONITOR SUSPENSION (TMS)

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994
- REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN: TOLERANCES: .XX ± .XXX ± ANGULAR ± °

MATERIAL: FINISH: μinch

SYSTEM: SUB-SYSTEM: SUS, AOS

CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: CUSTOM CABLE SPECIFICATION V25X-TBD

DESIGNER: J. HEEFNER APR/11/2012 SIZE DWG. NO. DRAFTER: E. BROWN JUL/20/2012 E D1000234

CHECKER: APPROVAL: SCALE: 2:1 PROJECTION: SHEET 1 OF 1

REV. v9

NOTES CONTINUED:  
 3. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE 07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VY, S/N 001. A VIBRATORY TOOL MAY BE USED.  
 6. APPROXIMATE WEIGHT = X.XXXX LB.  
 7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364.  
 8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.  
 9. ALL HELICOIL HOLES TO BE PREPARED ACCORDING TO EINHART HELICOIL PRODUCT CATALOG, HC2000, REV 4.

10. ALL HELICOIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.  
 11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.  
 12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER. FREE FROM SCRATCHES OR GROOVES.  
 13. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 25-30% HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.  
 14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.  
 15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 13 and 14 DO NOT APPLY TO THIS PART

**V25AB-36 CABLE ASSEMBLY CIRCUIT SUMMARY**  
**V-DB25HD M/S1-36-MM7PINHD F/X**

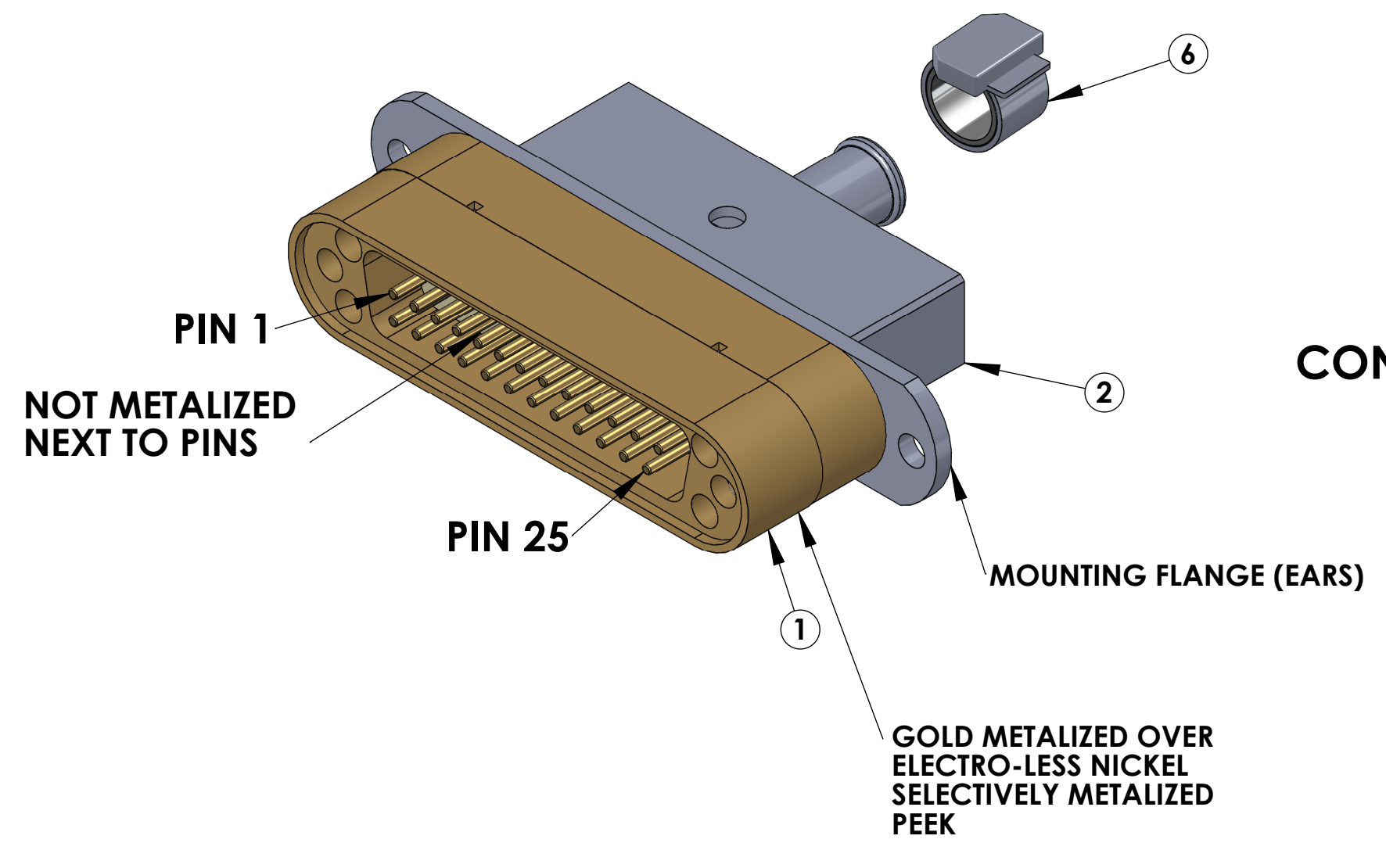
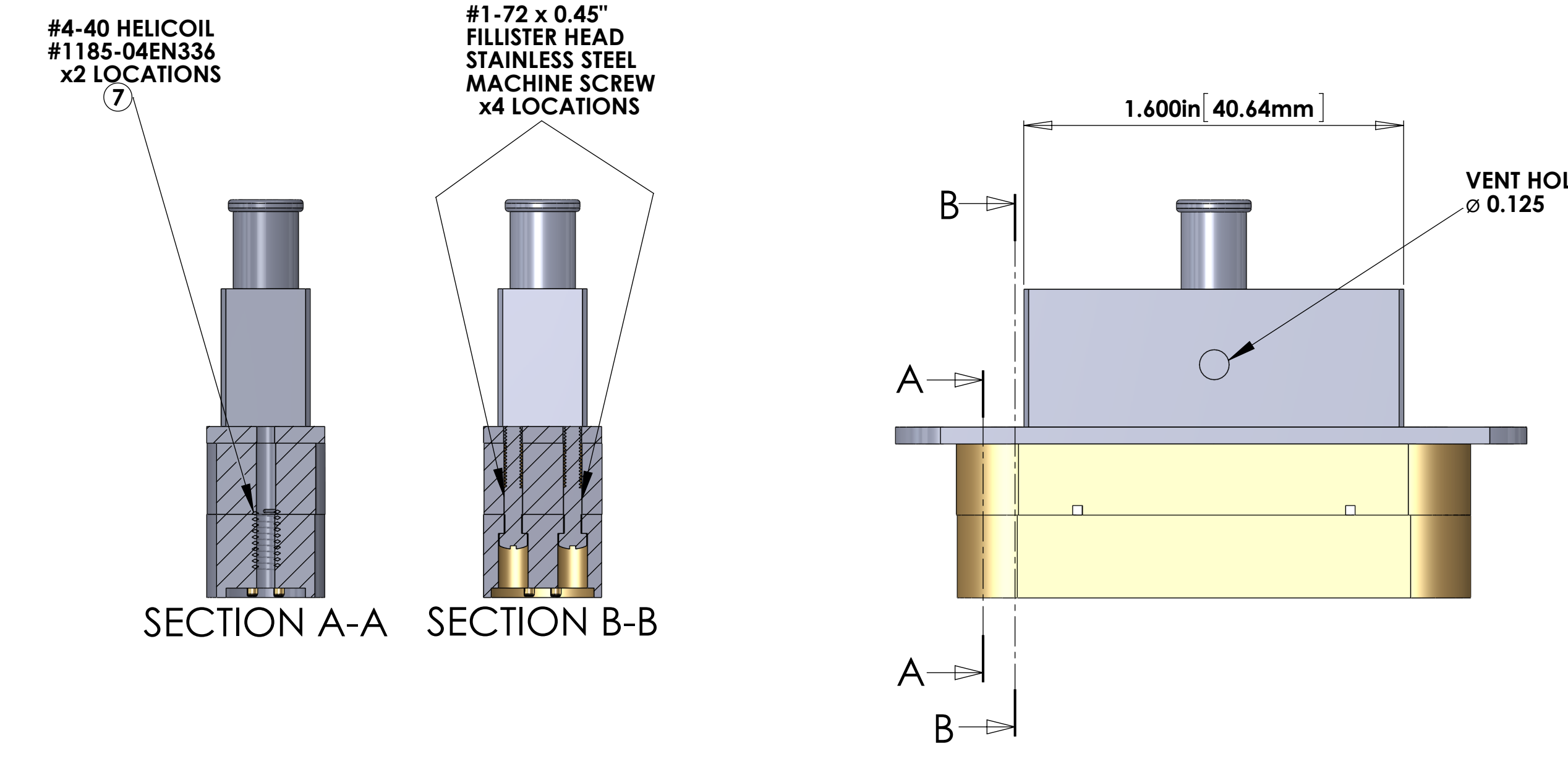
FROM

CONNECTOR J1 - 25 PIN SUBMINI-D CONNECTOR (GOLD METALIZED PEEK)

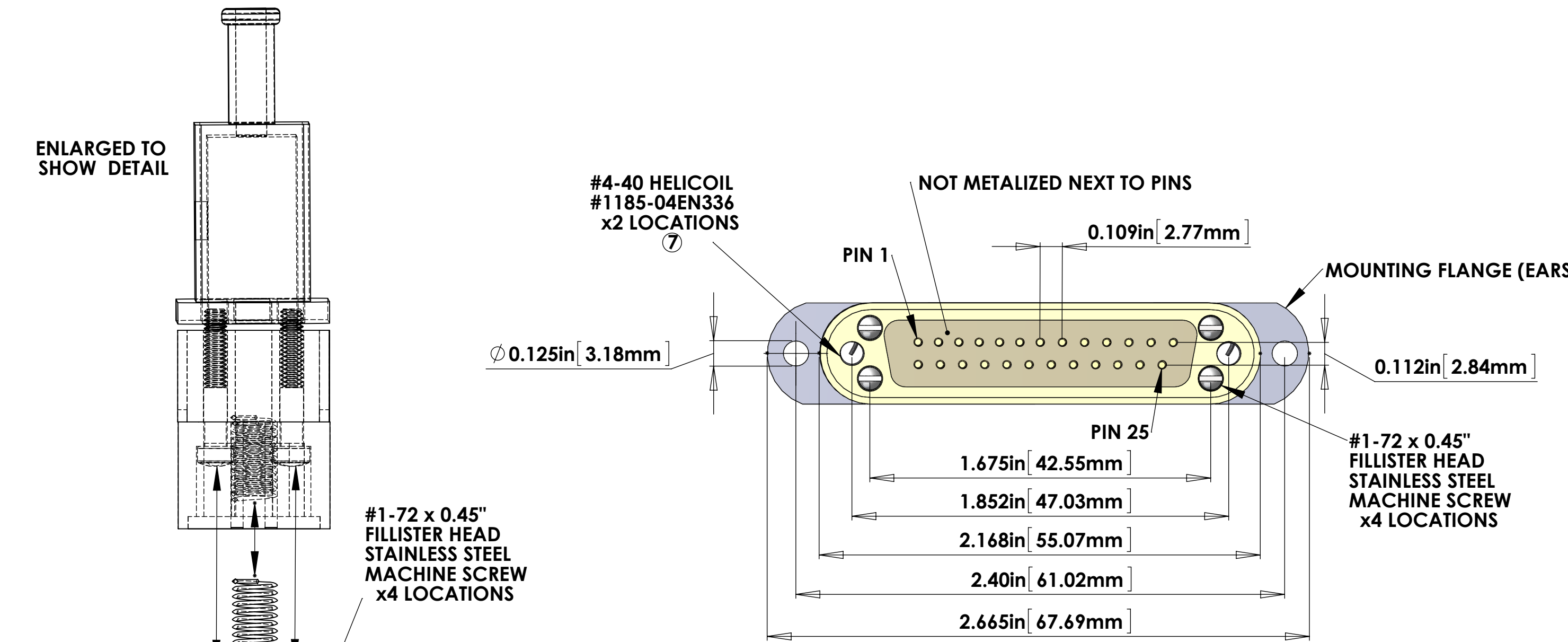
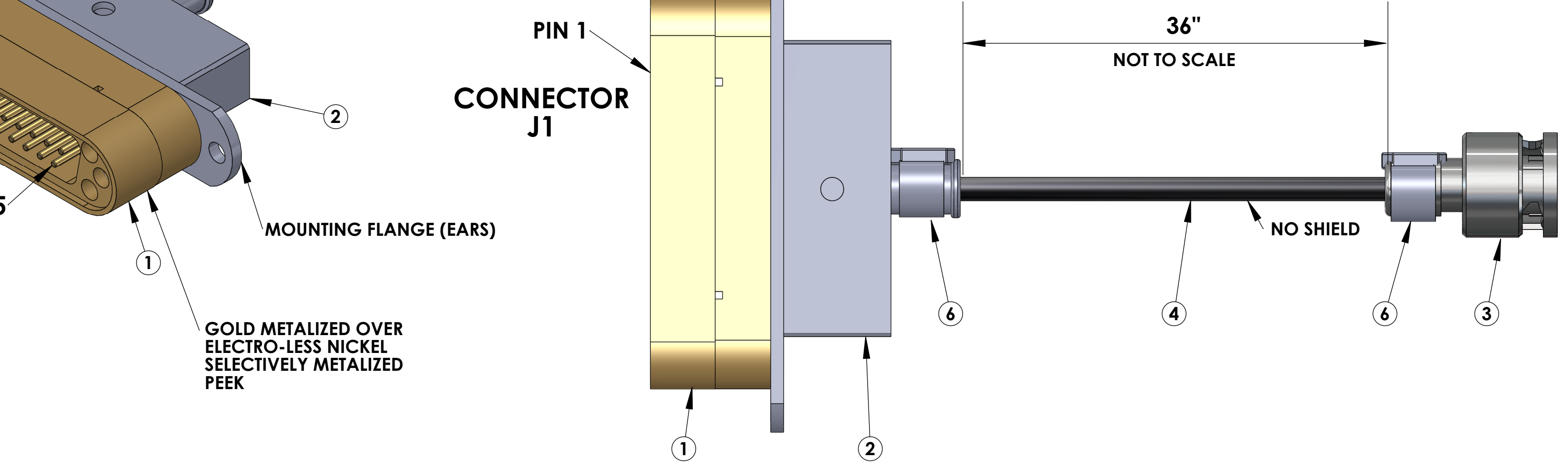
PIN	WIRE NAME	LENGTH *	TWISTED PAIR
1	(SHIELD) NOT CONNECTED		
13	WIRE 13	36"	TP-1
25	WIRE 25	36"	
12	WIRE 12	36"	
24	WIRE 24	36"	TP-2
11	WIRE 11	36"	
23	WIRE 23	36"	TP-3

PIN 2,14,3,15,4,16,5,17,6,18,7,19,8,20,9,21,10,22 AND SHIELD N/C (NOT CONNECTED)

**CONNECTOR J1**



**CONNECTOR J1**



**BILL OF MATERIALS**

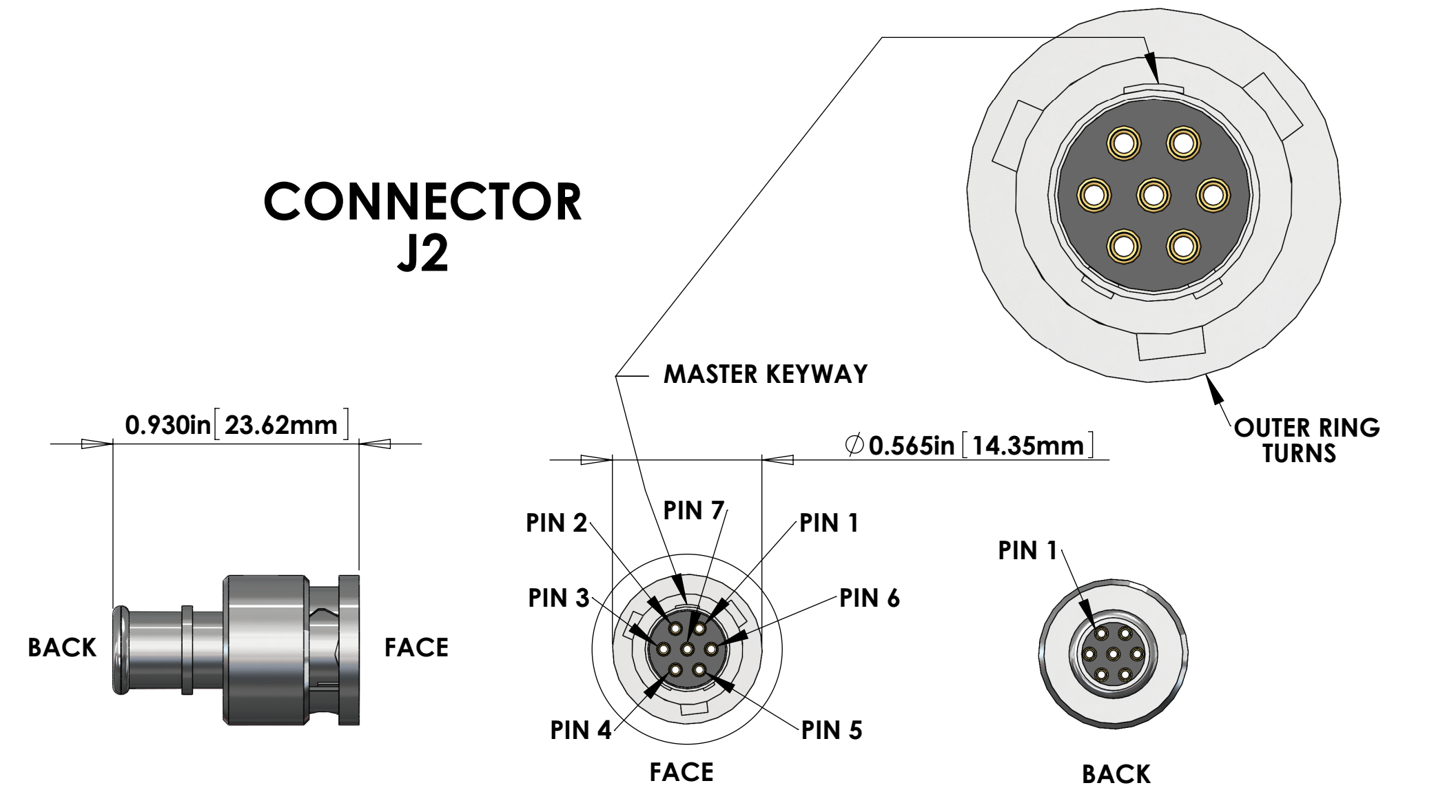
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR #TS0149-25CG20BS1-225F (TICOR #TS0125-3) OR EQUIVALENT **	CUSTOM DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2	GLENAIR # 803-001-06M6-75N-598A	DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS STEEL) WITH Ø0.225" I.D. PORT	1	
3	GLENAIR # 803-001-06M6-75N-598A	7 PIN MIGHTY MOUSE SOCKET CONNECTOR (J2)	1	
4	COONER WIRE # CZ2205 22GA PFA INSULATED BIOMEDICAL WIRE	6 COND. ( 3 TWISTED PAIR ) CABLE WITH (5) PEEK OVERBRAID, AND NO SHIELD	1	36in.*
5	PART #6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
6	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	
7	HELICOIL #1185-04EN336	#4-40 Nitronic 60® HELICOIL 0.336" LENGTH	2	

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM BRAID CLAMP (25 PIN D) TO BRAID CLAMP (7 PIN MIGHTY MOUSE) OF THE CABLE. USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTH.  
 \*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

**NOTES: ( UNLESS OTHERWISE SPECIFIED )**

- A. MATERIAL:
  - a. J1 - CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
  - b. BACKSHELL - STAINLESS STEEL WITH VENT HOLE.
  - c. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.00050 MIN. GOLD OVER NICKEL.
  - d. HARDWARE: STAINLESS STEEL, PASSIVATED.
  - e. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED.
- B. CABLE 6 COND. 22 AWG, ( 150 STRD 44 AWG ) WITH PFA INSULATION. 3 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ). OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE APPROX. 0.240 IN.
- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE.

**CONNECTOR J2**



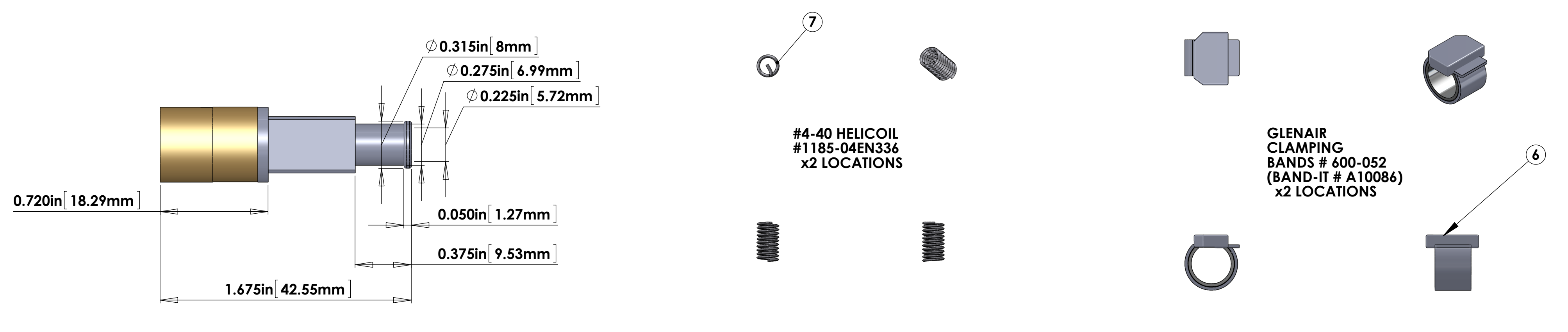
7 PIN MIGHTY MOUSE SOCKET CONNECTOR  
 GLENAIR # 803-001-06M6-75N-598A  
 (MATES WITH GLENAIR # 803-003-07M6-7PN-598A)

**V25AB-36 CABLE ASSEMBLY CIRCUIT SUMMARY**

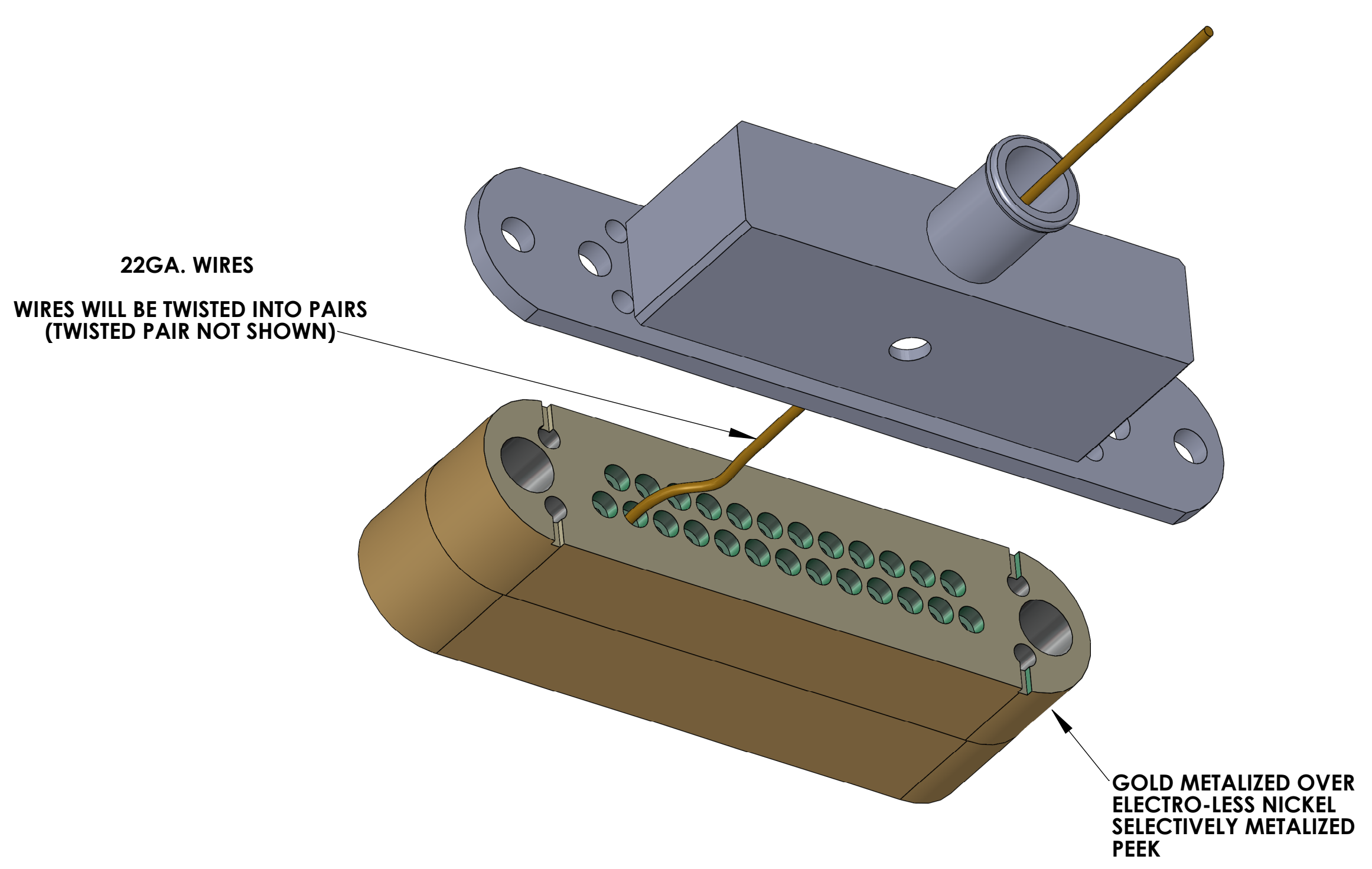
TO

CONNECTOR J2 - 7 PIN SOCKET MIGHTY MOUSE CONNECTOR

Pin	WIRE NAME	TWISTED PAIR	SIGNAL
SHELL	NOT CONNECTED		
1	WIRE 13	TP-1	+ COIL
2	WIRE 25		- COIL
3	WIRE 12	TP-2	+ CLOSED SENSOR
4	WIRE 24		- CLOSED SENSOR
5	WIRE 11	TP-3	+ OPEN SENSOR
6	WIRE 23		- OPEN SENSOR
7	N/C		N/C



**INTERNAL WIRING (ONLY ONE WIRE SHOWN FOR CLARITY)**



**TEST LIST**

FROM	TO
J1	J2
PIN	PIN
N/C	J2 - SHELL
J1 - SHELL	NOT CONNECTED
J1 - 13	J2 - 1
J1 - 25	J2 - 2
J1 - 12	J2 - 3
J1 - 24	J2 - 4
J1 - 11	J2 - 5
J1 - 23	J2 - 6
NOT CONNECTED	J2 - 7

**ISC TRANSMON BEAM DIVERTER CABLE**  
**SUSPENDED TRANSMON TABLE TO BEAM DIVERTER**

V25AB-36 - V-DB25HD M/S1-36-MM7PINHD F/X

STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
ISC	IN-VAC	TRANSMON BEAM DIVERTER

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)  
 1. INTERPRET DRAWING PER ASME Y14.5-1994.  
 2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.  
 3. DO NOT SCALE FROM DRAWING.  
 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN: .XX ± .XXX ±

TOLERANCES: .XX ± .XXX ±

ANGULAR ± °

MATERIAL: FINISH: µinch

SYSTEM: SUB-SYSTEM: ISC

CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: CUSTOM CABLE SPECIFICATION V25AB-36

DESIGNER: R. ABBOTT JUL/02/2012 SIZE DWG. NO. E D1000237

DRAFTER: E. BROWN JUL/02/2012

CHECKER: APPROVAL:

SCALE: 2:1 PROJECTION: SHEET 1 OF 1

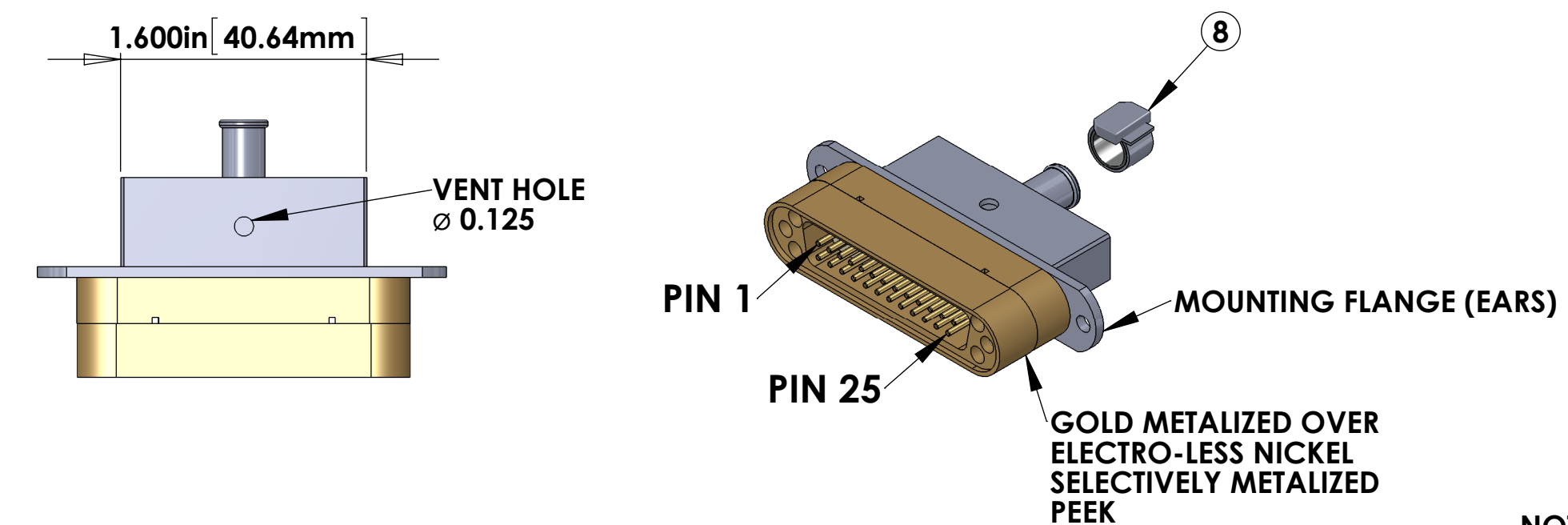
REV. v6

- NOTES CONTINUED:
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VV, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV 4
- NOTES 13 and 14 DO NOT APPLY TO THIS PART

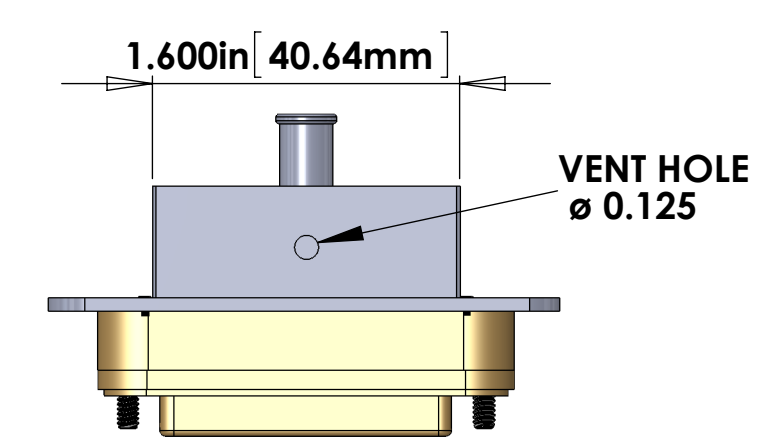
- ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
- DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

