INCH-POUND

MIL-STD-801E
10 August 2017
SUPERSEDING
MIL-STD-801D
10 April 2014

DEPARTMENT OF DEFENSE
TEST METHOD STANDARD

INSPECTION AND ACCEPTANCE STANDARDS FOR FLEXIBLE FUEL CELLS AND FITTINGS

AMSC N/A FSC 1560

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense.

2. This test method standard establishes:

a. A classification of commonly occurring defects in fuel cells and fuel cell fittings.

b. Standards for normal finish operations.

c. Standards for acceptance limits of rework on new fuel cells in the manufacturer's plant.

d. Limits of acceptable conditions requiring no rework.

e. Inspection criteria for acceptance determination of fuel cells that have been subjected to quality control stand test or dissection tests in accordance with MIL-DTL-5578, MIL-DTL-6396, and MIL-DTL-27422.

3. Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division Lakehurst, Code 4.3.5.3, Route 547, Mail Stop 120-3, Joint Base MDL, NJ 08733-5100 or via email to michael.sikora@navy.mil. Technical comments should be emailed to steve.mclaughlin@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

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1. SCOPE

1.1 Scope. This standard establishes a test method standard for fuel cells and fuel cell fittings. This standard applies to all fuel cells manufactured in accordance with MIL-DTL-5578, MIL-DTL-6396 (except Type I), and MIL-DTL-27422.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5578	-	Tanks, Fuel, Aircraft, Self-Sealing
MIL-DTL-6396	-	Tanks, Fuel, Oil, Cooling Fluids, Internal, Removable Non-Self-Sealing
MIL-DTL-27422	-	Tank, Fuel, Crash-Resistant, Ballistic-Tolerant, Aircraft

(Copies of these documents are available online at http://quicksearch.dla.mil.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM INTERNATIONAL)

ASTM D751	-	Standard Test Methods for Coated Fabrics

(Copies are available from www.astm.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Abrasion. The wearing away of a fabric or coating surface caused by friction.

3.2 Accessory, bonded. Any component internal or external to the fuel cell that is attached to the fuel cell but not the part of the inner liner or outer layer. Examples are pull tabs, hanger tabs, and chafing strips.

3.3 Activation. A condition that occurs in self-sealing fuel cells in which fuel comes in contact with the sealant ply, causing the sealant to swell and become spongy.

3.4 Adhesion. The strength of bond between cured adhesive and the surface to which the sealant is applied, or the strength of bond between a cured rubber surface or surfaces and a non-rubber surface. The interfacial bond strength between an adhesive and the corresponding substrate (rubber or fabric in fuel cells.)

3.5 Adhesive. A material that is used to structurally join two or more pieces of structure.

3.6 Approved rework procedures. Those rework procedures that have been approved by the fuel cell design authority.

3.7 Back rind. A surface blemish defect caused by mold flash material becoming folded inside a fitting cavity.

3.8 Baffle shoes. Fabric straps usually having holes protected by grommets. These straps are attached to the inner liner of the fuel cell for the purpose of securing the internal baffles.

3.9 Barrier. A film, typically pure nylon, usually located immediately behind the inner liner of all fuel cells, which prevents the diffusion of fuel through the remaining plies of the cells.

3.10 Bleeder cords. Cords that are built between the plies for the purpose of evacuating solvents and trapped air from between plies of a fuel cell.

3.11 Bleeder patch. A patch on the outside of a fuel cell that covers the cut ends of bleeder cords.

3.12 Blister. A raised spot on a surface or a separation between layers, which usually forms a void or air-filled space in a vulcanized article of fuel cells. The blister appearance is a raised area that can be depressed by finger pressure.

3.13 Bolt circle. The circumference made by a circular position of multiple bolts. The center of each bolt lies on the circumference.

3.14 Buffing. The intentional abrasion of a fuel cell surface for bonding purposes. Buffing produces a roughened or matte surface.

3.15 Chafing strip. Fabric adhered to the interior or exterior of the fuel cell to provide additional abrasion resistance.

3.16 Channel. A void left between the joint (lap seam) of two sheets of material. See figure 1 for allowances.

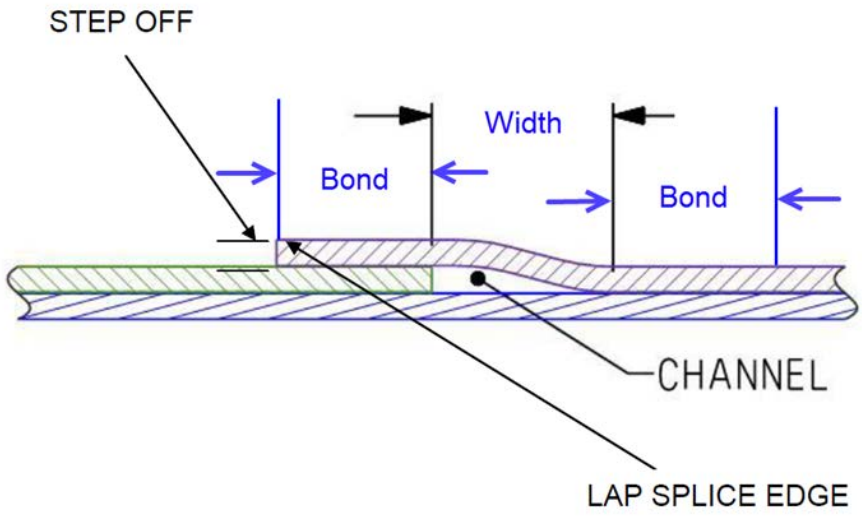

FIGURE 1. Lap splice and channel.

3.17 Cords. Flexible string made from several twisted strands.

3.18 Corner patch. Small cloth pattern used for meeting lap requirements in a corner. To be treated as a ply, not an accessory or component.

3.19 Crash resistant fuel cells. The column heading “crash resistant fuel cells,” which appears in tables I, II, and III applies to both self-sealing and non-self-sealing crash resistant fuel cells.

