



National Aeronautics and
Space Administration

Document #: SHIIVER-MEM-0007
Revision: Basic
Release Date: October 22, 2018

John H. Glenn Research Center
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Technology Demonstration Mission (TDM)
evolvable Cryogenics (eCryo) Project
Structural Heat Intercept, Insulation and
Vibration Evaluation Rig (SHIIVER)
Diode Rake Assembly and Installation

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Approval/Signatures

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Change History

Revision (<i>"Basic" or "Letter"</i>)	Release Date (<i>date document is published for release</i>)	Description (<i>e.g., describe state, change description, CR#, approval/board date, etc.</i>)
Basic	10/22/18	Initial Release

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1.0 INFORMATION

1.1 Objective

The objectives are:

- Upon receipt from the vendor, add perf board and diodes to the t-bar
- Assemble all rake parts except the lower ring
- Install the rake into the tank and attach the lower ring

1.2 Special Instructions

- CAUTION -

Do not damage the manway sealing surfaces during rake installation

1.3 Operations List

Operation		Haz (Y/N)
No.	Title	
10	Assemble top ring	N
20	Assemble bottom ring	N
30	Assemble T-bar	N
40	Attach T-bar to top ring	N
50	Prep for Install into tank	N
60	Install into tank	N

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2.0 SAFETY INFORMATION

- 2.1 Use standard facility lift practices to lower rake into tank from above

3.0 STAGING REQUIREMENTS

3.1 Reference Engineering Documentation

- 3.1.1 150801MRA180 internal instrumentation structure
- 3.1.2 150801MRA181 diode rake top ring
- 3.1.3 150801MRA182 diode rake bottom ring
- 3.1.4 150801MRA183 diode rake t-bar
- 3.1.5 150801MRA184 diode rake angle bracket
- 3.1.6 150801MRA185 diode rake z-bracket
- 3.1.7 150801MRA186 diode rake perf board modification
- 3.1.8 150801MRA187 cap probe capture
- 3.1.9 1865-MANWAYS-1, REV.6

OPERATION 10 ASSEMBLE TOP RING

1.1 Parts, Materials, Equipment, and Special Tools

- 1.1.1 Materials:
 - .010" stainless safety wire
- 1.1.2 Tools and Supporting Equipment
 - 1.1.2.1 Diagonal cutters
 - 1.1.2.2 Scissors
 - 1.1.2.3 pliers

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- a. Cut and lay metal mesh gasket in groove with round edge out. See Fig 1-1.
- b. If gasket will not stay in place (in the groove) holes will need to be drilled like in the lower ring and then the remainder of the steps below performed.
 - i. If the gasket stays in place in the groove, the remainder of steps below do not need to be performed.

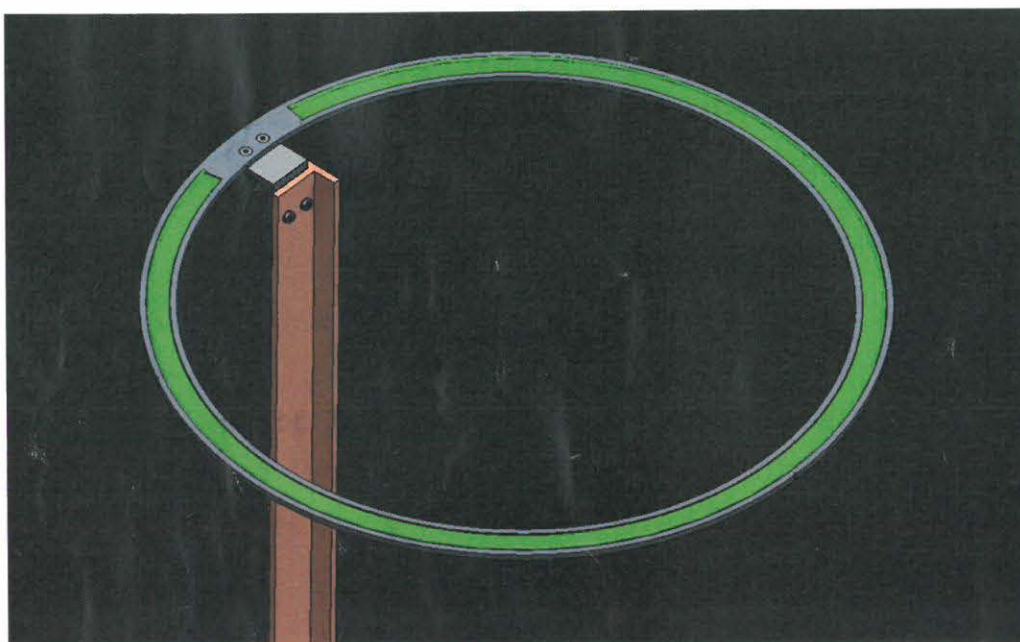


Figure 1-1 Upper mesh gasket layout

- c. Wire the gasket in place using the small holes as needed with .010 or .015" stainless safety wire.
- d. Tie wire ends opposite groove (gasket) side.
- e. Performed by

Joe S. Powell

Completed 5 Nov 18

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OPERATION 20 ASSEMBLE BOTTOM RING

1.1 Parts, Materials, Equipment, and Special Tools

1.1.1 Materials:

- .010" stainless safety wire

1.1.2 Tools and Supporting Equipment

- 1.1.2.1 Diagonal cutters
- 1.1.2.2 Scissors
- 1.1.2.3 Pliers
- 1.1.2.4 torque wrench, 22-26 in-lbs

- a. Cut and lay metal mesh gasket in grooves with round edge out. See Fig 2-1.

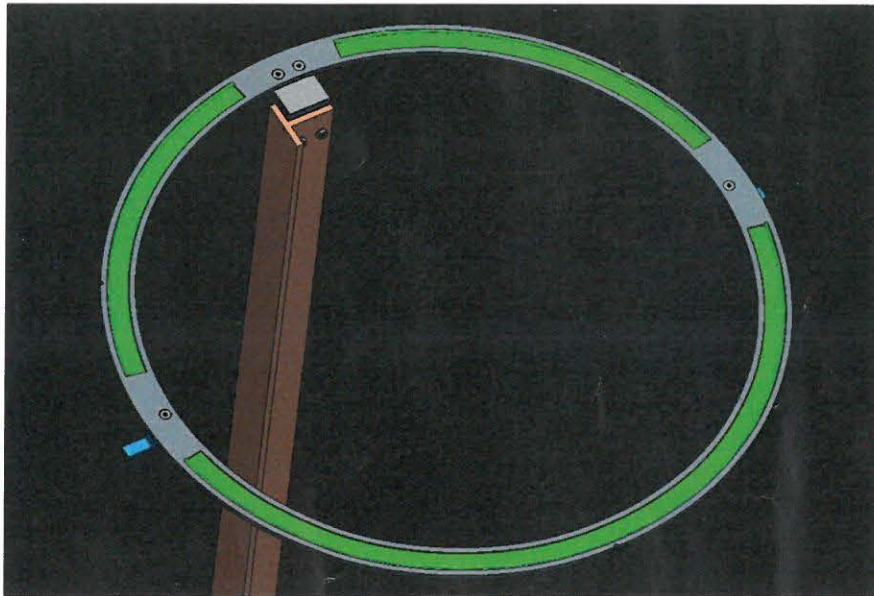


Figure 2-1 Lower mesh gasket layout

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- b. Wire the gasket in place using the small holes as needed with .010 or .015" stainless safety wire.
- c. Tie wire ends opposite groove (gasket) side.
- d. Install Z-brackets on ring opposite mesh gasket.
 - i. use #12 stainless steel 82° flat head machine screws.
 - ii. Use any stainless nut except nylon locking.
 - iii. Tighten screws where brackets can just be turned by hand.
- f. Install angle bracket on ring.
 - i. use #12 stainless steel 82° flat head machine screws.
 - ii. Use any stainless nut except nylon locking.
 - iii. Tighten screws 22-26 in-lbs.