REV.	DATE	DCN #	DRAWING TREE #

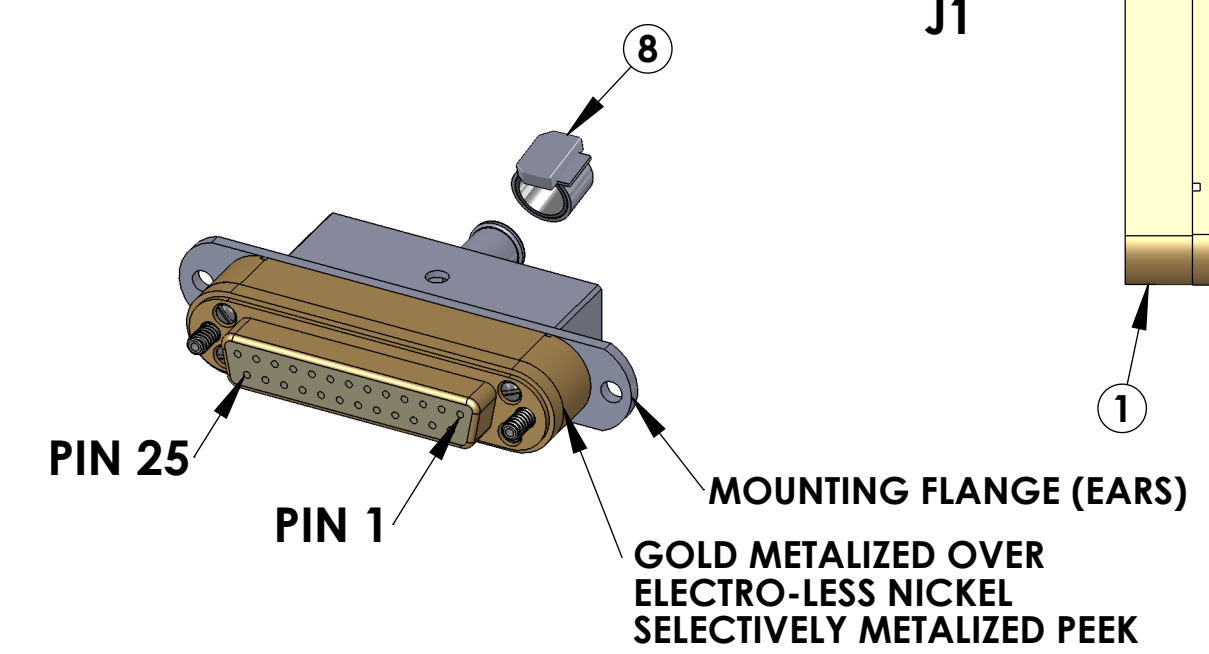
### CONNECTOR J1



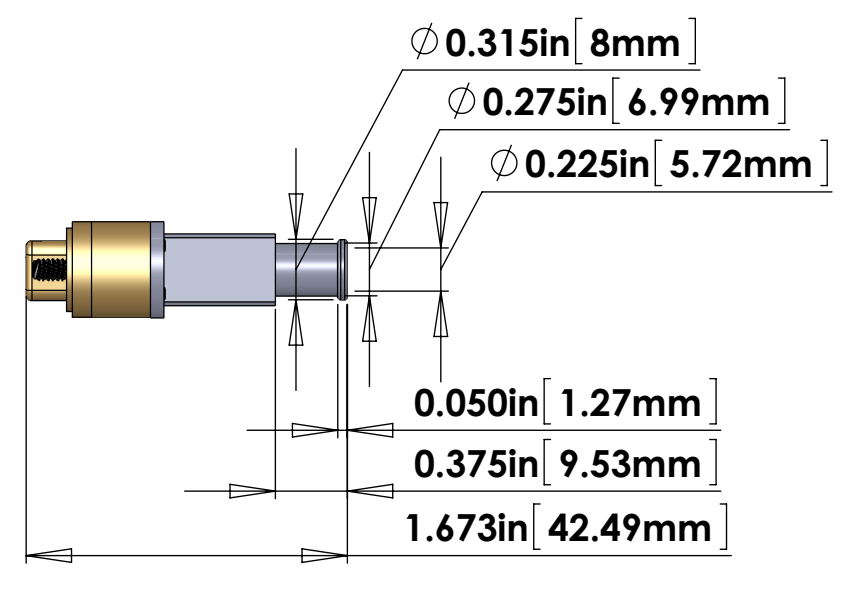
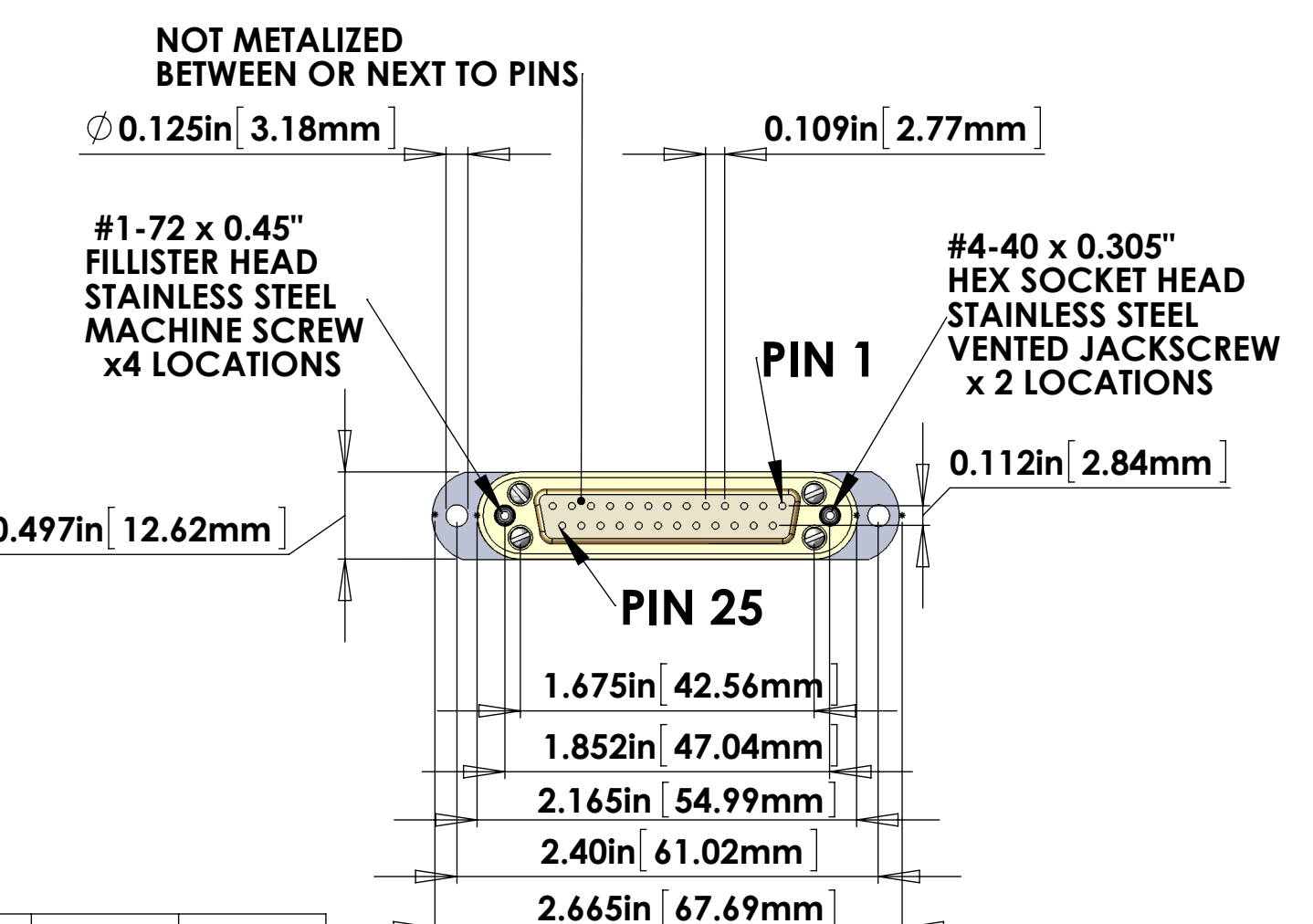
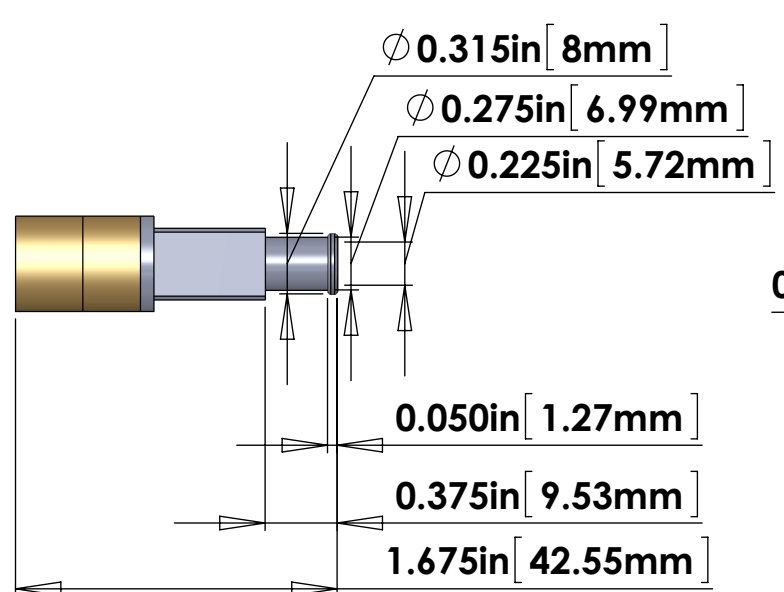
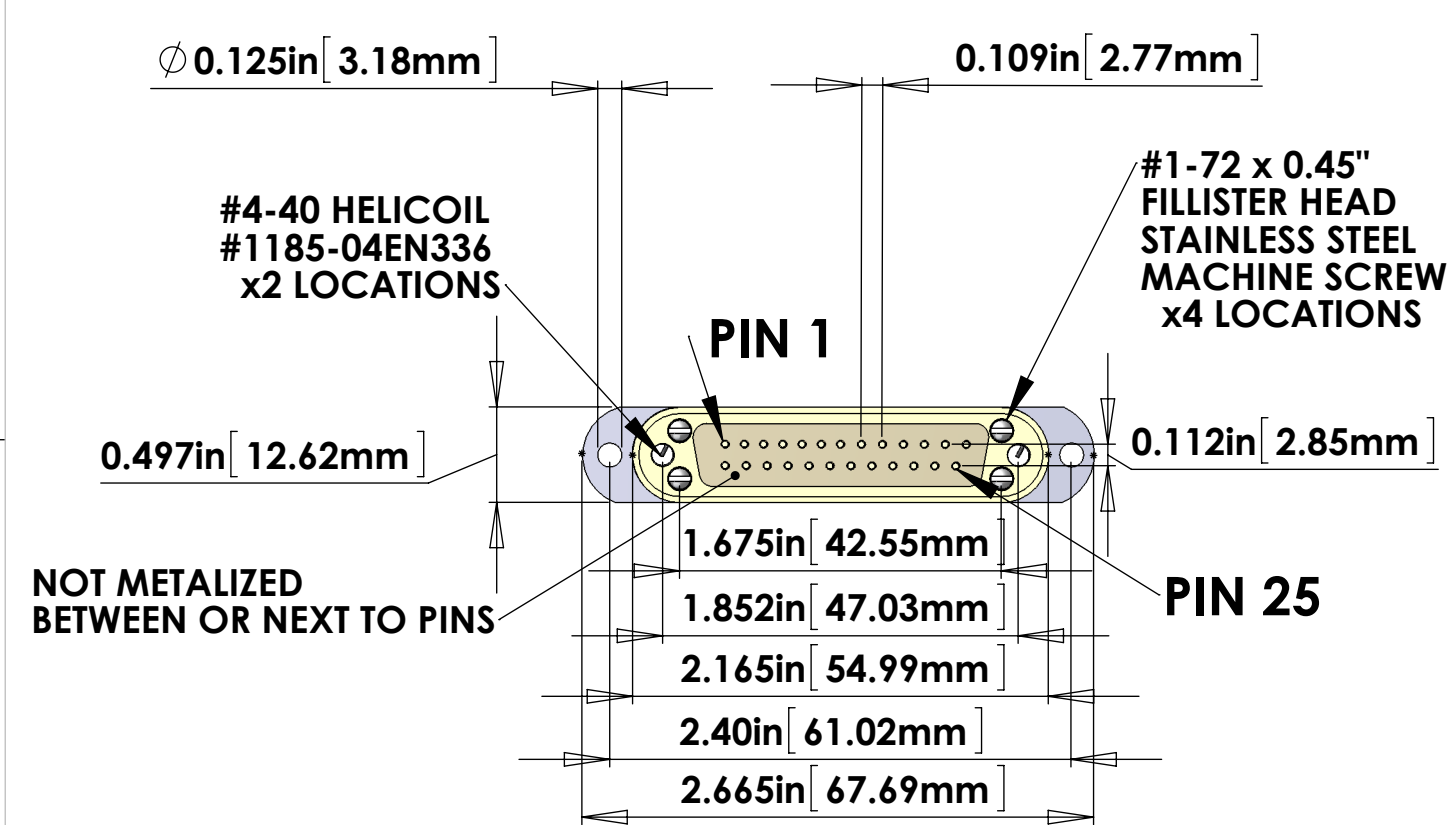
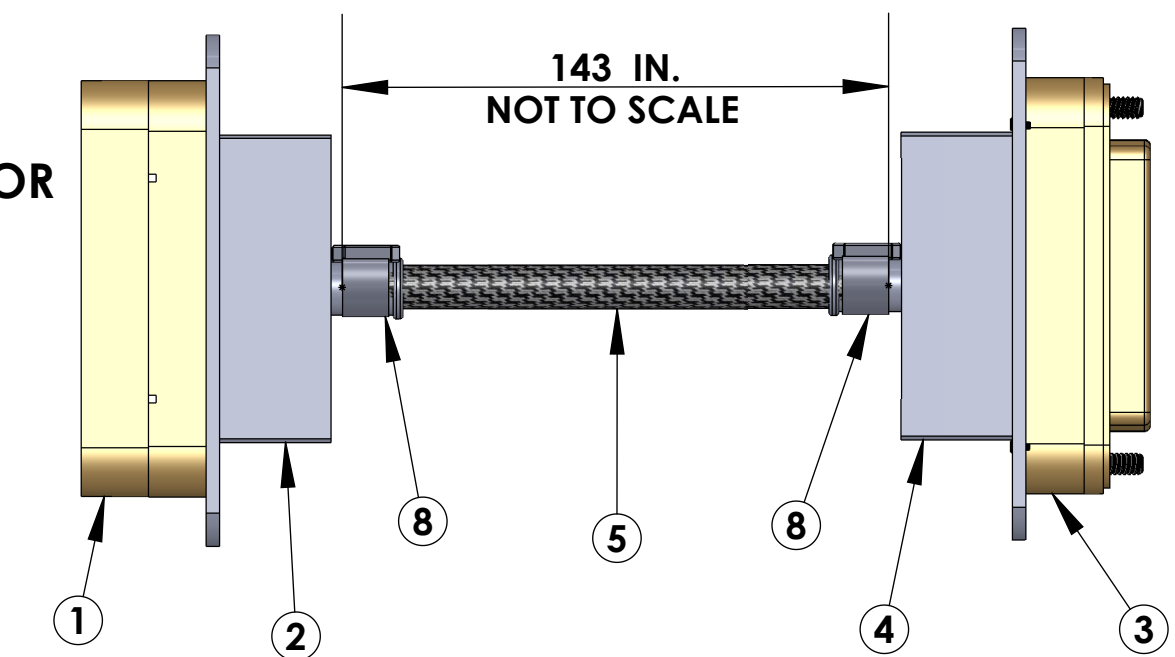
### CONNECTOR J2



### CONNECTOR J1



### CONNECTOR J2



#### V25J-143 CABLE ASSEMBLY CIRCUIT SUMMARY

##### V-DB25 M/S1-143-DB25 F/S1

CABLE NAME	COND. - WIRE ID	TWISTED PAIR	LENGTH *	FROM	TO
V25J-143	13 COND. CABLE	(6 TOTAL)	143 in.	Conn. J1	Conn. J2
	W1	SHIELD	143 in	PIN 1, SHELL	PIN 1, SHELL
	W8	TP-1	143 in	PIN 8	PIN 8
	W20		143 in	PIN 20	PIN 20
	W9	TP-2	143 in	PIN 9	PIN 9
	W21		143 in	PIN 21	PIN 21
	W10	TP-3	143 in	PIN 10	PIN 10
	W22		143 in	PIN 22	PIN 22
	W11	TP-4	143 in	PIN 11	PIN 11
	W23		143 in	PIN 23	PIN 23
	W12	TP-5	143 in	PIN 12	PIN 12
	W24		143 in	PIN 24	PIN 24
	W13	TP-6	143 in	PIN 13	PIN 13
	W25		143 in	PIN 25	PIN 25

PIN 14,2,15,3,16,4,17,5,18,6,19,7 N/C (NOT CONNECTED)

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0149-25CG20BS1-225F) OR EQUIVALENT **	DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS STEEL) WITH 0.225" i.d. PORT	1	
3	TICOR # (TS0148-25CG20BS1-225F) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS STEEL) WITH 0.225" i.d. PORT	1	
5	COONER WIRE # CZ1105 + 6 + 7	13 COND. (6 TW PAIR + 1 WIRE + SHIELD) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	143in *
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
7	#6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	

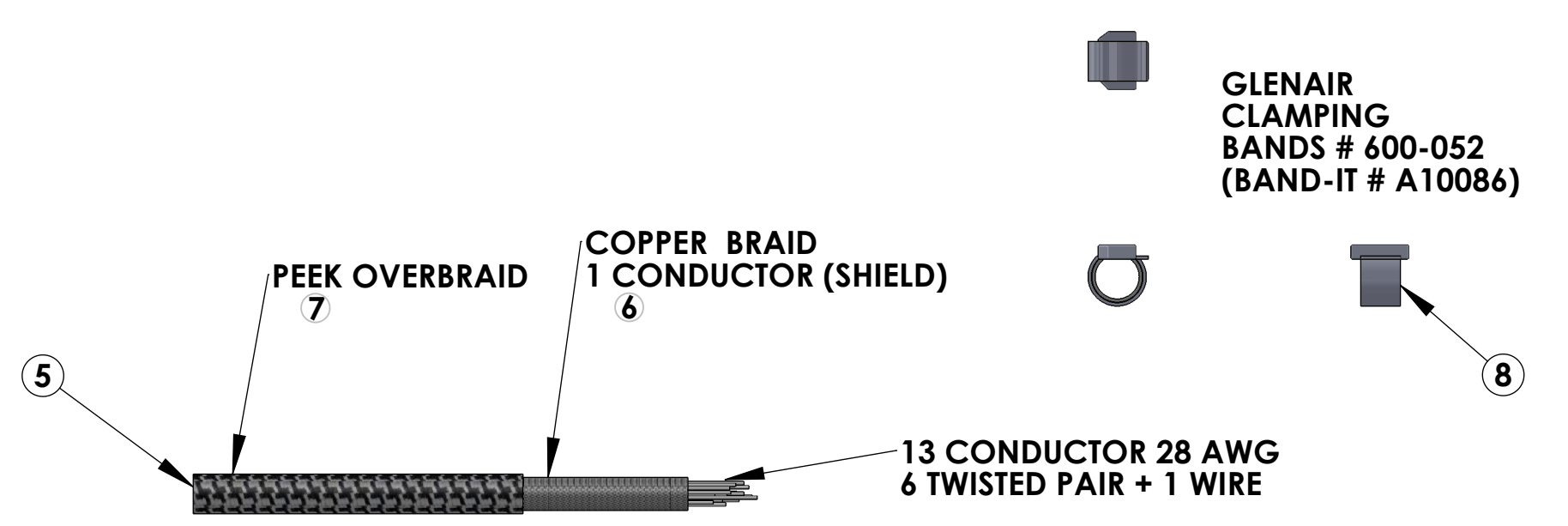
\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

#### NOTES: ( UNLESS OTHERWISE SPECIFIED )

- MATERIAL:
  - J1 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
  - J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
  - BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
  - CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - HARDWARE: STAINLESS STEEL, PASSIVATED.
  - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- CABLE 13 COND. 28 AWG (65/46), WITH PFA INSULATION COONER WIRE #CZ1105. 6 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE ~ 0.240 IN.
- CONNECTORS WILL BE SUPPLIED WITH HARDWARE. THE SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



DIMENSIONS ARE IN		TOLERANCES:		ANGULAR ± °	
.XX	±	.XX	±		
.XXX	±	.XXX	±		
MATERIAL		FINISH		NEXT ASSY	
Material <not specified>		μinch			

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
SYSTEM		CUSTOM CABLE SPECIFICATION V25J-143	
SUB-SYSTEM		ISIC	
DESIGNER	R. ABBOTT	JUL/02/2012	SIZE DWG. NO.
DRAFTER	E. BROWN	JUL/02/2012	D D1000568
CHECKER			REVISION
APPROVAL			v8

SCALE: 1:1		PROJECTION:		SHEET 1 OF 1	
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#### ISC TRANSMON QPD CABLE

#### SEISMIC TABLE TO SUSPENDED TRANSMON TABLE

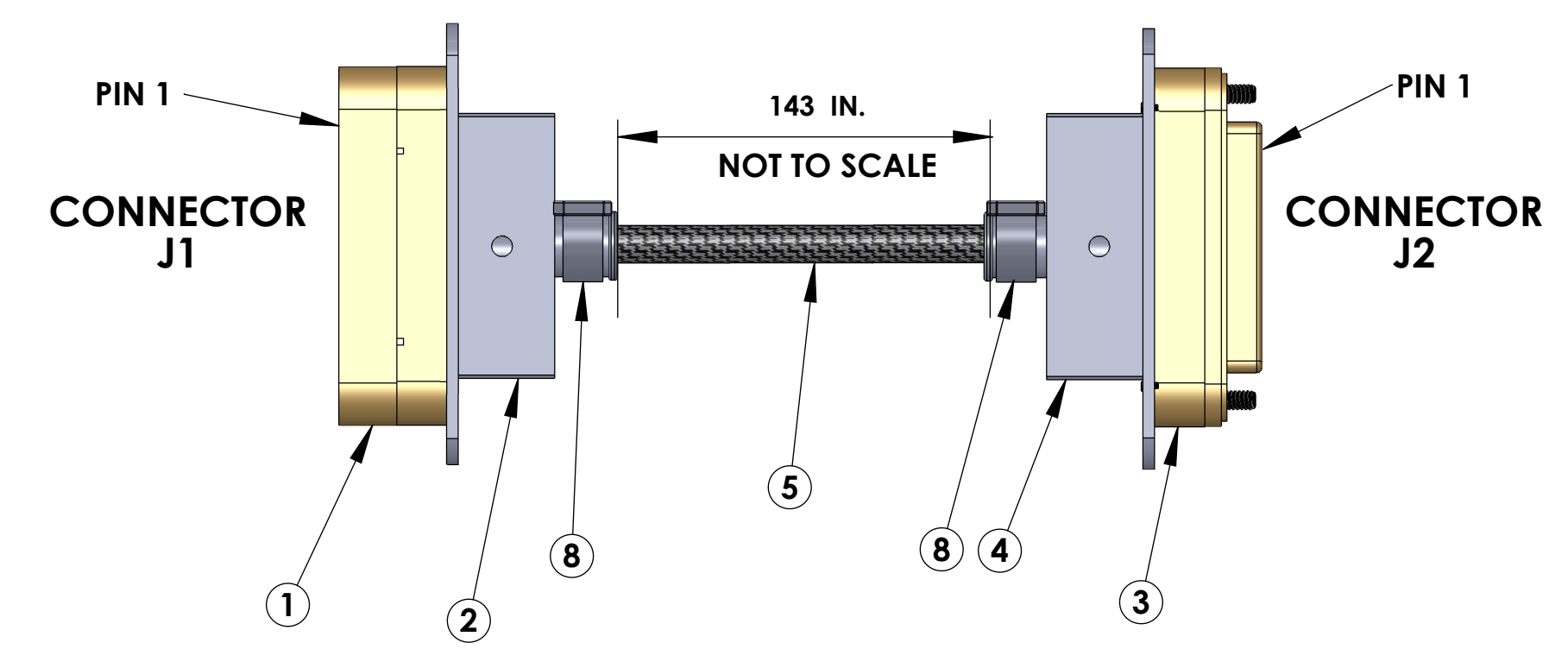
#### V-DB25 M/S1-143-DB25 F/S1

#### STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
ISC	IN-VAC	TRANSMON TABLE TO SEISMIC TABLE QPD FOR TRANSMON

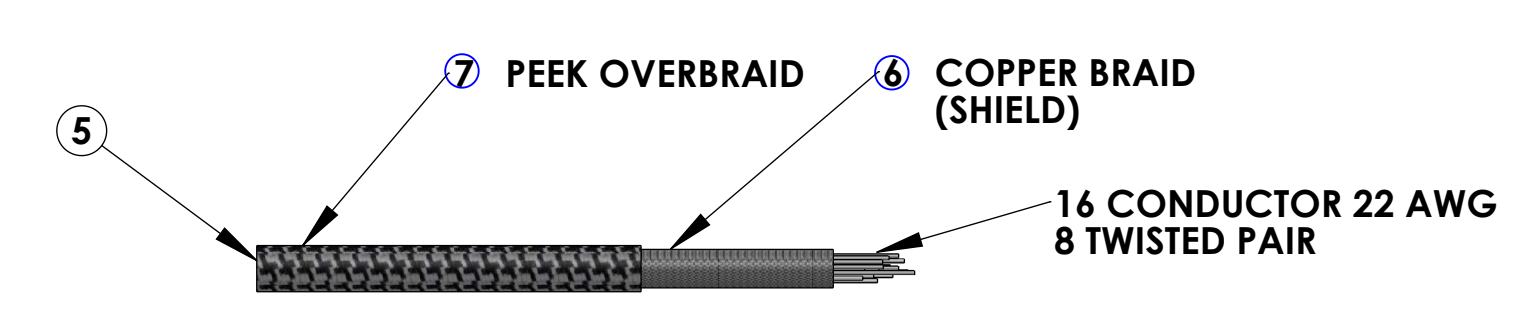
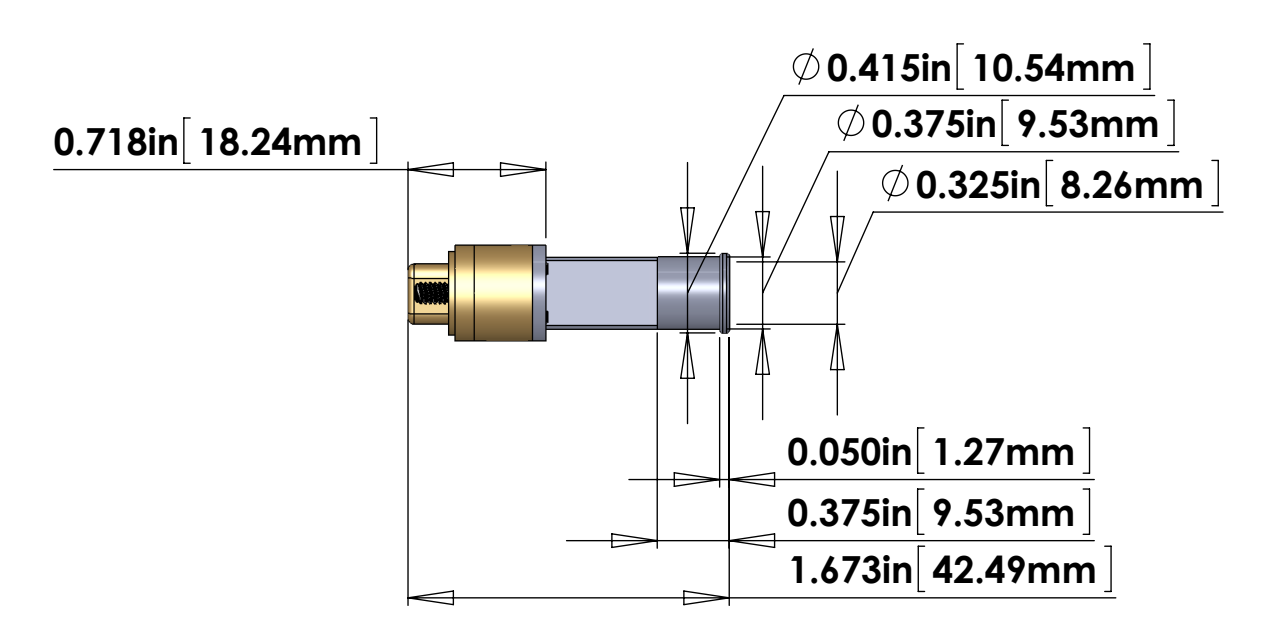
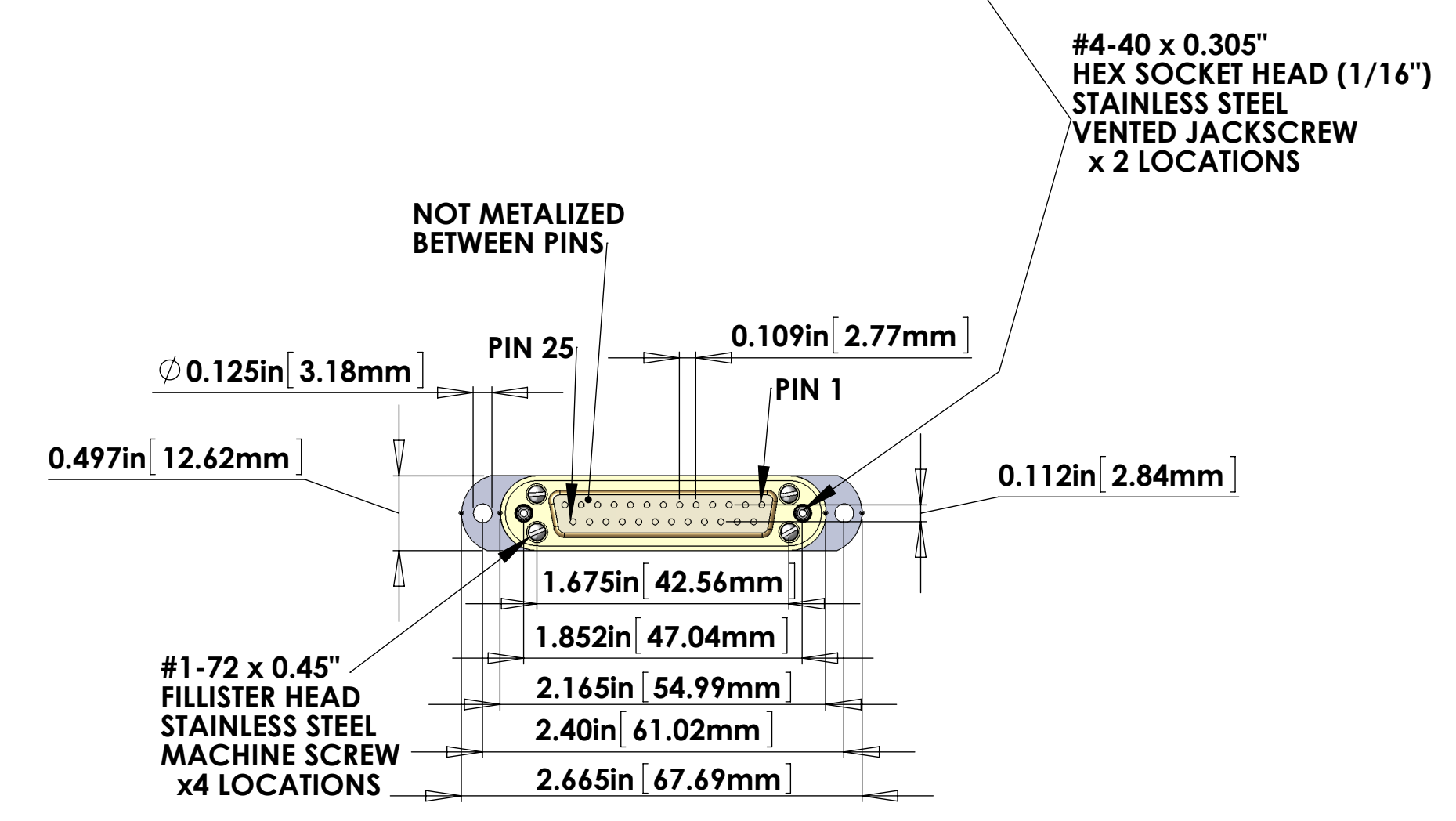
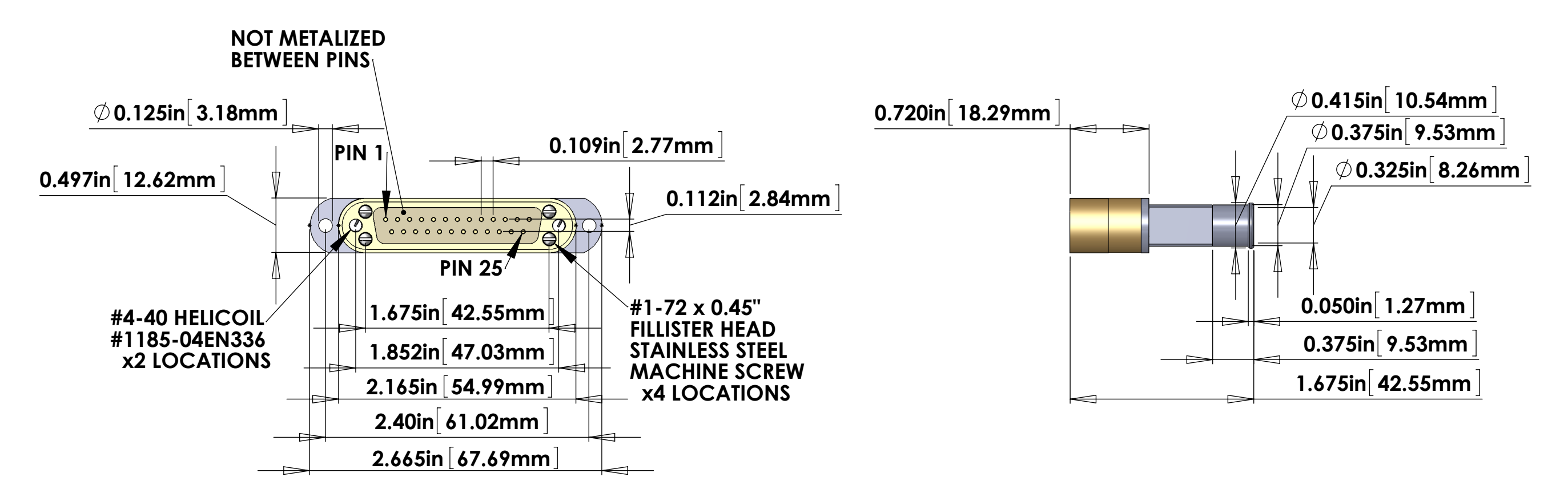
D:\000568-6-cable V25J-143 PART PDM REV. DRAWING PDM REV. X-000

- NOTES CONTINUED:
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE 07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VY, S/N 001. A VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-EP000364.
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMMART HELI-COIL PRODUCT CATALOG, HC2000, REV 4.
  - NOTES 13 and 14 DO NOT APPLY TO THIS PART.
  - ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.
  - ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-EP000364.
  - SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
  - PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E0900083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 7.5-8X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
  - DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
  - BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.



