

ENGINEERING PRACTICE STUDY

TITLE: FIBER OPTIC SHOCK FIXTURES

18 January 2007

STUDY PROJECT 60GP-2006-019

FINAL REPORT

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Fiber Optic Group

Prepared by:

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I. OBJECTIVES: Develop shock fixture drawings and documentation for fiber optic connectors and cables. The final draft of the documentation will be used as guidelines to facilitate the use of standard test fixtures, test fixture setups, and requirements for qualification to fiber optic Defense standardization documents for FSC 60.

Drawings for component fixtures include the single channel MIL-C-83522 type ST connectors and adapters, multi-channel connectors including MIL-PRF-28876, MIL-DTL-38999, the proposed MIL-PRF-NGCon connector, and hermaphroditic connectors such as the Navy pier-side connector or MIL-PRF-83526. Fixture drawings are also included for large and small diameter fiber optic cables in accordance with MIL-PRF-85045. The MIL-I-24728 interconnection box fixture component requirements are also defined in this documentation.

The fixture drawings show details for connector mounting configurations as well as cable routing entry and exit of the fiber optic interconnecting box. The fixture drawings also include configurations to control the various mounting plates for the different multi-channel connectors and hardware associated with the standard fixture configurations.

II. BACKGROUND: The standard test fixture drawings were requested by U.S. Navy test personnel to document standard practices to ensure that various test facilities use common approaches to shock testing of fiber optic components.

III. RESULTS: Drawings and associated notes were developed and reviewed between DSCC-VAT and the Navy test lab at Philadelphia, PA. The drawings were sent to DSCC-VA drafting to formulate a final version after numerous details were refined. The drafting work was coordinated through the Navy lab before finalizing the requirements included in this study.

IV. CONCLUSIONS: This documentation will be used in conjunction with MIL-S-901 shock test requirements where specific mounting configurations and setups require additional detail to ensure a standard approach to shock testing. This information will become a part of the Optical Test Measurement Guidelines document.

V. RECOMMENDATIONS: This EP Study should be posted to the DSCC VA web site. This will ensure availability within DSCC as well as commercial vendors and test laboratories. It is anticipated that this information will be ultimately be published as part of the Optical Test Measurement Guide in a Defense standard such as MIL-STD-1678 or other document. Further consideration should be given to developing a DSCC Drawing for publication of this information.

Mechanical Shock

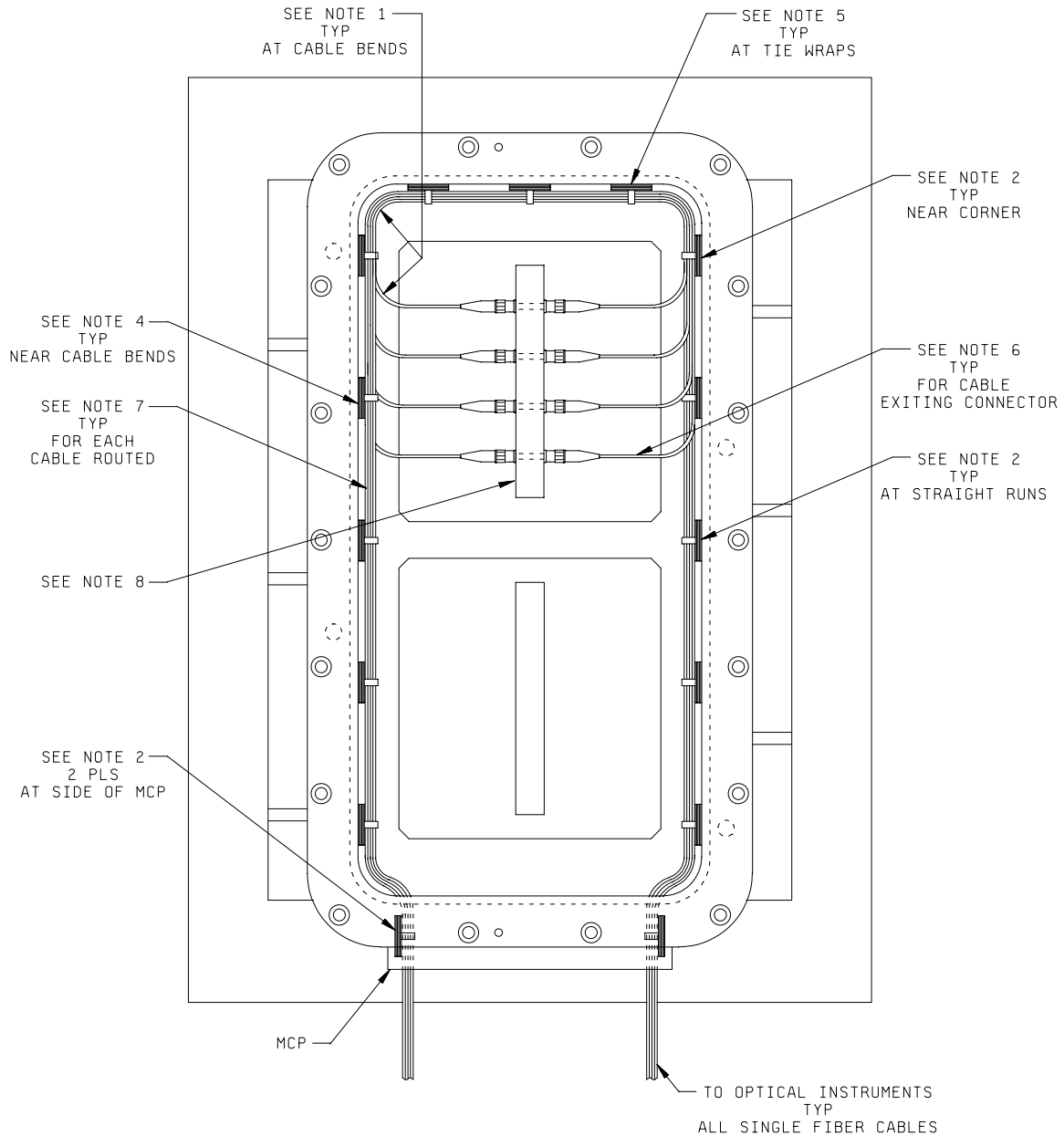


Figure 1: Supplemental test fixture with single ferrule connectors: cable routing and tie-downs.

Mechanical Shock

NOTES:

1. Maintenance of bend diameter. Each cable bend is not to exceed (be smaller than) the long term, minimum bend diameter of cable inside the interconnection box.
2. Mounting of tie wrap holders. On the inside of the interconnection box, tie wrap holders are to be placed as shown around the sides of the box. Place a tie wrap holder near the corners of the box, near cable bends and towards the middle for lengths of straight runs (about three on the top, four to five on both the left and right sides, and one on each side of the MCP). Tie wrap holders must be secured in place using epoxy. The adhesive on the tie wrap holder is not adequate to secure the tie wrap during the shock.
3. Type of tie wrap holder. Use the following type tie wrap holder or equivalent: Mounting base, tie down, electrical, Thomas & Betz P/N TC5347A. Four way configuration (versus two way) and with adhesive is optional.
4. Type of tie wrap. For most applications, 4-inch long tie wraps are used. SAE-AS33671 electrical tie down straps, adjustable, plastic, Type I, Class 1, miniature, 18 lb. minimum tensile strength (such as P/N MS3367-4-9, NSN 5975-00-727-5153 or P/N MS3367-4-0, NSN 5957-00-903-2284) or other equivalent commercial self-locking cable ties.
5. Degree of tightness. Tie wraps are to be snug so that movement of the cable is restricted, but tie wrap exerts no to minimum pressure on the cables.
6. Straighten cable at exit to connector. Cable that is exiting the connector is to be kept straight to maximum length practical before placement into the first bend while still maintaining requirement stated in note 1.
7. The cable from each single ferrule connector shall be routed within the interior, using tie wraps and tie wrap holders, such that each cable is routed at least three-quarters around the interior of the supplemental test fixture.
8. Patch panels, single ferrule connector supplemental fixture. A MIL-PRF-24728/6 patch panel (for an ST connector) or a MIL-PRF-24728/6 style patch panel (for other single terminus connectors) shall be mounted on the supplemental fixture standard mounting plate (see table below). The blank patch panel shall be used with the appropriate cutouts made for single ferrule connectors not listed. The appropriate adapter (such as a ST-to-ST adapter for a ST connector) shall be affixed to the patch panel.

Patch Panels for Shock Test Use

Description	CAGE Code	Part Number
ST-to-ST adapter patch panel per M24728/06-001	44291	11254-101
SC-to-SC adapter patch panel, 54 ports, M24728/1 to /3 compatible, without silk screened characters and with captive panel screws	44291	10909 MOD4
SC-to-SC adapter patch panel, 54 ports, M24728/1 to /3 compatible, with silk screened characters and with captive panel screws	44291	10914 MOD4
LC-to-LC adapter patch panel, 48 duplex ports, M24728/1 to /3 compatible, without silk screened characters and with captive panel screws	44291	10909 MOD7
LC-to-LC adapter patch panel, 48 duplex ports, M24728/1 to /3 compatible, with silk screened characters and with captive panel screws	44291	10914 MOD7
Patch panel, blank (without ports or silk screened characters), M24728/1 to /3 compatible, with captive panel screws (Note: user must machine in port configuration for connector being tested)	44291	

9. Dimensions are in inches.

Figure 1: Supplemental test fixture with single ferrule connectors: cable routing and tie-downs - Continued.