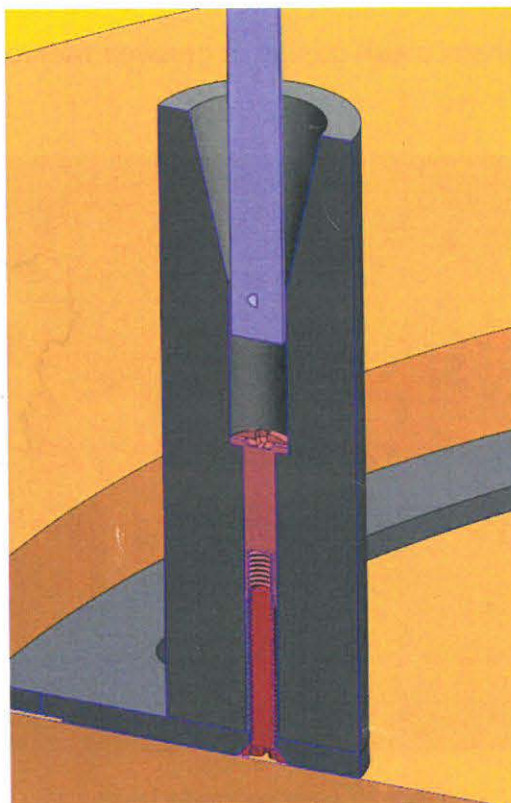


Figure 2-2 Teflon cap probe capture

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g. Install the Teflon capacitance probe capture block on the ring ear. See Fig 2-1.

i. Snug the bolt into the Teflon block just snug – DO NOT STRIP TEFLON THREADS.

1. Use a 5/16-18x1" stainless socket head cap screw

h. Performed by

Chris Snyder 2-11-13

OPERATION 30 ASSEMBLE T-BAR

1.1 Parts, Materials, Equipment, and Special Tools

1.1.1 Materials:

- Coated tie wire

1.1.2 Tools and Supporting Equipment

- 1.1.2.1 Diagonal cutters
- 1.1.2.2 Pliers
- 1.1.2.3 5/64" allen wrench
- 1.1.2.4 1/8" allen wrench
- 1.1.2.5 3/16" wrench and socket
- 1.1.2.6 3/8" wrench
- 1.1.2.7 Torque wrench, 2-4 in-lbs
- 1.1.2.8 Torque wrench, 22-26 in-lbs

a. Attach angle bracket to T-bar

- i. use #12 stainless steel 82° flat head machine screws.
- ii. Use any stainless nut except nylon locking.
- iii. Tighten screws 22-26 in-lbs.

b. Cut 2.25"x17" sections of perfboard.

c. Lay out sections of perfboard where they will bolt to T-bar per drawing and mark location of each diode on each board.

i. Locations are given on drawing 150801MRA180

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- ii. Tie diodes onto protruding edges of perfboard. See Fig 3-1.
 1. Use a double-loop of the heavier wire with one loop separating the diode can from the board.
 2. Allow diodes to protrude beyond the edge of the board slightly.
 3. Use the lighter wire and tie the leads to the board just behind each diode can.
 4. Also tie leads a 2nd time in the horizontal run with the lighter wire, near the edge of the perfboard where the leads will turn upward for the vertical run.
 5. Leave at least two tie wires protruding out from the board for the vertical runs, on each board.

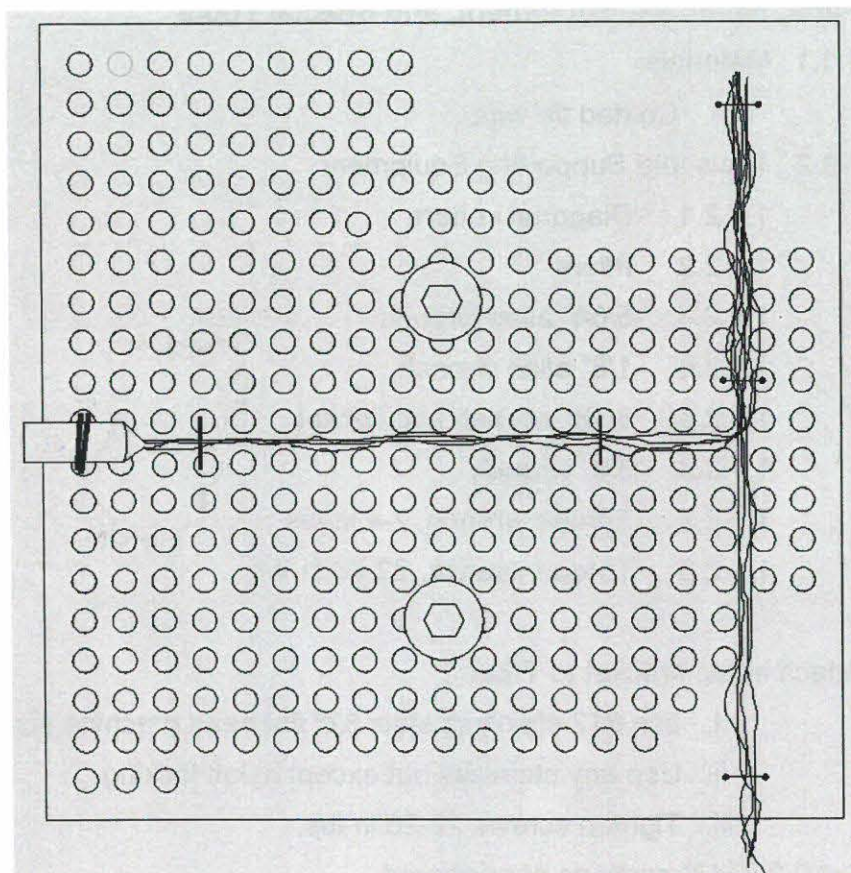


Figure 3-1 Diode layout on perfboard

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- d. Bolt perfboard sections onto T-bar per drawing 150801MRA180 and 186.
 - i. Use a stainless washer between the perfboard and T-bar.
 - ii. use #2 stainless steel socket head screws.
 - iii. Use any stainless nut except nylon locking.
 - iv. Tighten screws 2-4 in-lbs.
 - v. Route the diode leads up, as the board sections are bolted to the T-bar, using the inserted-but-loose vertical-run tie wires.
- e. Terminate the leads (80) in two D-sub 50 pin female connectors provided.
 - i. Pin locations per instrumentation list
 - ii. Length of leads between female connectors and last tie-off point on the perfboard, above the uppermost diode is 12". Depicted by the red wires in Fig 3-2 below.

f. Performed by

Andy Marlow tied on the diodes & routed the wires. Perf board put on T-bar by rake vendor. Completed 16 Nov 18

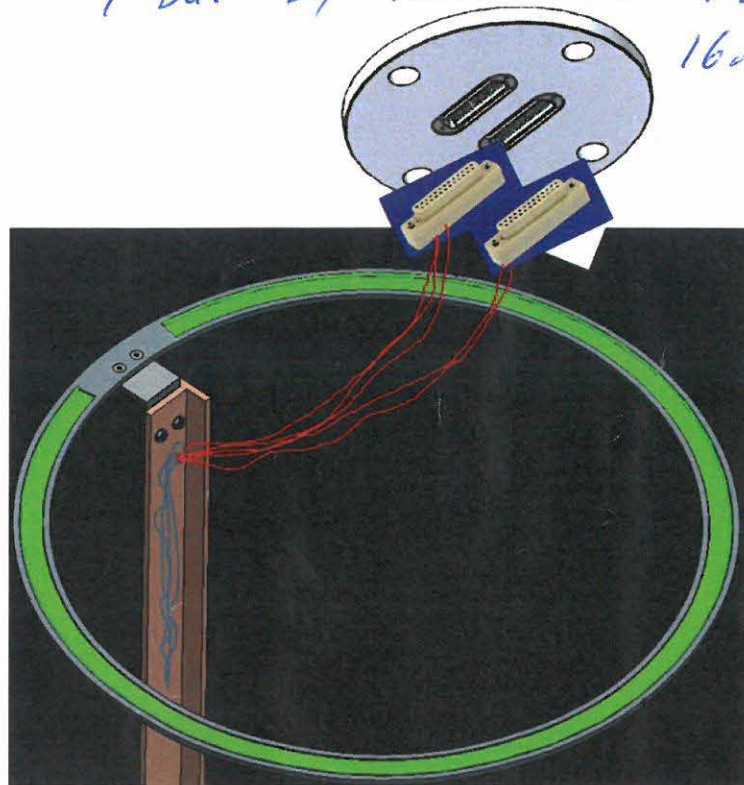


Figure 3-2 Connector leads layout

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- g. Measure distance from lower end of T-bar (datum B on drawing 150801MRA183) to center of can of each "as-installed" diode. (note: these numbers will be different than the installed distances on drawing 150801MRA180.) Example of measurement is shown in red in Fig 3-3 below.