3.20 Cure. Act of vulcanization of uncured rubber or the setting up of adhesives.

3.21 Delamination. A delamination is an area of no adhesion between plies of the fuel cell wall. A delamination is not an area in which adhesion between plies is intermittent, such as where the fabric inner liner adheres primarily to the high points produced by the coarse weave of a reinforcing layer of fabric and does not adhere to the low points (valleys). These areas are essentially unpressurized and do not prevent the cell from satisfactorily holding fuel.

3.22 Design failure. Failures caused by a physical breakdown of the fuel cell or attach points as a result of imposed loads, which the cell was designed to withstand.

3.23 Deterioration of construction or construction failure. A failure caused by action of the test fluid or fuel on any ply or coat of adhesive or barrier in the fuel cell.

3.24 Dissection test. A destructive test in which the fuel cell is sectioned to permit critical examination of the interstitial areas of the fuel cell (see MIL-DTL-5578, MIL-DTL-6396, and MIL-DTL-27422).

3.25 Edge looseness. Separation of the outermost or innermost layer of the fuel cell construction from the next parallel layer. At the outer diameter of the metal fitting, edge looseness occurs as separation from the fillet. This is not vertical edge looseness. See Figures 2, 3, and 4.

3.26 Fillet. Material applied or shaped to effect a rounded transition at an edge or interface.

3.27 Fitting flange. The fabric collar, usually composed of rubber, fabric or nylon, that supports the fitting metal so that the fitting may be mounted to the fuel cell structure.

3.28 Fitting leakage. Leakage from around a fuel cell fitting.

3.29 Fried, scarred, or blown condition. An area in the inner liner material, which has become sponge-like, where solvent-laden adhesive has “blown” during the vulcanization process. This can appear as depressed areas in the fuel cell inner liner.

3.30 Gum. Any rubber material unreinforced by fabric.

3.31 Hanger straps. An interior or exterior attachment to a fuel cell, usually made of loop of webbing, used to support internal components on the interior of the fuel cell installed in aircraft and storage containers when applied to the exterior.

3.32 Inner liner. The first construction ply on the fuel side of a fuel cell. It supports and protects the barrier.

3.33 Inner liner laps. Seams on the fuel side layer of a fuel cell.

3.34 Integral baffle. An integral baffle is a rubber coated fabric component, which is vulcanized into the tank wall construction as a part of the building process.

3.35 Lap splice. Bonding of overlapping edges. Applies to fittings, preforms, accessories and join lines (if applicable).

3.36 Layer. A thickness of one type of material that makes up the fuel cell construction.

3.37 Lumps and craters. Depressions or craters caused by scuffing of uncured gum stocks or inclusion of adhesive lumps or foreign material.

3.38 Manufacturing damage. Damage incurred while the fuel cell is in the process of being manufactured.

3.39 Manufacturing defect. A defect caused by the fuel cell not being fabricated in accordance with applicable drawings and specifications.

3.40 Multiple construction fuel cells. A fuel cell that consists of more than one basic construction.

3.41 Outer ply. Outermost ply on the dry side of the fuel cell.

3.42 Patch. An application of material, whether in process or rework, to bring the cell into spec compliance.

3.43 Preform. Pre-build subassembly often containing fittings or other accessories, placed in highly contoured areas. Tied into inner liner.

3.44 Ply. Any single or combination of layers of continuous basic fuel cell construction of either fabric or non-fabric.

3.45 Ply overlaps. Seam area between two different plies.

3.46 Rework damage. Damage incurred during rework or finishing operations.

3.47 Sealant. Specifically to the fuel cells, sealant refers to the self-sealing natural gum rubber compound in the fuel cell, which reacts to fuel contact by swelling.

3.48 Skim coat. A non-structural protective layer applied to the exterior of the fuel cell. Not considered a ply.

3.49 Source inspector. The quality control inspector or engineer who is directly responsible for the procuring activity quality control function.

3.50 Stand test. A stand test is a static test in which the test cell is filled with test fluid or fuel for a given period of time and then examined for evidence of leakage or material deterioration (see MIL-DTL-5578, MIL-DTL-6396, and MIL-DTL-27422).

3.51 Step off. The edge of a lap of one or more plies of materials (see figure 1). The edge of discontinued plies in a multiple construction fuel cell. An allowable fabrication characteristic.

3.52 Tailored corners. Use of folds and darts or similar methods to obtain contours.

3.53 Total effective bond. Amount of bond area in fitting flange or lap splice whether or not bond is continuous.

3.54 Vertical edge looseness. Separation of rubber material (fillet) from the vertical surface of the metal fitting. Looseness around the entire metal fitting is an acceptable condition for non-crash resistant urethane fuel cell fittings. This condition is unacceptable for nitrile fuel cells.