Mechanical Shock

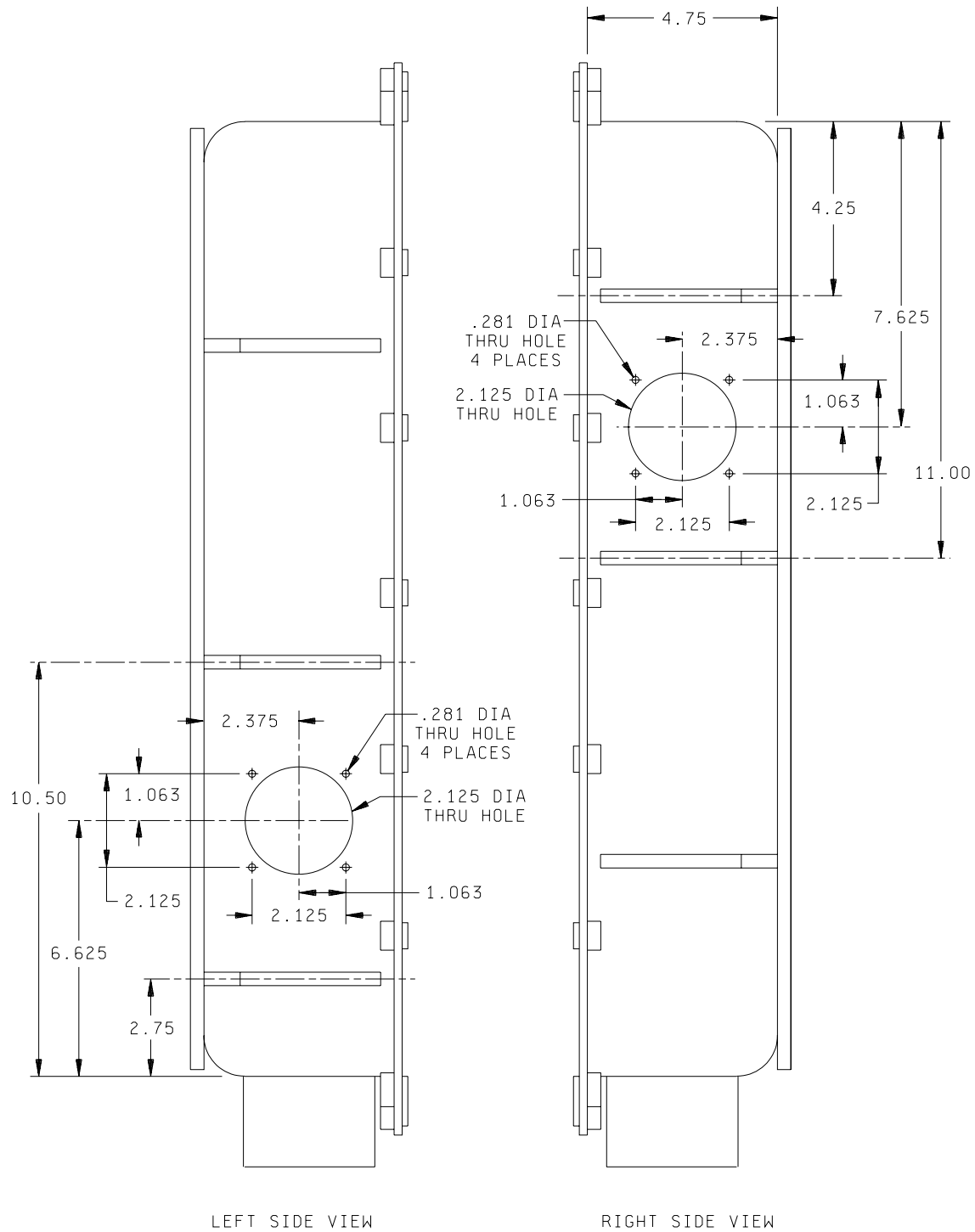
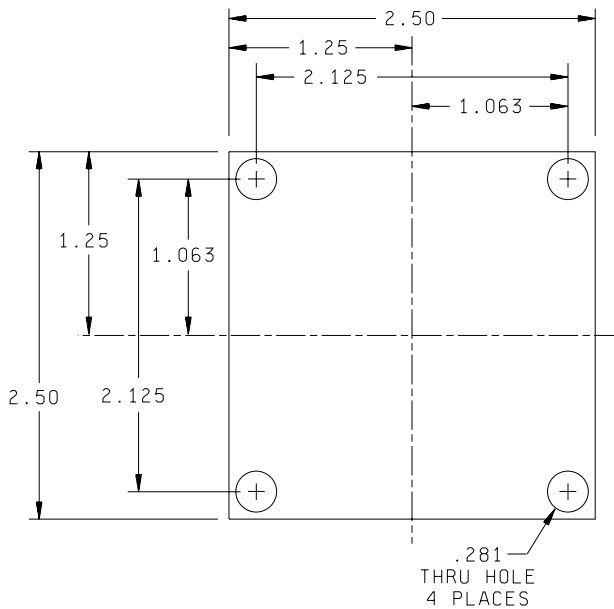


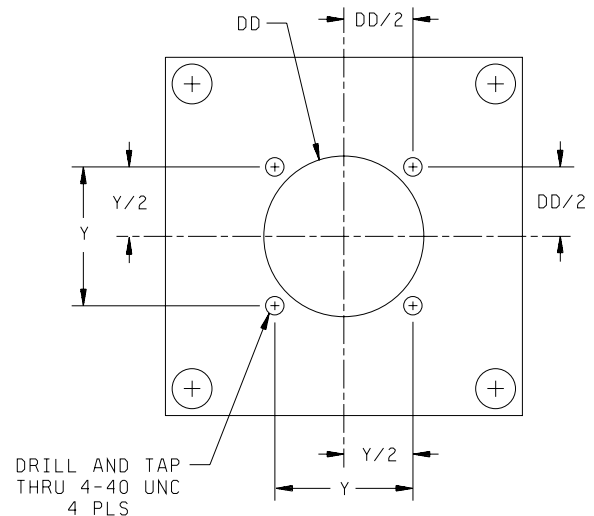
Figure 2: Mounting plate locations and plate configurations for multiple terminators supplemental test fixture.

Mechanical Shock



Master Adapter Plate
1/8inch steel

Inch	mm
0.281	7.14
1.063	27.00
1.25	31.75
2.125	53.98
2.375	60.36
2.50	63.50
2.75	69.85
4.25	107.95
6.625	168.28
7.625	193.68
10.50	266.70
11.00	279.40



MIL-PRF-28876 and MIL-PRF-NGCon
adapter plate. Use master adapter plate
for common dimensions & material

TABLE I. MIL-PRF-28876 and NGCon adapter
plate dimensions.

Shell Size	Y	DD dia +/- .010
11	0.750 (19.05)	0.812 (20.62)
13	0.843 (21.41)	0.937 (23.80)
15	0.968 (24.59)	1.124 (28.55)
23	1.281 (32.54)	1.562 (39.68)

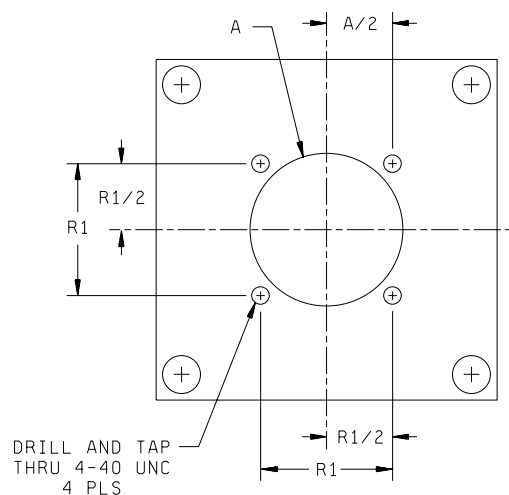
NOTES:

1. Adapter plates are used for affixing various multiple termini connectors to supplemental test fixture.
2. Dimensions are in inches.
3. Metric equivalents (mm) are in parenthesis.
4. Metric equivalents are given for general information only.

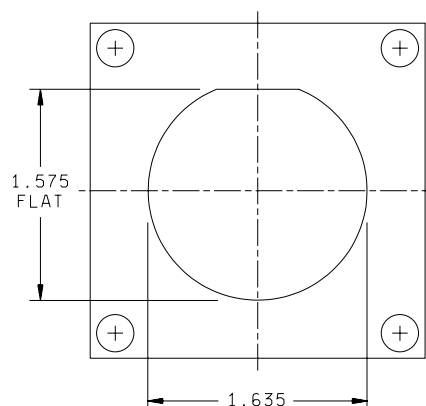
Detail A. Master plate and adapter plate configurations

Figure 2: Mounting plate locations and plate configurations for multiple termini connectors supplemental
test fixture - Continued.