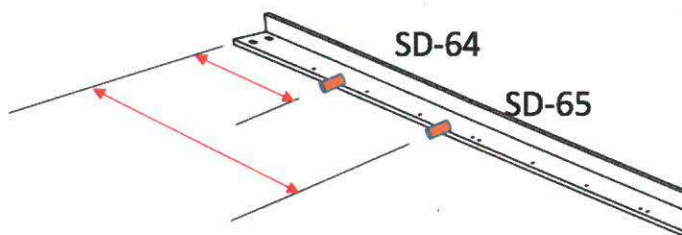


Figure 3-3 Installed measurements

Lower end of T-bar to:	SD-64	<u>14³/₈</u>
	SD-65	<u>22³/₁₆</u>
	SD-66	<u>28⁵/₈</u>
	SD-67	<u>34³/₈</u>
	SD-68	<u>39³/₄</u>
	SD-69	<u>46³/₈</u>
	SD-70	<u>49¹/₂</u>
	SD-71	<u>54⁷/₁₆</u>
	SD-72	<u>59³/₈</u>
	SD-73	<u>64³/₁₆</u>
	SD-74	<u>70¹/₈</u>
	SD-75	<u>75</u>
	SD-76	<u>79³/₄</u>
	SD-77	<u>83</u>
	SD-78	<u>89³/₄</u>
	SD-79	<u>95¹/₁₆</u>

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SD-80 100^{3/4}
SD-81 10 7^{1/4}
SD-82 115^{1/16}
SD-83 124^{5/8}

h. Performed by

[Signature] 7 June 18

1. OPERATION 40 ATTACH T-BAR TO TOP RING

1.1.1 Tools and Supporting Equipment

- 1.1.1.1 1/8" allen wrench
- 1.1.1.2 3/16" wrench and socket
- 1.1.1.3 Torque wrench, 2-4 in-lbs

a. Attach upper ring to the angle bracket on the T-bar

- i. use #12 stainless steel 82° flat head machine screws.
- ii. Use any stainless nut except nylon locking.
- iii. Tighten screws 22-26 in-lbs.

OPERATION 50 PREP FOR INSTALL INTO TANK

1.1.3 Materials:

- IPA or MEK
- Wipes
- Foam sheets (for SOFI)

1.1.4 Tools and Supporting Equipment

- 1.1.4.1 Wrench for cover removal
- 1.1.4.2 Personnel access to upper manway

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- a. Lay SOFI protection (foam sheets) over areas where persons and tools will pass
- b. Remove any covers and sealing surface protection from upper manway
- c. Clean C-seal sealing surface areas and upper diode rake ring lip area at upper manway
- d. Remove any cover from lower manway
- e. Clean diode rake ring lip area at lower manway
- f. At least one person must be stationed at upper manway as diode rake is lowered into position.
- g. On the rake, gently secure the diode leads/female connectors temporarily to the T-bar for lifting. These cannot be secured to the ring itself since it will be set onto the lip in the next step. Depicted in yellow in Fig 6-1 below.
- h. On the rake, tie a 'guide-string' on the lower end of the T-bar for the person at the lower manway to use in guiding the assembly as it is lowered through the tank.
- i. Determine where the 195° chamber location is on the upper manway area.

OPERATION 60 INSTALL INTO TANK

1.1.1 Tools and Supporting Equipment

- 1.1.1.1 3/16" wrench and socket
- 1.1.1.2 1/8" allen wrench
- 1.1.1.3 Torque wrench, 22-26 in-lbs
- 1.1.1.4 Lifting sling

- a. Record date installed

Chris Snyder 2-11-19

- b. Place small lifting strap under angle bracket of top ring and lift top ring/T-bar assembly above tank and down into upper manway. Depicted in brown in Fig 6-1 below.

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- alignment pins would not line up w/holes (notches) in rings*
- * ring notches were milled deeper (inward)*
- Person at top must guide the assembly into position as it is lowered
 - Person at the bottom must ensure lower end of T-bar does not hit anything.
 - Clock ring/T-bar assembly so T-bar is at the 195° chamber location. The 3 guide pins will dictate exact placement.

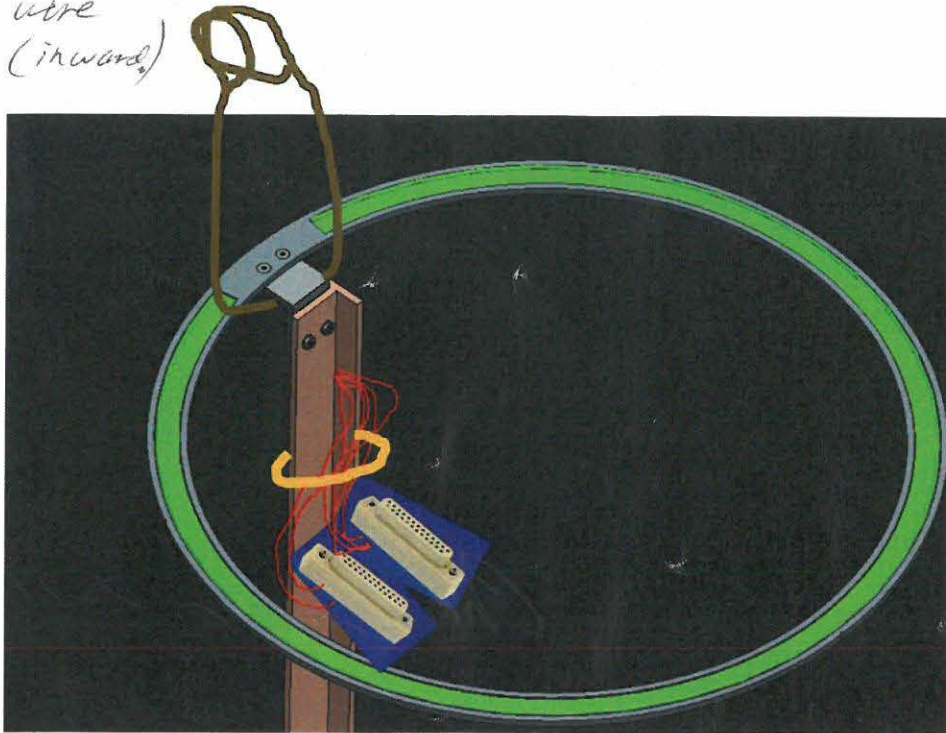


Figure 6-2 Lifting strap concept

- Raise lower ring into position and secure using the Z – brackets
- Bolt lower end of T-bar to angle bracket on lower ring.
 - Remove 'guide-string' if installed.
 - use #12 stainless steel 82° flat head machine screws.
 - Use any stainless nut except nylon locking.
 - Tighten screws 22-26 in-lbs.
- After installation is complete, measure distance from the lower end of the T-bar to lower side of lower ring. Shown in red in Fig 6-3 below.
 - Record distance measurement 1/2" AP

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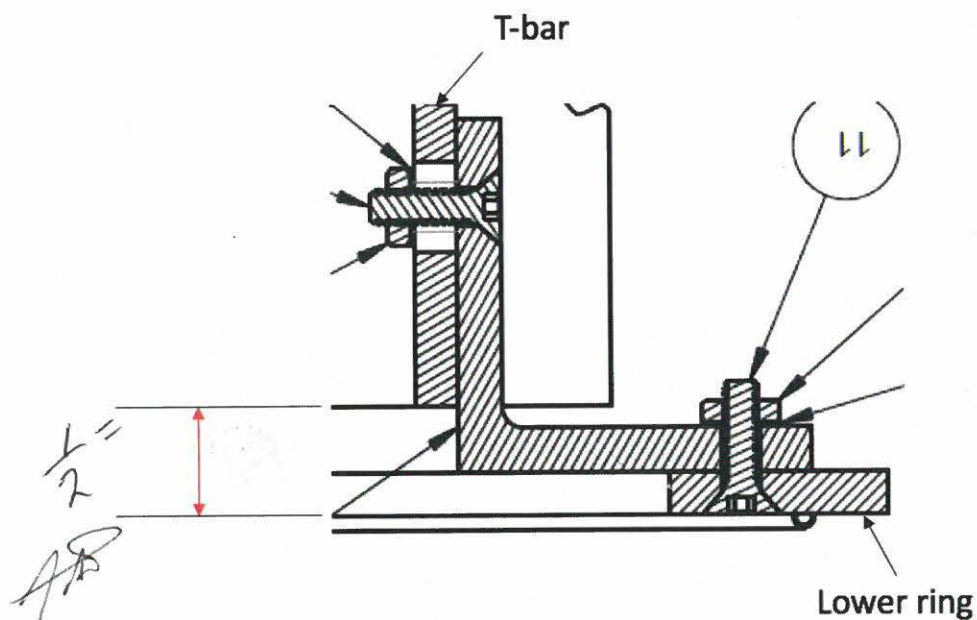