**CONNECTOR J1**

**CONNECTOR J2**



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0149-25CG20B5)-325F OR EQUIVALENT **	DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2		DB25 CONNECTOR BACKSHELL (WITH EARS) (LARGE PORT) FOR UHV (STAINLESS) WITH Ø0.325" I.D. PORT	1	
3	TICOR # (TS0148-25CG20B5)-325F OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) (LARGE PORT) FOR UHV (STAINLESS) WITH Ø0.325" I.D. PORT	1	
5	COONER WIRE # C72205 + 8 + 9	16 COND. 22Ga. (8 TWISTED PAIR) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEL OVERBRAID	1	143in *
6	CONTINENTAL PART # 24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
7	#6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	
9	HELICOIL #1185-04EN336	#4-40 Nitronic 60, HELICOIL 0.336" LENGTH	2	

\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.  
 \*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.



**V25C-143 CABLE ASSEMBLY CIRCUIT SUMMARY**  
**V-DB25HD M/S1-143-DB25HD F/S1**

CABLE NAME	COND.- WIRE ID	TWISTED PAIR	LENGTH *	FROM	TO
V25A-143	16 COND. CABLE	(8 TOTAL)	143 in.	Conn. J1	Conn. J2
	SHIELD		143 in	PIN 1, SHELL	PIN 1, SHELL
	W13	TP-1	143 in	PIN 13	PIN 13
	W25		143 in	PIN 25	PIN 25
	W12	TP-2	143 in	PIN 12	PIN 12
	W24		143 in	PIN 24	PIN 24
	W11	TP-3	143 in	PIN 11	PIN 11
	W23		143 in	PIN 23	PIN 23
	W10	TP-4	143 in	PIN 10	PIN 10
	W22		143 in	PIN 22	PIN 22
	W9	TP-5	143 in	PIN 9	PIN 9
	W21		143 in	PIN 21	PIN 21
	W8	TP-6	143 in	PIN 8	PIN 8
	W20		143 in	PIN 20	PIN 20
	W7	TP-7	143 in	PIN 7	PIN 7
	W19		143 in	PIN 19	PIN 19
	W6	TP-8	143 in	PIN 6	PIN 6
	W18		143 in	PIN 18	PIN 18

PIN 14,2,15,3,16,4,17,5 N/C (NOT CONNECTED)  
 \* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

SEE REFERENCE DCC# LIGO-D1100670

**ISC TRANSMON PICOMOTOR CABLE SEISMIC TABLE TO SUSPENDED TRANSMON TABLE**  
**V-DB25HD M/S1-143-DB25HD F/S1**

STANDARD USE FOR THIS CABLE	
SUBSYSTEM	AIR/VAC
ISC	IN-VAC

STANDARD USE  
 PICOMOTORS TOP TO TABLE

- NOTES: ( UNLESS OTHERWISE SPECIFIED )
- MATERIAL:**
    - J1 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
    - J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
    - BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
    - CONTACTS - BERYLLIUM COPPER ALLOY C17300.
    - HARDWARE - STAINLESS STEEL, PASSIVATED.
    - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.
  - CABLE:** 16 COND. 22 AWG. (150 STRD 44 AWG) WITH 0.005" PFA INSULATION. (COONER WIRE #C72205) 8 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.
  - CONNECTORS:** WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES .005-.015. FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

TOLERANCES:  
 .XX ±  
 .XXX ±  
 ANGULAR ± °

MATERIAL: Material <not specified> FINISH: μinch

SYSTEM: LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: CUSTOM CABLE SPECIFICATION V25C-143

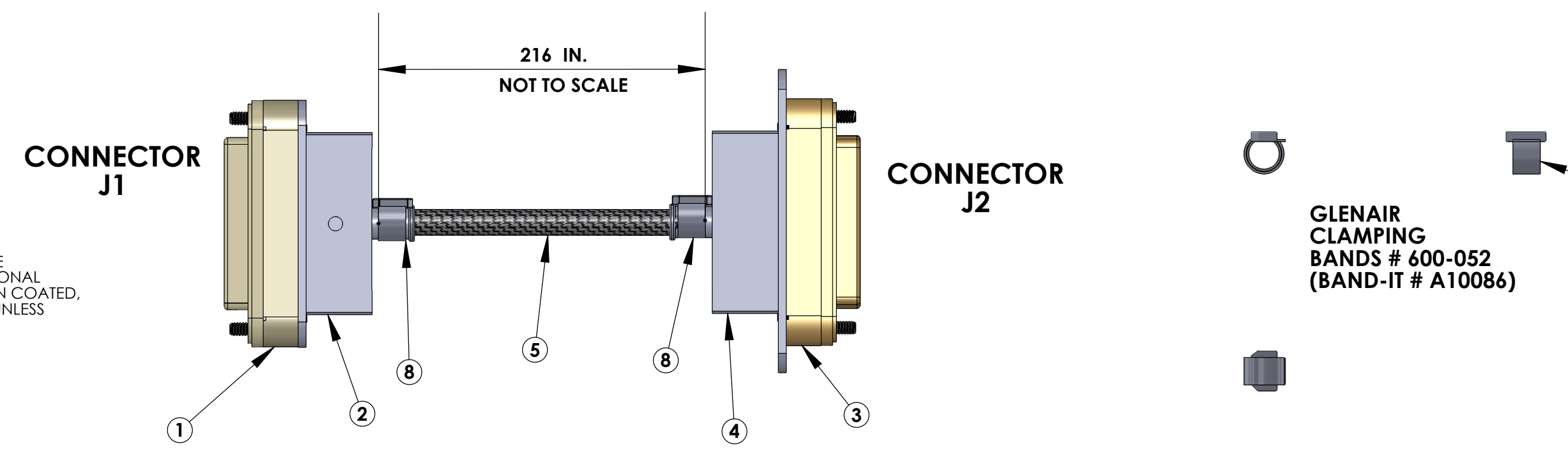
DESIGNER: R. ABBOTT JULI,02/2012 SIZE DWG. NO. E D1000921 REV. v7

DRAFTER: E. BROWN JULI,02/2012

CHECKER: APPROVAL: SCALE: 1:1 PROJECTION: SHEET 1 OF 1

- NOTES CONTINUED:**
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VY, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV. 4

- ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.
  - ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
  - SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
  - PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
  - DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
  - BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.
- NOTES 13 and 14 DO NOT APPLY TO THIS PART



REV.	DATE	DCN #	DRAWING TREE #

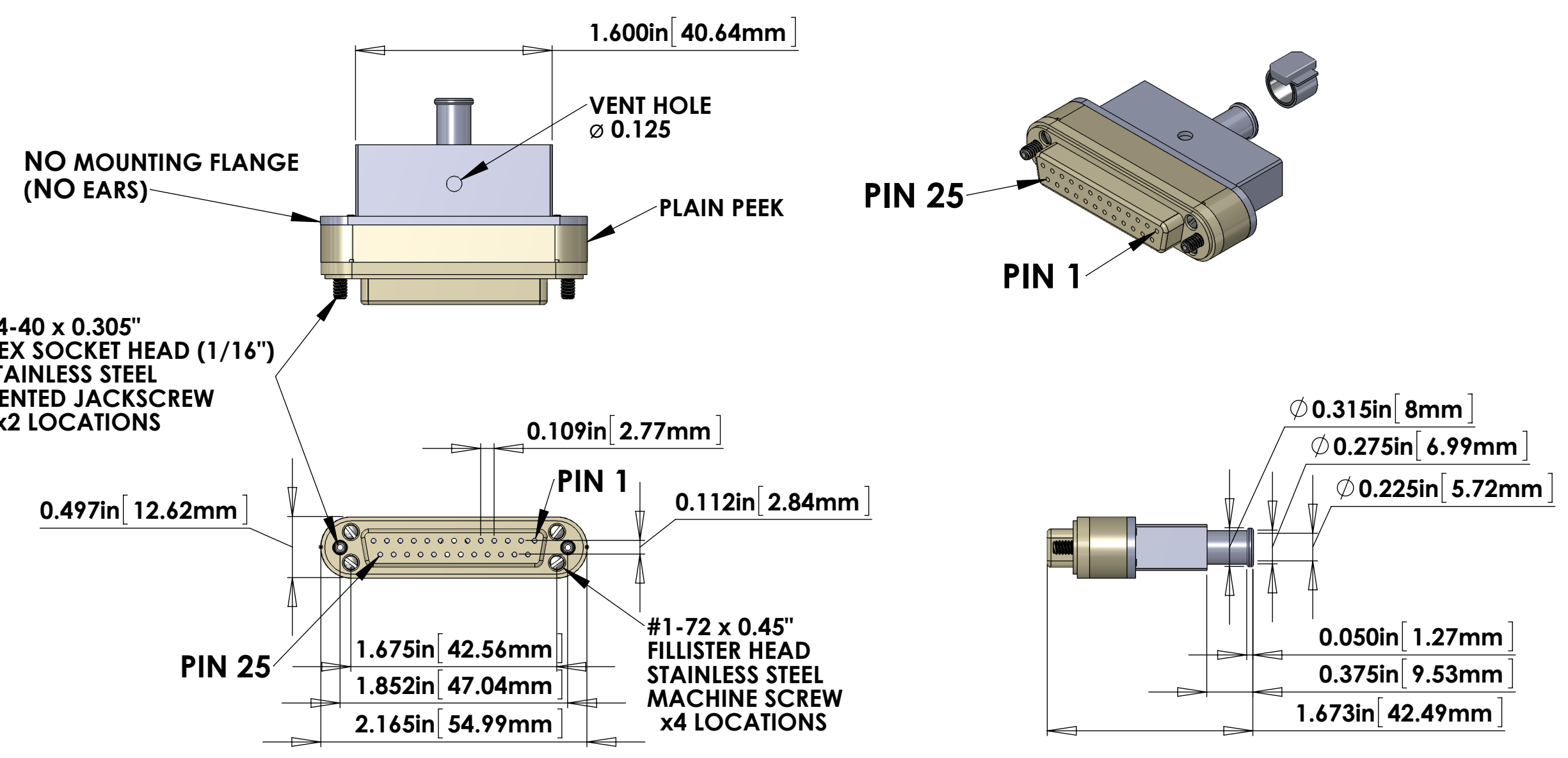
### V25A-216 CABLE ASSEMBLY CIRCUIT SUMMARY

#### V-DB25 F/S1-216-DB25 F/S1

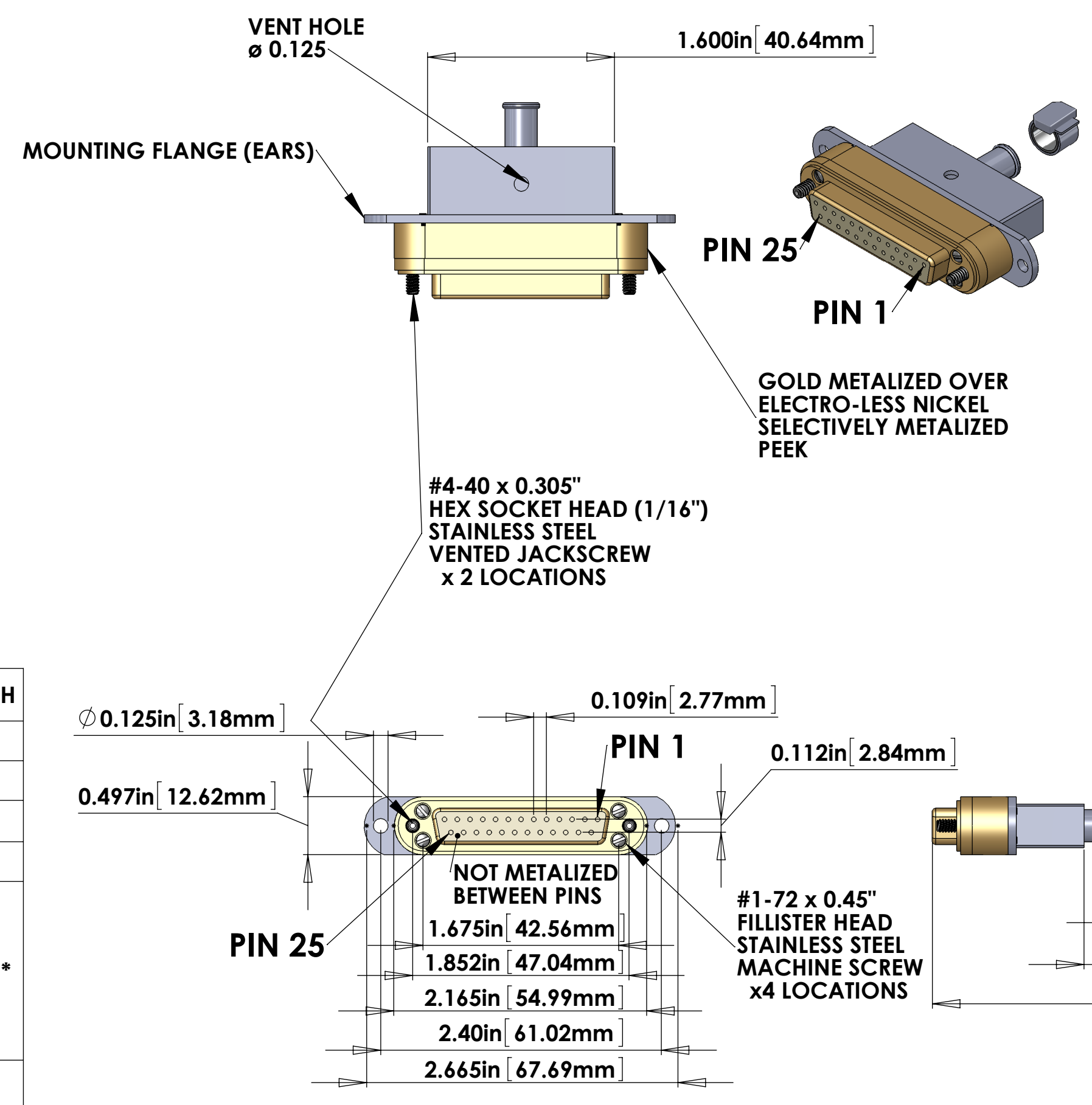
CABLE NAME	COND.-WIRE ID	TWISTED PAIR	LENGTH *	FROM	TO
V25A-216	25 COND. CABLE	(12 TOTAL)	216 in.	Conn. J1	Conn. J2
	W1	SHIELD	216 in	PIN 1, SHELL	PIN 1, SHELL
	W2	TP-1	216 in	PIN 2	PIN 2
	W14		216 in	PIN 14	PIN 14
	W3	TP-2	216 in	PIN 3	PIN 3
	W15		216 in	PIN 15	PIN 15
	W4	TP-3	216 in	PIN 4	PIN 4
	W16		216 in	PIN 16	PIN 16
	W5	TP-4	216 in	PIN 5	PIN 5
	W17		216 in	PIN 17	PIN 17
	W6	TP-5	216 in	PIN 6	PIN 6
	W18		216 in	PIN 18	PIN 18
	W7	TP-6	216 in	PIN 7	PIN 7
	W19		216 in	PIN 19	PIN 19
	W8	TP-7	216 in	PIN 8	PIN 8
	W20		216 in	PIN 20	PIN 20
	W9	TP-8	216 in	PIN 9	PIN 9
	W21		216 in	PIN 21	PIN 21
	W10	TP-9	216 in	PIN 10	PIN 10
	W22		216 in	PIN 22	PIN 22
	W11	TP-10	216 in	PIN 11	PIN 11
	W23		216 in	PIN 23	PIN 23
	W12	TP-11	216 in	PIN 12	PIN 12
	W24		216 in	PIN 24	PIN 24
	W13	TP-12	216 in	PIN 13	PIN 13
	W25		216 in	PIN 25	PIN 25

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

### CONNECTOR J1



### CONNECTOR J2



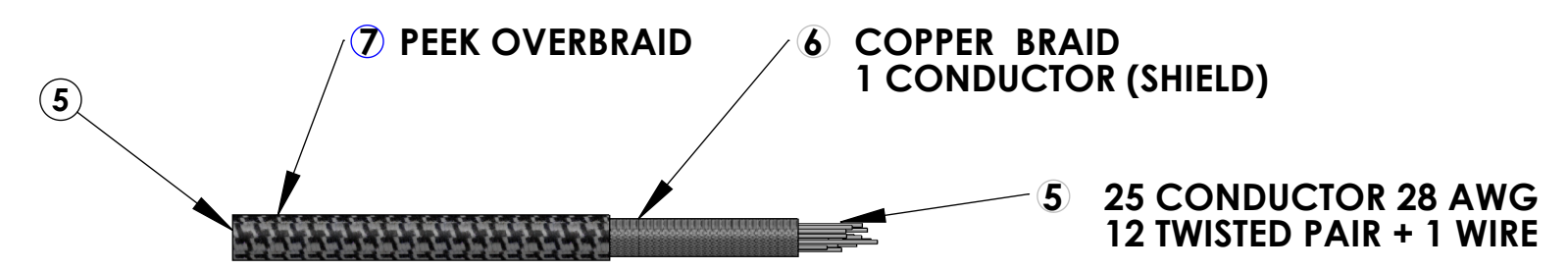
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0148-25C020BS1-225) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB25 CONNECTOR BACKSHELL (NO EARS) FOR UHV (STAINLESS) WITH $\phi$ 0.225" i.d. PORT	1	
3	TICOR # (TS0148-25CG20BS1-225F) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS) WITH $\phi$ 0.225" i.d. PORT	1	
5	COONER WIRE #CW6951rev1 + 6 + 7	25 COND. (12 TWISTED PAIR + 1 WIRE + SHIELD) 28AWG CABLE WITH 5 COPPER BRAID (SHIELD) AND 6 PEEK OVERBRAID	1	216in *
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
7	#6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	

\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.  
\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

#### NOTES: ( UNLESS OTHERWISE SPECIFIED )

- A. MATERIAL: a. J1 CONNECTOR SHELL - PEEK VICTREX 450GL30.  
b. J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.  
c. BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.  
d. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.00050 MIN. GOLD OVER NICKEL.  
e. HARDWARE: STAINLESS STEEL, PASSIVATED.  
f. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- B. CABLE 25 COND. 28 AWG, (40 STRD 44 AWG) WITH 2 LAYERS OF KAPTON TAPE (COONER # CW6951rev1). 12 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.
- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



### ISC TRANSMON QPD CABLE

#### V-DB25 F/S1-216-DB25 F/S1

STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
ISC	IN-VAC	FLANGE TO TOP CABLE QPD FOR TRANSMON

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN TOLERANCES: .XX ± .XXX ± ANGULAR ± °

MATERIAL: Material <not specified> FINISH:  $\mu$ inch

SYSTEM: LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: CUSTOM CABLE SPECIFICATION V25A-216

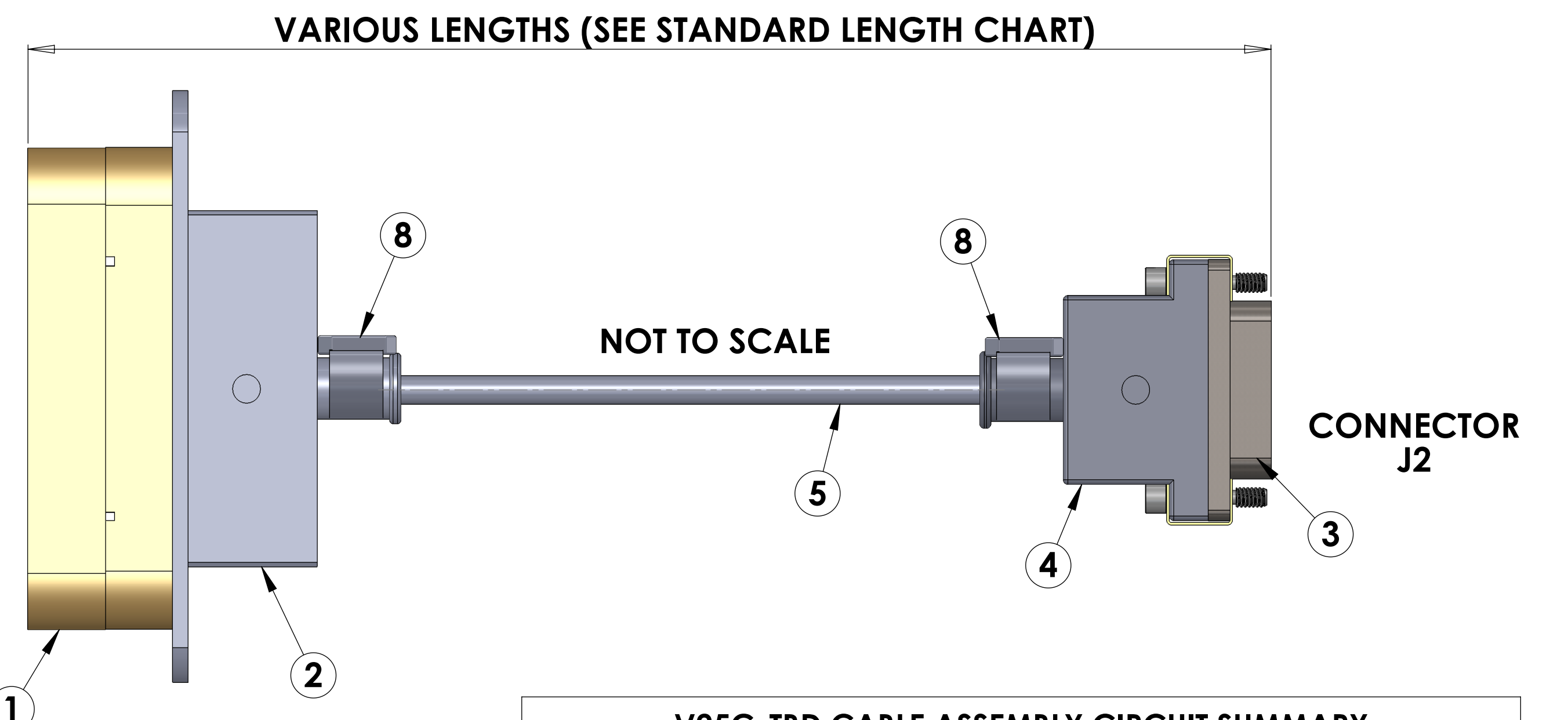
DESIGNER: R. ABBOTT JUL/02/2012 SIZE: DWG. NO. D1000924 REV. v6

DRAFTER: E. BROWN JUL/02/2012 CHECKER: APPROVAL: SCALE: 1:1 PROJECTION: SHEET 1 OF 1

NOTES CONTINUED:  
 3. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE 07" HIGH CHARACTERS. EXAMPLE: DXXXXXXVY, S/N 001. VIBRATORY TOOL MAY BE USED. A  
 6. APPROXIMATE WEIGHT = X.XXXX LB.  
 7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364  
 8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.  
 9. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV 4  
 NOTES 13 and 14 DO NOT APPLY TO THIS PART

10. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL AFTER DELIVERY OF FINISHED PARTS. USE NITRONIC 60 THREADED INSERTS.  
 11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.  
 12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.  
 13. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION; THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.  
 14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.  
 15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