Mechanical Shock



MIL-DTL-38999 connector adapter plate
Use master adapter plate for
common dimensions & material



Hermaphroditic connector adapter plate
Use master adapter plate for
common dimensions & material

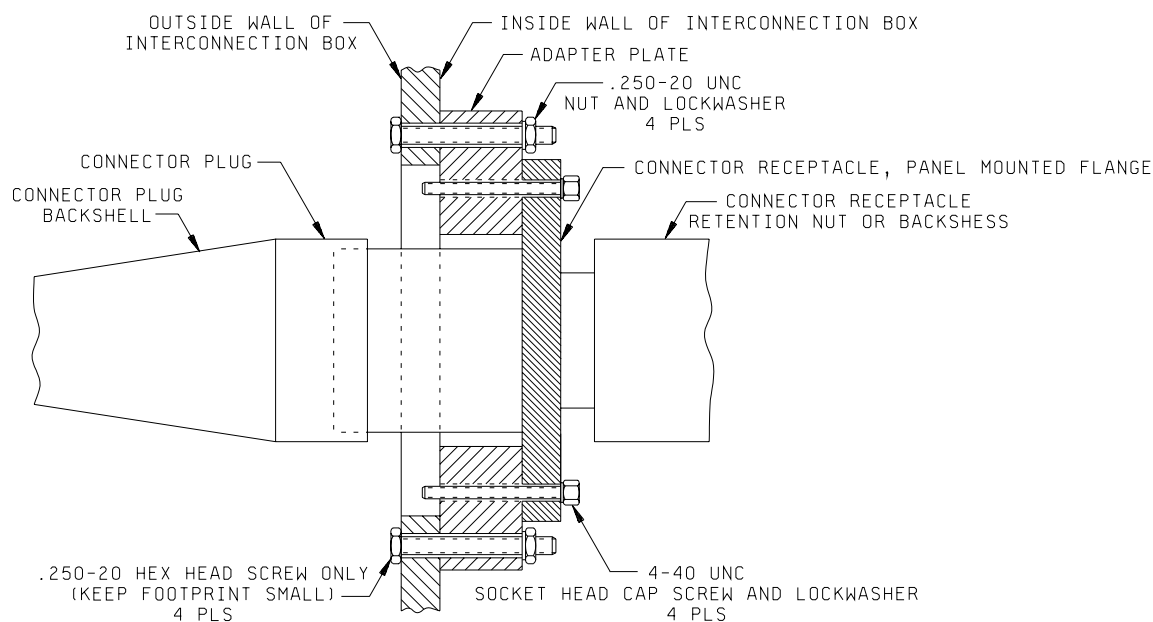
TABLE II. MIL-DTL-38999 adapter
plate dimensions.

Shell size	A	R1
09	.656 (16.66)	.719 (18.26)
11	.796 (20.22)	.812 (20.62)
13	.922 (23.42)	.906 (23.01)
15	1.047 (26.59)	.969 (24.61)
17	1.219 (30.96)	1.062 (26.97)
19	1.297 (32.94)	1.156 (29.36)
21	1.422 (36.12)	1.250 (31.75)
23	1.547 (39.29)	1.375 (34.93)
25	1.672 (42.47)	1.500 (38.10)

Detail A. Master plate and adapter plate configurations - Continued

Figure 2: Mounting plate locations and plate configurations for multiple termini connectors supplemental
test fixture - Continued.

Mechanical Shock



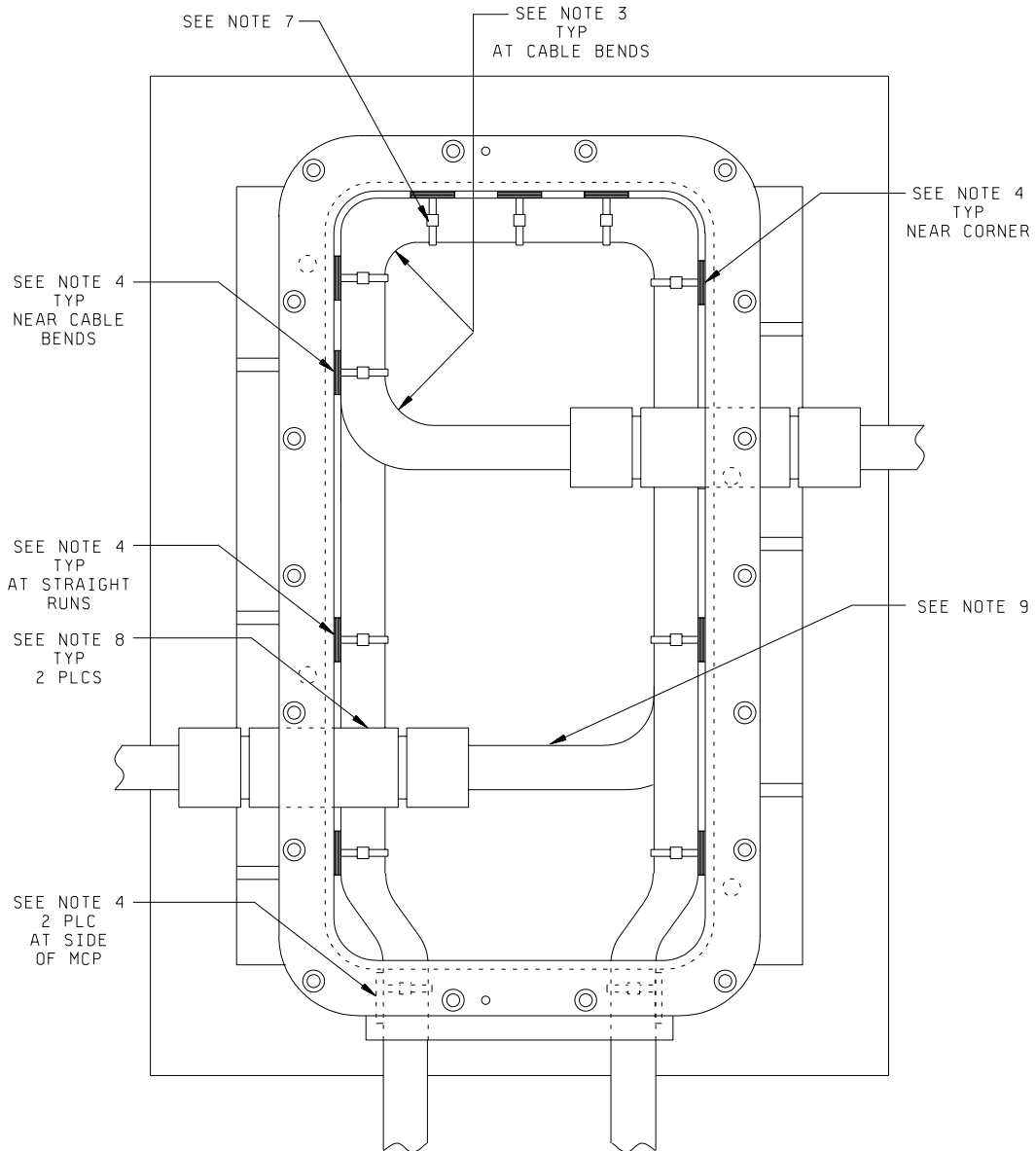
NOTES:

1. This detail shows the configuration to mount the applicable adapter plate to a multiple termin connector, and mounting the connector with adapter plate to the supplemental test fixture (i.e., side of the interconnection box).
2. Verify hardware used and direction hardware mounted are in accordance with this detail.
3. For tightening connector plug to connector receptacle with a strap wrench, keep hardware footprint small on the outside of the interconnection box.

Detail B. Master Adapter Plate Mounting to IC Box fixture

Figure 2: Mounting plate locations and plate configurations for multiple termini connectors supplemental test fixture - Continued.

Mechanical Shock



See Note 1

Figure 3: Supplemental test fixture with multiple terminus connectors: cable routing and tie-downs, smaller cable diameter.