Figure 6-3 Installed T-bar to ring measurement

g. Performed by

Chris Snyder 2-11-18

NOTE:

During installation of the upper manway flanged cover, SHIIVER-MEM-0014, the instrumentation connection will be completed

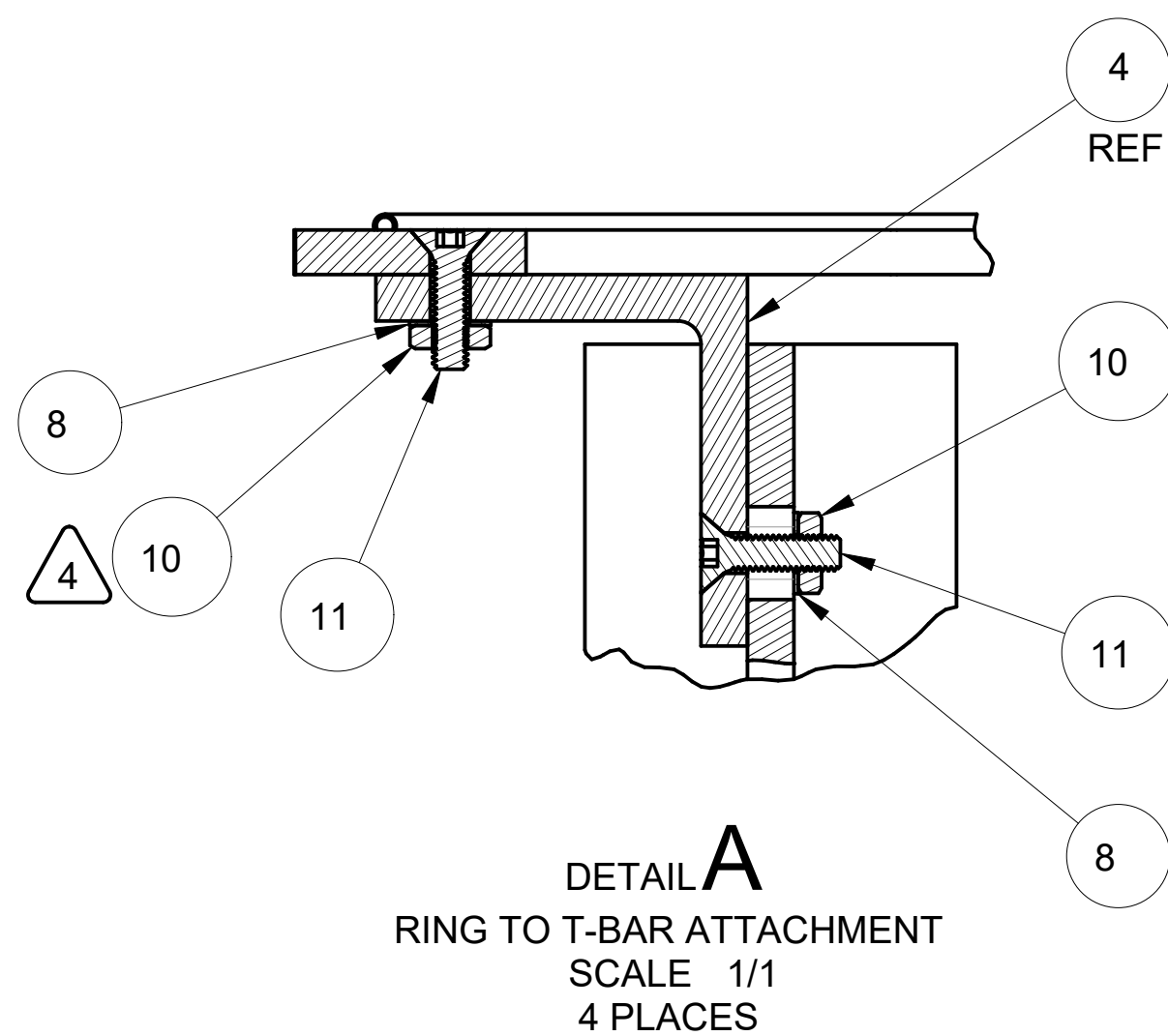
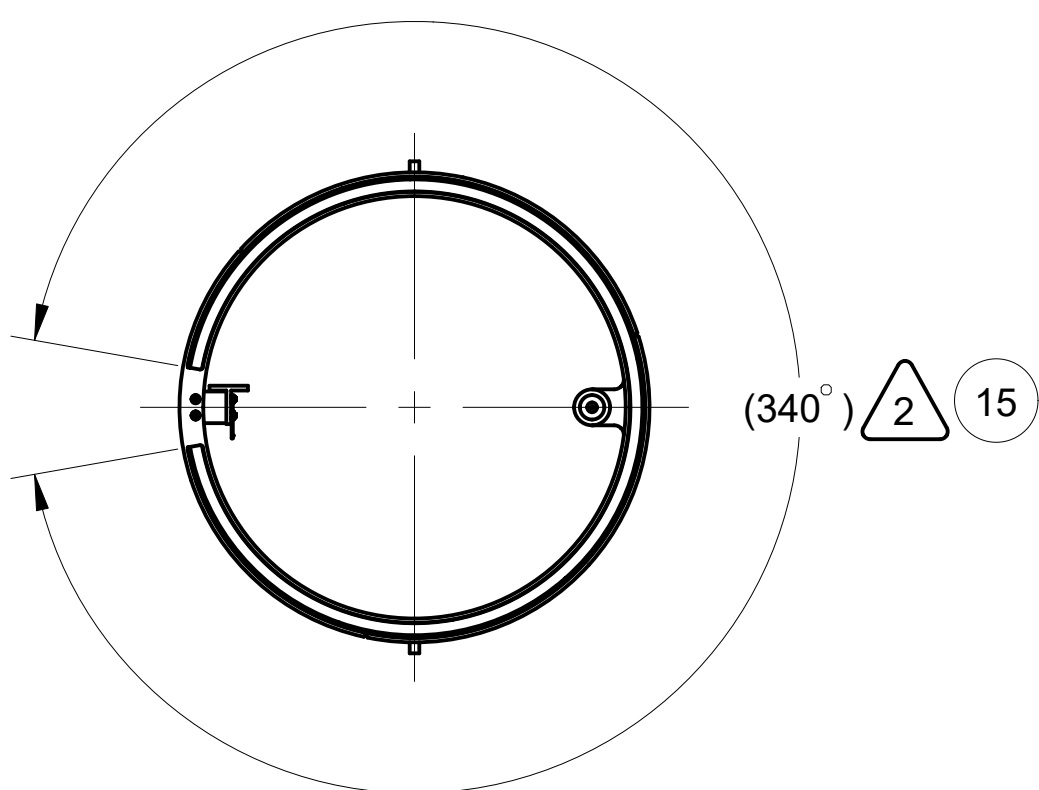
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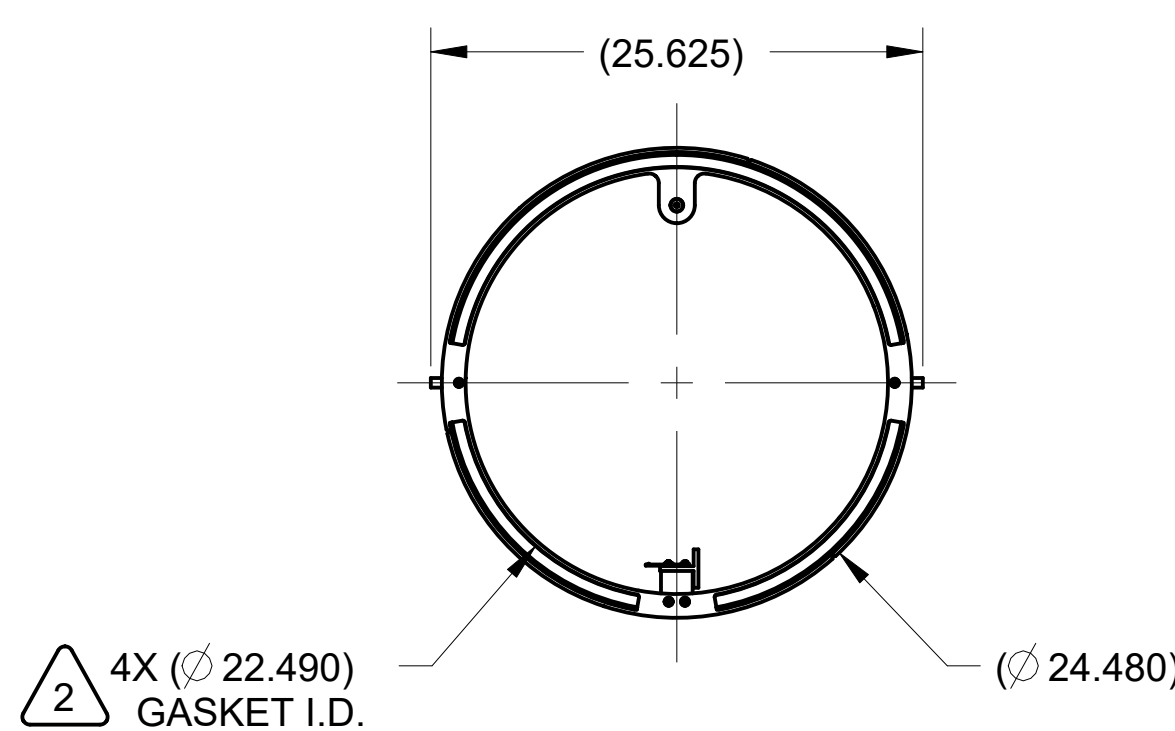