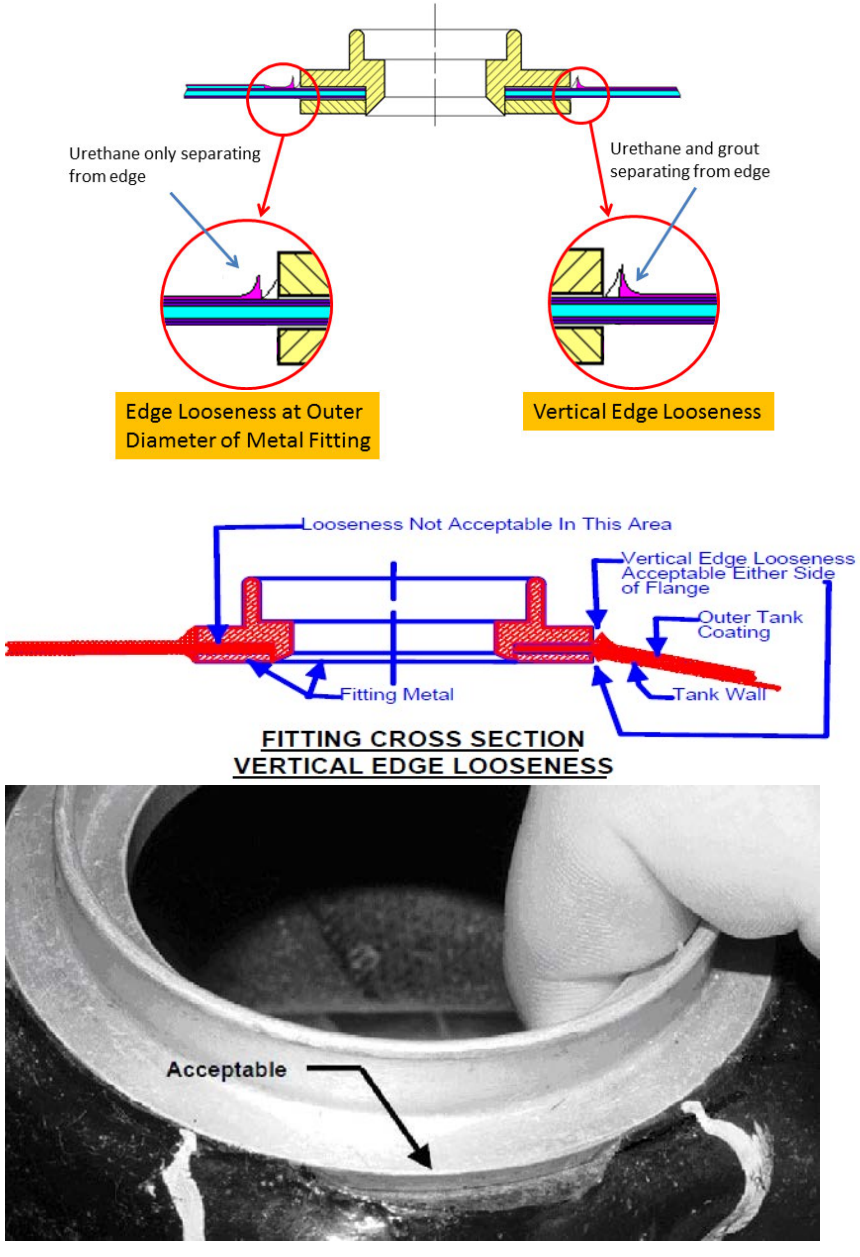

FIGURE 2. Edge looseness and vertical edge looseness.

4. GENERAL REQUIREMENTS

4.1 Inspection requirements. The inspection requirements described herein are not intended to supersede or delete any existing quality control standards. It is expected that the manufacturer or procuring activity will conduct further tests and have other detailed requirements in excess of those specified herein.

4.2 Results. Report of test results and inspections specified in this standard are in accordance with the applicable contract requirements.

5. DETAILED REQUIREMENTS

5.1 Classification of defects. Defects are considered with regard to character and extent. Defects are classified and limited to fall within one or more of the following classes.

a. Critical. A critical defect is one that judgment and experience indicate could result in hazardous or unsafe conditions for individuals using or maintaining the product; or for the aircraft; or a defect that could prevent performance of the aircraft's tactical function.

b. Major. A major defect is a defect, other than critical, that could result in failure or materially reduce the usability of the unit or product for its intended purpose.

c. Minor. A minor defect is a defect that does not materially reduce the usability of the unit or product for its intended purpose or is a departure from established standards having no significant bearing on the effective use or operation of the unit.

5.1.1 Unlisted defects. Unlisted defects, when deemed by the Inspector or Engineering to be such as to adversely affect the serviceability or strength of the fuel cell or fitting, are classified in accordance with the above criteria.

5.2 Use of tables. (See Table V for summary.)

5.2.1 Table I. Corrections of discrepancies listed in Table I are considered to be normal finishing operations and are not counted as defects when properly reworked prior to the time the fuel cell (or fitting) is submitted for acceptance or if the rework is accomplished prior to initiation of stand tests. An "X" in one or more of the columns below "Types of Fuel Cells" indicates the type of cell(s) or fitting(s), or the portion of the cell (interior, exterior) to which a particular inspection is considered applicable.

5.2.2 Table II. Finishing operations not corrected by rework in accordance with Table I are subject to acceptance criteria in Table II. This table presents acceptance standards for various defects that may occur on fuel cells that are submitted by the manufacturer for acceptance by the procuring activity. This table is also used for inspection of stand or dissection tested fuel cells (see 5.2.3). The columns below "Type of Fuel Cells" indicate the applicability of each defect with regard to type of cell, fitting, or location of defect (interior, exterior) to which a particular inspection is considered applicable.

5.2.3 Table III. This table lists inspections and defects that are unique to stand tested fuel cells. For stand tested cells, the inspections listed in Table III are conducted in addition to the inspections in Table II. Stand tests are normally conducted in fixtures lined with indicator paper. The "stains" referred to in Table III are stains showing on an indicator paper when cells are defective. If an alternate method of leak detection is used for stand tests, equivalent criteria are used for defect classification. Leaks that cannot be attributed to physical damage or shown to be a unique case are classified as a critical defect.

5.2.4 Table IV. Table IV lists additional defects that are applicable to dissection tested fuel cells. These inspections are conducted on dissection tested cells in addition to the inspections in Table II. Item 6 in Table IV is applicable to replacement fuel cell fittings that are subjected to

dissection tests on a sampling basis as well as to dissection tested cells.

5.2.5 Table V. Table V summarizes the contents of 5.2 and 5.3.

5.3 Action to be taken on identified defects. (See Table V for a summary of these actions.)

5.3.1 Minor defects. Discrepancies classified as minor defects are considered acceptable without rework provided they do not exceed the following limits:

a. Fuel cell interior - One defect per 10 square feet of total cell area. Where an accumulation of minor defects is not greater than the limits specified in the table, they will be considered one defect. For example, an accumulation of five 1/4-inch blisters in any one 5-foot length of splice (Table II, defect 1a) is counted as one minor defect.

b. Fuel cell exterior - Not greater than limits specified in table.

c. Installed fuel cell fittings - Minor defects in installed fittings are counted and included when determining acceptability of fuel cells without rework in accordance with 5.3.1, a and b.

d. Replacement fuel cell fittings - Replacement fittings submitted for acceptance are considered as acceptable without rework if minor defects are not greater than the following:

(1) Fittings with bolt circles of 6 inches or less - two minor defects permitted.

(2) Fittings with bolt circles larger than 6 inches - three minor defects permitted.

For non-circular fittings, consider bolt circle to be the largest dimension of the fitting. Minor defects greater than the criteria listed above are considered a major defect and reworked prior to acceptance.