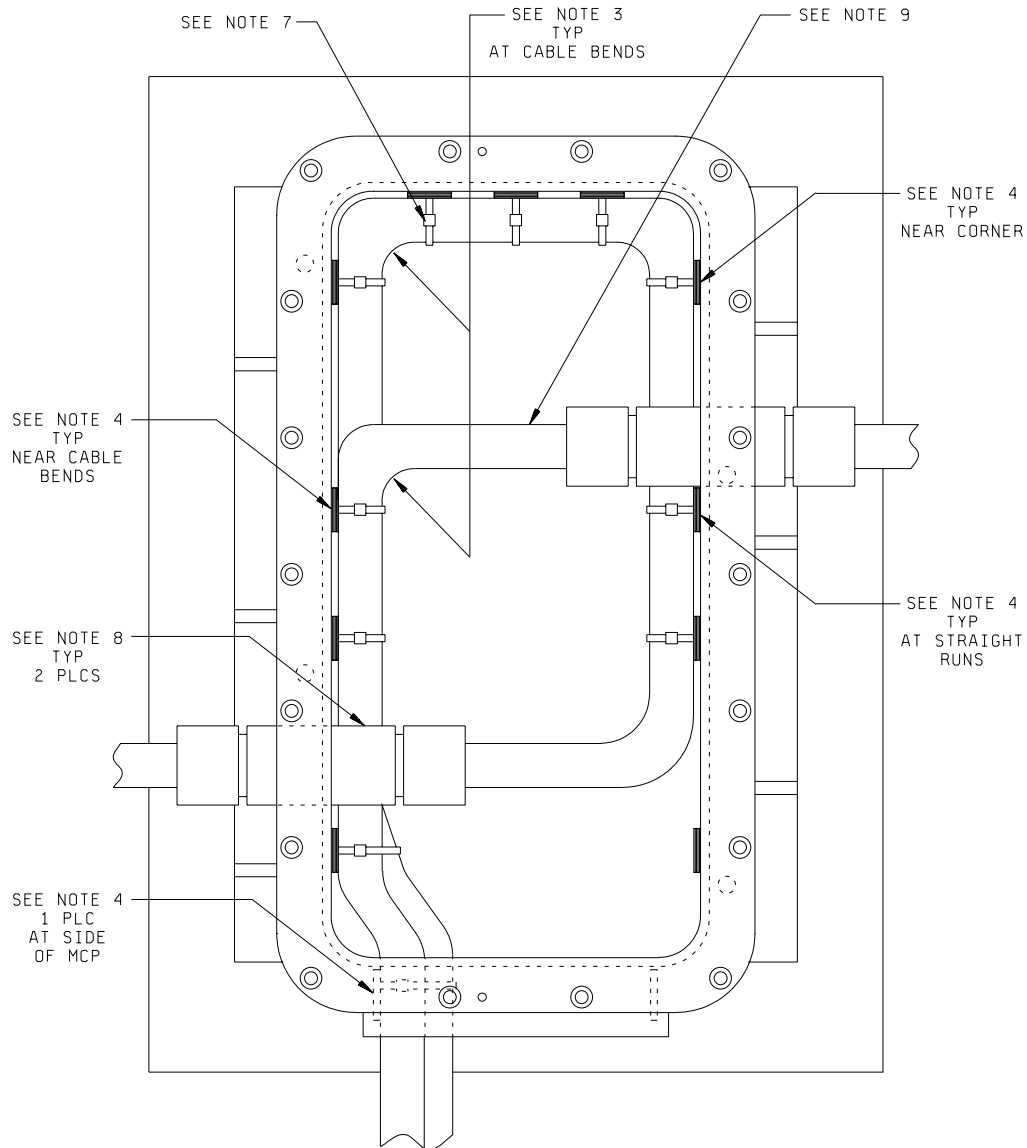
Mechanical Shock

NOTES:

1. Test fixture applicability. If $13.5 - B \leq 3$ where "B" is in inches, use supplemental test fixture in Figure 4 (See note 2).
2. Bend diameter. B = Long term, minimum bend diameter of cable under test.
3. Maintenance of bend diameter. Each cable bend is not to exceed (be smaller than) the long term, minimum bend diameter of cable inside the interconnection box.
4. Mounting of tie wrap holders. On the inside of the interconnection box, tie wrap holders are to be placed as shown around the sides of the box. Place a tie wrap holder near the corners of the box, near cable bends and towards the middle for lengths of straight runs (about three on the top, four to five on both the left and right sides and one on each side of the MCP). Tie wrap holders must be secured in place using epoxy. The adhesive on the tie wrap holder is not adequate to secure the tie wrap during the shock.
5. Type of tie wrap holder. Use the following type tie wrap holder or equivalent: Mounting base, tie down, electrical, Thomas & Bettz P/N TC5347A. Four way configuration (versus two way) and with adhesive are optional.
6. Type of tie wrap. For most applications, 4-inch long tie wraps are used. SAE-AS33671 electrical tie down straps, adjustable, plastic, Type I, Class 1, miniature, 18 lb. minimum tensile strength (such as P/N MS3367-4-9, NSN 5975-00-727-5153 or P/N MS3367-4-0, NSN 5957-00-903-2284) or other equivalent commercial self-locking cable ties.
7. Degree of tightness. Tie wraps are to be snug so that movement of the cable is restricted, but tie wrap exerts no to minimum pressure on the cables.
8. Connector receptacle mounted to side from inside the interconnection box.
9. Straighten cable at exit to connector. Cable that is exiting the connector is to be kept straight to maximum length practical before placement into the first bend while still maintaining requirement stated in note 3.
10. Dimensions are in inches.

Figure 3: Supplemental test fixture with multiple terminus connectors: cable routing and tie-downs, smaller cable diameter - Continued.

Mechanical Shock



See Note 1

Figure 4: Supplemental test fixture with multiple terminus connectors: cable routing and tie-downs, larger cable diameter.

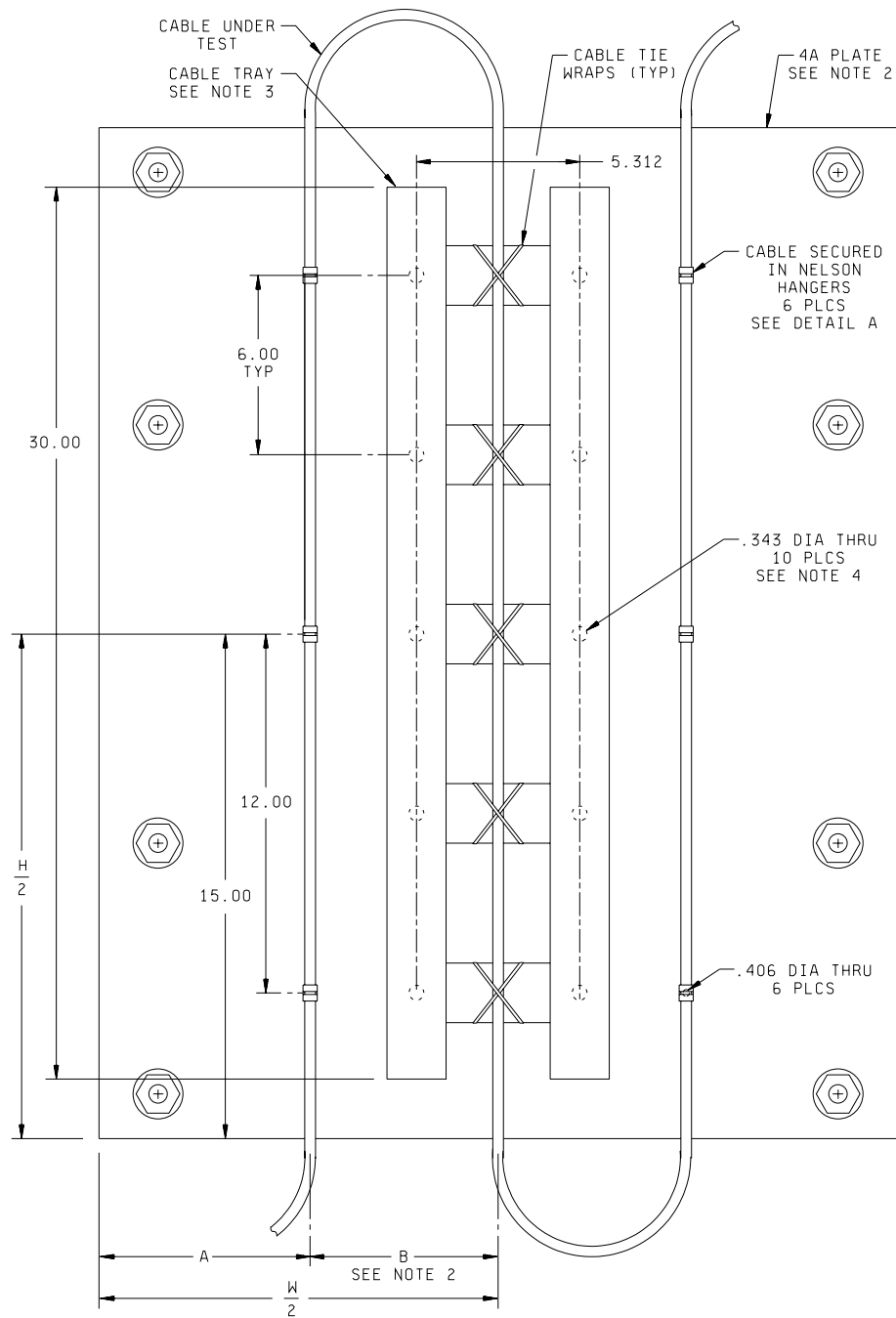
Mechanical Shock

NOTES:

1. Test fixture applicability. If $13.5 - B > 3$ where "B" is in inches, use supplemental test fixture in Figure 3 (See note 2).
2. Bend diameter. B = Long term, minimum bend diameter of cable under test.
3. Maintenance of bend diameter. Each cable bend is not to exceed (be smaller than) the long term, minimum bend diameter of cable inside the interconnection box.
4. Mounting of tie wrap holders. On the inside of the interconnection box, tie wrap holders are to be placed as shown around the sides of the box. Place a tie wrap holder near the corners of the box, near cable bends and towards the middle for lengths of straight runs (about three on the top, four to five on both the left and right sides and one on each side of the MCP). Tie wrap holders must be secured in place using epoxy. The adhesive on the tie wrap holder is not adequate to secure the tie wrap during the shock.
5. Type of tie wrap holder. Use the following type tie wrap holder or equivalent: Mounting base, tie down, electrical, Thomas & Betz P/N TC5347A. Four way configuration (versus two way) and with adhesive are optional.
6. Type of tie wrap. For most applications, 4-inch long tie wraps are used. SAE-AS33671 electrical tie down straps, adjustable, plastic, Type I, Class 1, miniature, 18 lb. minimum tensile strength (such as P/N MS3367-4-9, NSN 5975-00-727-5153 or P/N MS3367-4-0, NSN 5957-00-903-2284) or other equivalent commercial self-locking cable ties.
7. Degree of tightness. Tie wraps are to be snug so that movement of the cable is restricted, but tie wrap exerts no to minimum pressure on the cables.
8. Connector receptacle mounted to side from inside the interconnection box.
9. Straighten cable at exit to connector. Cable that is exiting the connector is to be kept straight to maximum length practical before placement into the first bend while still maintaining requirement stated in note 3.
10. Dimensions are in inches.