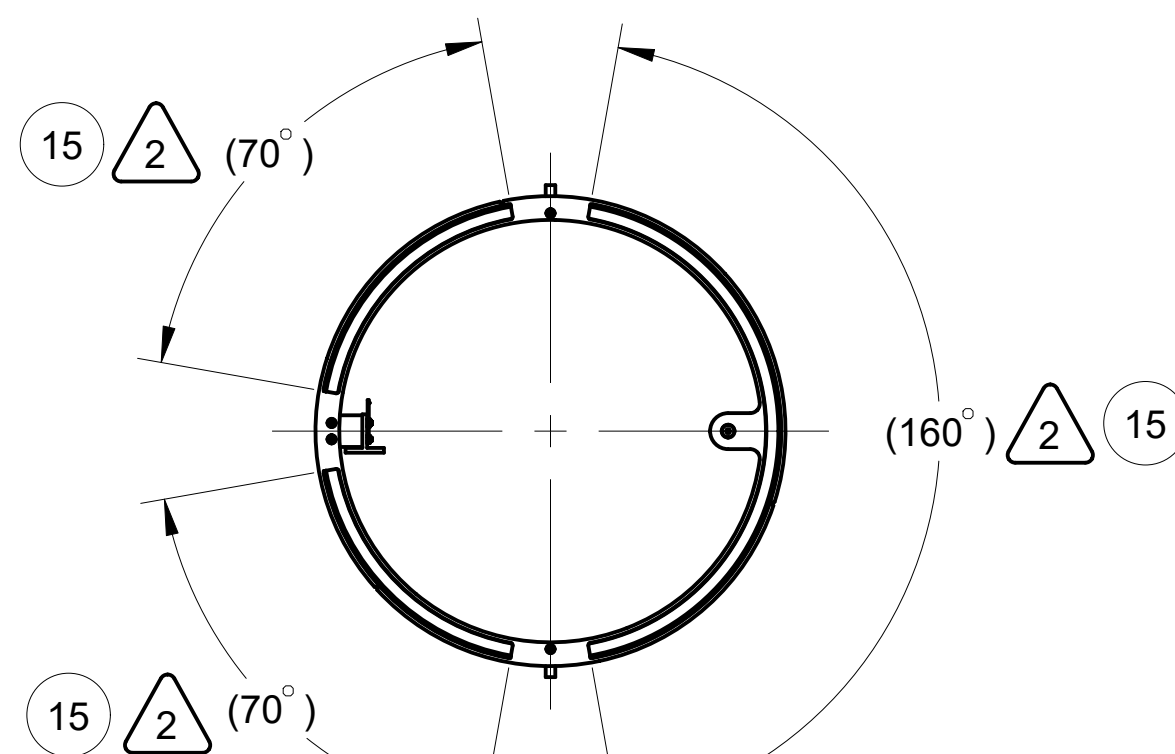
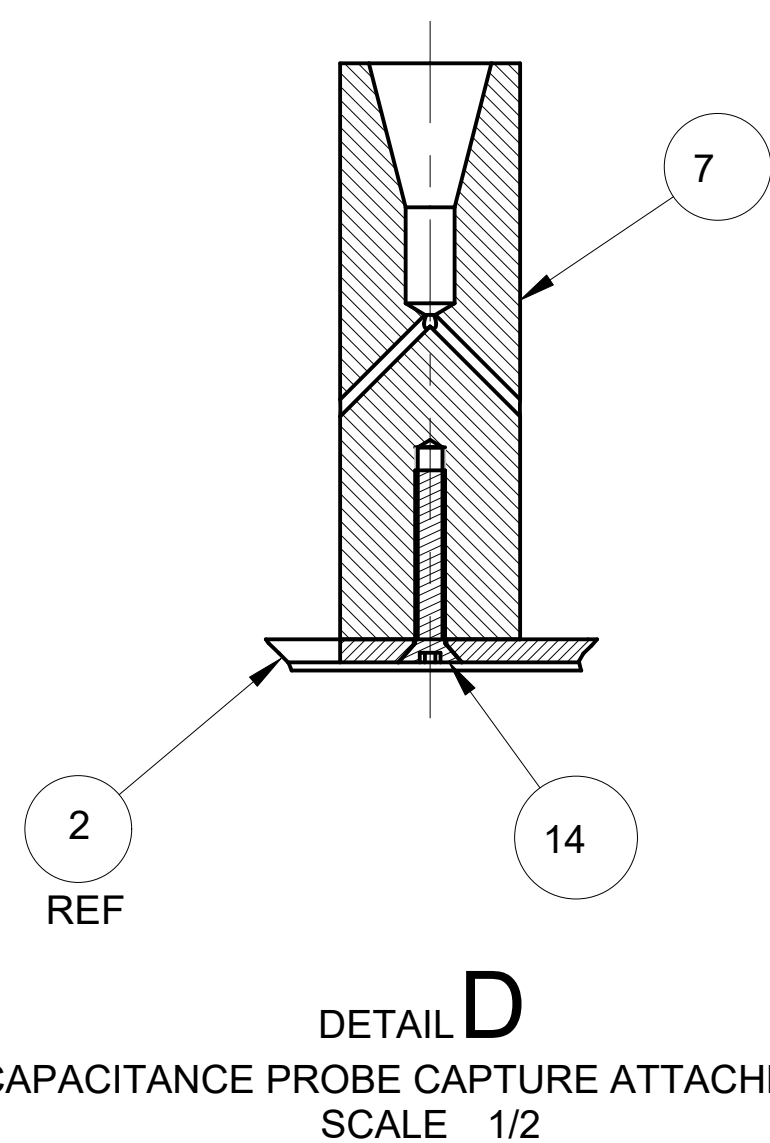
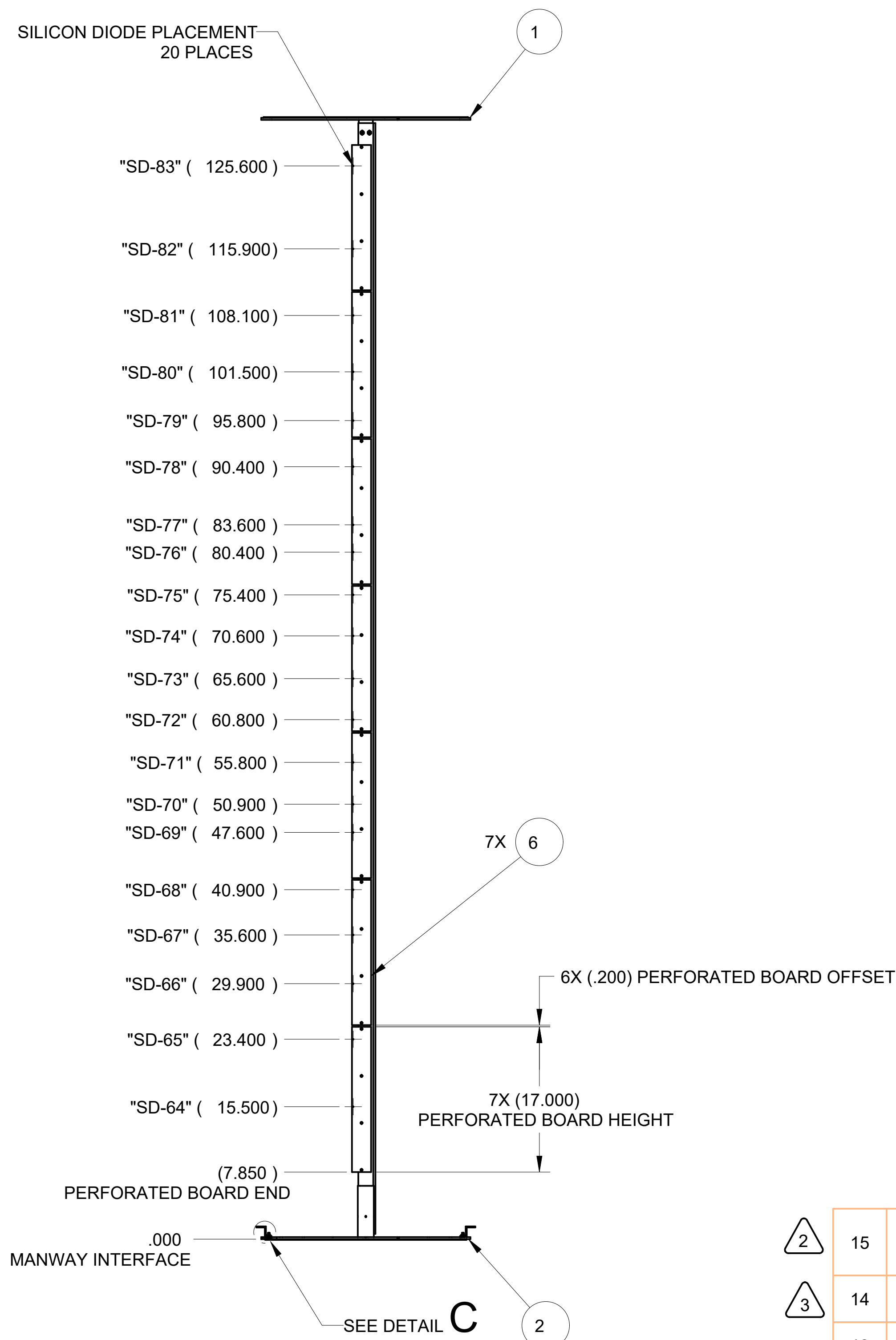
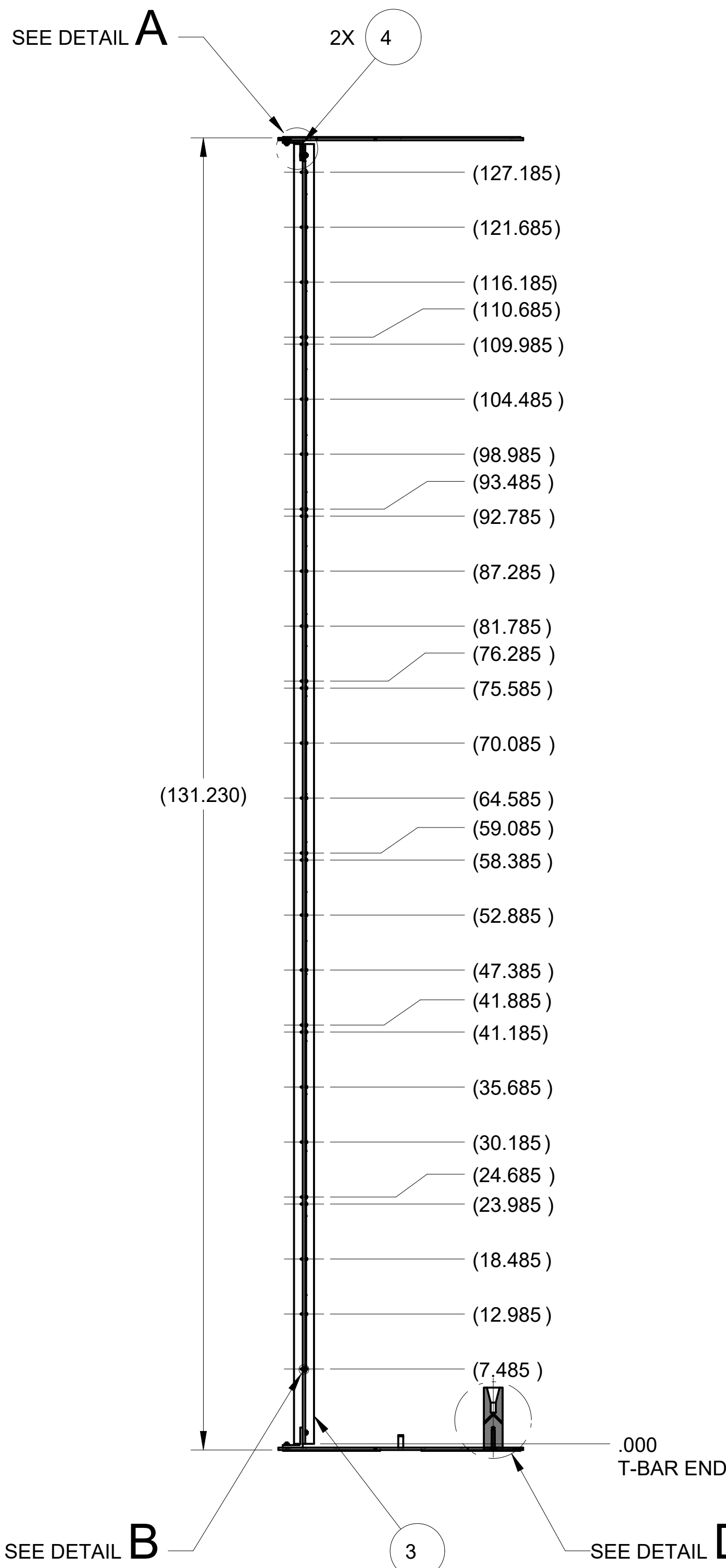
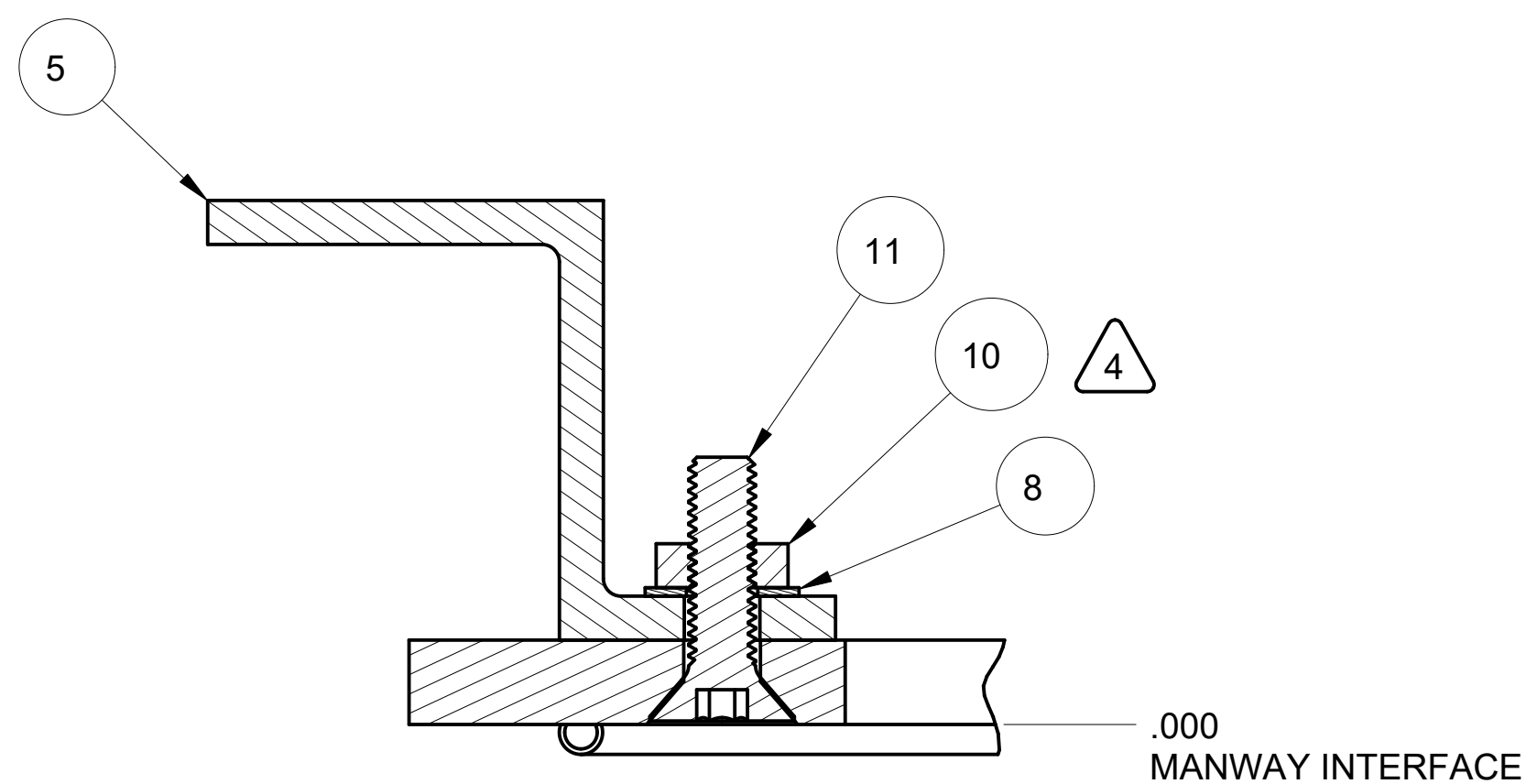
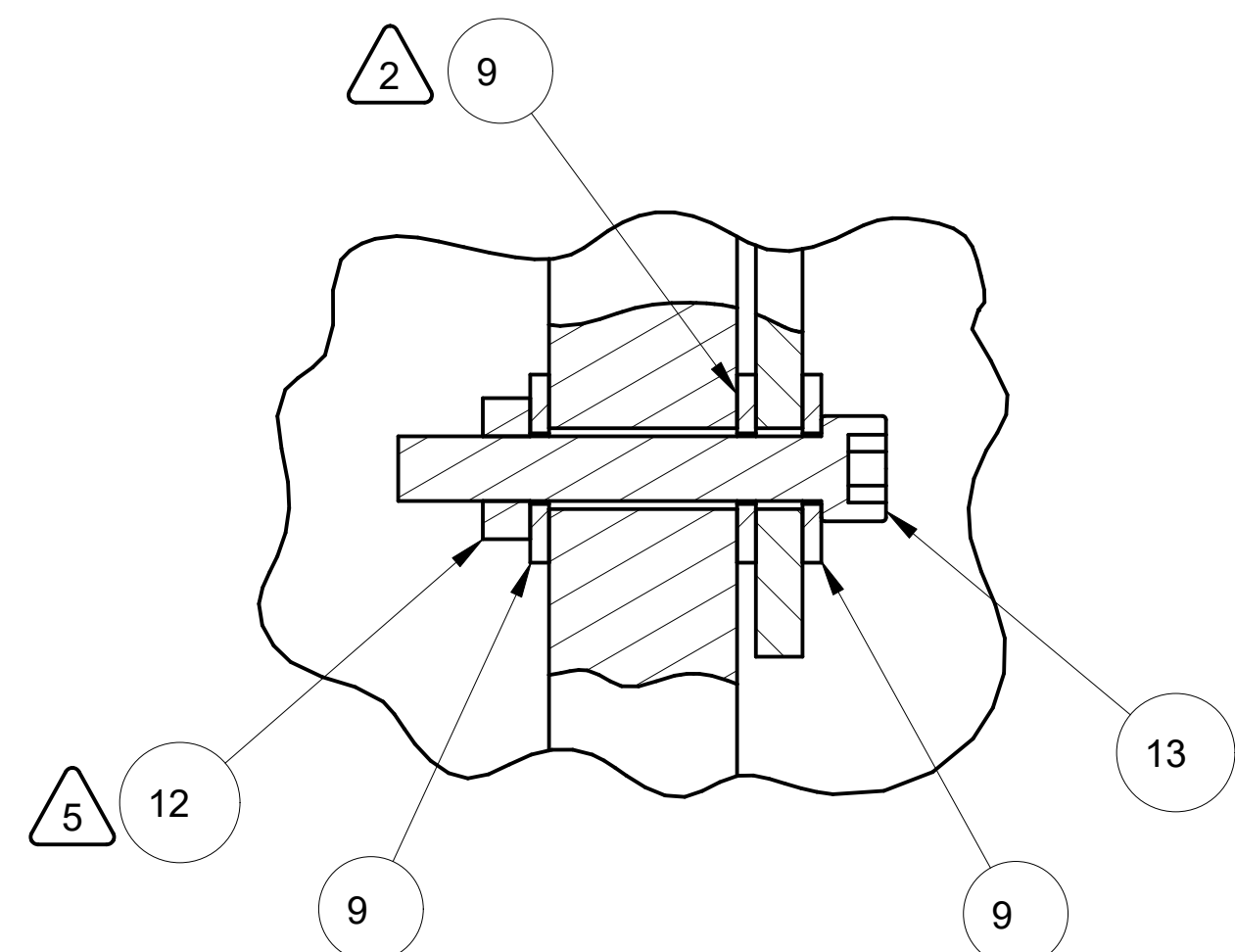
14 ³ / ₈ SD 64	= 7 ⁵ / ₈	From Bottom Part Board	5116643V
22 ³ / ₁₆ SD 65	= 7 ⁷ / ₈		5116649V
28 ⁵ / ₈ SD 66	= 6 ⁴ / ₈ or ¹ / ₂		5116645V