5.3.2 Major defects. Major defects in fuel cells or replacement fuel cell fittings submitted for acceptance under a production contract are corrected using an approved rework prior to acceptance. Major defects detected in cells during stand or dissection tests or in separate fittings subjected to destructive sampling tests are analyzed to determine cause. If the defect can be shown to be a unique case, the lot represented by the defective item may be accepted. If not unique, all like defects shall be reworked using the approved rework procedure prior to acceptance of the lot and appropriate alterations must be made in the manufacturing process to prevent repetition of the defect.

5.3.3 Critical defects. Critical defects in fuel cells or replacement fuel cell fittings are cause for rejection of the cell. The cell may be deliverable if the manufacturer can devise a special rework technique along with a test procedure, both of which are acceptable to the procuring activity. When a critical defect is identified in cells subjected to stand or dissection tests, the procuring activity is notified immediately. If a critical defect is identified during the production sampling's test, production is stopped until the problem is resolved and a course of action established that is mutually satisfactory to the cell manufacturer and the procuring activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard classifies common defects in fuel cells and fuel cell fittings. This standard establishes the requirements for normal finish operations and sets acceptance limits or rework on new cells. These finish operations and acceptance limits are intended for military aircraft fuel tanks.

6.2 Acquisition requirements. Acquisition documents should specify the title, number, and date of this standard.

6.3 Supersession note. When referenced in a specification or Government acquisition document, MIL-STD-801 governs the inspection of production fuel cells in the manufacturer's and prime contractor's plants or at Government facilities to the extent specified in the contract under which the cells were acquired. The following Air Force – Navy Aeronautical Bulletins were superseded by MIL-STD-801: ANA-BUL-107, Inspection Standards for Stand and Dissection Tested Self-Sealing Fuel and Oil Cells; ANA-BUL-112, Acceptance Standards for Self-Sealing Fuel and Oil Cells; and ANA-BUL-435, Inspection Standards for Stand and Dissection Tested Non-Self-Sealing Type Cells.

6.4 Subject term (key word) listing.

Aircraft	Finish operations
Bladder	Leakage
Classification	Rework
Crash resistant	Self-sealing
Critical	Stand test
Defects	

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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TABLE I. Fuel cell finishing operations. 1/

Item	Defects	Types of Fuel Cells/Location					Fittings		Table II Ref
		Non-Self-sealing	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement	
1	LOOSE CORNER PATCH	X	X	X	X	X	-	-	6
2	LOOSE BAFFLE SHOES/INTEGRAL BAFFLE	X	X	X	X	-	-	-	6
3	LOOSE INNER LINER OR OUTER LAYER AT METAL FITTING OUTER DIAMETER THAT CAN BE REWORKED BY TRIMMING, PROVIDED THE MINIMUM BOND PERMITTED BY APPLICABLE BUILD REQUIREMENT IS MAINTAINED.	X	X	X	X	X	X	-	14
4	LOOSE INNER LINER OR OUTER PLY LAP THAT CAN BE REWORKED BY TRIMMING OR USE OF ADHESIVES PROVIDED THE MINIMUM BOND PERMITTED BY APPLICABLE BUILD REQUIREMENT IS MAINTAINED.	X	X	X	X	X	-	-	12, 13
5	EDGE LOOSENESS ON REINFORCEMENT, ATTACHING STRAPS, CHAFING STRIPS, TABS, OR OTHER ACCESSORIES	X	X	X	X	X	-	-	6
6	VISIBLE FABRIC EDGES AFTER CURE, PROVIDED FABRIC IS NOT DAMAGED	X	X	X	X	X	-	-	24, 25, 26, 38
7	BLISTERS BETWEEN INNER LINER OR OUTER PLY AND FITTING FLANGES	X	X	X	X	X	X	-	3
8	DAMAGED GROMMETS IN ACCESSORIES	X	X	X	X	X	-	-	48
9	DAMAGED COATING ON METAL, RUBBER, OR COMPOSITE ACCESSORIES	X	X	X	X	X	-	-	40, 45
10	IMPROPER OR LACK OF IDENTIFICATION MARKING, EXCEPT REPLACEMENT OF ADHERED LABELS	X	X	X	X	X	-	-	NA
11	SKIM COAT/OUTER PLY/INNER LINER BLISTERS	X	X	X	X	X	X	-	5

1/ Corrections of the items listed in this table are normal finishing operations and are not counted as a defect when rework is completed. See Table II for defects that do not require rework.

TABLE I. Fuel cell finishing operations – Continued. 1/

Item	Defects	Types of Fuel Cells/Location					Fittings		Table II Ref
		Non-self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement	
12	MISSING BLEEDER PATCH	X	X	X	-	X	-	-	NA
13	RUST OR DIRT IN THREADS OR DEFECTIVE THREADED INSERTS	-	-	-	-	-	X	X	45
14	METAL FINISH DAMAGE OR CORROSION						X	X	45
15	BENT FITTINGS THAT CAN BE STRAIGHTENED WITHIN STRESS LIMITATIONS	-	-	-	-	-	X	X	47
16	MOLD FLASH ON FITTING SUBASSEMBLY	-	-	-	-	-	X	X	42
17	TEARS IN FITTING FLANGES THAT CAN BE TRIMMED WITHOUT VIOLATING APPLICABLE SPECIFICATION MINIMUM FLANGE LENGTH	X	X	X	X	X	X	X	35
18	DEFECTS SUCH AS MOLDING MARKS, CUTS, OR DEPRESSIONS THAT CAN BE CORRECTED BY BUFFING AND STILL MAINTAIN SPECIFICATION TOLERANCES	X	X	X	X	X	X	X	16, 17, 21, 32, 36, 37
19	VISIBLE FABRIC OR CORDS THAT CAN BE CORRECTED BY SEAL COATING PROVIDED THEY ARE NOT DAMAGED	X	X	X	X	X	X	X	24, 25, 26, 38
20	VISIBLE BARRIER AROUND METAL FITTING OUTER DIAMETER	X	X	X	X	X	X	X	23

1/ Corrections of the items listed in this table are normal finishing operations and are not counted as a defect when rework is completed. See Table II for defects that do not require rework.