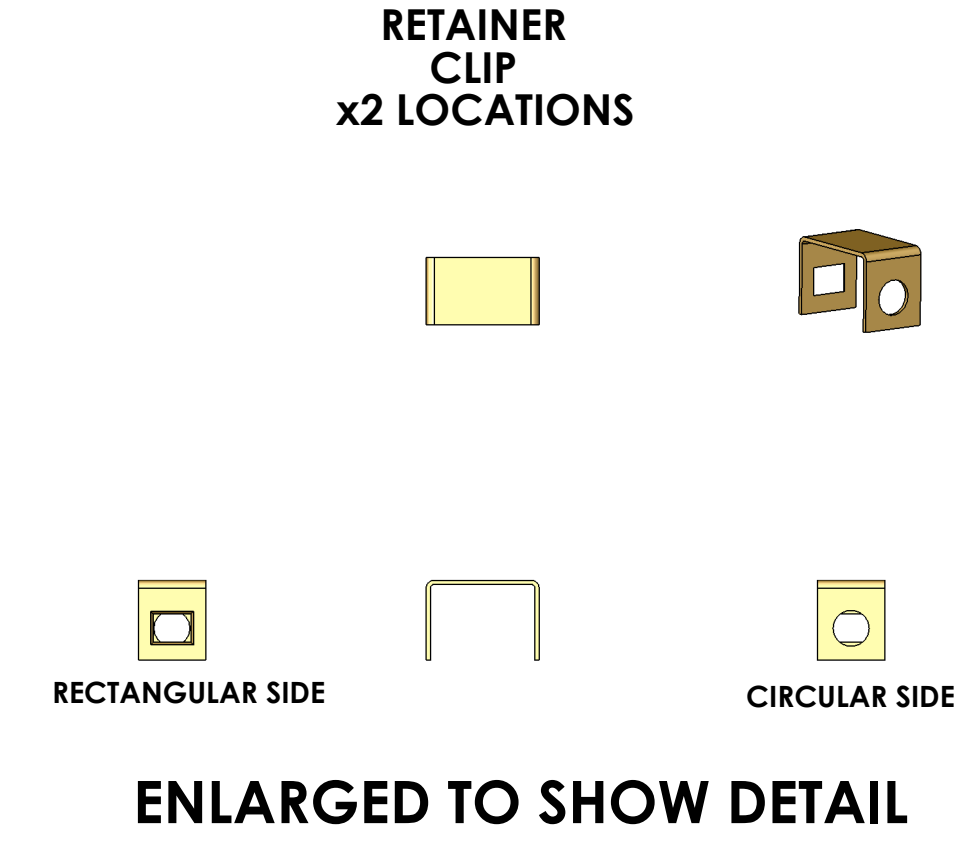
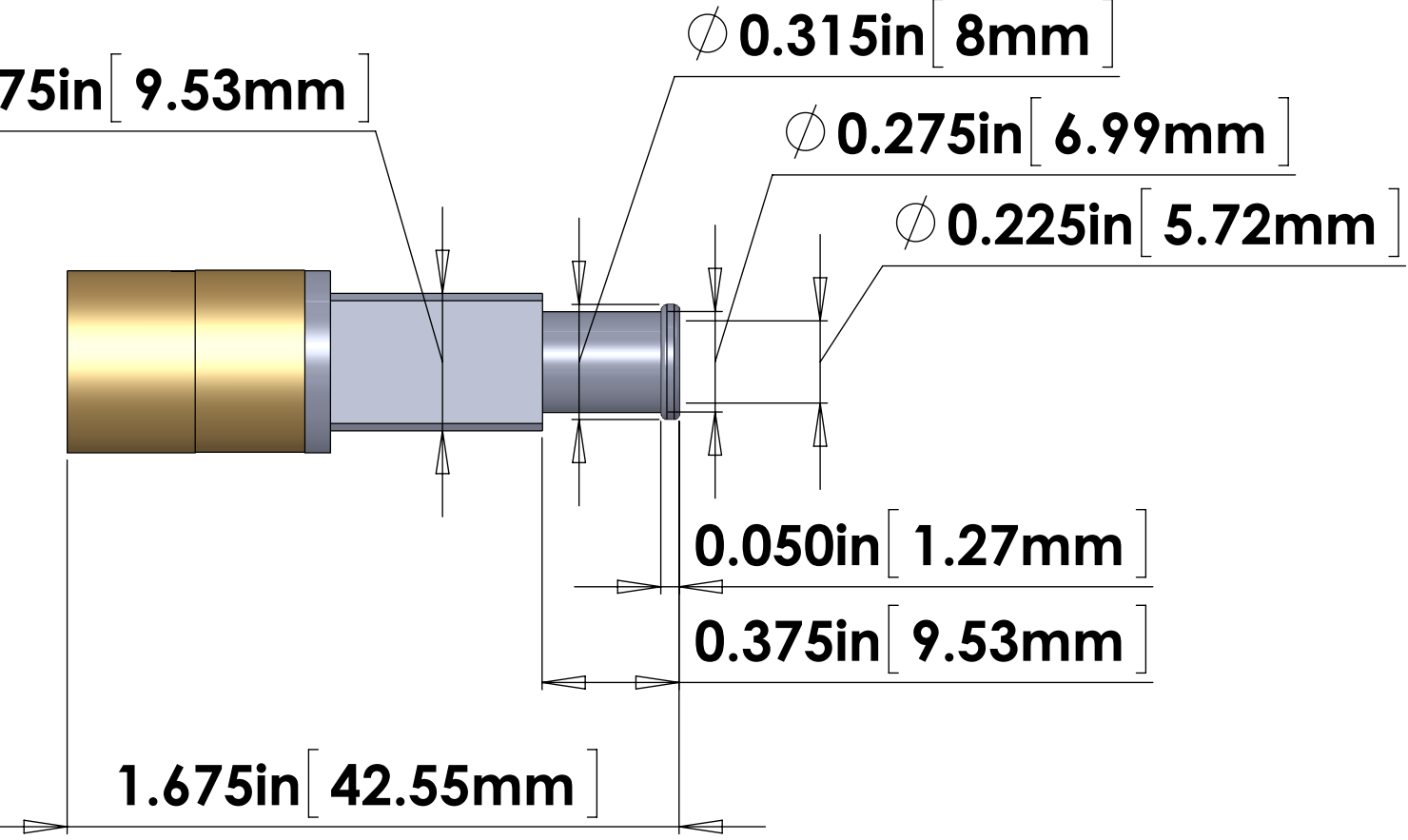
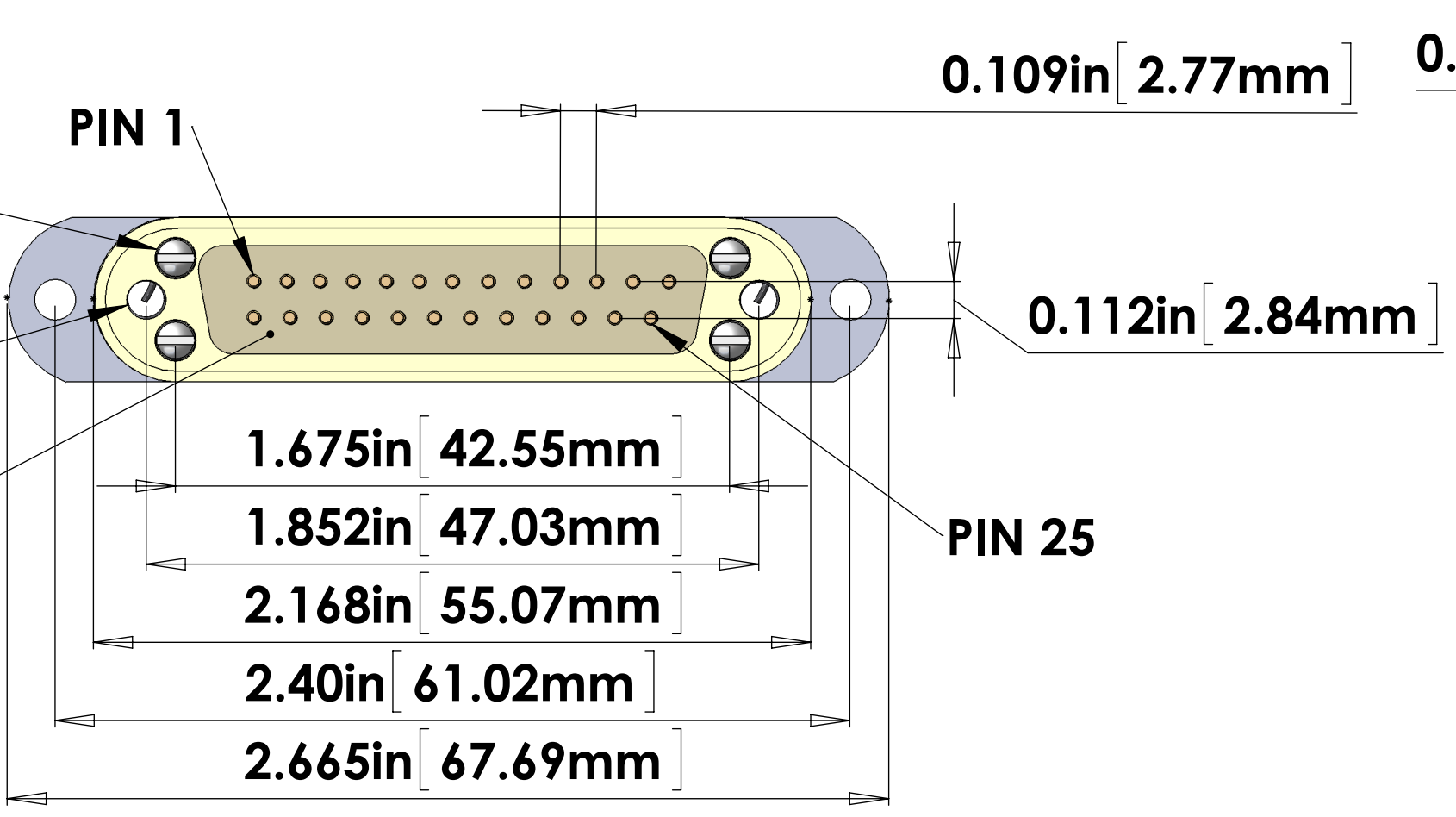
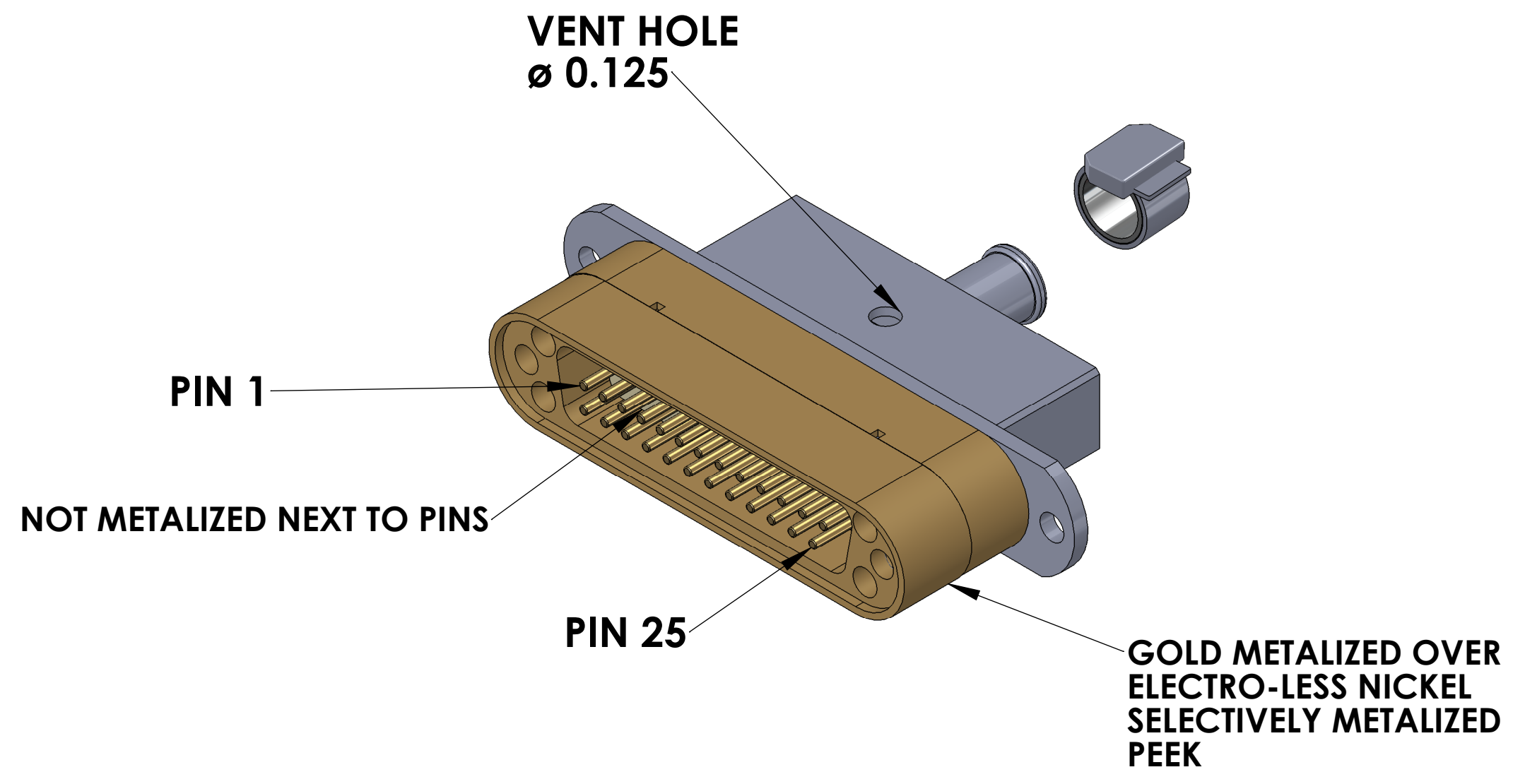
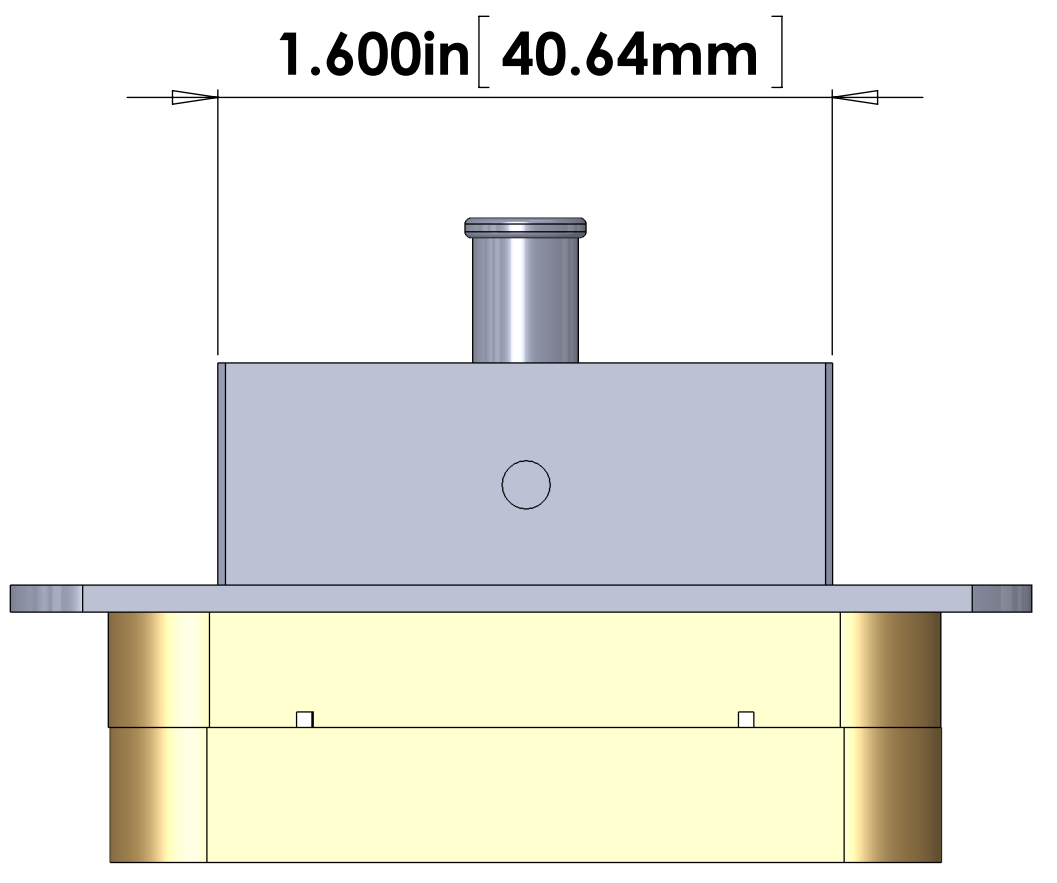
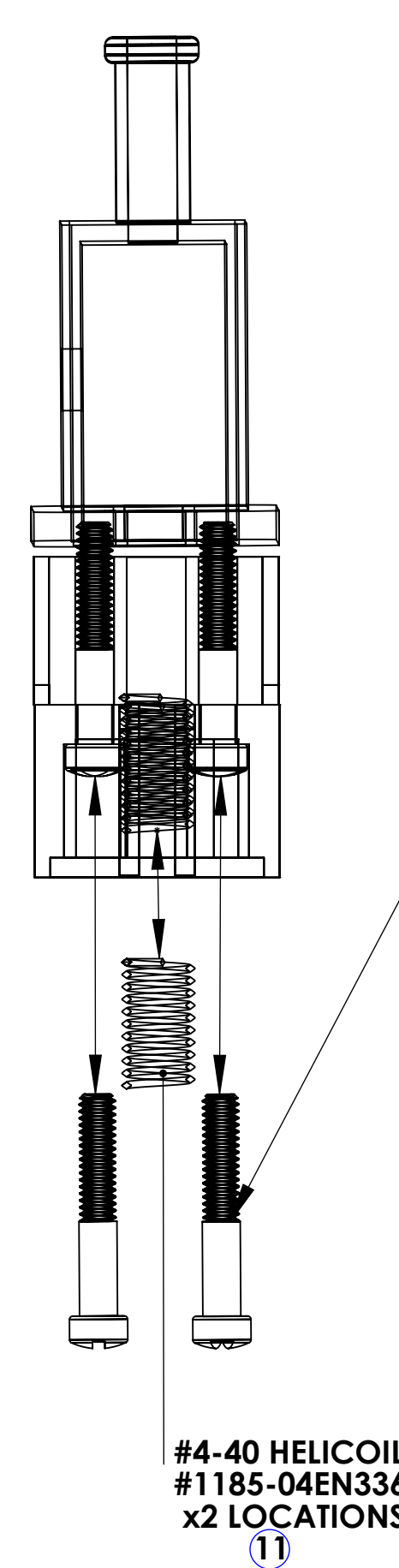
STANDARD CABLE LENGTH CHART		
DESIGNATOR	INCHES	FEET and INCHES
V25G-90	90	7 ft. 2 in.
V25G-110	110	9 ft. 2 in.
V25G-121	121	10 ft. 1 in.
V25G-156	156	13 ft.
V25G-TBD	TBD - ADDITIONAL CUSTOM LENGTHS	LENGTH TO BE DETERMINED AT TIME OF ORDER



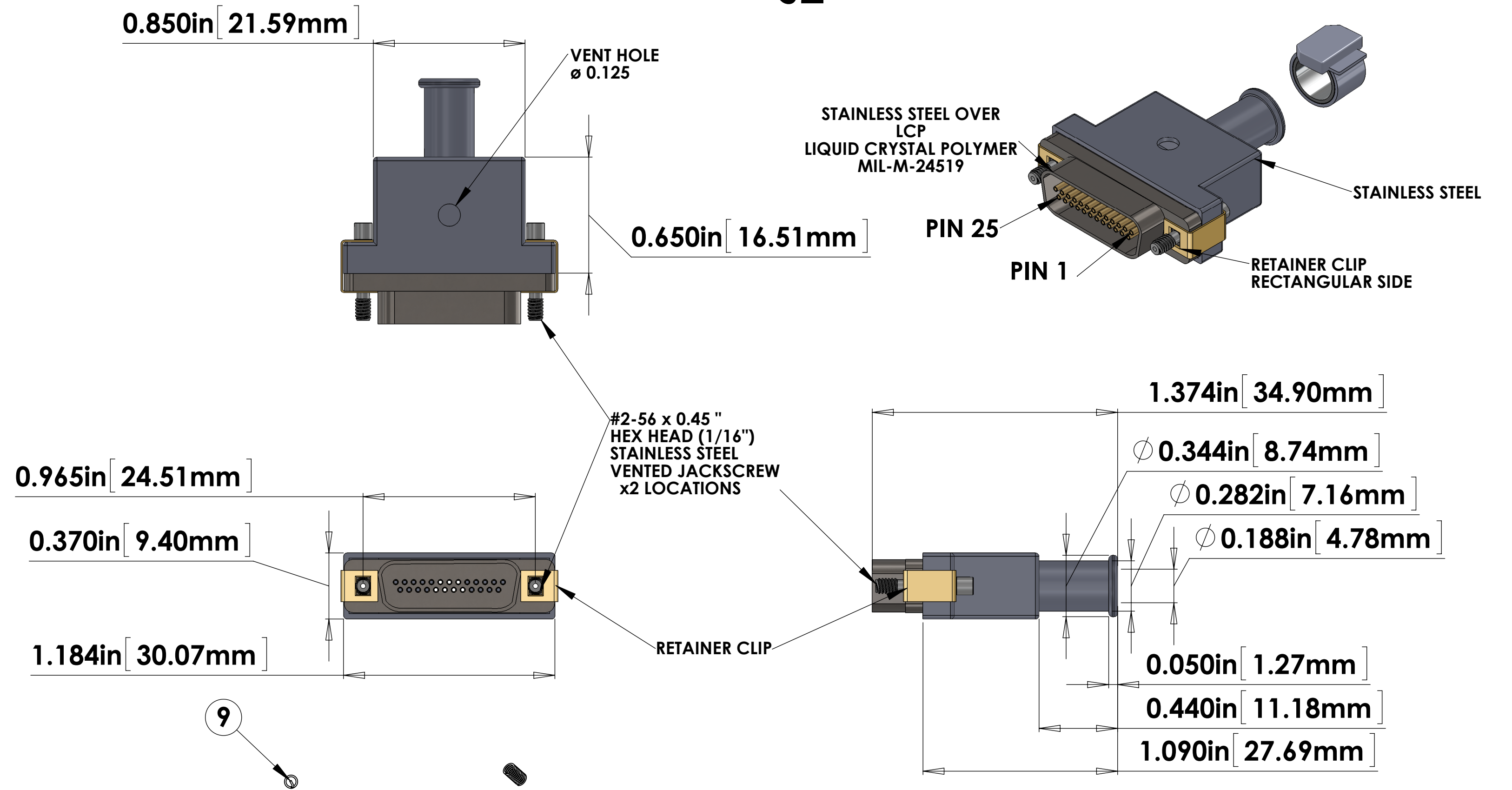
V25G-TBD CABLE ASSEMBLY CIRCUIT SUMMARY V-DB25 M/S1-TBD-μD25 F/S1					
CABLE NAME	COND. - WIRE ID	TWISTED PAIR	LENGTH **	FROM	TO
V25G-TBD	25 COND. CABLE	(12 TOTAL)	TBD in. *	CONN. J1	CONN. J2
C1	W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25	SHIELD (COPPER BRAID)	TBD in. *	PIN 1, SHIELD & SHELL	PIN 1, SHIELD & SHELL
		SINGLE WIRE	TBD in. *	PIN 1, SHIELD & SHELL	PIN 1, SHIELD & SHELL
		TP-1	TBD in. *	PIN 2	PIN 2
		TP-2	TBD in. *	PIN 3	PIN 3
		TP-3	TBD in. *	PIN 4	PIN 4
		TP-4	TBD in. *	PIN 5	PIN 5
		TP-5	TBD in. *	PIN 6	PIN 6
		TP-6	TBD in. *	PIN 7	PIN 7
		TP-7	TBD in. *	PIN 8	PIN 8
		TP-8	TBD in. *	PIN 9	PIN 9
		TP-9	TBD in. *	PIN 10	PIN 10
		TP-10	TBD in. *	PIN 11	PIN 11
TP-11	TBD in. *	PIN 12	PIN 12		
TP-12	TBD in. *	PIN 13	PIN 13		
TP-13	TBD in. *	PIN 14	PIN 14		
TP-14	TBD in. *	PIN 15	PIN 15		
TP-15	TBD in. *	PIN 16	PIN 16		
TP-16	TBD in. *	PIN 17	PIN 17		
TP-17	TBD in. *	PIN 18	PIN 18		
TP-18	TBD in. *	PIN 19	PIN 19		
TP-19	TBD in. *	PIN 20	PIN 20		
TP-20	TBD in. *	PIN 21	PIN 21		
TP-21	TBD in. *	PIN 22	PIN 22		
TP-22	TBD in. *	PIN 23	PIN 23		
TP-23	TBD in. *	PIN 24	PIN 24		
TP-24	TBD in. *	PIN 25	PIN 25		
TP-25	TBD in. *	PIN 26	PIN 26		

TBD in. \* = LENGTH TO BE DETERMINED AT TIME OF ORDER - see STANDARD CABLE LENGTH CHART  
 \*\* THE LENGTH SHOWN IN THIS LIST IS THE OVERALL LENGTH OF THE CABLE FROM THE CONNECTOR END TO THE OTHER CONNECTOR END. CHANGE LENGTH AS NECESSARY TO COMPENSATE FOR THE INTERNAL WIRING OF THE CONNECTOR AND STRIP LENGTH.

ENLARGED TO SHOW DETAIL



CONNECTOR J2



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH *
1	TICOR PART # TS0149-25CG20B51-225F OR EQUIVALENT **	CUSTOM DB25 MALE CONNECTOR (J1) FOR UHV (GOLD METALIZED PEEK)	1	
2	TICOR PART # TS-0143-1 BACKSHELL (Included in PART # TS-0143-1) OR EQUIVALENT	DB25 CONNECTOR BACKSHELL FOR UHV (STAINLESS STEEL) WITH ø0.225" I.D. PORT	1	
3	TICOR PART # TS-0143-1 BACKSHELL (Included in PART # TS-0143-1) OR EQUIVALENT	MicroD25 FEMALE CONNECTOR (J2) FOR UHV (PEEK)	1	
4	TICOR PART # TS-0143-1 BACKSHELL (Included in PART # TS-0143-1) OR EQUIVALENT	MicroD25 CONNECTOR BACKSHELL FOR UHV (STAINLESS STEEL) WITH ø0.188" I.D. PORT	1	
5	C1	25 COND. (12 TW PAIR + 1 WIRE + SHIELD) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	TBD in. *
6	CONTINENTAL PART #24x4x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x4x40BC	1	TBD in. *
7	PART #6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	TBD in. *
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	
9	HELICOIL #1185-04EN336	#4-40 Nitronic 60® HELICOIL 0.336" LENGTH	2	

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM PIN TIP (25 PIN D-SUB) TO PIN TIP (25 PIN μD) OF THE CABLE. USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTH.  
 \*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

ELECTRICAL NOTES: ( UNLESS OTHERWISE SPECIFIED )

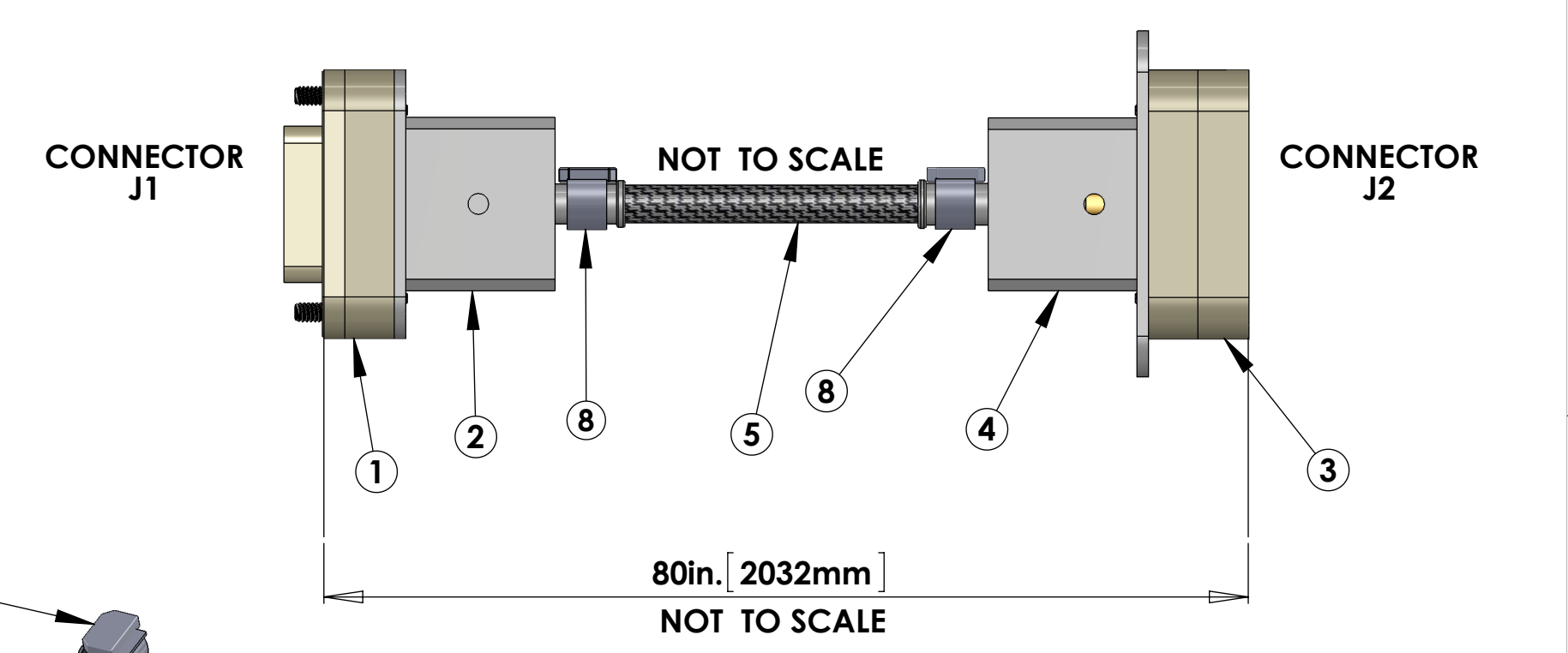
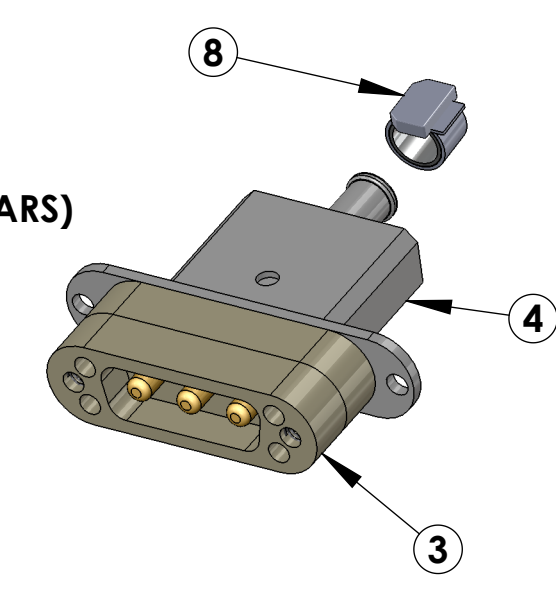
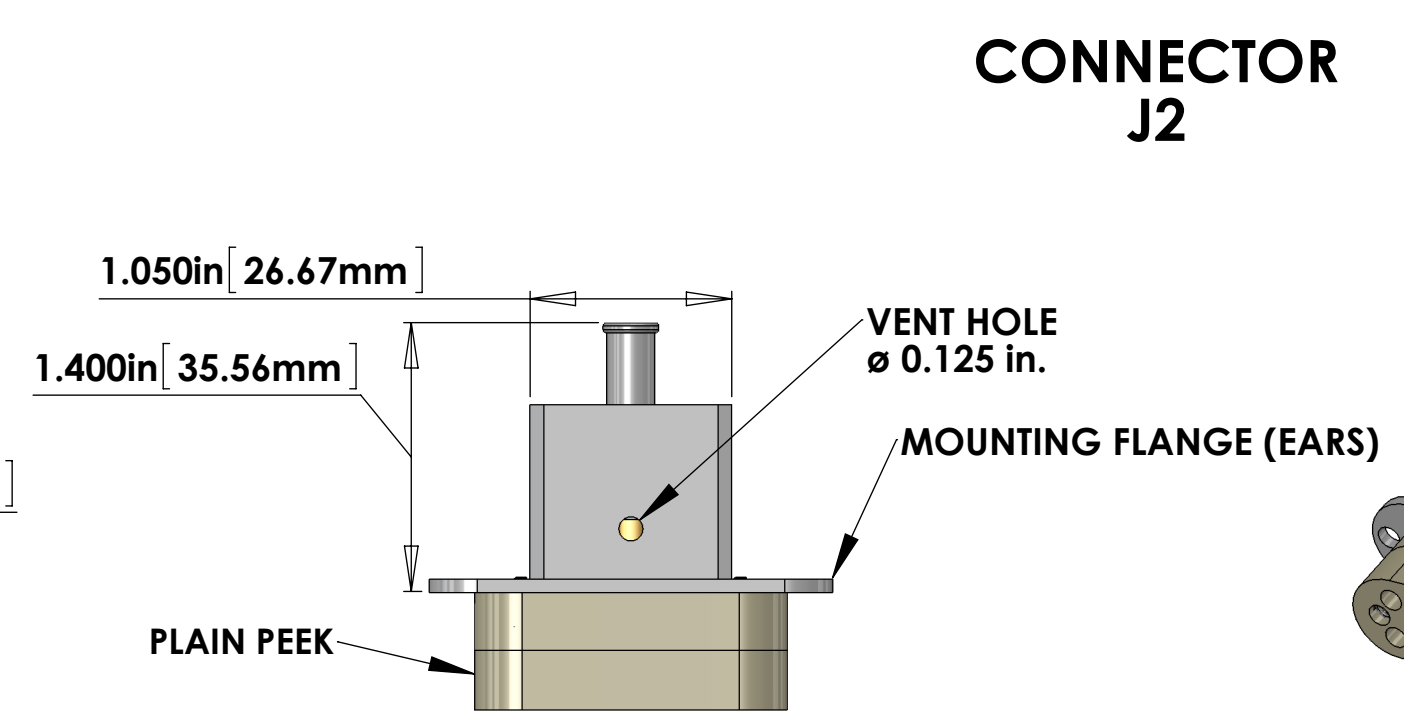
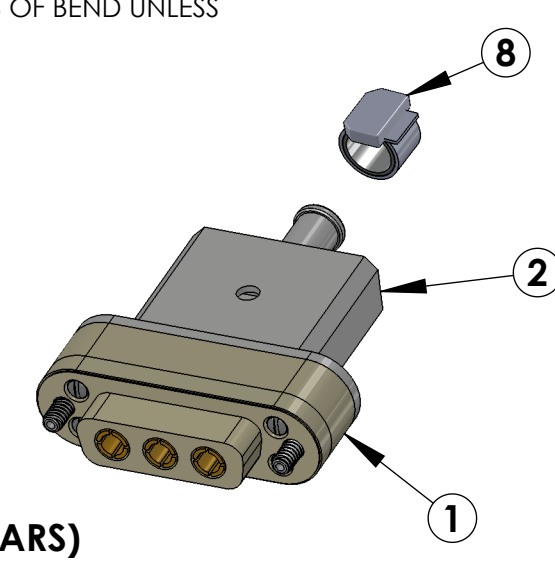
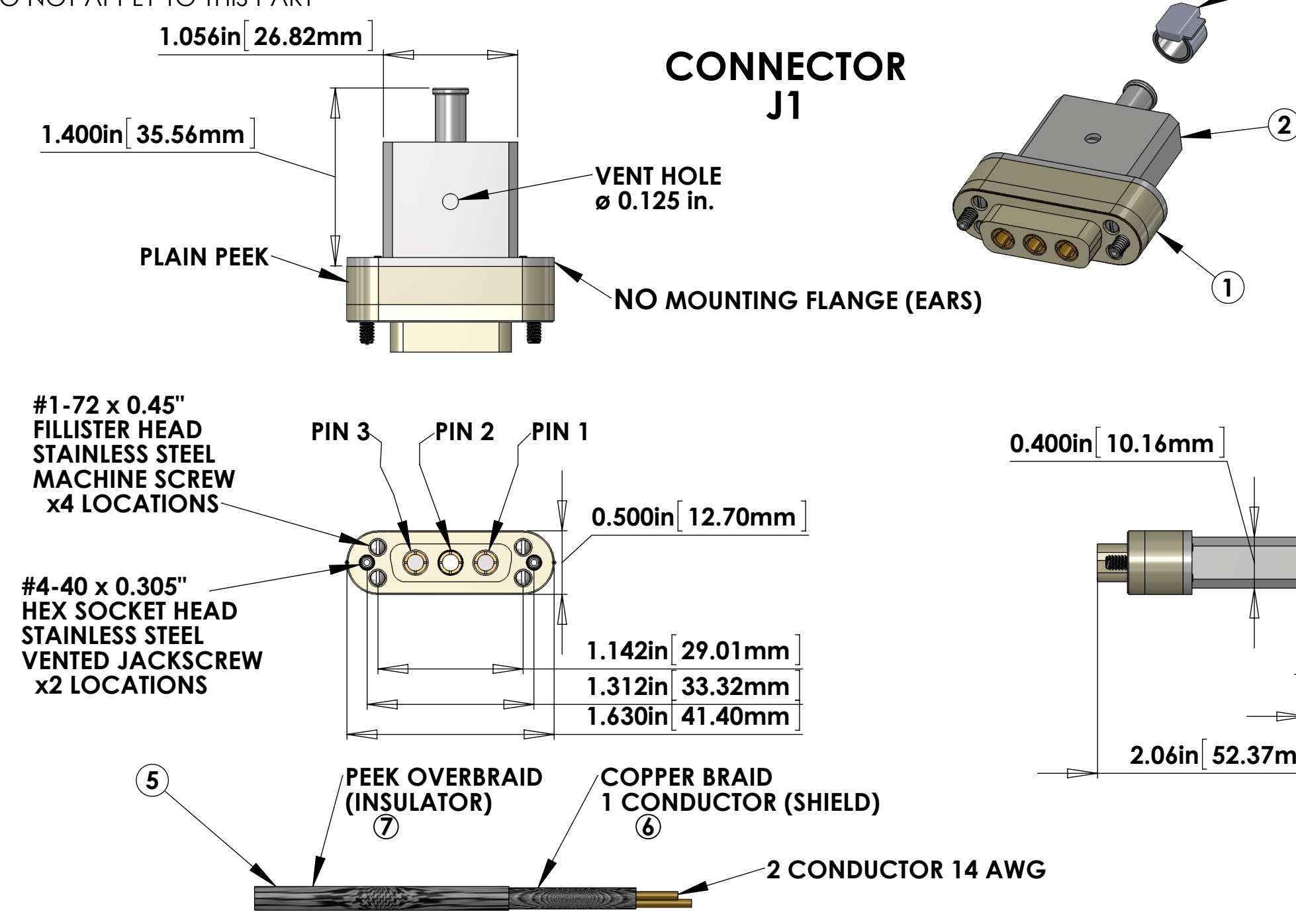
- A. MATERIAL: a. CONNECTOR SHELL - PEEK OR GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.  
 b. BACKSHELL - STAINLESS STEEL WITH VENT HOLE.  
 c. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.00050 MIN. GOLD OVER NICKEL.  
 d. HARDWARE: STAINLESS STEEL, PASSIVATED.  
 e. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED.
- B. CABLE 25 COND. 28 AWG. ( 65 STRD 46 AWG ) WITH PFA INSULATION COONER WIRE #CZ1105. 12 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 90% COVERAGE. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE ~ 0.240 IN.
- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.