34 ³ / ₈ SD 67	= 5 ⁶ / ₈ or ³ / ₄		5116646V
39 ³ / ₄ SD 68	= 5 ³ / ₄		5116647V
46 ³ / ₈ SD 69	= 6 ⁵ / ₈ * close to ⁶ / ₈ or ³ / ₄ (5116665) ^{Damaged} (5116648)V		5116648V
49 ¹ / ₂ SD 70	= 3 ³ / ₄ or ¹ / ₄		5116649V
54 ⁷ / ₁₆ SD 71	= 4 ¹⁵ / ₁₆		5116650V
59 ³ / ₈ SD 72	= 4 ¹⁵ / ₁₆		5116651V
64 ³ / ₁₆ SD 73	= 4 ¹⁴ / ₁₆ or ⁷ / ₈		5116652V
70 ¹ / ₈ SD 74	= 4 ¹⁵ / ₁₆	75	5116653
79 ³ / ₄ SD 75	= 4 ¹⁴ / ₁₆ or ⁷ / ₈	(more up below 75 down 1)	5116654
83 SD 76	= 4 ¹⁵ / ₁₆		5116655
89 ³ / ₄ SD 77	= 3 ⁴ / ₁₆ or ¹ / ₄		5116656
95 ¹ / ₁₆ SD 78	= 6 ¹³ / ₁₆		5116657
100 ³ / ₄ SD 79	= 5 ⁵ / ₁₆		5116658
107 ¹ / ₄ SD 80	= 5 ⁴ / ₈ or ³ / ₄		5116659
115 ¹ / ₁₆ SD 81	= 6 ⁹ / ₁₆ or		5116660
124 ⁵ / ₈ SD 82	= 7 ¹⁴ / ₁₆ or ⁷ / ₈		5116661
SD 83	= 9 ¹⁰ / ₁₆ or ⁵ / ₈		5116662