Figure 4: Supplemental test fixture with multiple terminus connectors: cable routing and tie-downs, larger cable diameter - Continued.

Mechanical Shock



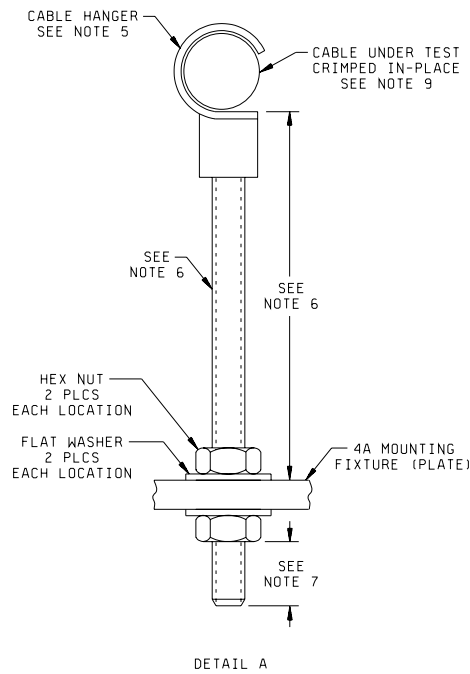
See Note 1

Figure 5: Supplemental Test Fixture For Cable of Small Diameter.

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NOTES:

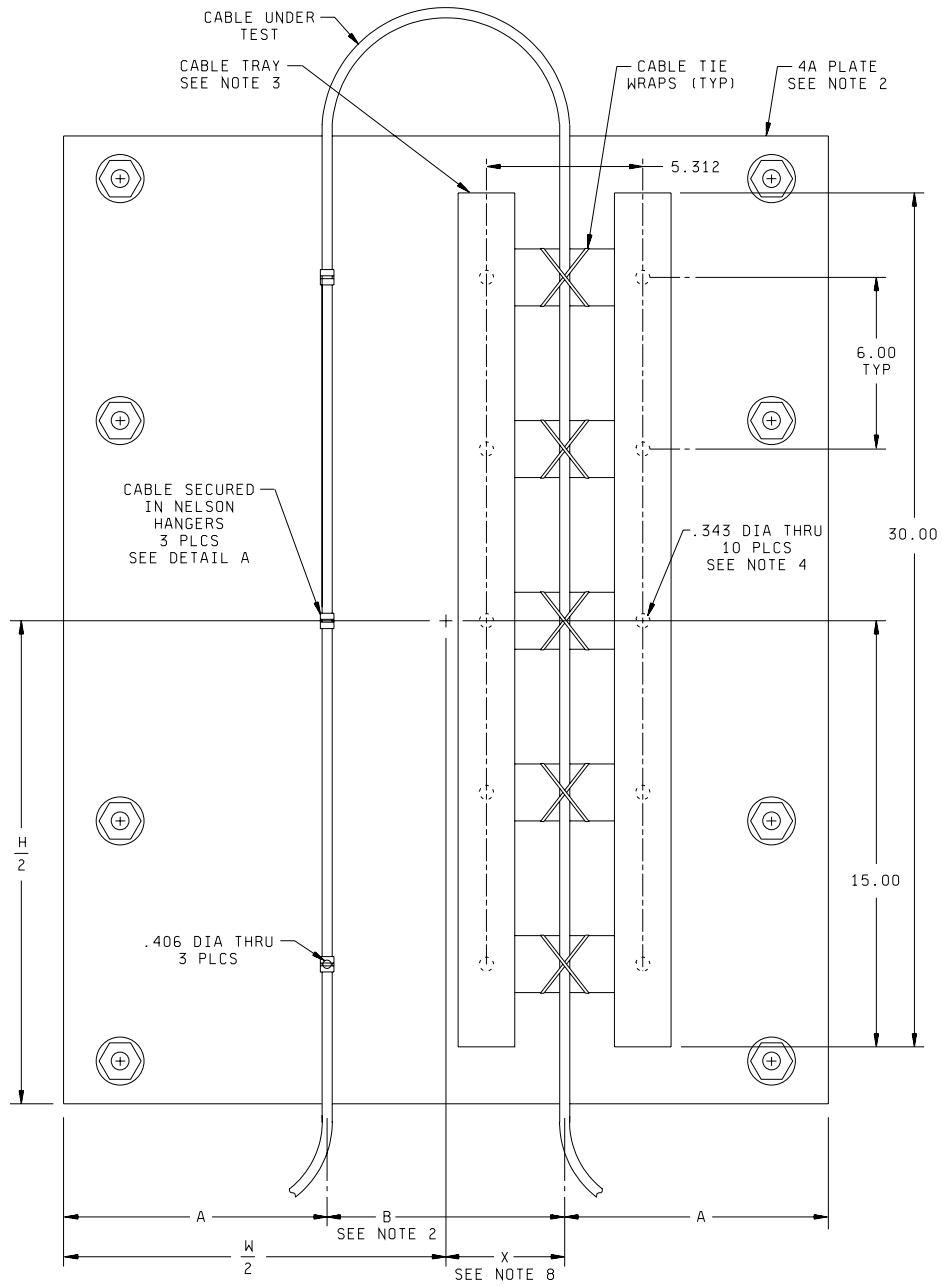
1. If $W/2 - B \leq 3$, use supplemental test fixture in Figure 6 (See note 2).
2. B = Long term, minimum bend diameter of cable under test. W = 27 inch, using 4A mounting fixture (plate) with standard width per MIL-S-901.
3. Metallic cable tray system, straight section, 3 inch NEMA/4.20 inch outside, 9 inch rung spacing, 12 inch width, aluminum, Cooper B-Line Product Catalog # 34A09-12-240 (where 240 is for 20 ft section) or equivalent cable tray.
4. Cable tray mounting holes. Minimum size to be used for mounting hardware is 5/16 diameter.
5. Single cable hanger, Nelson CrimpLoc style, Nelson Stud Welding, Inc. Part # SL091AA-TXL where AA is to be replaced by the designators for the applicable cable diameter or equivalent single cable hanger.
6. Use 3/8-16 all-thread (B7 or B16) for raising the single cable hanger to the same height as the cable tray, typically 4-1/8 inch for dimension shown. See detail A for installation.
7. Protruding thread length, 3 threads minimum.
8. Dimensions are in inches.
9. Degree of tightness: Cable shall be crimped into cable hanger in a manner that the cable is snug (movement restricted, but cable hanger exerts no to minimum pressure on the cable). Additional guidance may be obtained in DoD-STD-2003-4 (such as Figure 4C7).
10. Recommended cable hanger crimping instructions. Use channel-lock pliers to compress the clip portion of the cable hanger. Start by gripping both the tip (i.e., the open end or the fingers) and the base of the cable clamp with the channel-lock pliers – squeeze pliers to close the hanger until it contacts the cable jacket. Then, use the pliers as necessary to close/form the fingers so that the hanger conforms to the cable outside diameter and clamps evenly around the circumference without crushing the cable jacket. Degree of tightness to achieve is stated in note 9.



Detail A . Nelson hanger for cable test setup.

Figure 5: Supplemental Test Fixture For Cable of Small Diameter – Continued.

Mechanical Shock



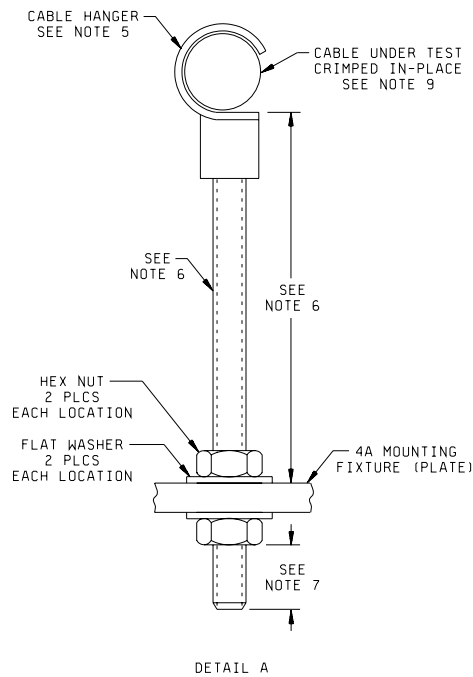
See Note 1

Figure 6: Supplemental Test Fixture For Cable of Larger Diameter

Mechanical Shock

NOTES:

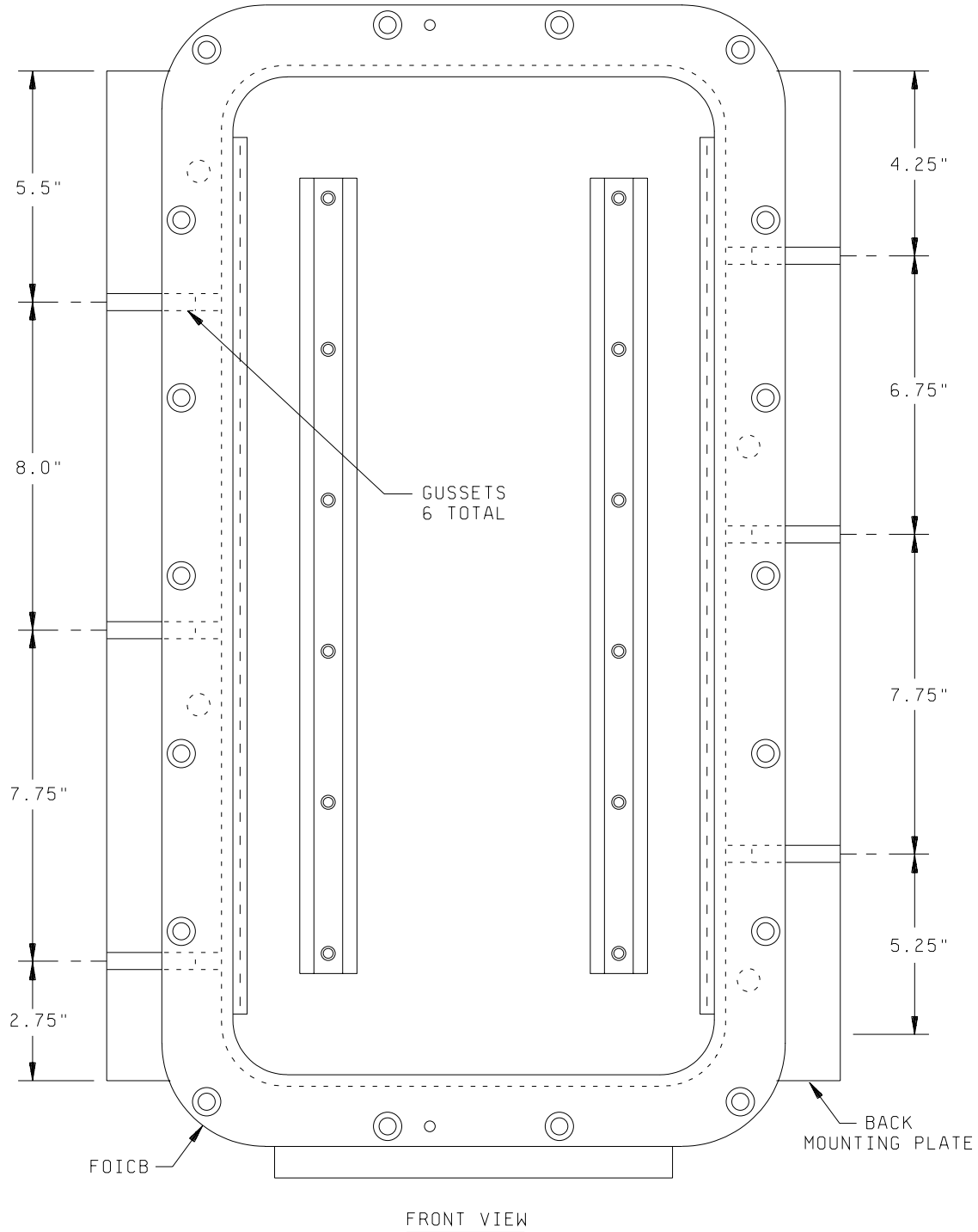
1. If $W/2 - B > 3$, use supplemental test fixture in Figure 5 (See note 2).
2. B = Long term, minimum bend diameter of cable under test. $W = 27$ inch, using 4A mounting fixture (plate) with standard width per MIL-S-901.
3. Metallic cable tray system, straight section, 3 inch NEMA/4.20 inch outside, 9 inch rung spacing, 12 inch width, aluminum, Cooper B-Line Product Catalog # 34A09-12-240 (where 240 is for 20 ft section) or equivalent cable tray.
4. Cable tray mounting holes. Minimum size to be used for mounting hardware is 5/16 diameter.
5. Single cable hanger, Nelson CrimpLoc style, Nelson Stud Welding, Inc. Part # SL091AA-TXL where AA is to be replaced by the designators for the applicable cable diameter or equivalent single cable hanger.
6. Use 3/8-16 all-thread (B7 or B16) for raising the single cable hanger to the same height as the raceway, typically 4-1/8 inch for dimension shown. See detail A for installation.
7. Protruding thread length, 3 threads minimum.
8. Center dimension B on vertical centerline of the 4A plate so that $W = B + 2A$ (See note 2).
9. Degree of tightness: Cable shall be crimped into cable hanger in a manner that the cable is snug (movement restricted, but cable hanger exerts no to minimum pressure on the cable). Additional guidance may be obtained in DoD-STD-2003-4 (such as Figure 4C7).
10. Recommended cable hanger crimping instructions. Use channel-lock pliers to compress the clip portion of the cable hanger. Start by gripping both the tip (i.e., the open end or the fingers) and the base of the cable clamp with the channel-lock pliers – squeeze pliers to close the hanger until it contacts the cable jacket. Then, use the pliers as necessary to close/form the fingers so that the hanger conforms to the cable outside diameter and clamps evenly around the circumference without crushing the cable jacket. Degree of tightness to achieve is stated in note 9.
11. Dimensions are in inches.



Detail A . Nelson hanger for cable test setup.

Figure 6: Supplemental Test Fixture For Cable of Larger Diameter – Continued.

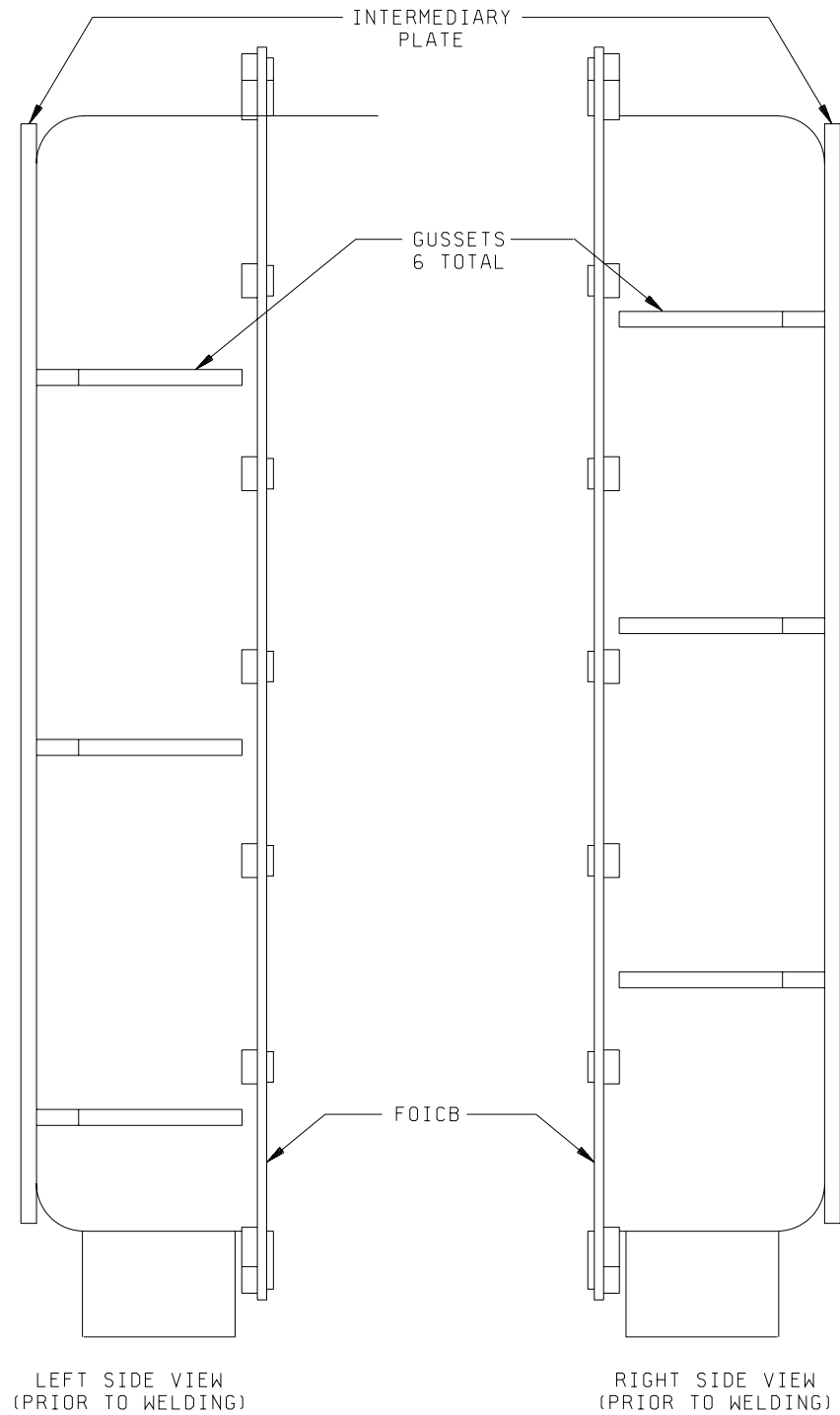
Mechanical Shock



Front view

Figure 7. Supplemental fixture for connectors, fabrication drawing.