DIMENSIONS ARE IN		NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)		LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
TOLERANCES:	.XX ±	1. INTERPRET DRAWING PER ASME Y14.5-1994	2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.	CUSTOM CABLE SPECIFICATION V25G-TBD		DESIGNER	J. HEEFNER
ANGULAR ± °	.XXX ±	3. DO NOT SCALE FROM DRAWING	4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.	STANDARD USE FOR THIS CABLE		DRAFTER	E. BROWN
				SUBSYSTEM		SUS	APR/11/2012
				NEXT ASSY			SIZE
				MATERIAL			DWG. NO.
				FINISH		μinch	E D1002522
				APPROVAL			REV.
				SCALE: 1:1			v6
				PROJECTION:			SHEET 1 OF 1

- NOTES CONTINUED:**
5. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXX-VY, S/N 001. VIBRATORY TOOL MAY BE USED.
  6. APPROXIMATE WEIGHT = X.XXX LB.
  7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  9. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV 4

10. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
13. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E0900083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 13 and 14 DO NOT APPLY TO THIS PART



**BILL OF MATERIALS**

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH*
1	TICOR # TS0148-15C003BS1-188 OR EQUIVALENT**	DB3 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB3 CONNECTOR BACK SHELL (NO EARS) FOR UHV (STAINLESS) WITH Ø0.188" I.D. PORT	1	
3	TICOR # TS0149-15C003BS1-188F OR EQUIVALENT**	DB3 MALE CONNECTOR (J2) FOR UHV (PEEK)	1	
4		DB3 CONNECTOR BACK SHELL (with EARS) FOR UHV (STAINLESS) WITH Ø0.188" I.D. PORT	1	
5	C1	2 COND. (2 WIRES + SHIELD) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	80in.
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART # 24x3x40BC	1	
7	PEEK BRAID PART #6759	PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	
9	HELICOIL #1185-04EN336	#4-40 Nitronic 60® HELICOIL 0.336" LENGTH	2	

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM PIN TIP (3 PIN) TO PIN TIP (CRIMP PINS) OF THE CABLE. THE OTHER MEASUREMENT IS SPACER TO PIN TIPS (CRIMP PINS). USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

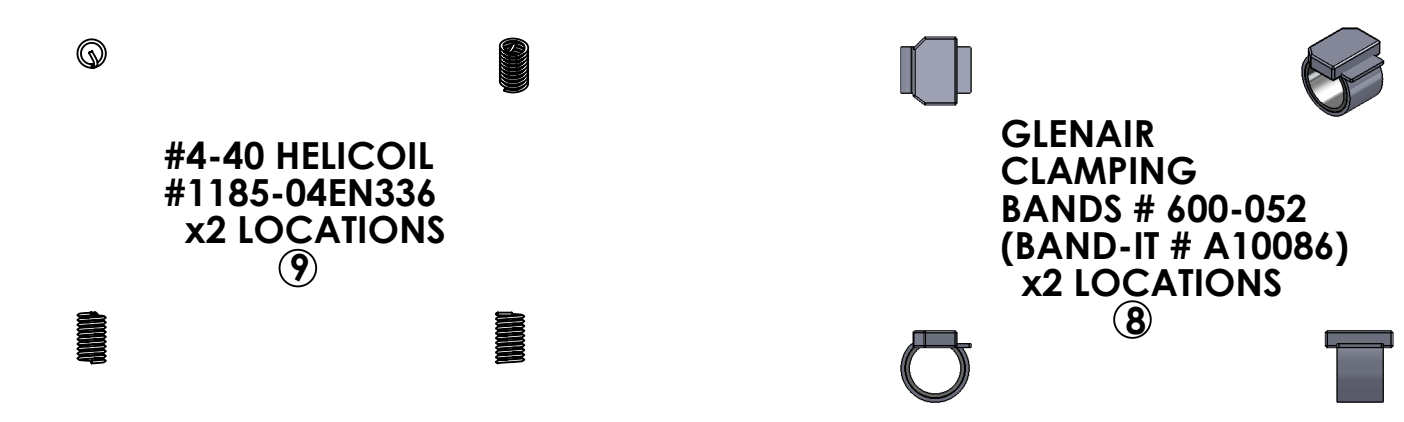
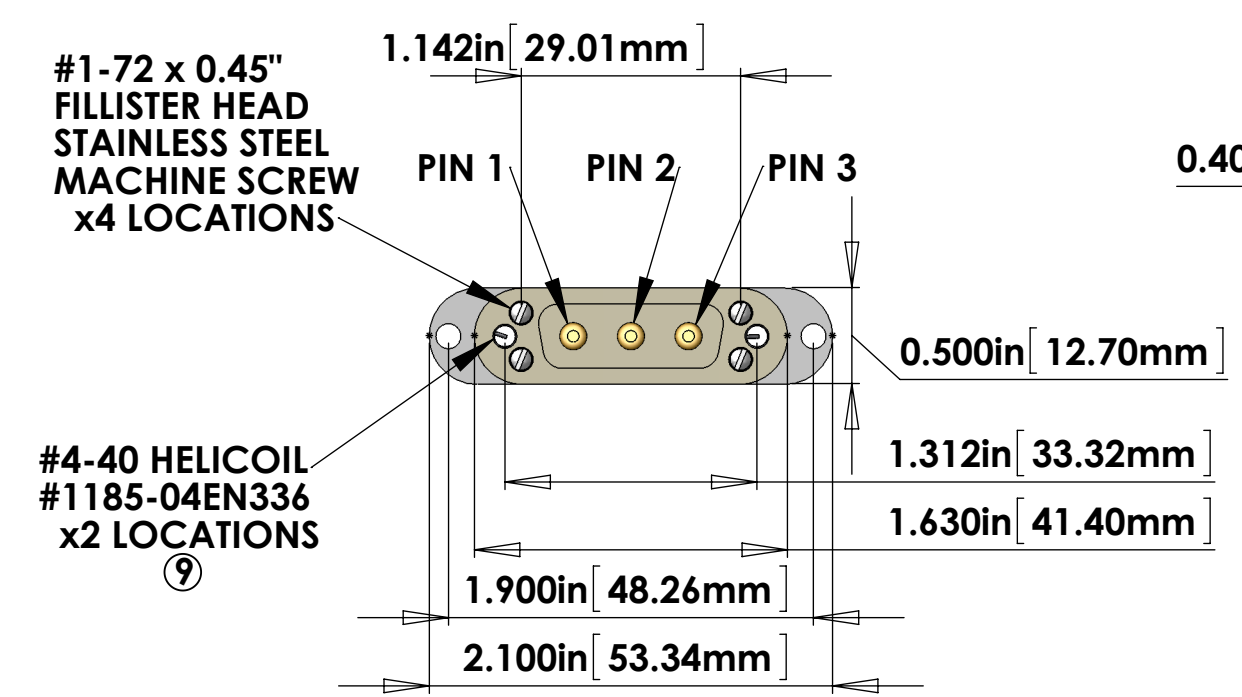
\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

**NOTES: ( UNLESS OTHERWISE SPECIFIED )**

- A. MATERIAL:**
- a. CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - b. BACKSHELL - STAINLESS STEEL WITH VENT HOLE.
  - c. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - d. HARDWARE: STAINLESS STEEL, PASSIVATED.
  - e. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- B. CABLE 2 COND. 14 AWG, (STRANDED) WITH 2 LAYERS OF KAPTON TAPE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.**

- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.**



**V3B-80 CABLE ASSEMBLY CIRCUIT SUMMARY**  
V-DB3 F/S1-80-DB3 M/S1

CABLE NAME	WIRE NAME	WIRE SIZE	LENGTH*	FROM	TO
V3B-80	SHIELD	COPPER BRAID		J1 PIN 1	J2 PIN 1
	W1	14 AWG	80in.	J1 PIN 2	J2 PIN 2
	W2	14AWG	80in.	J1 PIN 3	J2 PIN 3

**V-DB3 F/S1-80-DB3 M/S1**  
STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
SEI	IN-VAC	FROM FLANGE TO TABLE

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES, .005-.015. FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN  
TOLERANCES:  
.XX ±  
.XXX ±  
ANGULAR ± °

MATERIAL: FINISH: NEXT ASSY: μinch

**LIGO** CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

**SYSTEM** SUB-SYSTEM: **SEI**

**PART NAME**  
**CUSTOM CABLE SPECIFICATION V3B-80**

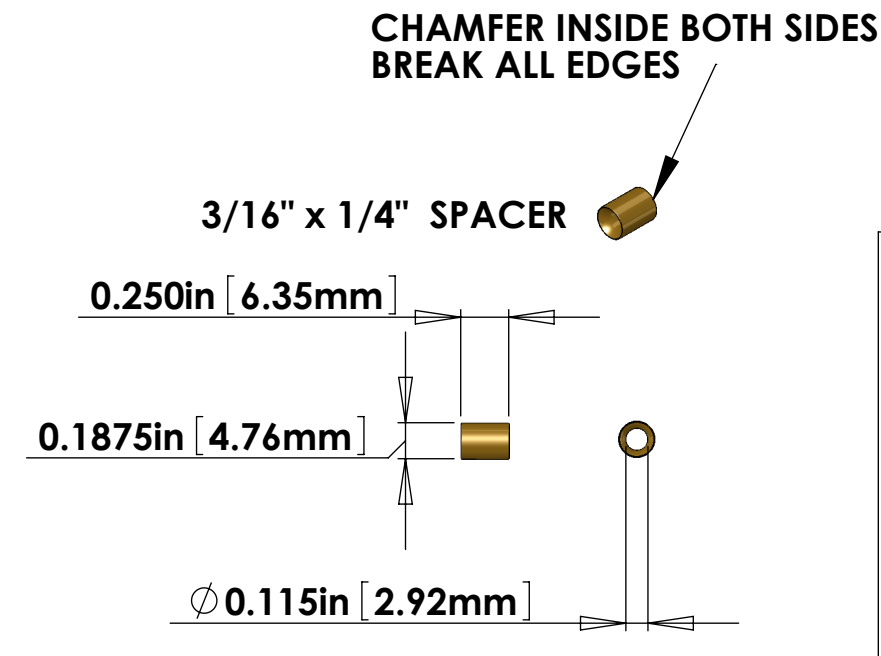
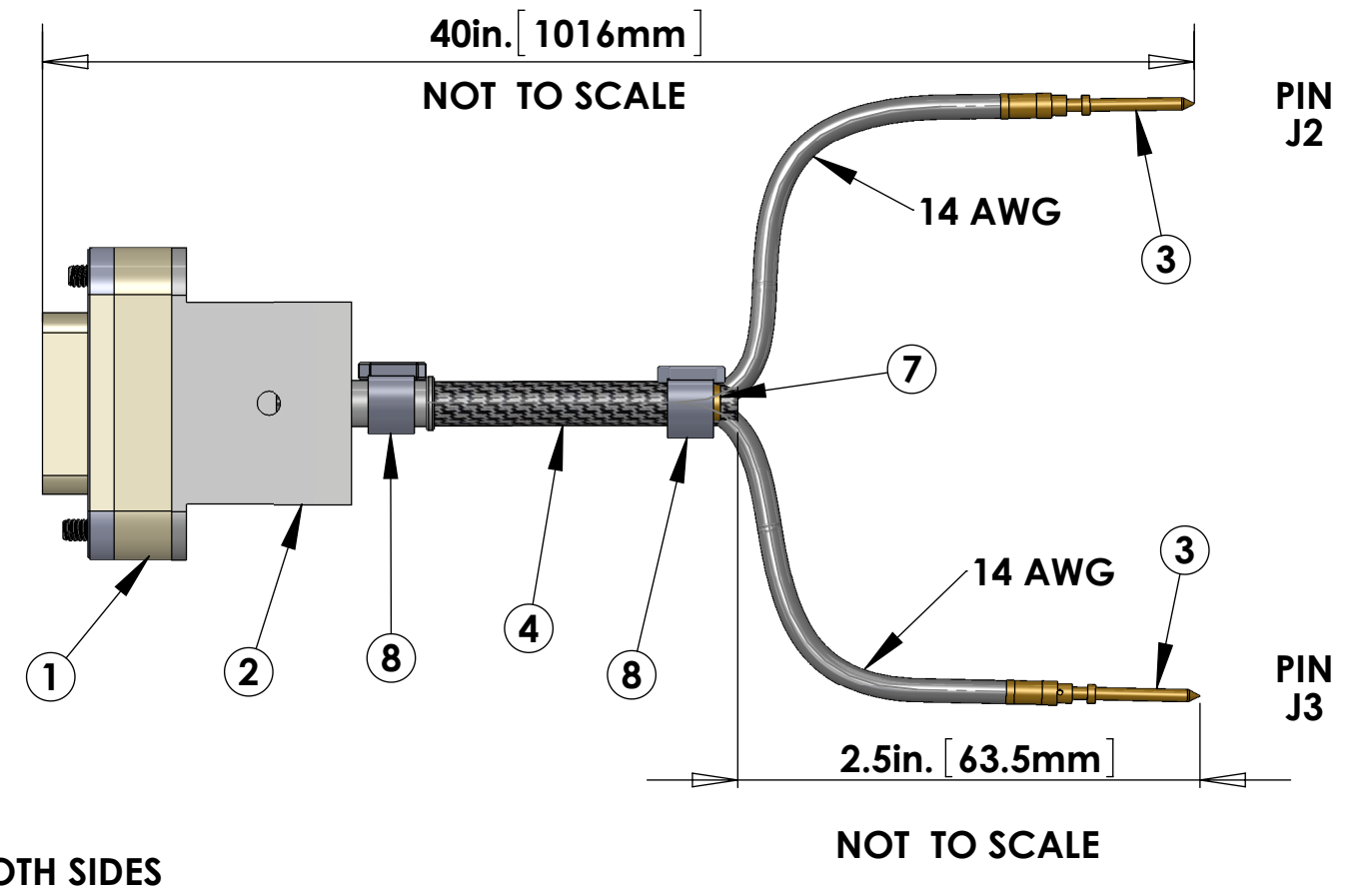
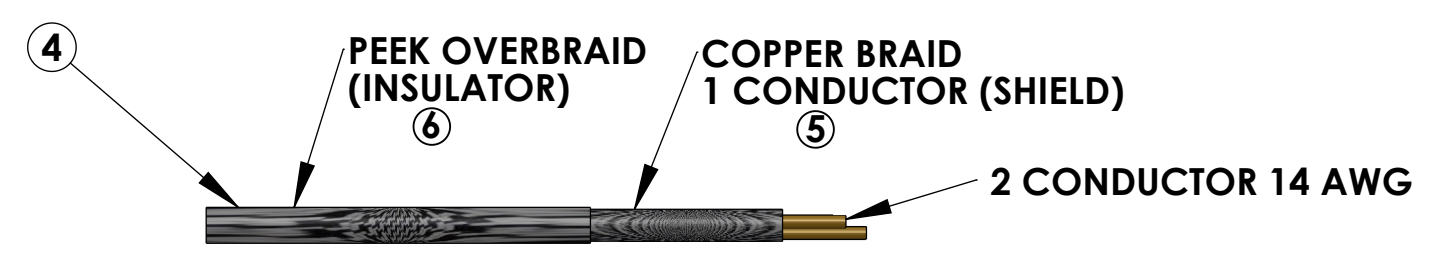
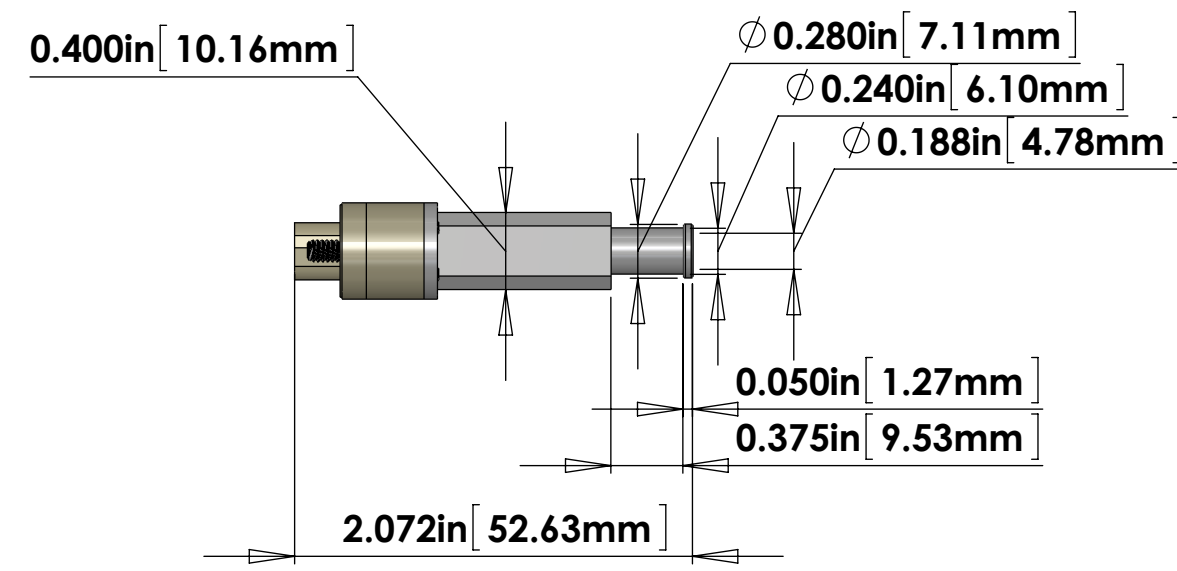
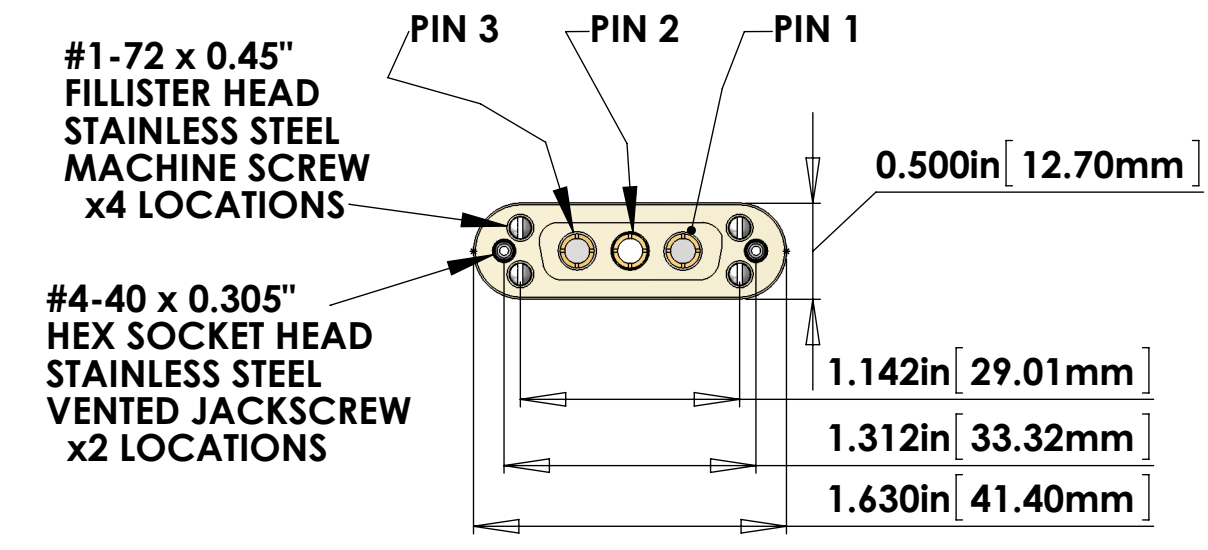
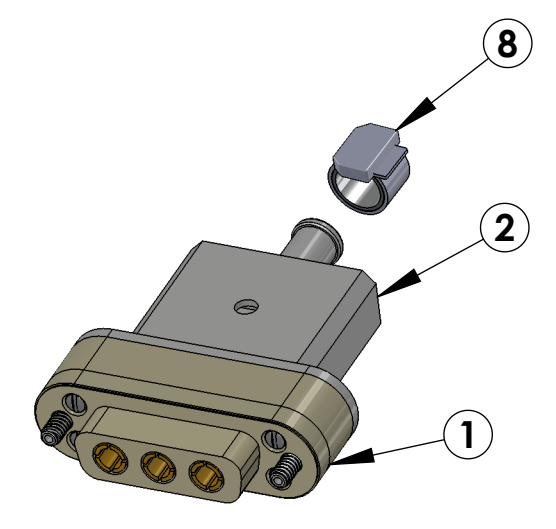
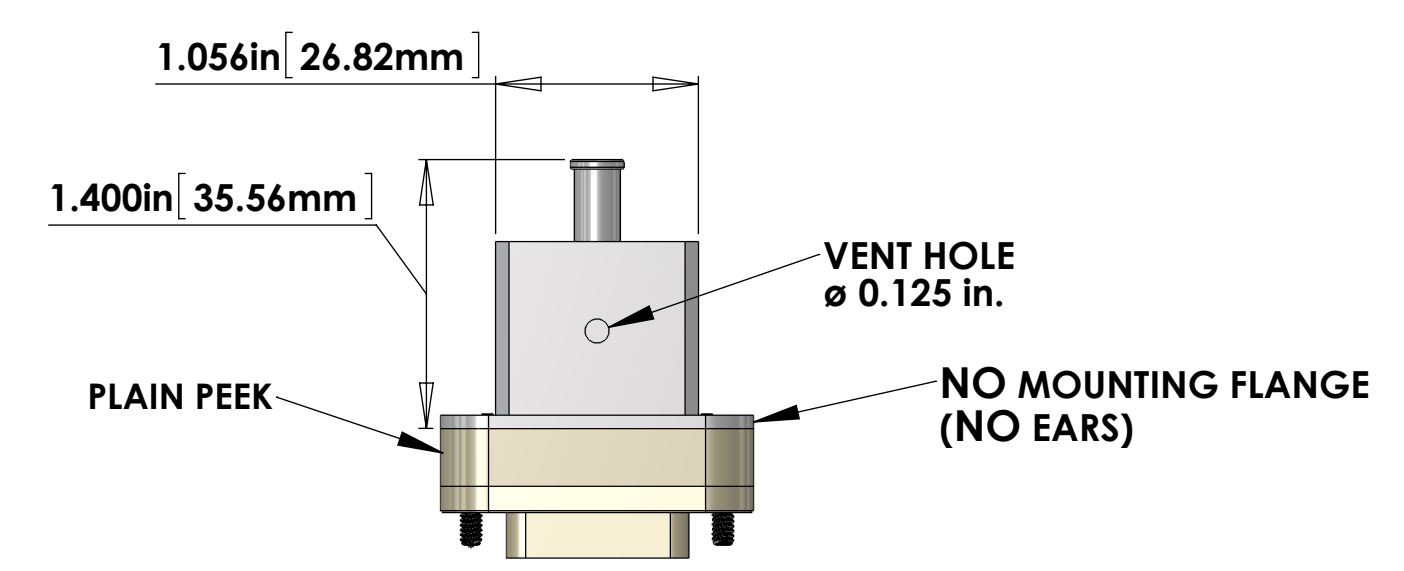
DESIGNER	B. ABBOTT	JUN/29/2012	SIZE	DWG. NO.	REV.
DRAFTER	E. BROWN	JUN/29/2012	D	<b>D1100148</b>	<b>v3</b>
CHECKER					
APPROVAL					

SCALE: 1:1 PROJECTION: SHEET 1 OF 1

- NOTES CONTINUED:**
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VY, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELIX-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELIX-COIL PRODUCT CATALOG, HC2000, REV.4

- ALL HELIX-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1600083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
- DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART



**NOT TO SCALE**

CRIMP PIN NEWARK P/N 94B8812  
 CRIMP PIN HARTING # TB09150006126  
 HARTING CRIMPER # 79K0525  
 STRIPPING LENGTH FOR WIRE 0.236" (6mm)

**BILL OF MATERIALS**

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH *
1	TICOR #TS0148-15C003B51-188 OR EQUIVALENT **	DB3 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB3 CONNECTOR BACK SHELL (NO EARS) FOR UHV (STAINLESS) WITH 0.188" i.d. PORT	1	
3	94B8812	CRIMP PINS (J2, J3) HARTING # 09 15 000 6126 NEWARK # 94B8812	2	
4	C1	2 COND. (2 WIRES + SHIELD) CABLE WITH 5 COPPER BRAID (SHIELD) 6 AND PEEK OVERBRAID	1	40in.
5	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART # 24x3x40BC	1	
6	PEEK BRAID PART #6759	PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
7	SPACER	3/16" SPACER 1/4" LENGTH 0.115" i.d.	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM PIN TIP (3 PIN) TO PIN TIP (CRIMP PINS) OF THE CABLE. THE OTHER MEASUREMENT IS SPACER TO PIN TIPS (CRIMP PINS). USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

**NOTES: ( UNLESS OTHERWISE SPECIFIED )**

- A. MATERIAL:**
- CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - BACKSHELL - STAINLESS STEEL WITH VENT HOLE.
  - CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - HARDWARE: STAINLESS STEEL, PASSIVATED.
  - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- B. CABLE 2 COND. 14 AWG, (STRANDED) WITH 2 LAYERS OF KAPTON TAPE.**
- OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO.
  - OVERALL PEEK BRAID MIN. 50% COVERAGE.
  - OVERALL CABLE O.D. WILL BE 0.240 IN.

- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.**



**V3A-40 CABLE ASSEMBLY CIRCUIT SUMMARY**  
**V-DB3 F/S1-40-2\_PIN-94B8812 M/X**

CABLE NAME	WIRE NAME	WIRE SIZE	LENGTH *	FROM	TO
V3A-40	SHIELD	COPPER BRAID		J1 PIN 1	END OF CABLE
	W1	14 AWG	40in.	J1 PIN 2	J2
	W2	14AWG	40in.	J1 PIN 3	J3

**V-DB3 F/S1-40-2\_PIN-94B8812 M/X**

STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
SEI	IN-VAC	FROM TABLE TO ISI ACTUATOR

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN TOLERANCES: .XX ± .XXX ± ANGULAR ± °

MATERIAL: Material <not specified> FINISH: μinch

SYSTEM: LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: **CUSTOM CABLE SPECIFICATION V3A-40**

DESIGNER: B. ABBOTT JUN/29/2012 SIZE: DWG. NO. D1100150

DRAFTER: E. BROWN JUN/29/2012 CHECKER: APPROVAL: SCALE: 1:1 PROJECTION: SHEET 1 OF 1

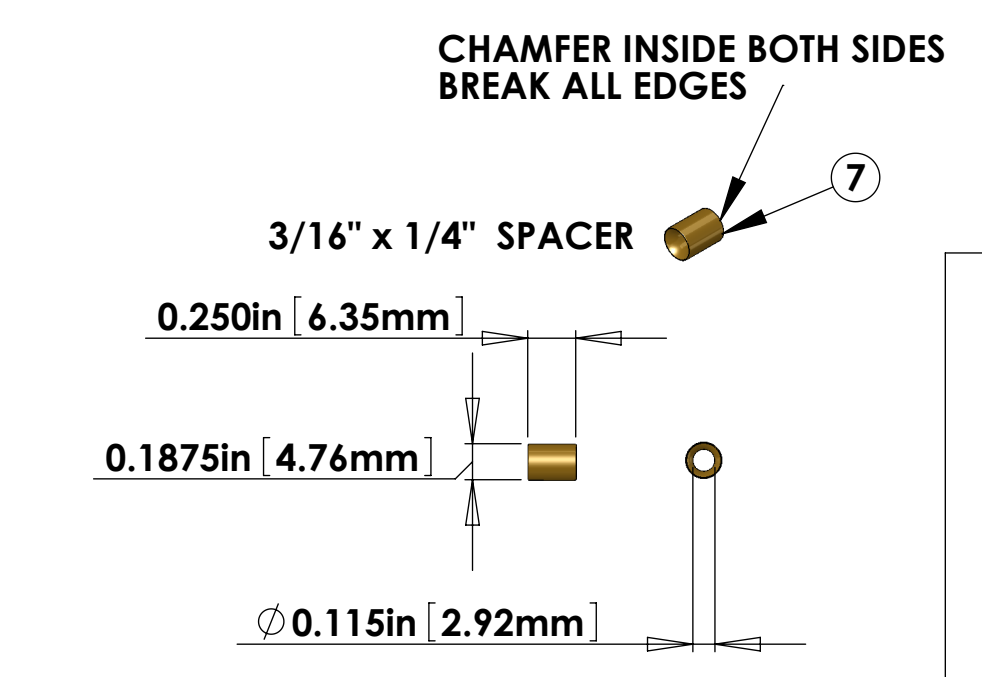
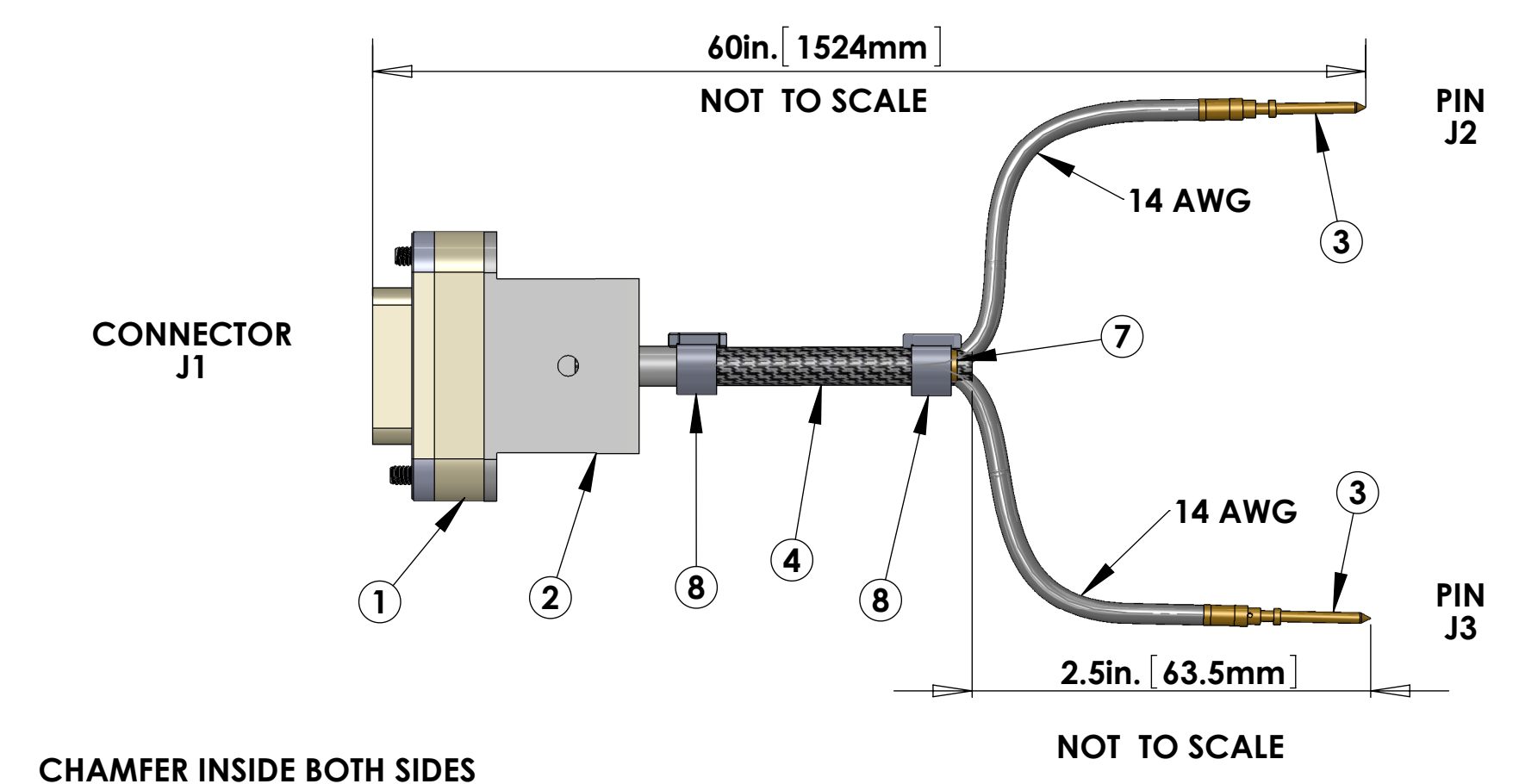
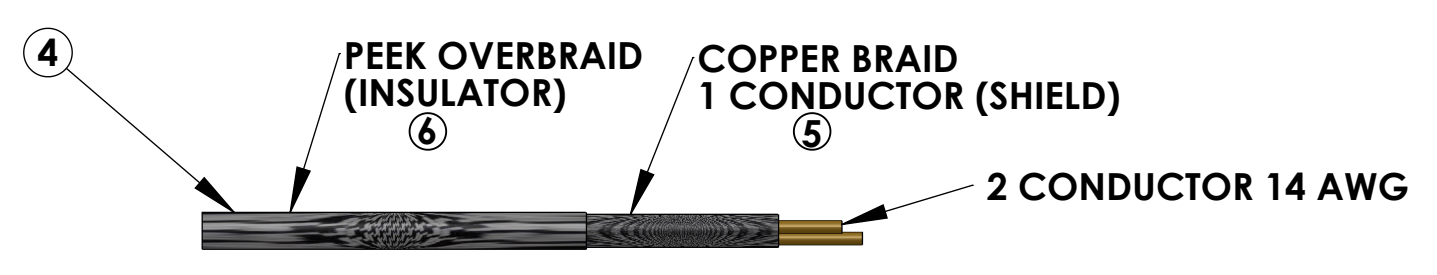
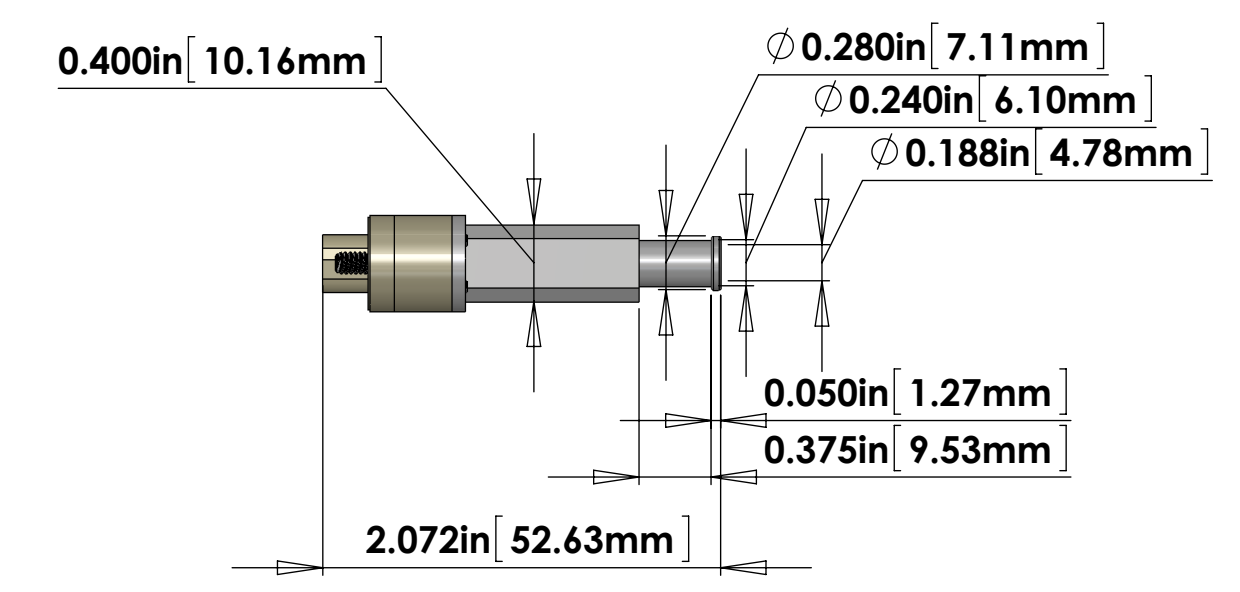
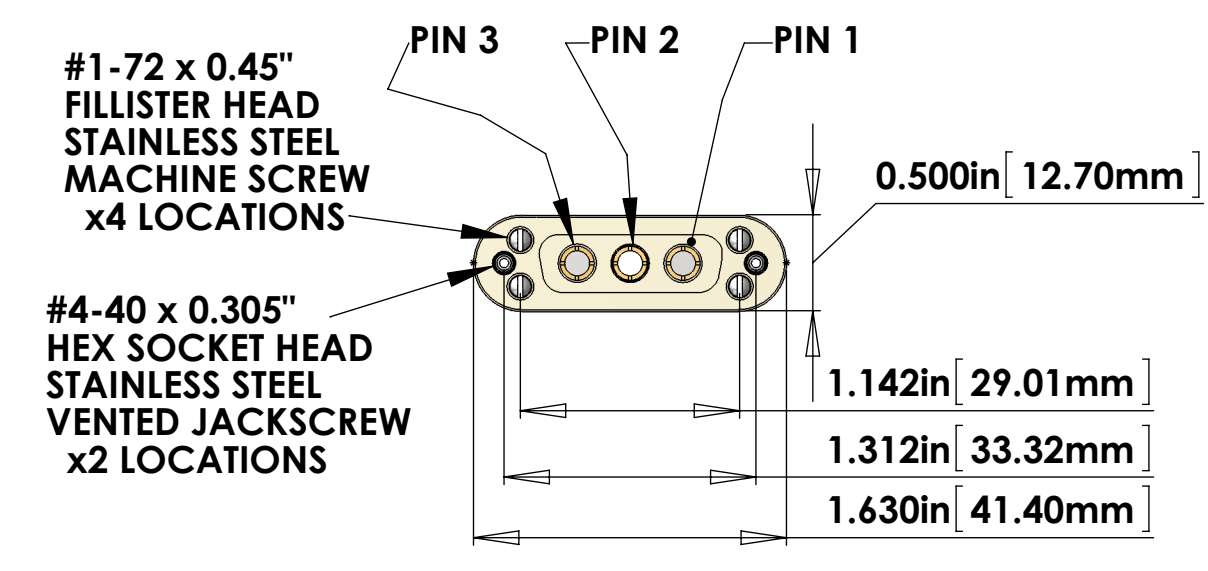
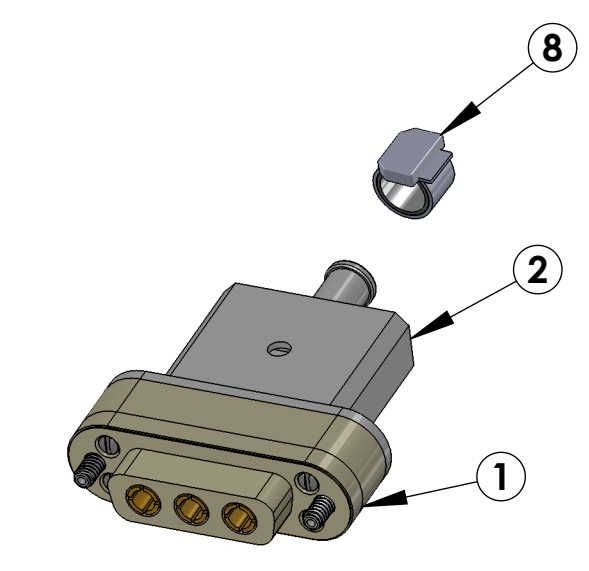
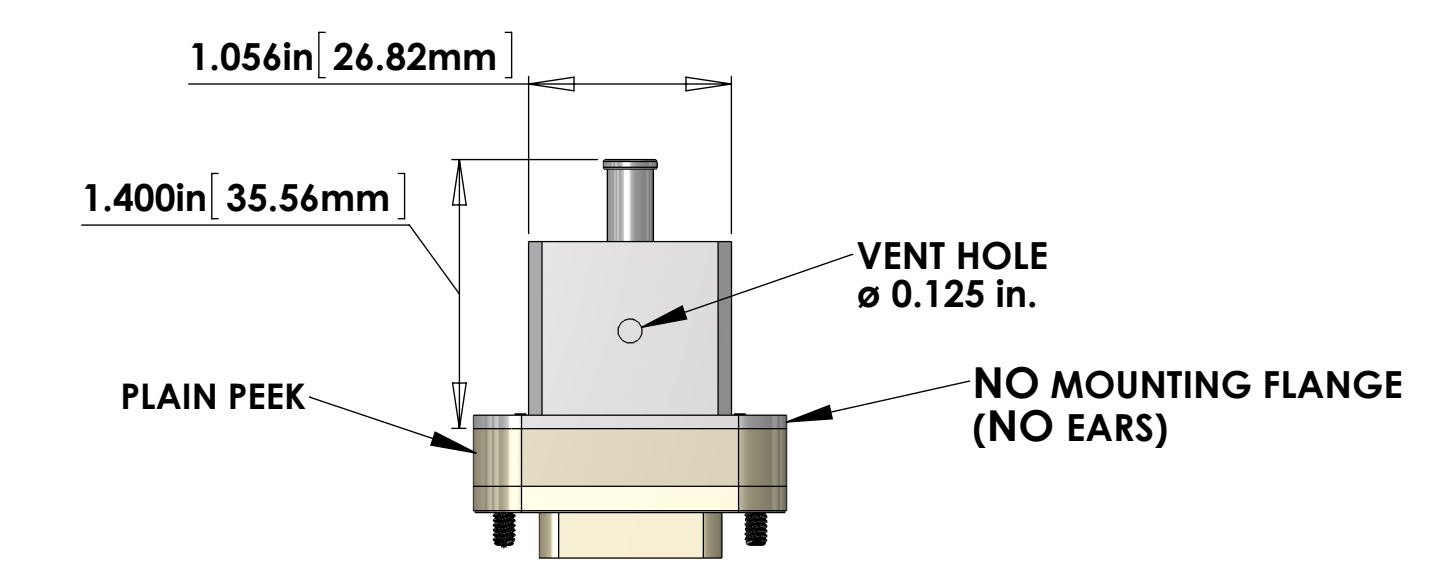
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- NOTES CONTINUED:**
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VV, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELIX-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELIX-COIL PRODUCT CATALOG, HC2000, REV. 4