NOTE: MEASUREMENTS FROM BOTTOM OF PREVIOUS SENSOR.

6. APPROXIMATE WEIGHT: 47.826 LBS.



TORQUE VALUES (IN-LBS)		REVISION HISTORY				
		ZONE	REV	DESCRIPTION	DATE	APPROVED
NO.		TIGHTENING TORQUE				
10		22 TO 26				
12		2 TO 4				



2	15	A/R		8103-0106-40	ULTRAFLEX KNITTED CONDUCTIVE GASKET, HOLLOW CORE ROUND WITH SINGLE FIN, 0.750" WIDE X 0.125" HIGH	LAIRD TECHNOLOGIES
3	14	1		90585A590	Ø .3125-18 UNC-3A X 2" LONG COUNTERSUNK SOCKET HEAD SCREW, 316 STAINLESS STEEL	MCMMASTER-CARR OR EQUIVALENT
4	13	28		92196A085	Ø .086-56 UNC-3A SOCKET HEAD CAP SCREW, 0.625" LONG, 18-8 SS	MCMMASTER-CARR OR EQUIVALENT
	12	28		91841A003	Ø .086-56 UNC-2B HEX NUT, 18-8 SS	MCMMASTER-CARR OR EQUIVALENT
4	11	10		90585A991	Ø .190-24 UNC-3A, 82" FLAT HEAD CAP SCREW, 316" LONG, 316 SS	MCMMASTER-CARR OR EQUIVALENT
	10	10		90257A011	Ø .190-24 UNC-2B HEX NUT, 316 SS	MCMMASTER-CARR OR EQUIVALENT
	9	84		92141A003	WASHER FOR #2 SCREW, 18-8 SS	MCMMASTER-CARR OR EQUIVALENT
	8	10		90107A011	WASHER FOR #10 SCREW, 316 SS	MCMMASTER-CARR OR EQUIVALENT
	7	1	1QFP5	150801MRA187	CAPACITANCE PROBE CAPTURE	
	6	7	1QFP5	150801MRA186	DIODE RAKE PERFORATED BOARD MODIFICATION	
	5	2	1QFP5	150801MRA185	DIODE RAKE Z-BRACKET	
	4	2	1QFP5	150801MRA184	DIODE RAKE ANGLE BRACKET	
3	1	1QFP5	150801MRA183	DIODE RAKE T-BAR		
2	1	1QFP5	150801MRA182	DIODE RAKE BOTTOM RING		
1	1	1QFP5	150801MRA181	DIODE RAKE TOP RING		

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES X.X ± 0.03 X.XXX ± 0.005 X.XX ± 0.01 ANGLE ± 0° 30' BREAK EDGES: 01-02		PARTS LIST RELEASE DATE 2018/08/10 MODEL LMP / H. HARRIS ENGINEER LSC / J. POWELL STATE Released WINDCHILL PRODUCT 448887 SHIVER CM Data MODEL 150801_INTERNAL_INST_STRUCTURE		 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION JOHN H. GLENN RESEARCH CENTER LEWIS FIELD, CLEVELAND, OHIO		
150801MRA000		SHIVER	INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M - 1994		TITLE INTERNAL STRUCTURE			
NEXT ASSY		USED ON	THIRD ANGLE PROJECTION		SIZE CAGE CODE DWG NO E 1QFP5 150801MRA180			
APPLICATION				REV -				
CONTRACTOR:								
CONTRACT NO:								

D

C

B

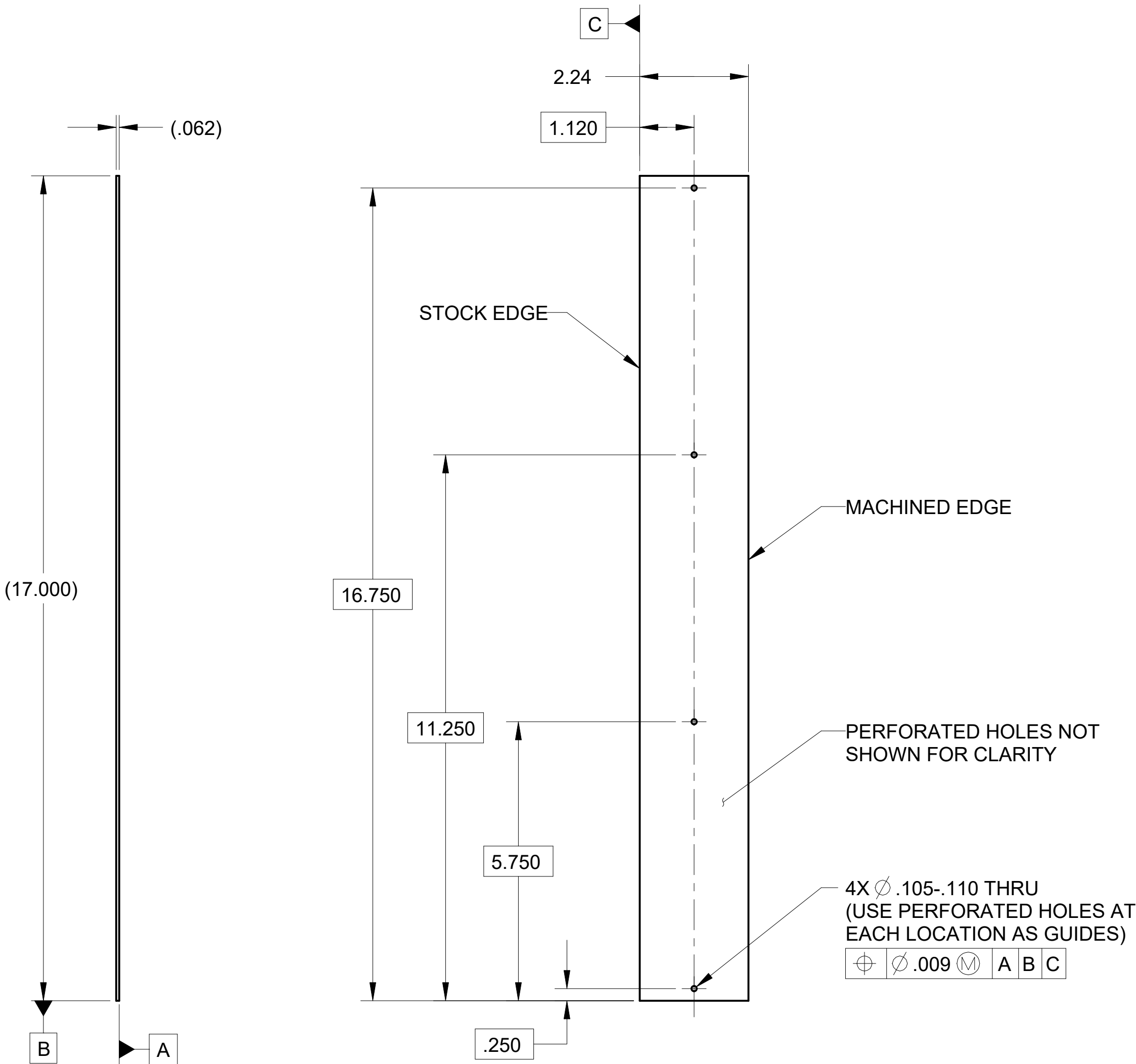
A

D

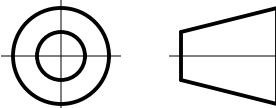
C

A

1. MATERIAL: MANUFACTURED FROM 17" X 4-1/2" X 1/16" THICK FR4 EPOXY GLASS PERFORATED BOARD, AS PROVIDED BY VECTOR ELECTRONICS AND TECHNOLOGY, INC.
2. IDENTIFY BY TAGGING WITH DRAWING PART NUMBER 150801MRA186, PER SAE-AS478, METHOD 35.
3. APPROXIMATE WEIGHT: 0.153 LBS.



ALTERATED PART DRAWING

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES X.X ± 0.03 X.XXX ± 0.005 X.XX ± 0.01 ANGLE ± 0° 30' BREAK EDGES: .01-.02	RELEASE DATE	2018/08/10	 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION JOHN H. GLENN RESEARCH CENTER LEWIS FIELD, CLEVELAND, OHIO	
			MODELER	LMP / H. HARRIS		
			ENGINEER	LSC / J. POWELL		
			STATE	Released		
150801MRA180	SHIIVER	INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M - 1994	TITLE DIODE RAKE PERFORATED BOARD MODIFICATION			
NEXT ASSY	USED ON					
APPLICATION		THIRD ANGLE PROJECTION	WINDCHILL PRODUCT			
CONTRACTOR:			448887 SHIIVER CM Data			
CONTRACT NO:			MODEL	SIZE C CAGE CODE 1QFP5 DWG NO 150801MRA186 REV -		
			150801MRA186_INST_PRFBRD		SCALE:	SHEET 1 OF 1

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED

DWG NO	150801MRA186	SH	1	REV	-
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