TABLE II. Acceptance standards. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non-self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
1	AREAS OF NON-ADHESION OR BLISTERS BETWEEN INNER LINER LAPS.										
	a. 1/4 inch maximum dimension - average 1 per 5 linear feet of splice with maximum of 5 in any 5 foot length of splice.	X	-	-	X	X	-	X	-	-	-
	b. 1/2 inch maximum dimension - average 1 per 5 linear feet of splice with maximum of 5 in any 5 foot length of splice.	X	-	-	-	-	X	X	-	-	-
	c. Areas in excess of 1a or 1b.	-	X	-	X	X	X	X	-	-	-
2	BLISTERS, DELAMINATIONS, OR SEPARATIONS IN OR BETWEEN PLIES										
	a. 1-inch maximum dimension; maximum of 5 blisters in any one 5 square foot area; over the total surface area, not to exceed an average of 1 per 5 square foot area; minimum of 6 inches solid bond between blisters. For example, in a 100 square foot area, maximum 20 blisters are allowable, provided no more than 5 blisters are in any 5 square foot area. (See Figure 5.)	X	-	-	X	X	X	X	X	-	-
	b. Blisters between plies in excess of 2a.	-	X	-	X	X	X	X	X	-	-
3	BLISTERS BETWEEN FITTING FLANGE AND ADJACENT PLY										
	a. 1/4 inch maximum dimension - Maximum of 1 in any 1 linear foot of flange or maximum of 1 per fitting when flange is less than 1 linear foot.	X	-	-	X	X	X	X	X	X	-
	b. In excess of 3a.	-	X	-	X	X	X	X	X	X	-
4	FABRIC COATING BLISTERS OF FABRIC INNER LINERS/LAYERS	X	-	-	X	X	X	X	-	-	X
5	SKIM COAT BLISTERS										
	a. 1-inch maximum dimension; maximum of 5 blisters in any one 5 square foot area; over the total surface area, not to exceed an average of 1 per 5 square foot area; minimum of 6 inches solid bond between blisters. For example, in a 100 square foot area, maximum 20 blisters are allowable, provided no more than 5 blisters are in any 5 square foot area. (See Figure 5.)	X	-	-	X	X	X	-	X	-	-
	b. In excess of 5a.	-	X	-	X	X	X	-	X	-	-
6	BLISTERS OR SEPARATIONS BETWEEN BONDED ACCESSORIES (SUCH AS CHAFING STRIPS, PATCHES, AND TABS) AND OUTER LAYER OR INNER LINER										
	a. Not exceeding 15 percent looseness provided a continuous bond at least 1/4 inch wide is maintained around edge except at step-off where Item 10 applies.	X	-	-	X	X	X	X	X	-	-
	b. In excess of 6a.	-	X	-	X	X	X	X	X	-	-

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non-self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
7	CHANNELS BETWEEN PLIES AT BURIED EDGE OF LAP SPLICES AND IN TRANSITION AREA, ENTIRE LENGTH OF SPLICE										
	a. In excess of 1/4 inch in width	-	X	-	X	X	X	X	X	-	-
	b. In excess of 3/8 inch in width for crash resistant cells	-	X	-	-	-	X	X	X	-	-
8	CHANNEL AROUND ENTIRE OUTER EDGE OF FITTING FLANGE										
	a. In excess of 1/4 inch in width	-	X	-	X	X	-	X	X	X	-
	b. In excess of 1/2 inch in width for crash resistant cells	X		-	-	-	X	X	X	X	-
9	CHANNEL AROUND ENTIRE METAL FITTING OUTER DIAMETER										
	a. Up to 1/4 inch in width	X	-	-	X	X	-	X	X	X	X
	b. In excess of 9a.	-	X	-	X	X	-	X	X	X	X
	c. In excess of 1/2 inch in width for crash resistant cells	-	X	-	-	-	X	X	X	X	X
10	CHANNEL AT PLY OVERLAPS										
	a. 1/4 inch wide maximum dimension - maximum of 1 in any 1 linear foot.	X	-	-	X	X	X	X	X	-	-
	b. In excess of 10a.	-	X	-	X	X	X	X	X	-	-
11	OPEN END CHANNELS IN 3 PLY-INNER OVERLAPS OR TAILORED CORNERS										
	a. Less than 1/4 inch wide by 3 inches long and less than 1 inch bond maintained between end of channel and barrier (N/A if 1 inch bond is maintained)	X	-	-	X	X	X	X	-	-	-
	b. In excess of 1/4 inch wide by 3 inches long and less than 1 inch bond maintained between end of channel and barrier	-	X	-	X	X	X	X	-	-	-

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non Self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
12	LAP SPLICE EDGE LOOSENESS (Except for accessories)										
	a. Up to 1/8 inch in width and 3 inches long; no more than 1 per 5 linear feet and rework can be made by trimming	X	-	-	X	X	X	X	X	-	-
	b. In excess of 12a. or if rework cannot be made by trimming	-	X	-	X	X	X	X	X	-	-
13	EDGE LOOSENESS BETWEEN FITTING FLANGE AND FABRIC (SEE FIGURE 3.)	X	-	-	X	X	X	X	X	X	-
14	INTERNAL OR EXTERNAL EDGE LOOSENESS AT OUTER DIAMETER OF METAL FITTING (SEE FIGURE 4.) 2/	-	X	-	X	X	X	X	X	X	-
15	VERTICAL EDGE LOOSENESS										
	a. Vertical Edge Looseness on urethane non-crash resistant cells	3/	-	-	X	X	-	X	X	X	-
	b. Vertical Edge Looseness on all nitrile cells	-	X	-	X	X	X	X	X	X	-
	c. Vertical edge looseness on all crash resistant cells	-	-	X	-	-	X	X	X	X	-
16	CUTS OR HOLES IN INNER LINER										
	a. Elastomer or fabric inner liner (Note: This item is not applicable to stand test or dissection test, see tables III and IV.)	-	-	X	X	X	X	X	-	-	-