- ALL HELIX-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1600083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
- DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART



NOT TO SCALE  
 CRIMP PIN NEWARK P/N 94B8812  
 CRIMP PIN HARTING # TB09150006126  
 HARTING CRIMPER # 79K0525  
 STRIPPING LENGTH FOR WIRE 0.236" (6mm)

**BILL OF MATERIALS**

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH *
1	TICOR #TS0148-15C003BS1-188 OR EQUIVALENT **	DB3 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB3 CONNECTOR BACK SHELL (NO EARS) FOR UHV (STAINLESS) WITH ø0.188" i.d. PORT	1	
3	94B8812	CRIMP PINS (J2, J3) HARTING # 09 15 000 6126 NEWARK # 94B8812	2	
4	C1	2 COND. (2 WIRES + SHIELD) CABLE WITH 5 COPPER BRAID (SHIELD) 6 AND PEEK OVERBRAID	1	60in.
5	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART # 24x3x40BC	1	
6	PEEK BRAID PART #6759	PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
7	SPACER	3/16" SPACER 1/4" LENGTH 0.115" i.d.	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR # 600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" # A10089)	2	

\* NOTE: THE OVERALL LENGTH IS MEASURED FROM PIN TIP (3 PIN) TO PIN TIP (CRIMP PINS) OF THE CABLE. THE OTHER MEASUREMENT IS SPACER TO PIN TIPS (CRIMP PINS). USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.  
 \*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

**NOTES: ( UNLESS OTHERWISE SPECIFIED )**

- MATERIAL:
  - CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - BACKSHELL - STAINLESS STEEL WITH VENT HOLE.
  - CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - HARDWARE: STAINLESS STEEL, PASSIVATED.
  - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.
- CABLE 2 COND. 14 AWG, (STRANDED) WITH 2 LAYERS OF KAPTON TAPE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.
- CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



GLENAIR CLAMPING BANDS # 600-052 (BAND-IT # A10086) x2 LOCATIONS 8

**V3A-60 CABLE ASSEMBLY CIRCUIT SUMMARY**  
 V-DB3 F/S1-60-2\_PIN-94B8812 M/X

CABLE NAME	WIRE NAME	WIRE SIZE	LENGTH *	FROM	TO
V3A-60	SHIELD	COPPER BRAID		J1 PIN 1	END OF CABLE
	W1	14 AWG	60in.	J1 PIN 2	J2
	W2	14AWG	60in.	J1 PIN 3	J3

**V-DB3 F/S1-60-2\_PIN-94B8812 M/X**  
 STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
SEI	IN-VAC	FROM TABLE TO ISI ACTUATOR

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN TOLERANCES: .XX ± .XXX ± ANGULAR ± °

MATERIAL: Material <not specified> FINISH: μinch

SYSTEM: LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME: CUSTOM CABLE SPECIFICATION V3A-60

DESIGNER: B. ABBOTT JUN/29/2012 SIZE: DWG. NO. D1100151

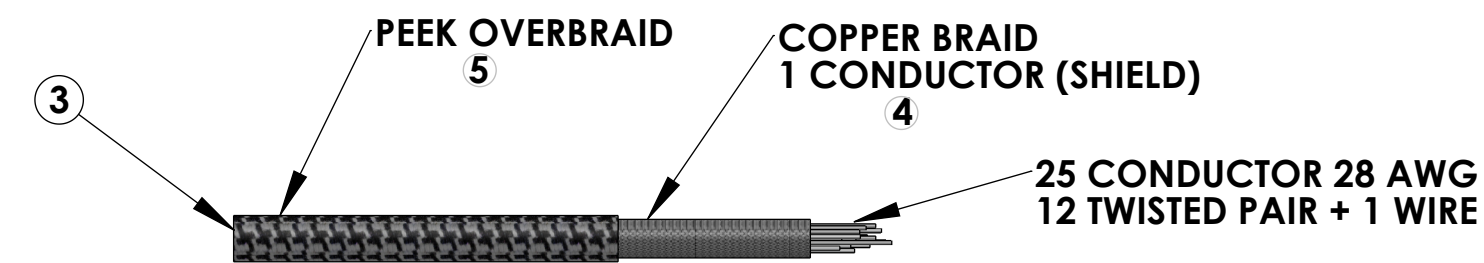
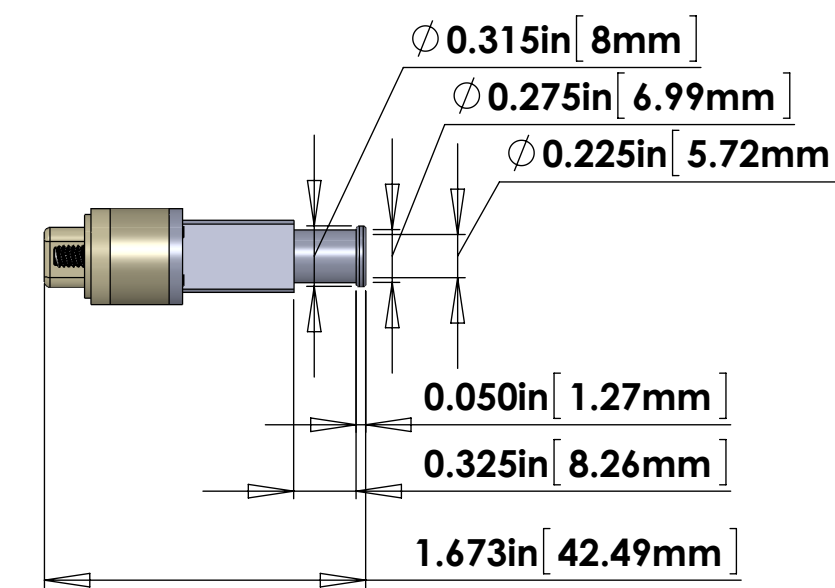
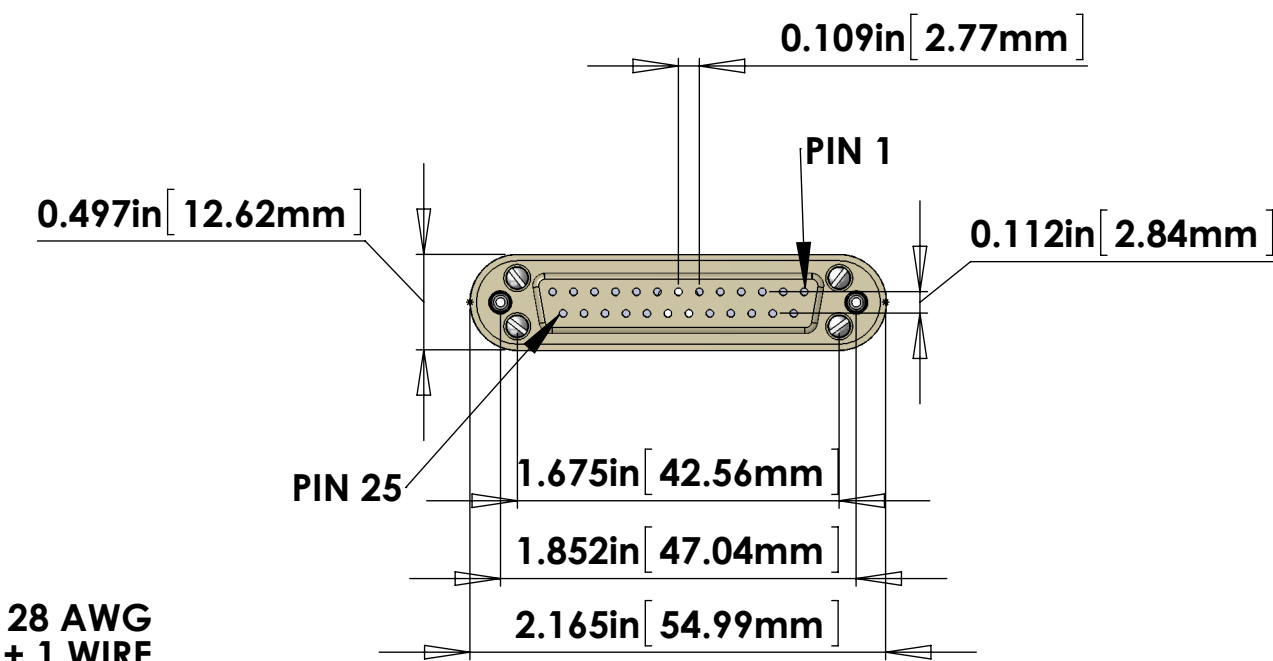
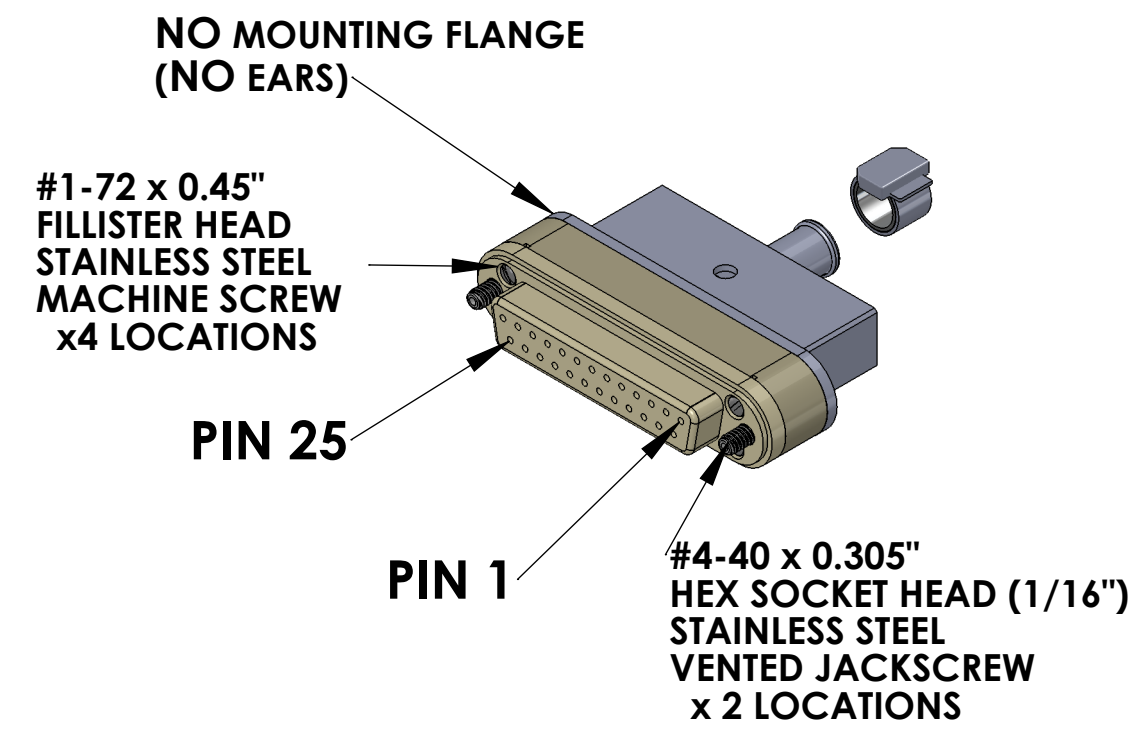
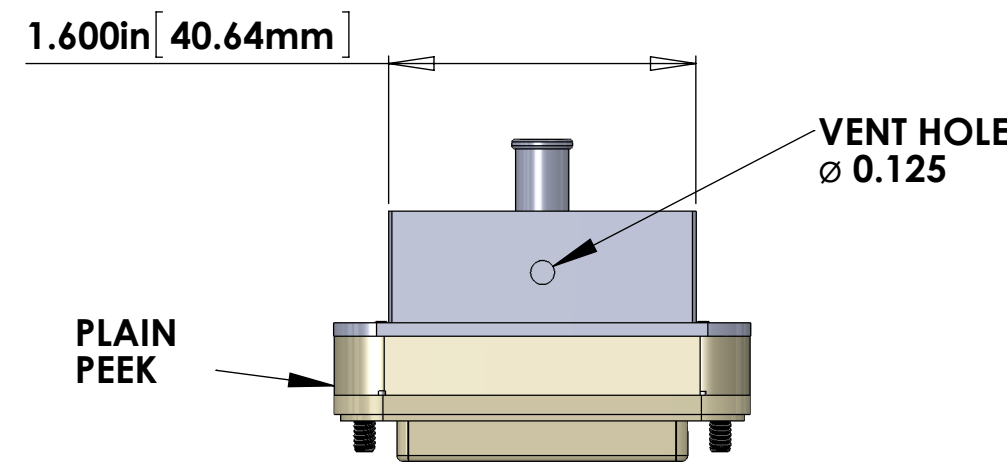
DRAFTER: E. BROWN JUN/29/2012 CHECKER: APPROVAL: SCALE: 1:1 PROJECTION: SHEET 1 OF 1

- NOTES CONTINUED:**
5. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXXX-VY S/N 001. VIBRATORY TOOL MAY BE USED.
  6. APPROXIMATE WEIGHT = X.XXX LB.
  7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  9. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HG2000, REV 4

10. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
13. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART

### CONNECTOR J1 and J2



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH *
1	TICOR # (TS0148-25C020BS1-225) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J1 & J2) FOR UHV (PEEK)	2	
2		DB25 CONNECTOR BACKSHELL (NO EARS) FOR UHV (STAINLESS) WITH 0.225" I.D. PORT	2	
3	C1	25 COND. (12 TW PAIR + 1 WIRE + SHIELD) CABLE WITH 4 COPPER BRAID (SHIELD) AND 5 PEEK OVERBRAID	1	110 in.
4	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
5	#6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
6	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR #600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" #A10089)	2	

\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

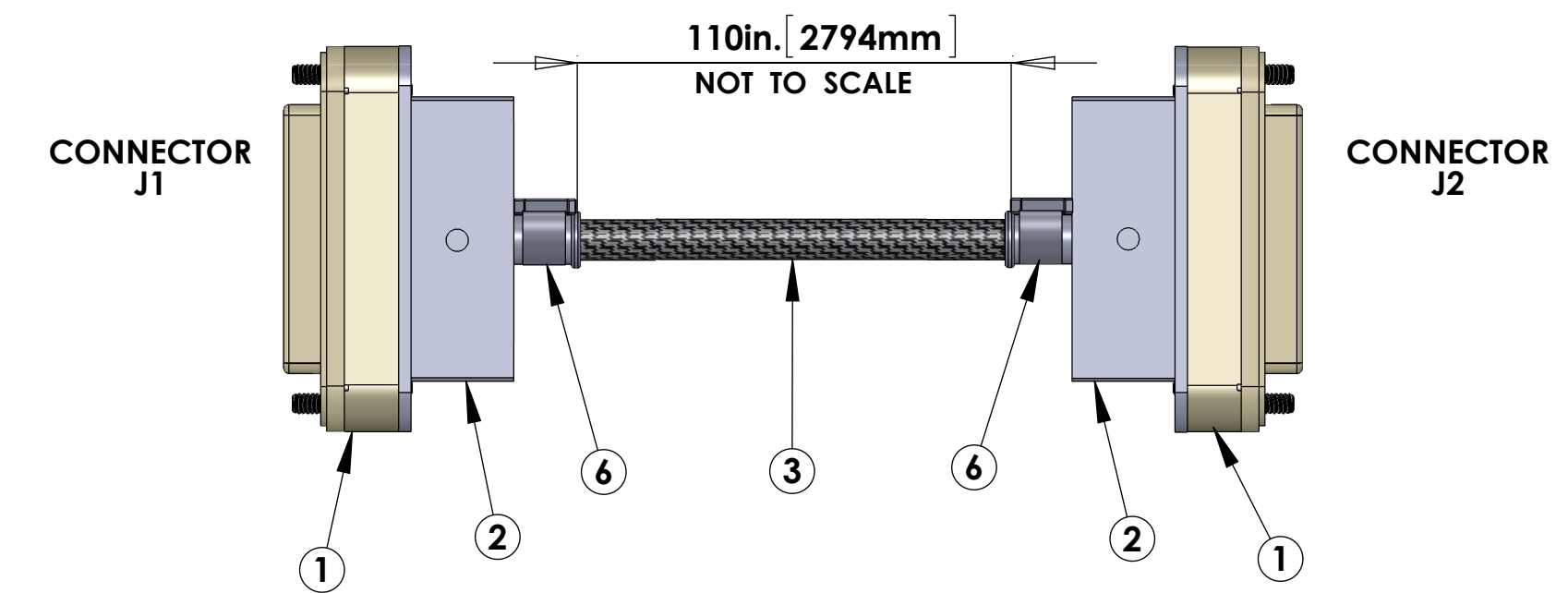
**NOTES: ( UNLESS OTHERWISE SPECIFIED )**

- A. MATERIAL:**
- a. J1 CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - b. BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
  - c. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - d. HARDWARE: STAINLESS STEEL, PASSIVATED.
  - e. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- B. CABLE 25 COND. 28 AWG, (STRANDED) WITH 2 LAYERS OF KAPTON TAPE. 12 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.**

- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.**

REV.	DATE	DCN #	DRAWING TREE #



### V25A-110 CABLE ASSEMBLY CIRCUIT SUMMARY V-DB25 F/S1-110-DB25 F/S1

CABLE NAME	COND.- WIRE ID	TWISTED PAIR	LENGTH *	FROM	TO
V25A-110	25 COND. CABLE	(12 TOTAL)	110 in.	CONN. J1	CONN. J2
	W1	SHIELD	110 in	PIN 1, SHELL	PIN 1, SHELL
	W2	TP-1	110 in	PIN 2	PIN 2
	W14		110 in	PIN 14	PIN 14
	W3	TP-2	110 in	PIN 3	PIN 3
	W15		110 in	PIN 15	PIN 15
	W4	TP-3	110 in	PIN 4	PIN 4
	W16		110 in	PIN 16	PIN 16
	W5	TP-4	100 in	PIN 5	PIN 5
	W17		110 in	PIN 17	PIN 17
	W6	TP-5	110 in	PIN 6	PIN 6
	W18		110 in	PIN 18	PIN 18
	W7	TP-6	110 in	PIN 7	PIN 7
	W19		110 in	PIN 19	PIN 19
	W8	TP-7	110 in	PIN 8	PIN 8
	W20		100 in	PIN 20	PIN 20
	W9	TP-8	110 in	PIN 9	PIN 9
	W21		110 in	PIN 21	PIN 21
	W10	TP-9	110 in	PIN 10	PIN 10
	W22		110 in	PIN 22	PIN 22
	W11	TP-10	110 in	PIN 11	PIN 11
	W23		110 in	PIN 23	PIN 23
	W12	TP-11	110 in	PIN 12	PIN 12
	W24		110 in	PIN 24	PIN 24
	W13	TP-12	110 in	PIN 13	PIN 13
	W25		110 in	PIN 25	PIN 25

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

### V-DB25 F/S1-110-DB25 F/S1

#### STANDARD USE FOR THIS CABLE

SUBSYSTEM	AIR/VAC	STANDARD USE
SEI	IN-VAC	FROM FLANGE TO TRILLIUM PODS

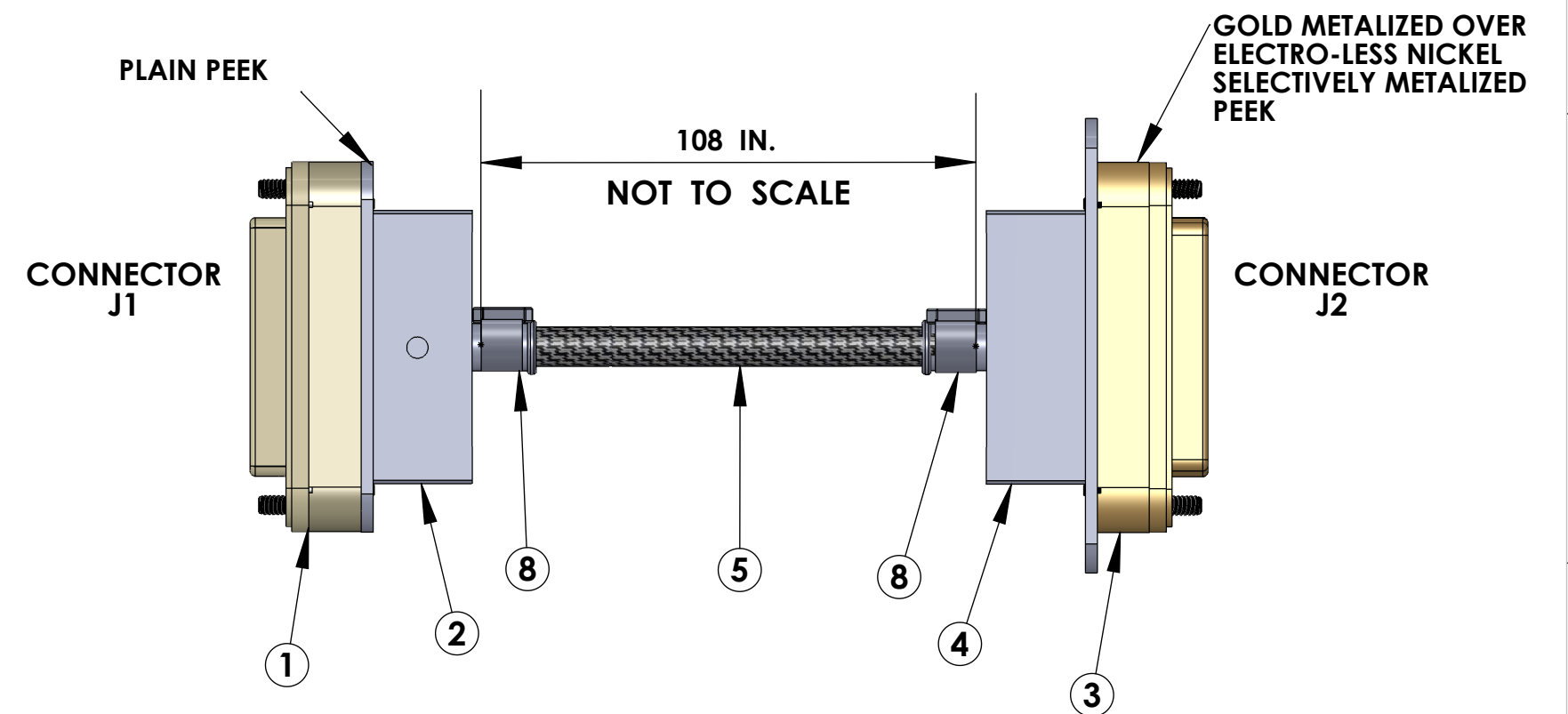
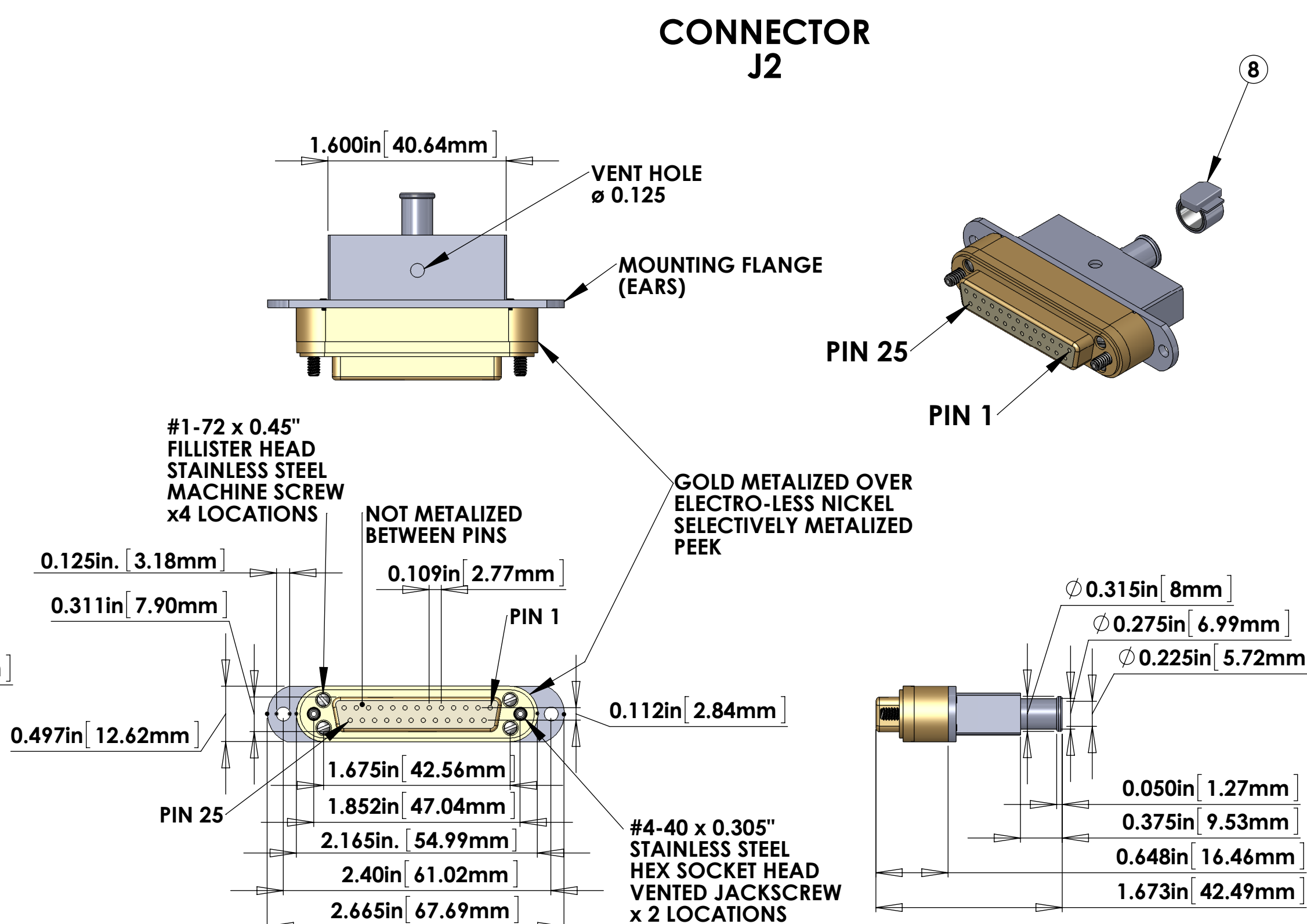
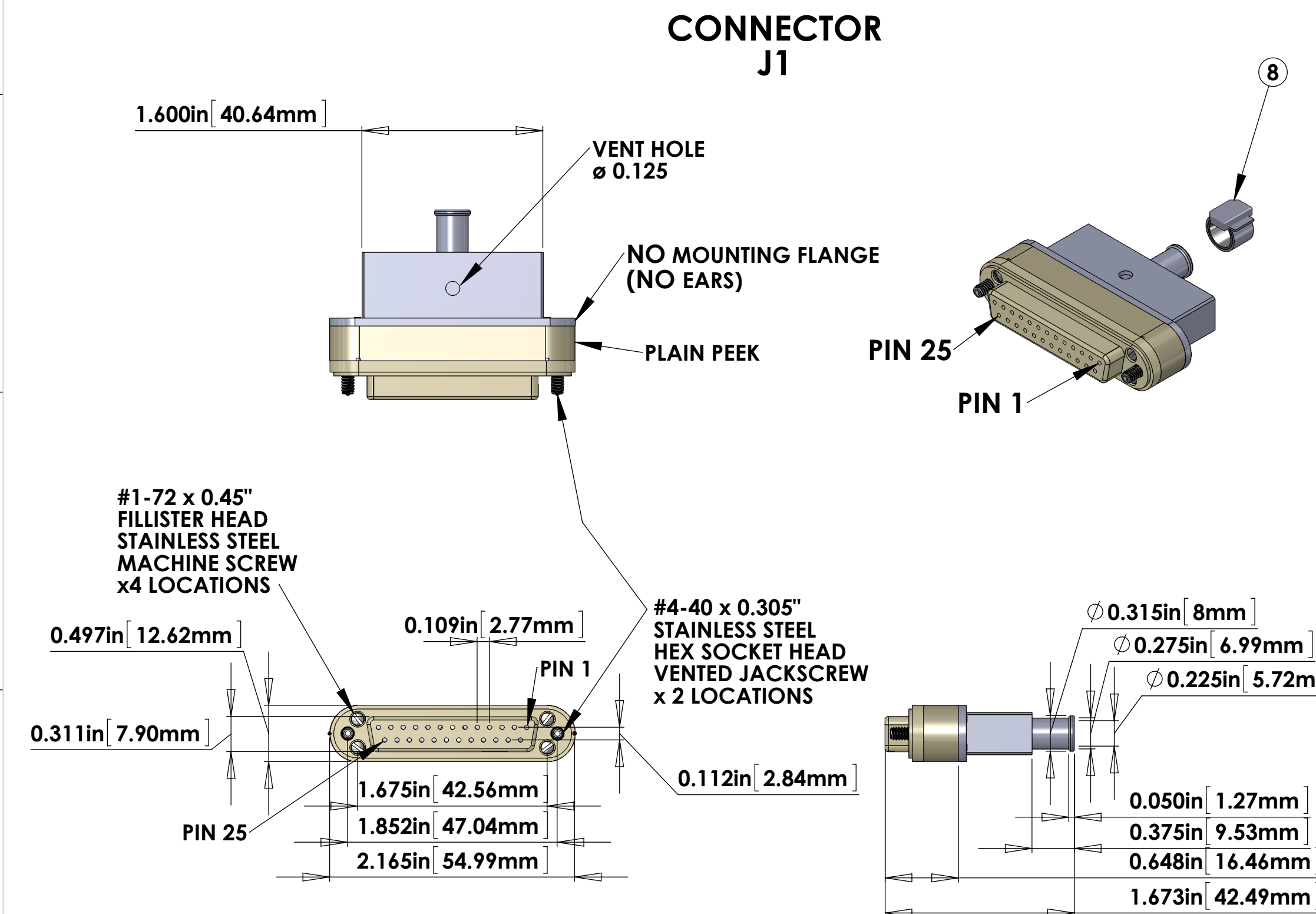
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)	
DIMENSIONS ARE IN	1. INTERPRET DRAWING PER ASME Y14.5-1994.
TOLERANCES:	2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
.XX ±	3. DO NOT SCALE FROM DRAWING.
.XXX ±	4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.
ANGULAR ± °	
MATERIAL	Material <not specified>
FINISH	μinch

CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME <b>CUSTOM CABLE SPECIFICATION V25A-110</b>	
SYSTEM	SEI	DESIGNER	B. ABBOTT
CHECKER		DRAFTER	E. BROWN
APPROVAL		CHECKER	
NEXT ASSY		DATE	JUN/29/2012
		DATE	JUN/29/2012
		SIZE	D
		DWG. NO.	<b>D1100152</b>
		REV.	<b>v7</b>
		SCALE:	1:1
		PROJECTION:	
		SHEET 1 OF 1	

- NOTES CONTINUED:
- SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: DXXXXX-VV, S/N 001. VIBRATORY TOOL MAY BE USED.
  - APPROXIMATE WEIGHT = X.XXX LB.
  - MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
  - ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
  - ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV. 4.

- ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
- DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART



### V25A-108 CABLE ASSEMBLY CIRCUIT SUMMARY

#### V-DB25 F/S1-108-DB25 F/S1

CABLE NAME	COND.-WIRE ID	TWISTED PAIR	LENGTH *	FROM	TO
V25A-108	25 COND. CABLE	(12 TOTAL)	108 in.	Conn. J1	Conn. J2
	W1	SHIELD	108 in	PIN 1, SHELL	PIN 1, SHELL
	W2	TP-1	108 in	PIN 2	PIN 2
	W14		108 in	PIN 14	PIN 14
	W3	TP-2	108 in	PIN 3	PIN 3
	W15		108 in	PIN 15	PIN 15
	W4	TP-3	108 in	PIN 4	PIN 4
	W16		108 in	PIN 16	PIN 16
	W5	TP-4	108 in	PIN 5	PIN 5
	W17		108 in	PIN 17	PIN 17
	W6	TP-5	108 in	PIN 6	PIN 6
	W18		108 in	PIN 18	PIN 18
	W7	TP-6	108 in	PIN 7	PIN 7
	W19		108 in	PIN 19	PIN 19
	W8	TP-7	108 in	PIN 8	PIN 8
	W20		108 in	PIN 20	PIN 20
	W9	TP-8	108 in	PIN 9	PIN 9
	W21		108 in	PIN 21	PIN 21
	W10	TP-9	108 in	PIN 10	PIN 10
	W22		108 in	PIN 22	PIN 22
	W11	TP-10	108 in	PIN 11	PIN 11
	W23		108 in	PIN 23	PIN 23
	W12	TP-11	108 in	PIN 12	PIN 12
	W24		108 in	PIN 24	PIN 24
	W13		108 in	PIN 13	PIN 13
	W25		108 in	PIN 25	PIN 25

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

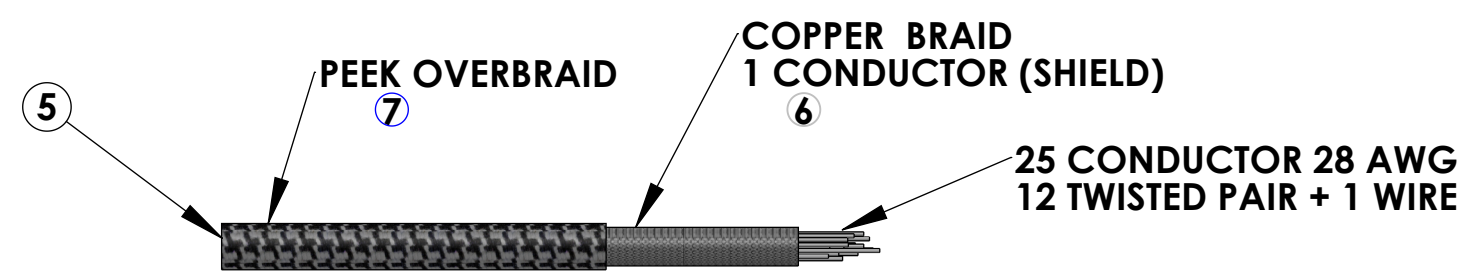
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0148-25C020BS1-225) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB25 CONNECTOR BACKSHELL (NO EARS) FOR UHV (STAINLESS) WITH ø0.225" I.D. PORT	1	
3	TICOR # (TS0148-25CG20BS1-225F) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS) WITH ø0.225" I.D. PORT	1	
5	COONER WIRE #CZ1105 + 6 + 7	25 COND. (12 TWISTED PAIR + 1 WIRE + SHIELD) 28AWG CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	108in *
7	#6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR #600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" #A10089)	2	

\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

NOTES: ( UNLESS OTHERWISE SPECIFIED )

- A. MATERIAL:
- J1 CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
  - BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
  - CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - HARDWARE: STAINLESS STEEL, PASSIVATED.
  - PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.
- B. CABLE 25 COND. 28 AWG, (65 STRD 46 AWG) WITH PFA INSULATION COONER WIRE #CZ1105. 12 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ) + 1 WIRE. OVERALL 40AWG COPPER BRAID 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. WILL BE 0.240 IN.
- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



DIMENSIONS ARE IN		TOLERANCES:		ANGULAR ± °	
.XX	±	.XX	±		
.XXX	±	.XXX	±		
MATERIAL		FINISH		NEXT ASSY	
Material <not specified>		μinch			

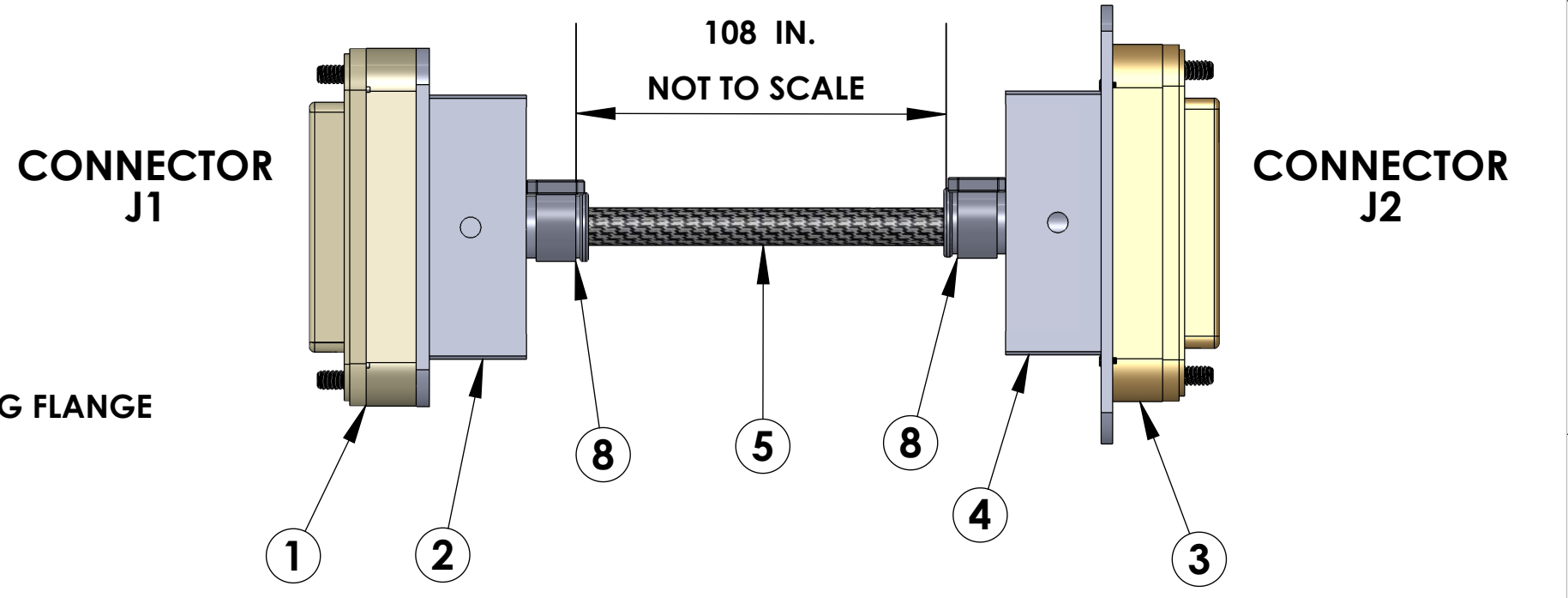
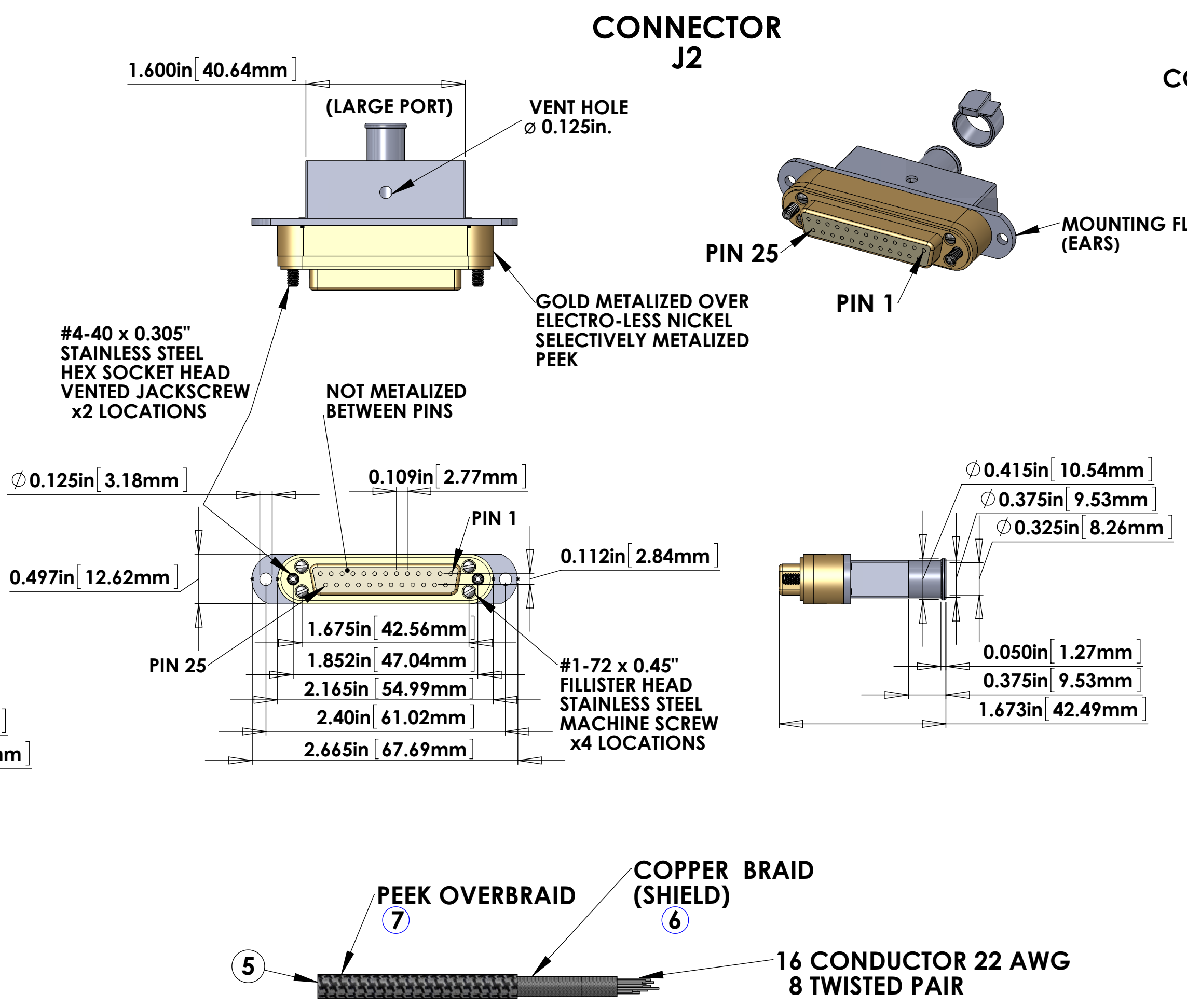
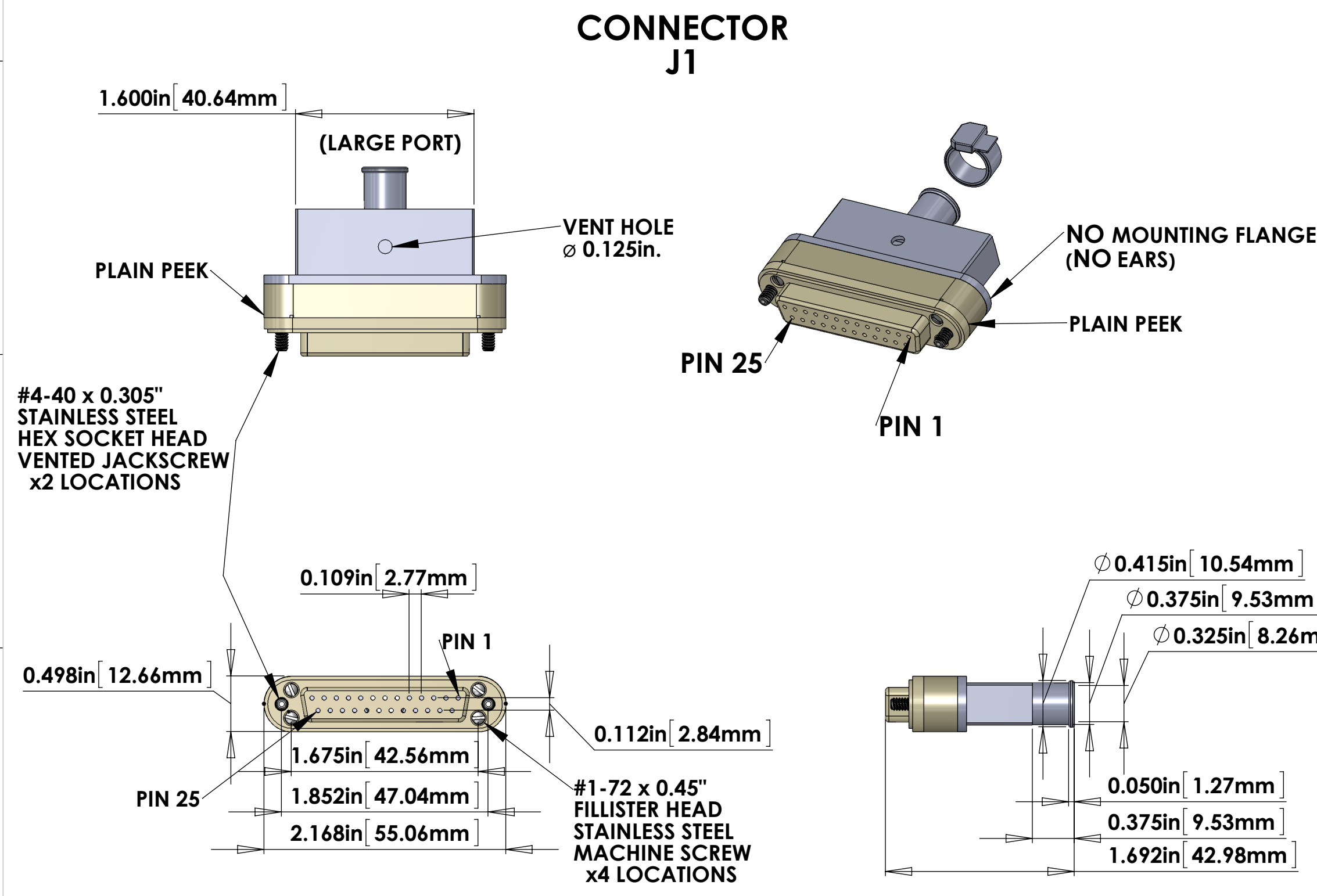
LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
SYSTEM		CUSTOM CABLE SPECIFICATION V25A-108	
SUB-SYSTEM		ISC	
DESIGNER	R. ABBOTT	JUL/02/2012	SIZE
DRAFTER	E. BROWN	JUL/02/2012	DWG. NO.
CHECKER			D
APPROVAL			D1101658

SUBSYSTEM		AIR/VAC	STANDARD USE
ISC		IN-VAC	FLANGE TO TOP CABLE QPD FOR TRANSMON
			HAM3 FLANGE D3-3C2 to CB3, ISC QPDs
SCALE: 1:1		PROJECTION:	SHEET 1 OF 1

- NOTES CONTINUED:
5. SCRIBE, ENGRAVE, OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER AND REVISION ON NOTED SURFACE FOLLOWED ON THE NEXT LINE BY A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE .07" HIGH CHARACTERS. EXAMPLE: A  
DXXXXX-VY, S/N 001
6. APPROXIMATE WEIGHT = X.XXX LB.
7. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
8. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
9. ALL HELI-COIL HOLES TO BE PREPARED ACCORDING TO EMHART HELI-COIL PRODUCT CATALOG, HC2000, REV.4
- NOTES 9, 10, 13 and 14 DO NOT APPLY TO THIS PART

10. ALL HELI-COIL INSERTS TO BE INSTALLED BY LIGO PERSONNEL. AFTER DELIVERY OF FINISHED PARTS, USE NITRONIC 60 THREADED INSERTS.
11. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
12. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
13. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION; THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
14. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
15. BEND RADIUS: UNLESS OTHERWISE NOTED, THE BEND RADIUS SHOULD BE THE MINIMUM REQUIRED TO FORM WITHOUT CRACKING OR REQUIRING ADDITIONAL WORK WHEN FORMING. IN PARTICULAR IF SHEET METAL IS TO BE PORCELAIN COATED, THE BEND RADIUS SHALL BE A MINIMUM OF .12" OUTSIDE RADIUS OF BEND UNLESS OTHERWISE NOTED.

REV.	DATE	DCN #	DRAWING TREE #



### V25B-108 CABLE ASSEMBLY CIRCUIT SUMMARY

#### V-DB25HD F/S1-108-DB25HD F/S1

CABLE NAME	COND.- WIRE ID	DOUBLE TWISTED PAIR	LENGTH *	FROM	TO
V25B-108	16 COND. CABLE	(12 TOTAL)	108 in.	Conn. J1	Conn. J2
	SHIELD		108 in	PIN 1, SHELL	PIN 1, SHELL
	W13	TP-1	108 in	PIN 13	PIN 13
	W25		108 in	PIN 25	PIN 25
	W12	TP-2	108 in	PIN 12	PIN 12
	W24		108 in	PIN 24	PIN 24
	W11	TP-3	108 in	PIN 11	PIN 11
	W23		108 in	PIN 23	PIN 23
	W10	TP-4	108 in	PIN 10	PIN 10
	W22		108 in	PIN 22	PIN 22
	W9	TP-5	108 in	PIN 9	PIN 9
	W21		108 in	PIN 21	PIN 21
	W8	TP-6	108 in	PIN 8	PIN 8
	W20		108 in	PIN 20	PIN 20
	W7	TP-7	108 in	PIN 7	PIN 7
	W19		108 in	PIN 19	PIN 19
	W6	TP-8	108 in	PIN 6	PIN 6
	W18		108 in	PIN 18	PIN 18

PIN 14,2,15,3,16,4,17,5 N/C (NOT CONNECTED)

\* THE LENGTH SHOWN IN THIS LIST IS THE LENGTH OF THE CABLE BETWEEN THE TWO CONNECTORS. ADD ADDITIONAL LENGTH AS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH.

SEE REFERENCE DCC# LIGO-D1100670

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	LENGTH
1	TICOR # (TS0148-25C020BS1-325) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J1) FOR UHV (PEEK)	1	
2		DB25 CONNECTOR BACKSHELL (NO EARS) FOR UHV (STAINLESS) WITH Ø0.325" i.d. PORT	1	
3	TICOR # (TS0148-25CG20BS1-325F) OR EQUIVALENT **	DB25 FEMALE CONNECTOR (J2) FOR UHV (GOLD METALIZED PEEK)	1	
4		DB25 CONNECTOR BACKSHELL (WITH EARS) FOR UHV (STAINLESS) WITH Ø0.325" i.d. PORT	1	
5	COONER WIRE # CZ2205 22GA PFA INSULATED BIOMEDICAL WIRE	16 COND. (8 TW PAIR) CABLE WITH 6 COPPER BRAID (SHIELD) AND 7 PEEK OVERBRAID	1	108in *
6	CONTINENTAL PART #24x3x40BC	COPPER BRAID - CONTINENTAL CORDAGE PART #24x3x40BC	1	
7	PART # 6759	PEEK BRAID - PART #6759 MANUFACTURED WITH ZEUS 0.016" BLACK PEEK DRAWN MONOFILAMENT - SUPPLIED BY LIGO	1	
8	GLENAIR # 600-052 or BAND-IT # A10086	GLENAIR #600-052 STANDARD BRAID CLAMP or BAND-IT PART # A10086 (0.240" WIDE) ("BAG OF 100" #A10089)	2	

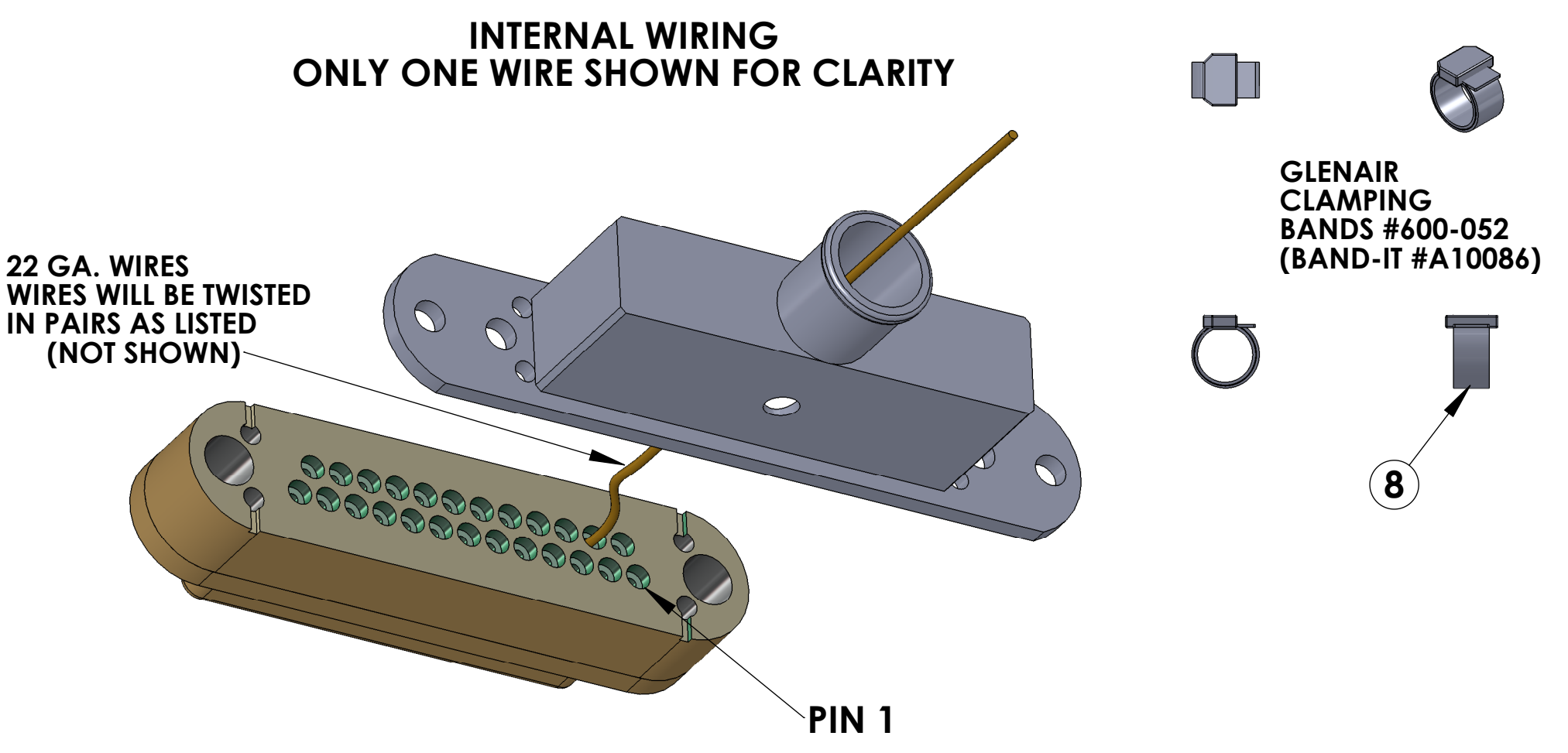
\* NOTE: USE WHATEVER LENGTH IS NECESSARY FOR THE INTERNAL WIRING OF THE CONNECTORS AND STRIP LENGTH TO ACHIEVE THE CORRECT OVERALL LENGTHS.

\*\* NOTE: SEE THE "TICOR CONNECTOR PART NUMBER BUILDER" DCC#D1000219 FOR DETAILS ON THIS PART NUMBER.

- NOTES: (UNLESS OTHERWISE SPECIFIED)
- A. MATERIAL:
- a. J1 CONNECTOR SHELL - PEEK VICTREX 450GL30.
  - b. J2 CONNECTOR SHELL - GOLD OVER ELECTRO-LESS NICKEL SELECTIVELY METALIZED PEEK VICTREX 450GL30.
  - c. BACKSHELLS - STAINLESS STEEL WITH VENT HOLE.
  - d. CONTACTS - BERYLLIUM COPPER ALLOY C17300, 0.000050 MIN. GOLD OVER NICKEL.
  - e. HARDWARE: STAINLESS STEEL, PASSIVATED.
  - f. PEEK BRAID - PEEK VICTREX GRADE TDS-450CA30 CARBON LOADED - SUPPLIED BY LIGO.

- B. CABLE 16 COND. 22 AWG (150/44), WITH PFA INSULATION COONER WIRE #CZ2205, 8 TWISTED PAIRS ( 4 TO 5 TWISTS PER INCH ). OVERALL 40AWG COPPER BRAID SHIELD MIN. 50% COVERAGE - SUPPLIED BY LIGO. OVERALL PEEK BRAID MIN. 50% COVERAGE. OVERALL CABLE O.D. ~ 0.260 IN.

- C. CONNECTORS WILL BE SUPPLIED WITH HARDWARE. SCREWS SHOULD BE THE PROPER LENGTH FOR MATING.



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATELY R.02 FOR SHEET METAL PARTS.
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

DIMENSIONS ARE IN	
TOLERANCES:	
.XX ±	
.XXX ±	
ANGULAR ± °	
MATERIAL	Material <not specified>
FINISH	μinch

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SYSTEM LIGO NEXT ASSY

SUB-SYSTEM ISC

PART NAME CUSTOM CABLE SPECIFICATION V25B-108

DESIGNER	R. ABBOTT	JUL/02/2012	SIZE	DWG. NO.	REV.
DRAFTER	E. BROWN	JUL/02/2012	D	D1101659	v5
CHECKER					
APPROVAL					

SCALE: 1:1 PROJECTION: SHEET 1 OF 1

D1101659-5-0006 V25B-108 PART PDM REV. DRAWING PDM REV. A.001



## **LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY (LIGO)**

### **COMMERCIAL ITEMS OR SERVICES CONTRACT**

#### **GENERAL PROVISIONS CALIFORNIA INSTITUTE OF TECHNOLOGY "INSTITUTE"**

##### GENERAL PROVISION TITLE

1. Offer and Contract
2. Time of Delivery
3. Improper Delivery
4. Assignment
5. Authority of Institute Representative and Required Notices
6. Changes
7. Force Majeure
8. Existing Commercial Computer Software – Licensing
9. Export Licenses
10. Disputes and Governing Law
11. Inspection and Acceptance
12. Insurance
13. Indemnification
14. New Material
15. Order of Precedence
16. Payment
17. Use of Name
18. Title and Risk of Loss
19. Government Title to Property Purchased or Fabricated with Contract Funds
20. Taxes
21. Termination
22. Warranty
23. Audit and Records
24. Site Visits
25. Nondiscrimination
26. Equal Employment Opportunity
27. Anti-Kickback
28. Clean Air Act and the Federal Water Pollution Contract Act
29. Debarment and Suspension
30. Byrd Anti-Lobbying Amendment
31. Copeland "Anti-Kickback" Act
32. Davis Bacon Act
33. Surety Bonds
34. Rights to Inventions – 37 CFR part 401
35. Patent Rights - Bayh-Dole Act [35 U.S.C. 200 et seq.]

(See Page 2 for Individual General Provision Applicability)

## APPLICABILITY OF INDIVIDUAL GENERAL PROVISIONS

### APPLICABLE TO ALL TRANSACTIONS IN THE UNITED STATES

The term *United States* includes the several States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, Guam, Wake Island, the Canal Zone, and all other territories and possessions of the United States, and the term *States* includes any one of the forgoing.

- |                                                                |                                                                              |
|----------------------------------------------------------------|------------------------------------------------------------------------------|
| 1. Offer and Contract                                          | 16. Payment                                                                  |
| 2. Time of Delivery                                            | 17. Use of Name                                                              |
| 3. Improper Delivery                                           | 18. Title and Risk of Loss                                                   |
| 4. Assignment                                                  | 19. Government Title to Property Purchased or Fabricated with Contract Funds |
| 5. Authority of Institute Representatives and Required Notices | 20. Taxes                                                                    |
| 6. Changes                                                     | 21. Termination                                                              |
| 7. Force Majeure                                               | 22. Warranty                                                                 |
| 8. Existing Commercial Computer Software – Licensing           | 23. Audit and Records                                                        |
| 10. Disputes and Governing Law                                 | 24. Site Visits                                                              |
| 11. Inspection and Acceptance                                  | 25. Nondiscrimination                                                        |
| 13. Indemnification                                            | 26. Equal Employment Opportunity                                             |
| 14. New Material                                               | 28. Clean Air Act and the Federal Water Pollution Control Act                |
| 15. Order of Precedence                                        |                                                                              |

### TAXES

20. The applicability of State sales tax is addressed on the face of the Purchase Order  
**[For imports]** Value Added Tax (VAT) is addressed on the face of the Purchase Order

### APPLICABLE IN SPECIAL CIRCUMSTANCES ACCORDING TO THEIR TERMS

9. **[For exports]** Compliance with Export Regulations  
12. **[Suppliers Working on Site]** Insurance  
27. **[For Contracts in excess of \$100,000]** Anti-Kickback Enforcement Act of 1986  
29. **[For Contracts in excess of \$25,000]** Debarment and Suspension  
30. **[For Contracts of \$100,000 or More]** Byrd Anti-Lobbying Amendment  
31. **[For designated Construction/Repair Contracts in excess of \$2,000]** Copeland “Anti-Kickback” Act  
32. **[For designated Construction/Repair Contracts in excess of \$2,000]** Davis-Bacon Act  
33. **[For designated Construction/Repair Contracts in excess of \$500,000]** Surety Bonds  
34. **[For designated Experimental, Development or Research Work]** Rights to Inventions- 37 CFR part 401  
35. **[For designated Experimental, Development or Research Work]** Patent Rights - Bayh-Dole Act [35 U.S.C. 200 et seq.]