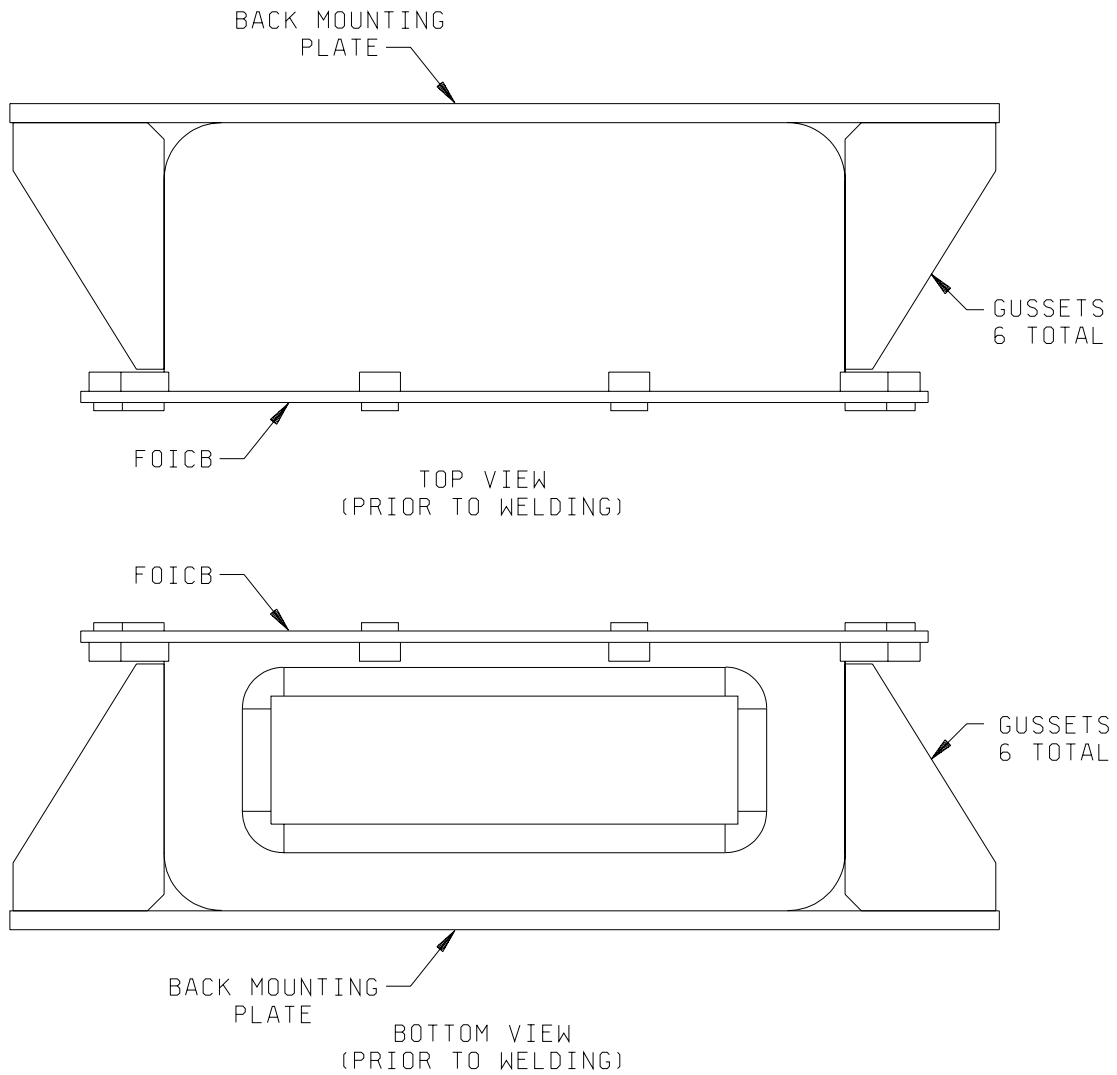
Mechanical Shock



Left and right view prior to welding

Figure 7. Supplemental fixture for connectors, fabrication drawing - Continued.

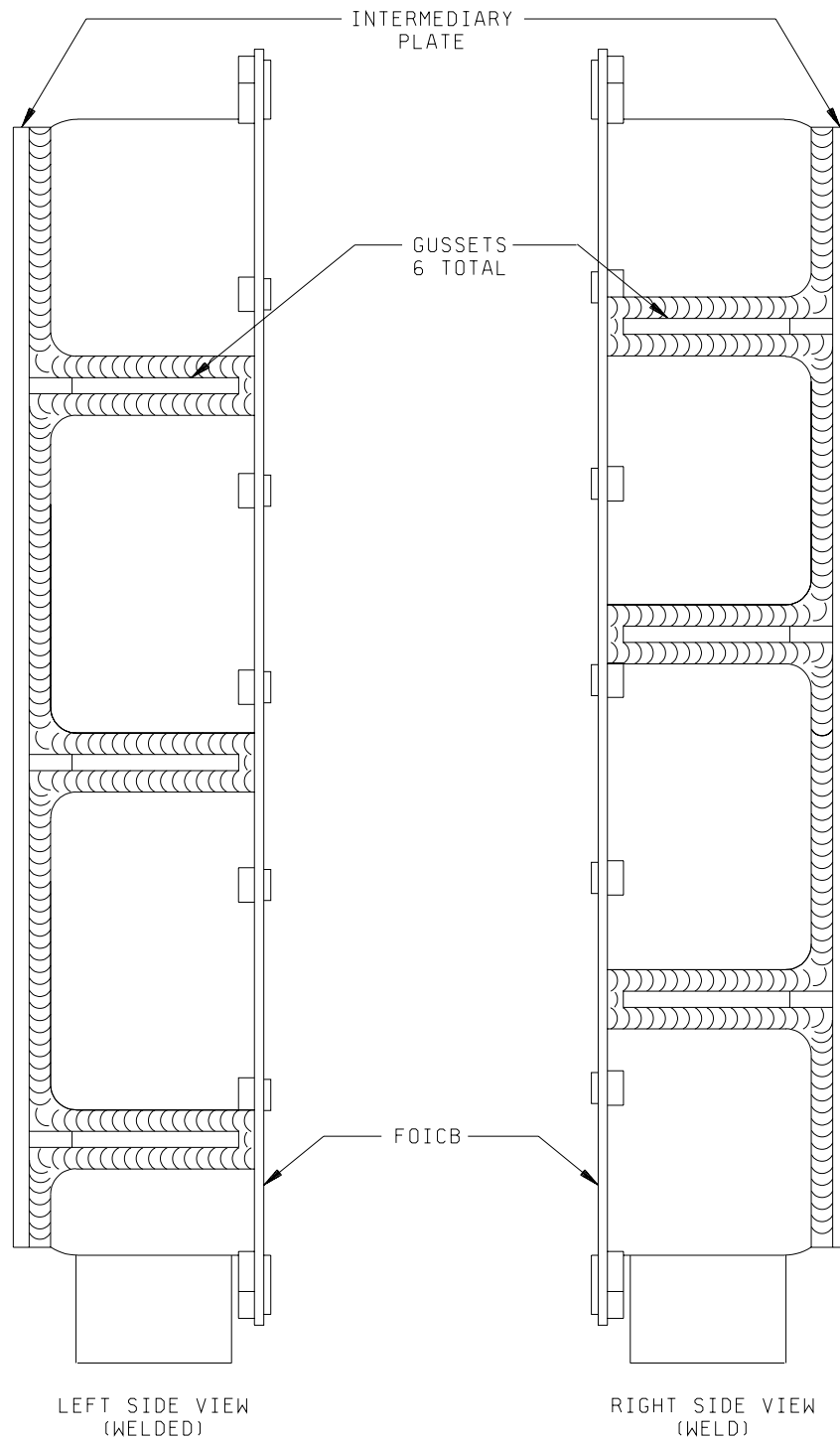
Mechanical Shock



Top and bottom view prior to welding

Figure 7. Supplemental fixture for connectors, fabrication drawing - Continued.