1/Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.
2/ Applicable to urethane fittings.
3/ Acceptable for urethane non-crashworthy fittings.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non Self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
17	OUTER PLY CUTS, HOLES, OR SPLITS										
	a. Parallel to cords, cords are not damaged	X	-	-	X	X	X	-	X	-	-
	b. Cords damaged (for example, bleeder cord exits)	-	X	-	X	X	X	-	X	-	-
18	FRIED OR SCARRED CONDITION OR THINNING OUT OF GUM INNER LINER IN NONSELF-SEALING CELLS										
	a. Less than 1/2 of specified thickness	X	-	-	X	-	X	X	-	-	-
	b. In excess of 1/2 of specified thickness	-	X	-	X	-	X	X	-	-	-
19	FRIED OR SCARRED CONDITION OR THINNING OUT OF GUM INNER LINER IN SELF-SEALING CELLS										
	a. In excess of 1/2 of specified inner liner thickness (less than 1/3 - no defect)	-	X	-	-	X	X	X	-	-	-
20	BUFFING THROUGH FABRIC INNER LINER/LAYER	-	-	X	X	X	X	X	-	-	X
21	LUMPS, CRATERS OR FOREIGN MATERIALS IN INNER LINERS										
	a. Lumps and craters up to 1/2 specified inner liner thickness for unreinforced gum	X	-	-	X	X	X	X	-	-	-
	b. Lumps and craters in excess of 1/2 of specified inner liner thickness for unreinforced gum	-	X	-	X	X	X	X	-	-	-
	c. Foreign material for all inner liners	-	X	-	X	X	X	X	-	X	-
22	ANY CONDITION CAUSING VISIBLE BARRIER AT METAL FITTING OUTER DIAMETER	-	X	-	X	X	X	X	X	X	-
23	ANY CONDITION CAUSING VISIBLE BARRIER ON THE INNER LINER SURFACE OF WALL CONSTRUCTION	-	X	-	X	X	X	X	-	-	-

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non-self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
24	ANY CONDITION CAUSING VISIBLE FABRIC AT METAL FITTING OUTER DIAMETER	-	X	-	X	X	X	X	X	X	-
25	FABRIC INNER LINER - ANY CONDITION CAUSING VISIBLE INNER LINER FABRIC										
	a. No damage to fabric inner liner	X	-	-	X	X	X	X	-	X	-
	b. Damage to fabric inner liner	-	X	-	X	X	X	X	-	X	-
26	ANY CONDITION CAUSING VISIBLE FABRIC, WITH NO FABRIC DAMAGE OF OUTER PLY										
	a. 1/8 inch maximum diameter dimension; not to exceed a quantity of 3 areas of visible fabric per any 5 square foot	X	-	-	X	X	X	-	X	-	X
	b. In excess of 1/8 inch or in excess of 3 areas of visible fabric in any 5 square foot area.	-	X	-	X	X	X	-	X	-	X
27	EXTERNAL DIMENSIONS OF CELL OUT OF TOLERANCE	-	-	X	X	X	X	-	X	-	-
28	FITTING MISLOCATED OR FITTING ROTATED BEYOND SPECIFIED TOLERANCE	-	-	X	X	X	X	X	X	X	-
29	LOOSENESS UNDER HANGER FITTINGS INCORPORATING METAL OR FABRIC PLATES OR METAL RINGS, IN EXCESS OF THE CONTACT SURFACE AREA OF THE PLATES AND RINGS AND UP TO 1/4 INCH BEYOND OUTER EDGE OF PLATE OR RING	-	X	-	X	X	X	X	X	X	-

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non-self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
30	BLISTERS IN FLANGE AREA OF REPLACEMENT FITTINGS	-	X	-	-	-	X	-	-	-	X
31	BLISTERS IN FITTING FILLET										
	a. Up to 1/8 inch	X	-	-	X	X	X	X	X	X	X
	b. In excess of 1/8 inch	-	X	-	X	X	X	X	X	X	X
32	MOLD MARKS IN FLANGE: AREA OF FITTING										
	a. No interference with design characteristics of fitting	X	-	-	X	X	X	X	X	X	X
	b. Interference with design characteristics of fitting	-	X	-	X	X	X	X	X	X	X
33	LAMINATIONS, POROUS AREAS OR BACK RINDS IN EXCESS OF 1/2 BODY THICKNESS OF FITTING FLANGE AT LOCATION OF DEFECT	-	X	-	X	X	X	X	X	X	X
34	FOREIGN MATERIAL IN FITTING FLANGE										
	a. 1/32 inch or less	X	-	-	X	X	X	X	X	X	X
	b. Over 1/32 inch but less than 1/2 body thickness at defect	-	X	-	X	X	X	X	X	X	X
35	TEARS IN FITTING FLANGE										
	a. If fairing can be accomplished while still maintaining specified minimum flange width	X	-	-	X	X	X	X	X	X	X
	b. In excess of 35a.	-	X	-	X	X	X	X	X	X	X
36	CUTS OR NICKS IN FITTING FLANGE										
	a. 1/32 inch or less	X	-	-	X	X	X	X	X	X	X
	b. Over 1/32 inch but less than 1/2 body thickness at defect	-	X	-	X	X	X	X	X	X	X
	c. Greater the 1/2 body thickness	-	-	X	X	X	X	X	X	X	X
37	CUTS OR CRACKS IN FITTING FILLETS	X	-	-	X	X	X	X	X	X	X