### APPLICABLE TO ALL TRANSACTIONS IN THE UNITED STATES

These provisions **do not apply to foreign suppliers** performing outside the United States.

- |                                  |                                                               |
|----------------------------------|---------------------------------------------------------------|
| 25. Nondiscrimination            | 32. Clean Air Act and the Federal Water Pollution Control Act |
| 27. Equal Employment Opportunity |                                                               |

This agreement is a subcontract pursuant to an NSF Cooperative Agreement (CA) between the NSF and the Institute, [PHY-0328418](#).

1. **OFFER AND CONTRACT** The following terms, together with such terms, plans, specifications or other documents as attached or incorporated by reference as set forth on the face of this purchase order, constitute the offer of the Institute to Supplier and shall, when accepted, constitute the entire agreement ("Contract") between the Institute and Supplier. Institute hereby gives notice of its objection to any different or additional terms. This Contract is valid only as written. If price, terms, shipping date or other expressed condition of this Contract are not acceptable, the Institute must be notified and any variation must be accepted in writing prior to shipment or delivery. This Contract shall be deemed to have been accepted (a) in the absence of written notification of non-acceptance by the Supplier within a reasonable time, or (b) upon timely delivery of the products identified to the shipping address specified on the face of the order.
2. **TIME OF DELIVERY** Time is of the essence in this Contract. If delivery dates cannot be met, Supplier must notify the Institute immediately. Such notification shall not, however, constitute a change to the terms of this Contract except as the order may be modified in writing by the Institute.
3. **IMPROPER DELIVERY** In addition to other remedies provided by law, the Institute reserves the right to refuse any goods or services and to cancel all or any part of this Contract if Supplier fails to deliver all or any part of the goods or services in accordance with the terms and conditions of this Contract. Acceptance of any part of this order shall not bind the Institute to accept any future shipments nor deprive it of the right to return goods already accepted.
4. **ASSIGNMENT** The Supplier shall have no right to assign this Contract or any benefits from this Contract without prior written consent of the Institute.
5. **AUTHORITY OF INSTITUTE REPRESENTATIVES AND REQUIRED NOTICES; FACSIMILE AND ELECTRONIC SIGNATURES ACCEPTABLE**
  - (a) No order, notice, or direction received by the Supplier and issued pursuant to this Contract shall be binding upon either the Supplier or the Institute, unless issued or ratified in writing by the Institute Purchasing Agent, the Director of Procurement Services, or by representatives designated in writing by either of them.
  - (b) The parties agree that facsimile (fax) or electronic signature copies of contract documents are just as binding as originally-executed documents.
6. **CHANGES** The Institute may at any time, by a written order to the Supplier, make changes within

the general scope of this Contract in any one or more of the following: (a) drawings, designs, or specifications; (b) method of shipment or packing; and (c) time or place of delivery. If any such change causes an increase or decrease in the cost of, or the time required for, the performance of any part of the work under this order, an equitable adjustment may be made in the order price or delivery schedule or both, and the order shall be modified in writing accordingly. Any claim by Supplier for adjustment under this Article must be asserted within 30 days from the date of receipt by Supplier of the notification of change; provided, however, that the Institute, if it decides that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this purchase order. Nothing in this clause shall excuse Supplier from proceeding with this order as changed.

7. **FORCE MAJEURE** Each party shall not be liable for damages arising out of either its failure to deliver or any delay in delivery caused by strikes, lockouts, fires, war, or acts of God. The Supplier shall notify the Institute in writing as soon as it is reasonably possible after the commencement of any event triggering a delayed delivery or inability to deliver.
8. **EXISTING COMMERCIAL COMPUTER SOFTWARE – LICENSING** (This Article is applicable to the acquisition of any existing commercial computer software under this Contract.)
  - a) Where the Supplier proposes its standard commercial software license, only those applicable portions that comply with the provisions of this Contract are incorporated into and made a part of this Contract.
  - (b) If the Supplier does not propose its standard commercial software license until after this Contract has been issued, or at or after the time the computer software is delivered, such license shall nevertheless be deemed incorporated into and made a part of this Contract under the same terms and conditions as in paragraph (a) above. For purposes of receiving updates, correction notices, consultation, and similar activities on the computer software, any authorized user may acknowledge receipt of a registration form or card and return it directly to the Supplier; however, such signing shall not add to or alter any of the terms and conditions of this Contract.
  - (c) If the specified computer software is shipped or delivered to the Institute, it shall be understood that the Supplier has unconditionally accepted the terms and conditions set forth in this Article, and that the terms and conditions of this Contract (including the incorporated license) constitute the entire agreement between the parties concerning rights in the computer software.
  - (d) Supplier understands and agrees that the computer software may be: (1)

Used, or copied for use, in or with any computer owned or leased by, or on behalf of the Institute provided that the software is not used, nor copied for use, in or with more than one computer simultaneously, unless otherwise permitted; (2) Reproduced for safekeeping (archives) or backup purposes; (3) Modified, adapted, or combined with other computer software, provided that the modified, combined, or adapted portions of the derivative software incorporating restricted computer software shall be subject to the same restricted rights; and (4) Disclosed and reproduced for use by Institute designees in accordance with this Article. (e) Supplier agrees that the software may be used by the Institute in support and furtherance of any of its obligations to the US Government or other funding organization. (f) Supplier warrants that it has the right to sell, license, or transfer the license for the software furnished to the Institute under this Contract in accordance with the terms of this Contract.

9. **EXPORT LICENSES** The Supplier shall comply with all U.S. export control laws and regulations, including the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120 through 130, and the Export Administration Regulations (EAR), 15 CFR Parts 730 through 799, in the performance of this Contract. In the absence of available license exemptions/exceptions, the Supplier shall be responsible for obtaining the appropriate licenses or other approvals, if required, for exports of hardware, technical data, and software, or for the provision of technical assistance.

10. **DISPUTES AND GOVERNING LAW** (a) Any dispute or claim arising out of, in connection with, or relating to this Contract shall be submitted for resolution to ascending levels of management of the parties. If the dispute cannot be resolved after such negotiations, either party may pursue any appropriate legal recourse not inconsistent with the provisions of this Contract. (b) Pending any decision, appeal or judgment or the settlement of any dispute, Supplier agrees to proceed diligently with the performance of the requirements of this Contract. (c) This Contract shall be construed and enforced in accordance with the laws of the State of California. Disputes will be adjudicated in Los Angeles, California.

11. **INSPECTION AND ACCEPTANCE** The Institute shall have the right to inspect the work and activities of the Supplier under this Contract in such manner and at all reasonable times as are deemed appropriate. Final inspection shall be at the Institute's premises unless otherwise agreed in writing. The Institute, at its option, may reject any non-conforming items and (i) return such non-conforming items to the Supplier at the Supplier's

risk and expense for credit to the Institute at the full invoice price plus all transportation and other related costs, or (ii) hold them for disposition in accordance with the Supplier's instructions at the Supplier's expense, including storage and handling. If the Institute rejects items as nonconforming, the quantities under this Contract will automatically be reduced unless the Institute otherwise notifies the Supplier. The Supplier will not replace quantities so reduced without written instruction by the Institute. Payment for nonconforming goods shall not constitute an acceptance thereof, limit, or impair the Institute's right to assert any legal or equitable remedy, or relieve the Supplier's responsibility for latent defects. The Institute may also opt for a refund of the amount paid under this Contract.

12. **INSURANCE** (This Article is applicable when the Supplier will be entering Institute-controlled premises.) (a) The Supplier shall, at its own expense, provide and maintain during the entire performance period of this Contract at least the following types and minimum amounts of insurance with the Institute named as an additional insured in policies for comprehensive liability insurance with a licensed carrier authorized to do business in the State of California: (1) Workers' Compensation and Employer's Liability Insurance, as required by applicable Federal and State workers' compensation and occupational disease statutes. The Employer's Liability coverage shall be at least \$100,000, except in states with exclusive or monopolistic funds that do not permit worker's compensation to be written by private carriers. (2) Comprehensive Liability Insurance, including automobiles (owned, non-owned, or leased), completed operations, products, and contractual liability, for a combined single limit of not less than \$1,000,000 for all deaths, injuries, and property damage arising from one accident or occurrence. (b) Insurance Certificates and Endorsements. Before commencing work under this Contract, the Supplier shall furnish (i) certificates of insurance for the coverages specified in paragraph (a) above, and (ii) an additional insured endorsement naming the Institute as an additional insured to the Contract for the coverage specified above. Such certificates and the endorsement shall provide that any cancellation or material change in the insurance policies shall not be effective (i) for such period as the laws of the State in which this Contract is to be performed, or (ii) until 30 days after the insurer or the Supplier gives written notice to the Institute, whichever period is longer. Also, such certificates and the endorsement shall (i) cover contractual liability assumed under this Contract, and (ii) be primary and noncontributing to any insurance procured by the Institute. The Supplier agrees to



permit the Institute to examine its original policies, should the Institute so request. Should the Supplier at any time neglect or refuse to provide the insurance required herein, or should such insurance be canceled, the Institute shall have the right to procure same and the costs thereof shall be deducted from monies then due or thereafter to become due to the Supplier.

13. **INDEMNIFICATION** The Supplier agrees to defend, indemnify and hold harmless the Institute from and against all claims, liability and expenses, including reasonable legal fees, arising from any actual or claimed: (i) injury to any person or property resulting from any act or omission of Supplier, its employees or agents, excepting such liability as may result solely from the negligent acts or omissions of the Institute or its employees; and (ii) infringement of any patent, copyright, or trademark by reason of the sale or use of the goods provided by Supplier hereunder. The Supplier's obligations hereunder shall survive acceptance of the goods and payment thereof by the Institute.
14. **NEW MATERIAL** Unless this Contract specifies otherwise, the Supplier represents that the supplies are new and are not of such age or so deteriorated as to impair their usefulness or safety. If the Supplier believes that furnishing other than new material will be in the Institute's interest, the Supplier shall so notify the Purchasing Agent in writing and request authority to use such material.
15. **ORDER OF PRECEDENCE** To the extent there is inconsistency among any documents relating to this order, the inconsistency will be resolved in the following order of priority: (a) These General Provisions; (b) The details specified on the order, or description of products or services; (c) any other documents the Institute agrees in writing to incorporate by reference.
16. **PAYMENT** (a) Invoices shall be submitted in duplicate to the attention of the Institute's Accounts Payable Department, unless otherwise specified, and shall contain the following information as applicable: (i) Contract number, (ii) item number, (iii) description of supplies or services, (iv) size, (v) quantity, (vi) unit price, (vii) extended totals and (viii) any other information which may be specified on the face of this Contract. Any applicable state sales or use taxes or Federal excise taxes shall be shown separately on the invoice. (b) The Institute shall pay the Supplier, upon the submission of proper invoices, the prices stipulated in this Contract for supplies delivered and accepted or services rendered and accepted, less any deductions provided in this Contract. (c) The Institute shall make its best effort to make payments within the net period, if any, specified in the Contract, measured from the date of receipt of

the goods or services at the destination or the date of receipt of the invoice, whichever is later. Discount time periods will be measured from the same date. Payment shall be deemed to have been made on the date the check is mailed or on the date on which an electronic funds transfer was made. In no event will the Institute be liable for or pay a surcharge, interest, or any kind of penalty as a result of the Institute's payment not being made within the net period, if any, specified in the Contract or the date of payment by electronic funds transfer. (d) Payment for goods or services in accordance with this paragraph will not waive or otherwise affect the right of the Institute to inspect such goods or services or to reject, or revoke acceptance of, nonconforming goods.

17. **USE OF NAME** Supplier agrees not to use the name or trademarks of the Institute or any member its staff in sales promotional work or advertising, or in any form of publicity, without the prior written permission of the Institute.
18. **TITLE AND RISK OF LOSS** (a) Unless otherwise provided in Section 19 or elsewhere in this Contract, title to tangible property (property of any kind except intangible property and debt instruments) furnished under this Contract shall pass to the Institute upon formal acceptance by the Institute, regardless of when or where the Institute takes physical possession, unless the Contract specifically provides for earlier passage of title. (b) Risk of loss shall not pass to the Institute until the tangible property called for in this Contract has been actually received and accepted by the Institute at the destination specified. Supplier assumes all responsibility for packing, crating, marking, transportation and liability for loss or damage in transit, notwithstanding any agreement by Institute to pay freight, express or other transportation charges. Supplier agrees to trace lost or delayed shipments at the request of the Institute.
19. **GOVERNMENT TITLE TO PROPERTY PURCHASED OR FABRICATED WITH CONTRACT FUNDS** Title to tangible property shall vest in the Government upon acquisition when the tangible property is intended to be installed at, incorporated into, built, or necessary for the construction or operation of either the Hanford or Livingston Observatories. All Government property acquired in accordance with this Section 19 shall be subject to the requirements set forth below:
  1. Title.

(a) Tangible Property means property of any kind except intangible property and debt instruments. Title to all tangible property procured with funds provided through this Contract, and subject to this Section 19, shall vest in the Government as follows:

1) If this Contract contains a provision directing the Supplier to purchase material which the Government will reimburse as a direct item of cost under the Institute's primary Award, title to property shall pass to and vest in the Government upon delivery of such property to the Government, to the Institute, to the Supplier, to any subcontractor, or to any agent of the Government, of the Supplier, or of any subcontractor; and

2) Title to all other property shall pass to and vest in the Government upon the earliest to occur of the following:

(i) issuance of the property for use in contract performance pursuant to this Contract;

(ii) commencement of processing of the property or its use in contract performance pursuant to this Contract; or

(iii) reimbursement of the cost of the property by the Institute on behalf of the Government.

2. Legal title to all tangible property furnished by the NSF or acquired from other Government agencies shall remain with the Government, unless otherwise specified in this Contract.

3. Title to Government property shall not be affected by the incorporation or attachment thereof to any property not owned by the Government, nor shall any Government property lose its identity by reason of affixation to any realty.

4. All subcontracts issued or awarded with respect to the performance of this Contract shall include provisions regarding the determination of title to tangible property acquired by the subcontractor in accordance with Sections 18 and 19.

5. Should Supplier purchase tangible property pursuant to this Contract and subject to this Section 19, Supplier shall be a limited agent of the NSF solely for the purpose of transferring and vesting title to such tangible property in the Federal Government. The agent shall be solely responsible for the payment of the purchase price of tangible property acquired, and the agent shall have no authority to bind or obligate the Institute, NSF or the Federal Government for payment of the purchase price to any third party. Such agents shall be and shall remain liable for the risk of loss of, destruction of, or damage to tangible property acquired until such tangible property is transferred to the possession of the Government or acceptance by the Institute.

20. **TAXES** (a) **Except as may be otherwise provided on this order**, the contract price includes all applicable Federal, State, and local taxes and duties. With respect to transactions for which the

Institute may be exempt from any tax or duty, the Institute will provide, upon request, evidence to support its claim to such exemption. (b) The Institute will comply with all Federal and State income tax laws with respect to withholding and year-end tax reporting. (c) The Internal Revenue Service (IRS) requires the Institute to have on file a Taxpayer Identification Number (TIN) for every US person or US business that receives a payment, regardless if the payment is tax reportable or not. This information is provided on IRS Form W-9. US Citizens and Resident Aliens are required to complete a Form W-9 before receiving any payments from the Institute. A TIN can be any of the following: a Social Security Number (SSN) an Individual Taxpayer Identification Number (ITIN) or an Employer Identification Number (EIN). Failure to provide a TIN will result in delay of payment and/or backup withholding. (d) Foreign businesses providing services in the US for the Institute are required to provide the appropriate IRS Form W-8 (i.e., Form W-8BEN, W-8ECI, or W-8IMY). (e) Foreign individuals providing services in the US for the Institute are required to provide an IRS Form W-8BEN or IRS Form 8233 depending on the appropriate tax withholding treatment.

21. **TERMINATION** (a) **For Cause.** The Institute may terminate this Contract, or any part of it, for cause in the event of any default by the Supplier, or if the Supplier fails to comply with any Contract terms and conditions, or fails to provide the Institute, upon request, with adequate assurances of future performance. In the event of termination for cause, the Institute shall not be liable to the Supplier for any amount for supplies or services not accepted, and the Supplier shall be liable to the Institute for any and all rights and remedies provided by law. If it is determined that the Institute improperly terminated this Contract for cause, such termination shall be deemed a termination for convenience. (b) **For Convenience.** The Institute reserves the right to terminate this Contract, or any part hereof, for its sole convenience. In the event of such termination, the Supplier shall immediately stop all work hereunder and shall immediately cause any and all of its subcontractors to cease work. Subject to the terms of this Contract, the Supplier shall be paid a percentage of the Contract price reflecting the percentage of the work performed prior to the notice of termination, plus reasonable charges the Supplier can demonstrate to the satisfaction of the Institute, using its standard record keeping system, have resulted from the termination. The Supplier shall not be paid for any work performed or costs incurred which reasonably could have been avoided.

22. **WARRANTY** Supplier expressly warrants all goods and services delivered under this Contract to be free from defects in material and workmanship and to be of the quality, size and dimensions ordered. This express warranty shall not be waived by reason of the acceptance of the goods or services or payment by Institute. The Supplier shall provide the Institute with a copy of any standard warranty which is normally offered on a commercial product deliverable under this Contract. The commercial product warranty shall be deemed to be incorporated by reference and the Institute shall be entitled to all rights under such warranty.
23. **AUDIT AND RECORDS** Financial records, supporting documents, statistical records, and other records pertinent to this Contract shall be retained by the Supplier for a period of five years from acceptance by the Institute. Supplier agrees that the Institute, the National Science Foundation, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers and records of the Supplier which are directly pertinent to this Contract, for the purpose of making audits, examinations, excerpts and transcriptions.
24. **SITE VISITS** NSF and the Institute, through authorized representatives, have the right, at all reasonable times, to make site visits to review project accomplishments and management control systems and to provide such technical assistance as may be required. If any site visit is made by NSF or the Institute on the premises of the Supplier or a contractor under a subcontract, the Supplier shall provide and shall require its contractors to provide all reasonable facilities and assistance for the safety and convenience of the Institute or Government representatives in the performance of their duties. All site visits and evaluations shall be performed in such a manner that will not unduly delay the work.
25. **NONDISCRIMINATION** The Contract is subject to the provisions of Title VI of the Civil Rights Act of 1964 [42 U.S.C. § 2000d], Title IX of the Education Amendments of 1972 [20 USC §§ 1681 et seq.], the Rehabilitation Act of 1973 [29 U.S.C. § 794], the Age Discrimination Act of 1975 [42 U.S.C. §§ 6101 et seq], and all regulations and policies issued by NSF pursuant to these statutes. In accordance with these statutes, regulations, and policies, no person on the basis of race, color, national origin, sex, disability, or age shall be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under the Contract.
26. **EQUAL EMPLOYMENT OPPORTUNITY** This Contract is subject to the requirements of Executive Orders 11246 and 11375 and the rules and regulations or the Secretary of Labor (41 CFR Chapter 60) in promoting Equal Employment Opportunities.
27. **ANTI-KICKBACK ENFORCEMENT ACT OF 1986** This Contract is subject to the provisions of the Anti-Kickback Enforcement Act of 1986, Public Law 99-634 (41 U.S.C. 51-58). By accepting this order, Seller certifies that it has not paid kickbacks directly or indirectly to any Institute employee for the purpose of obtaining this or any other Institute purchase order or to obtain favorable treatment in an Institute matter.
28. **CLEAN AIR ACT AND THE FEDERAL WATER POLLUTION CONTROL ACT** – Should this Contract be for an amount in excess of \$100,000, Supplier agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251 et seq.). Further, Supplier agrees as follows:
- To comply with all the requirements of Section 114 of the Clean Air Act [42 U.S.C. §7414] and Section 308 of the Clean Water Act [33 U.S.C. § 1318], respectively, relating to inspection, monitoring, entry, reports and information, as well as other requirements specified in Section 114 and Section 308 of the Clean Air Act and the Clean Water Act, respectively, and all regulations and guidelines issued thereunder before the Contract.
  - That no portion of the work required by the Contract will be performed in a facility listed on the Environmental Protection Agency List of Violating Facilities on the date that the Contract was awarded unless and until EPA eliminates the name of such facility or facilities from such listing.
  - To use its best efforts to comply with clean air standards and clean water standards at the facility in which the Contract is being performed.
  - To insert the substance of the provisions of this article into any nonexempt subcontract.
29. **DEBARMENT AND SUSPENSION** – (a) Supplier shall fully comply with the requirements stipulated in 2 CFR Part 180, as modified by 45 CFR 620.330 and shall ensure that any lower tier covered transaction, as described in 2 CFR 180.220 and modified by 45 CFR 620.200 and 620.220 includes a term or condition requiring compliance with these requirements. The Supplier acknowledges that failing to disclose the information required under 45 CFR § 620.335 may result in the termination of the Contract, or pursuance of other available remedies, including suspension and debarment. Supplier may access the Excluded Parties List System at <http://epls.arnet.gov>. (b) No contract at any tier shall be made to parties listed on the General Services Administration's List

of Parties Excluded from Federal Procurement or Nonprocurement Programs in accordance with E.O.s 12549 and 12689, "Debarment and Suspension." This list contains the names of parties debarred, suspended, or otherwise excluded by agencies, and contractors declared ineligible under statutory or regulatory authority other than E.O. 12549. Supplier, whose Contract exceeds the small purchase threshold, shall provide the required certification regarding its exclusion status and that of its principal employees.

30. **[FOR CONTRACTS OF \$100,000 OR MORE] BYRD ANTI-LOBBYING AMENDMENT** - Supplier warrants that Supplier has applied or bid on a Contract of \$100,000 or more and has filed the required certification. Each subcontracting tier must certify to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.
31. **[FOR CONSTRUCTION/REPAIR CONTRACTS >\$2000] Copeland "Anti-Kickback" Act (18 U.S.C. 874 and 40 U.S.C. 276c)** Supplier shall comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874), as supplemented by Department of Labor regulations (29 CFR part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States").
32. **[FOR CONSTRUCTION/REPAIR CONTRACTS >\$2000] Davis-Bacon Act, as amended (40 U.S.C. 276a to a-7)** Supplier shall comply with the Davis-Bacon Act (40 U.S.C. 276a to a-7) and as supplemented by Department of Labor regulations (29 CFR part 5, "Labor Standards Provisions Applicable to Contracts Governing Federally Financed and Assisted Construction").
33. **[FOR CONSTRUCTION/REPAIR CONTRACTS >\$500,000] Surety Bonds - If so directed**, the Supplier shall furnish separate bid guarantees, performance and payment bonds to the Institute. Each bond shall set forth a penal sum in an amount not less than the Contract Price. Each bond furnished by the Supplier shall incorporate by reference the terms of this Contract as fully as though they were set forth verbatim in such bonds. In the event the Contract Price is adjusted by Change Order executed by the Contractor, the

penal sum of both the performance bond and the payment bond shall be deemed increased by like amount. The performance and payment bonds furnished by the Supplier shall be in form suitable to Institute and shall be executed by a surety, or sureties, reasonably acceptable to the Institute.

34. **[For designated Experimental, Development or Research Work] Rights to Inventions** - For non-profit organizations and small business firms, patent rights shall be governed by 37 CFR part 401, titled "Rights to Inventions Made by Non-Profit Organizations and Small Business Firms under Government Grants, Contracts and Cooperative Agreements".
35. **[For designated Experimental, Development or Research Work] Patent Rights** – Bayh-Dole Act [35 U.S.C. 200 et seq.]



*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-Q0900001-v5

3 February 2010

**Advanced LIGO Supplier Quality Requirements**

Jeff Lewis, Bob Anderson, Calum Torrie

Distribution of this document:  
LIGO Scientific Collaboration  
and LIGO Suppliers

**California Institute of Technology**  
LIGO Project – MS 18-34  
1200 E. California Blvd.  
Pasadena, CA 91125  
Phone (626) 395-2129  
Fax (626) 304-9834  
E-mail: [info@ligo.caltech.edu](mailto:info@ligo.caltech.edu)

**Massachusetts Institute of Technology**  
LIGO Project – NW22-295  
185 Albany St  
Cambridge, MA 02139  
Phone (617) 253-4824  
Fax (617) 253-7014  
E-mail: [info@ligo.mit.edu](mailto:info@ligo.mit.edu)

**LIGO Hanford Observatory**  
P.O. Box 1970  
Mail Stop S9-02  
Richland WA 99352  
Phone 509-372-8106  
Fax 509-372-8137

**LIGO Livingston Observatory**  
P.O. Box 940  
Livingston, LA 70754  
Phone 225-686-3100  
Fax 225-686-7189

<http://www.ligo.caltech.edu/>

email: [quality@ligo.caltech.edu](mailto:quality@ligo.caltech.edu)

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## 1. Scope

This document is intended for Suppliers and potential Suppliers to LIGO when specified on the Statement of Work (SOW). Supplier requirements are defined, including: the Supplier's Quality System; inspection, material handling, packaging and shipping procedures.

## 2. Supplier Quality System

### 2.1. Certified or Compliant

During the Request for Proposal (RFP) or Request for Quote (RFQ) process, preference will be given to potential and current suppliers who are currently ISO 9001, AS9100, or TS16949 certified. LIGO can still contract with suppliers who are not certified but those suppliers typically have ISO 9001 compliant Quality Systems. Potential suppliers having neither an ISO 9001 certified nor compliant Quality System will be required to create a quality document addressing the main points of ISO 9001 with respect to the LIGO work. Only potential suppliers lacking certification shall submit a copy of their Quality System along with the bid package for consideration.

### 2.2. Calibration Program

The supplier shall maintain an ISO 9001 compliant calibration program of all instruments and tools required for the inspection of all LIGO production parts and assemblies manufactured by the supplier or sub-contractor.

## 3. Procurement Process

### 3.1. Pre-RFP/RFQ Supplier Visit

A LIGO representative may conduct a visit or audit to gage a potential supplier's Quality System, facilities, equipment and personnel capabilities, and capacity. The LIGO representative can explain any LIGO specific requirements that are not clear.

### 3.2. LIGO Procurement Documentation

LIGO will provide the supplier with the following documentation in support of the bid process (if applicable):

- 3.2.1. Statement of Work (SOW)
- 3.2.2. Technical documents, drawings, and specifications, identified by revision. Solid Models are available on request.
- 3.2.3. On-line access to all applicable LIGO specifications

### 3.3. Pre-Award Inspection

Prior to contract award LIGO staff may perform an audit of the prospective supplier's Quality System. The audit scope includes but is not limited to:

- Understanding of the various LIGO requirements and specifications. This should be an opportunity for both parties to communicate.
- Supplier QA/QC program and how it will be implemented for Advanced LIGO contracts.
- Manufacturing methodologies, especially as regards cleanliness and use of approved materials and fluids.
- Cleaning and packaging methodologies compared to RFP/RFQ requirements.
- Critical worker certification levels (i.e., welding, electrical, CNC, etc.).

- Calibration program review.

## 4. Manufacture, Assembly, and Inspection Requirements

### 4.1. Manufacturing Planning / Traveler

Unless otherwise instructed, the supplier shall create planning for each manufacturing job which identifies the following components. This planning shall be available for review by LIGO before, during, or after manufacturing.

- The schedule of operations, including the type of process to be performed (ie, mill, lathe, deburr, outside processing, etc.)
- Machinist sign-off and date, including quantity conforming and non-conforming
- Identification and definition of the inspection points during the manufacturing process
- Inspector sign-off and date, including quantity conforming and non-conforming
- Identification of process specifications, as applicable, for internal and external processes
- Identification of operational constraints, as appropriate (ie, no abrasive metal removal techniques for parts destined for Ultra High Vacuum use.)

### 4.2. First Article Inspection

LIGO may wish to witness or inspect the First Article part before the rest of the order is completed. The requirement for this will be defined on the Statement of Work if applicable.

### 4.3. In-Process Inspection

In-process inspections shall be performed where subsequent assembly stages will prevent/limit inspection access, and to detect defects early in the process. In-process inspections shall be identified in the manufacturing planning (see Section 4.1 above).

### 4.4. Final Inspection

The Supplier shall conduct a Final Inspection of all component parts and assemblies to verify completion and conformance of the following items:

- Conformance to all applicable drawings, SOW, and specifications.
- End Item Data Package review (refer to SOW for complete list)
- LIGO property control documentation, when LIGO materials are in possession of a supplier.
- Evidence of safety requirements compliance, if applicable.
- Shipping documentation such as the manifest or shipper.
- Verification of the adequacy of the shipment packaging and weather protection.
- Verification that transportation environmental controls and monitoring requirements will be satisfied.

### 4.5. Source Inspection

Source inspection by LIGO personnel may be required. The supplier will be notified of this in advance of shipping the components.

### 4.6. Discrepant Material

Discrepant parts must be identified and segregated immediately upon detection. If the discrepant parts are required to complete an order and the parts can be reworked to comply with the drawing and/or specifications and with no effect on the delivery date



then LIGO does not need to be notified. If the parts can be reworked to comply with the drawing and/or specifications but the rework process will adversely affect the delivery date, then the LIGO Contracting Officer must be notified.

Please immediately contact LIGO to discuss discrepant parts that cannot be reworked to comply with the drawing and/or specification. Suppliers should use the LIGO form [Q110001 Request for Deviation](#) to formalize a request to submit or rework discrepant parts which will not comply to the drawing and/or specifications. Email the completed form to [quality@ligo.caltech.edu](mailto:quality@ligo.caltech.edu) for a disposition.

The supplier must retain records of any rework processes as part of the job traveler package.

#### **4.7. Drawing and Specification Change Control**

All drawings and specifications will be controlled by the suppliers Quality Assurance Department, including receipt and distribution. Upon receiving the order/contract, all drawings will be verified as to correct number and revision.

Controlled documents must be kept updated at every document change or engineering change. The contract administrator under the guidance of QA will insure that all controlled documents, whether in house or out, will be updated.

Occasionally, LIGO may need to revise drawings for design or manufacturing reasons after the purchase order has been issued. These changes are normally discussed with the supplier in advance of official notification to come to a common agreement on the feasibility and implications of the desired changes. When the change will have no adverse effect on the cost or delivery of the part(s) then a Technical Directive Memorandum will be issued by LIGO to formally document the change. If the change is estimated to affect either cost or delivery of the part(s), then a Change Request will be initiated and sent to the supplier, followed by a revised Purchase Order.

Upon receipt of drawing and specification changes, the supplier Quality Assurance or other appropriate personnel will remove obsolete drawing and/or specifications and issue the latest drawing and/or specification to proper personnel. Obsolete drawings shall either be marked "obsolete" if needed for records or destroyed.

#### **4.8. Welding Certifications**

Suppliers of parts or assemblies requiring welding which will be used in an Ultra High Vacuum environment must refer to LIGO specification [E0900048 Welding Specification for Weldments used within the Advanced LIGO Vacuum System](#). This specification details numerous welding specific requirements. The SOW will state if this specification is invoked for a certain part or order.

#### **4.9. End Item Data Package**

The end item data package is the set of required documents to be supplied to LIGO upon delivery of ordered parts or services. Refer to the Statement of Work (SOW) for the complete list of documents to be included.

**Acceptable Quality Level (AQL) for Inspection of LIGO Components**

AUTHOR(S)	DATE	Document Change Notice, Release or Approval
Jeff Lewis, Bob Anderson	2/11/2011	see LIGO DCC record Status

**1 Scope**

This document defines the number of components to be 100% inspected from a manufacturing lot of a particular size based on a specified AQL number.

**2 Definition**

The maximum percent defective (or the maximum number of defects per 100 units) that, for the purposes of sampling inspection, can be considered satisfactory as a process average.

**3 Procedure****AQL Number**

Lot Size	0.25	0.4	0.65	1.0	1.5	2.5	4.0	6.5	10
2 to 8	*	*	*	*	*	5	3	2	2
9 to 15	*	*	*	13	8	5	3	2	2
16 to 25	*	*	20	13	8	5	3	3	2
26 to 50	*	32	20	13	8	5	5	5	3
51 to 90	50	32	20	13	8	7	6	5	4
91 to 150	50	32	20	13	12	11	7	6	5
151 to 280	50	32	20	20	19	13	10	7	6
281 to 500	50	48	47	29	21	16	11	9	7
501 to 1200	75	73	47	34	27	19	15	11	8
1201 to 3200	116	73	53	42	35	23	18	13	9
3201 to 10,000	116	86	68	50	38	29	22	15	9

\* Denotes inspection of entire lot. Acceptance Criteria (C) = 0

Table 1. AQL Inspection Frequency.

Use Table 1. to determine the number of pieces from a manufacturing lot to 100% inspect for a specified AQL number. For example: a lot of 100 parts with an AQL number of 1.0 signifies that 13 parts shall be 100% inspected. With the Acceptance Criteria (C) = 0, then if one feature on one part is found to be non-conforming then the entire lot shall have that feature inspected.

The first and last part of a manufacturing lot must always be inspected.