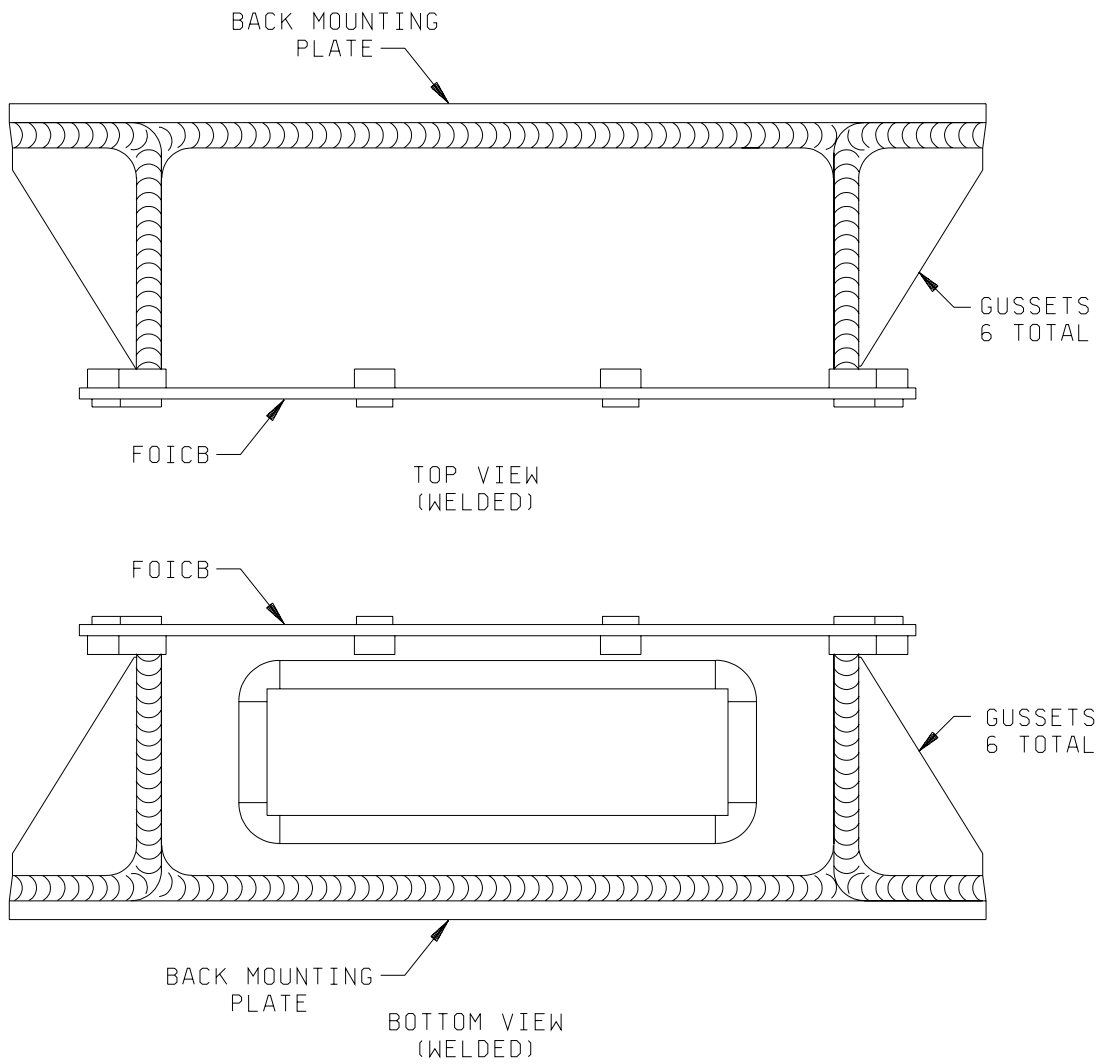
Mechanical Shock



Left and right view welded

Figure 7. Supplemental fixture for connectors, fabrication drawing - Continued.

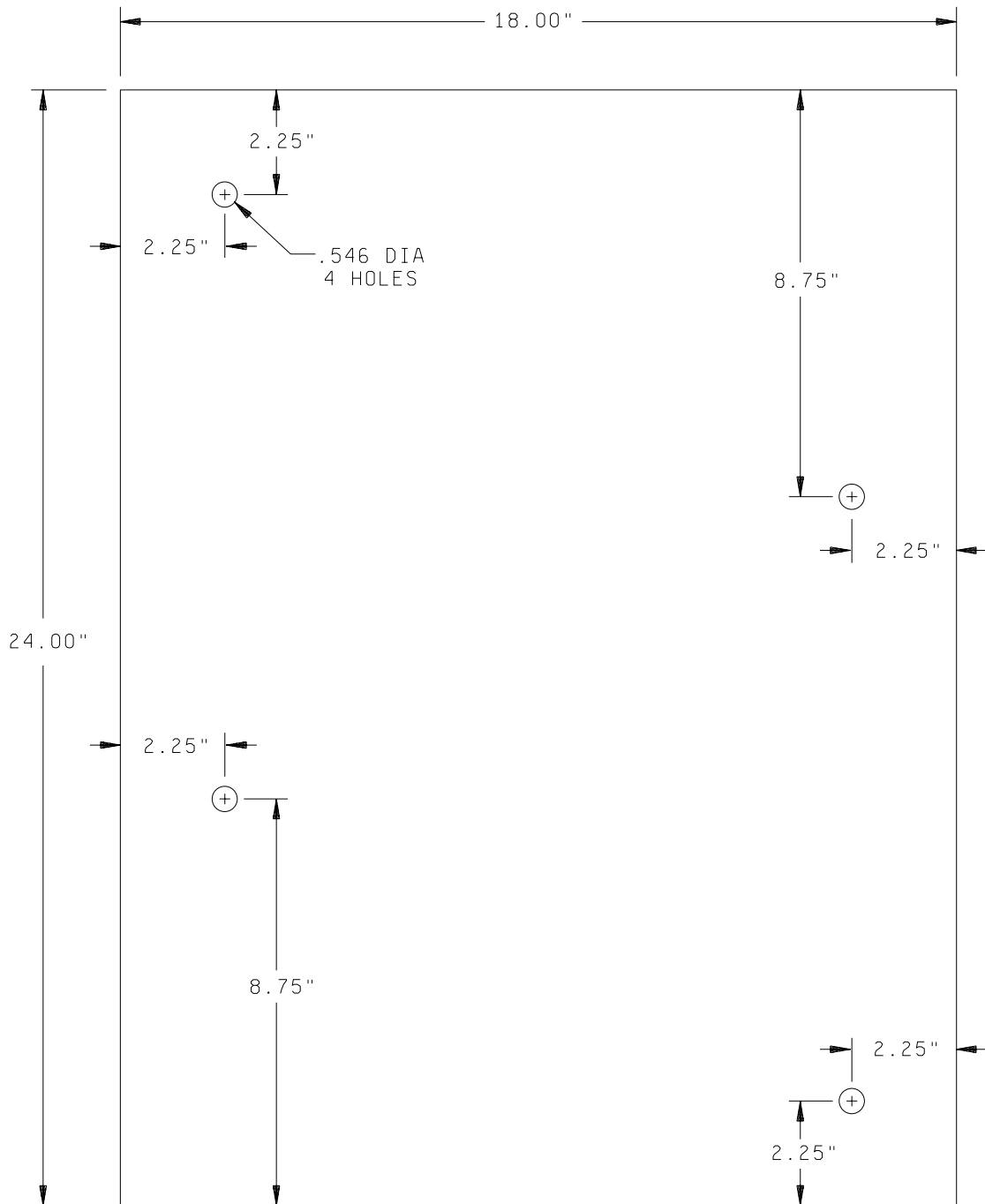
Mechanical Shock



Top and bottom view welded

Figure 7. Supplemental fixture for connectors, fabrication drawing - Continued.

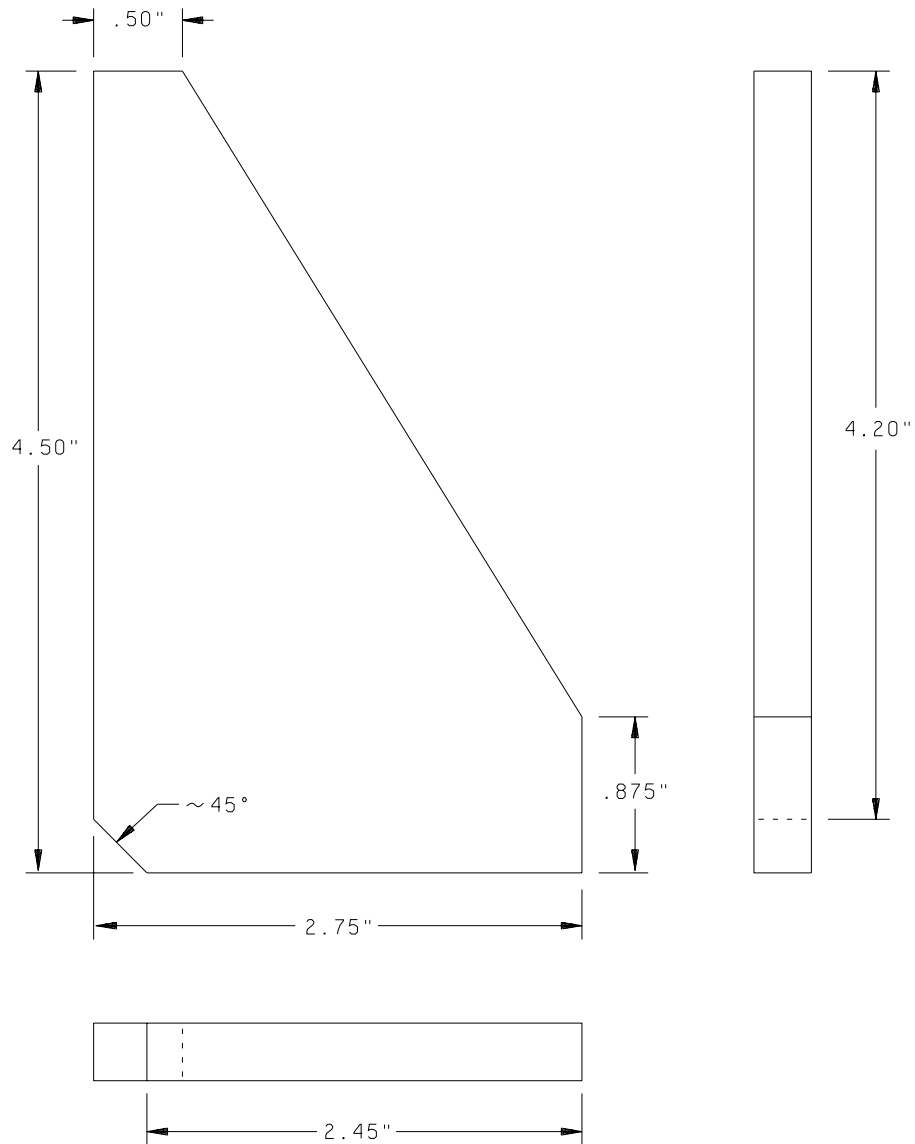
Mechanical Shock



Intermediary plate

Figure 7. Supplemental fixture for connectors, fabrication drawing – Continued.

Mechanical Shock



Gusset

Figure 7. Supplemental fixture for connectors, fabrication drawing - Continued.