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

TABLE II. Acceptance standards – Continued. 1/

Item	Defects	Defect Classes			Types of Fuel Cells/Location					Fittings	
		Minor	Major	Critical	Non Self-sealing Cells	Self-sealing Cells	Crash Resistant Cells	Cell Interior	Cell Exterior	Installed	Replacement
38	VISIBLE FABRIC IN FITTING FLANGE OR PLY LAP ON FITTING FLANGE										
	a. With no damaged cords. Cords visible at edge of fitting flange or ply lap are permitted	X	-	-	X	X	X	X	X	X	X
	b. With damaged cords	-	X	-	X	X	X	X	X	X	X
39	SEALING SURFACE OF FITTING ROUGHER THAN SPECIFICATION LIMITS	-	X	-	X	X	X	X	X	X	X
40	FITTING CRITICAL FLAT AREA FINISH, OTHER THAN SEALING SURFACE, ROUGHER THAN SPECIFICATION LIMITS	-	X	-	X	X	X	X	X	X	X
41	SCRATCHES, PITS, OR MARS IN SEALING SURFACE BEYOND LIMITS OF SPECIFICATIONS	-	-	X	X	X	X	X	X	X	X
42	MOLDING FLASH ON SEALING SURFACE OF FITTING OR AREAS THAT CAUSE INTERFERENCE WITH INSTALLED COMPONENTS	-	-	X	X	X	X	X	X	X	X
43	FAULTY DOME NUT	-	-	X	X	X	X	X	X	X	X
44	THREAD DIMENSIONS OUT OF TOLERANCE	-	X	-	X	X	X	X	X	X	X
45	CORROSION, DIRT, METAL FINISH DAMAGE OR LACK OF SPECIFIED PROTECTIVE COATING	-	X	-	X	X	X	X	X	X	X
46	O-RING GROOVE WIDTH OR DEPTH, FITTING FLATNESS, THICKNESS, INSIDE DIMENSION, OR BOLT HOLE DIMENSIONS OUT OF TOLERANCE	-	X	-	X	X	X	X	X	X	X
47	BENT FITTING										
	a. Can be straightened within stress limits of metal	-	X	-	X	X	X	X	X	X	X
	b. Cannot be straightened within stress limits of metal	-	-	X	X	X	X	X	X	X	X
48	DAMAGED GROMMETS IN ACCESSORIES	-	X	-	X	X	X	-	-	-	-

1/ Unless otherwise specified in the applicable detail specification, a one-inch minimum effective bond shall be maintained. A defect violating the applicable minimum bond requirement shall be classified as a major defect.

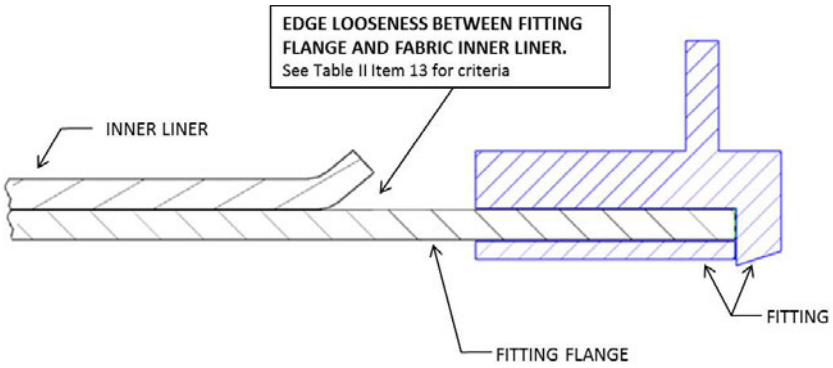


FIGURE 3. Edge looseness between fitting flange and fabric inner liner.

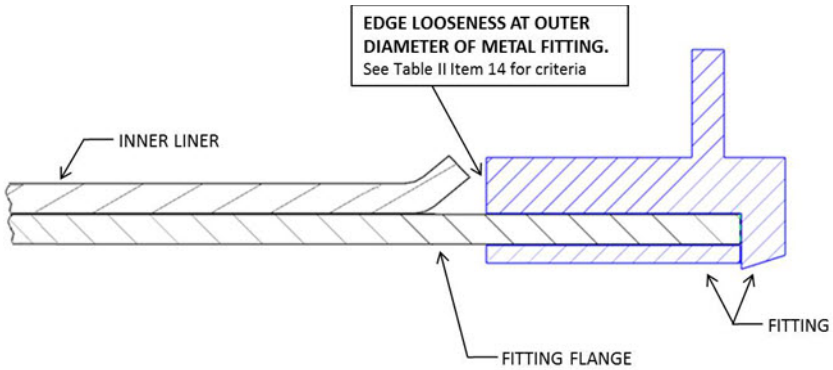
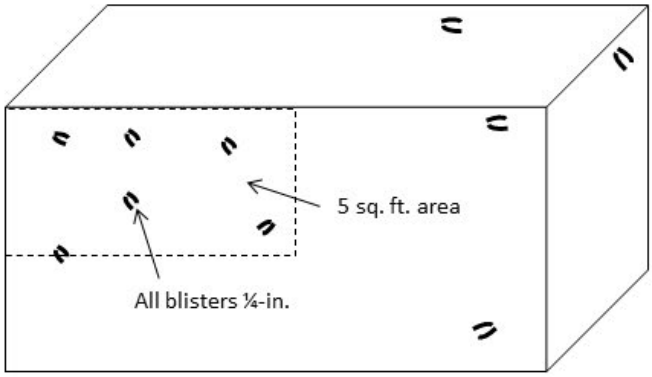


FIGURE 4. Edge looseness at metal fitting outer diameter.

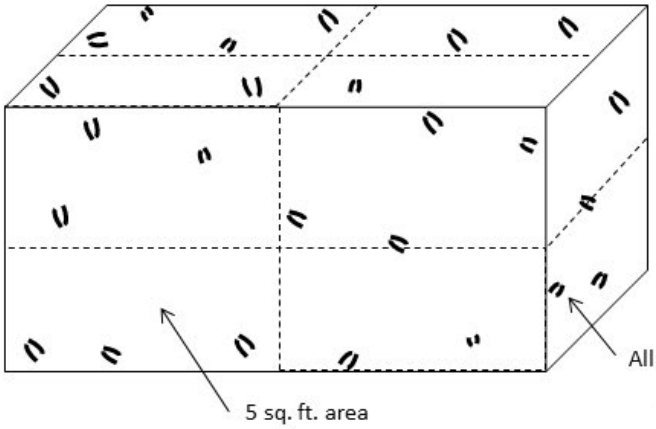
Total Surface Area: 100 sq. ft.
Blister allowance for 100 sq. ft.: 20 blisters

(Illustrations not to scale)



Unacceptable

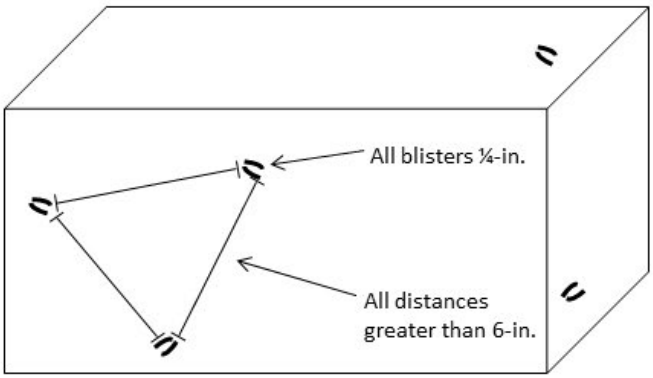
☐ Blister larger than 1-in
☒ More than 5 blisters in a 5 sq. ft. area
☐ Exceeds blister limit over total surface area
☐ Less than 6-in bond between blisters



25 total blisters

Unacceptable

☐ Blister larger than 1-in
☐ More than 5 blisters in any 5 sq. ft. area
☒ Exceeds blister limit over total surface area
☐ Less than 6-in bond between blisters



Acceptable

☐ Blister larger than 1-in
☐ More than 5 blisters in a 5 sq. ft. area
☐ Exceeds blister limit over total surface area
☐ Less than 6-in bond between blisters

FIGURE 5. Blisters, delaminations, separations (Ref Table II, Items 2 and 5).

TABLE III. Additional criteria for stand tested fuel cell finishing operations. 1/

Item	Defects	Defect Classes			Types of Fuel Cells		
		Minor	Major	Critical	Non Self-sealing Cells	Self-sealing Cells	Crash Resistant Cells
1	STAIN OR ACTIVATION DUE TO DETERIORATION OF CELL 2/	-	-	X	X	X	X
2	STAIN OR ACTIVATION DUE TO DESIGN FAILURE 2/	-	-	X	X	X	X
3	STAIN OR ACTIVATION DUE TO MANUFACTURING DEFECT 2/	-	-	X	X	X	X
4	STAIN OR ACTIVATION DUE TO MISHANDLING OR REWORK DAMAGE 2/	-	-	X	X	X	X
5	STAIN OR ACTIVATION DUE TO MISHANDLING OR IMPROPER CELL 2/						
	a. Condition of cell does not preclude complete evaluation of cell.	no defect	-	-	X	X	X
	b. Condition precludes complete evaluation.	retest	-	-	X	X	X
6	ACTIVATION ANYWHERE IN THE CELL	-	X	-	-	X	-

1/ Following stand test, the above inspection standards shall apply in addition to the acceptance standard of Table II.

2/ If it is impossible to determine source of the stain by thorough engineering and laboratory tests, excluding dissection, a stain of 1 inch maximum diameter or equivalent area is allowable, except self-sealing fuel cells, provided there is not greater than one such stain per 150 square feet of cell area.

TABLE IV. Additional criteria for dissection tested fuel cells. 1/

Item	Defects	Defect Classes			Types of Fuel Cells		
		Minor	Major	Critical	Non Self-sealing Cells	Self-sealing Cells	Crash Resistant Cells
1	ADHESION OF INNER LINER TO SEALANT OR ADJACENT PLY IN FLAT PANEL AREAS IS LESS THAN 6 LBS. PER INCH WIDTH 2/	-	X	-	X	X	X
2	ADHESION OF INNER LINER TO CHAFING STRIPS IS LESS THAN 6 LBS. PER INCH OF WIDTH 2/	-	X	-	X	X	X
3	ADHESION OF FITTING FLANGE TO INNER PLY IS LESS THAN 6 LBS. PER INCH WIDTH 2/	-	X	-	X	X	X
4	ADHESION OF INSIDE AND OUTSIDE ACCESSORIES IS LESS THAN DESIGN VALUES 2/	-	X	-	X	X	X
5	DISSECTION OF FITTING FLANGE INDICATES CONSTRUCTION IS NOT IN ACCORDANCE WITH APPROVED MANUFACTURING SPECIFICATIONS	-	X	-	X	X	X
6	ADHESION OF FABRIC FITTING FLANGES TO METAL RINGS IS LESS THAN 150 LBS. PER INCH OF WIDTH 2/ 3/	-	X	-	X	X	X

1/ Following dissection test, the above inspection standards shall apply in addition to the acceptance standards of Table II.

2/ Test Method: ASTM D751, dry pull at 2 inches per minute. This factor also used for sampling tests of replacement fittings.

3/ Failure of fabric flange prior to adhesion failure does not constitute a defect.

TABLE V. Summary.

Purpose of Inspection	Applicable Table	Action to be Taken with Defective Items		
		Minor Defect	Major Defect	Critical Defect
Production cells submitted for acceptance	Table II	Cells with minor defects are acceptable without rework provided the defects do not exceed the limits noted in 5.3.1a, b, and c. If these limits are exceeded, they shall be treated as major defects.	All major defects shall be corrected using an approved rework or repair procedure prior to acceptance.	Cells with critical defects shall be rejected. The cell shall be scrapped unless manufacturer proposes a rework or repair procedure acceptable to the procuring activity.
Replacement production fittings submitted for acceptance	Table II	Fittings with minor defects are acceptable without rework provided the defects do not exceed the limits noted in 5.3.1d. If these limits are exceeded, they shall be treated as major defects.		
Inspection of cells subjected to stand test or dissection test	Table II and either Table III or Table IV, as applicable	Test results shall be considered satisfactory if minor defects do not exceed limits listed in applicable portion of 5.3.1. If limits are exceeded, they shall be treated as major defects.	When major defects are identified, production items shall be given approval provided it can be shown that this is a unique case. If it is not a unique case, all like defects in production cells shall be reworked or repaired. Lot represented by test is then acceptable. Take appropriate action to prevent repetition of defect.	When a critical defect is identified, test is considered unsatisfactory. Notify prime contractor and procuring activity. All production represented by test shall be inspected to determine if this is a unique case and shall be found free of this defect prior to acceptance. If this is a unique case, test cell shall be reworked or repaired, if possible, utilizing approved procedures. If not a unique case, action shall be taken to determine if defective cells can be reworked or repaired and the defect shall be corrected in future production.
Replacement fittings subjected to dissection test	Table II and Item 6 in Table IV			

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 70
DLA - CC

Review activities:
Army - AT, MI
Navy - SA
Air Force - 170

Preparing activity:
Navy - AS

(Project 1560-2017-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST online database at https://assist.dla.mil.