Verizon NEBS™ Compliance: Test Requirements for Buffered/Protected Optical Fiber with Adhesive Assemblies for Residential Use

Verizon Technical Purchasing Requirements

VZ.TPR.9459

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CHANGE CONTROL RECORD:

Version	Date	Action*	Reason for Revision
Initial	*01/24/11*	New	New Document
2	*04/27/11*	Change	Revised UV Criterion

* **New, Add, Delete, Change, Reissue**

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1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to provide test requirements to evaluate Buffered/Protected Optical Fiber with Adhesive Assemblies for Residential Use. Such Cables may be installed in Indoor Living Unit (ILU) and other applications.

2.0 SCOPE

Optical Buffered/Protected Fiber 500-900 um category.

3.0 REFERENCES

GR-20-CORE, Issue 2, July 1998	Generic Requirements for Optical Fiber and Optical Fiber Cables
GR-409-CORE, Issue 1, June 1994	Generic Requirements for Premises Fiber Optic Cable
VZ.TPR.9430	Optical Fiber and Optical Fiber Cable
VZ.TPR.9424	MDU Drop Cable

4.0 ACRONYMS

A	After
B	Before
D	During
FOC	Fiber Optic Components
IL	Insertion Loss
ITL	Independent Test Laboratory
ILU	Indoor Living Unit
um	Micro-meter
nm	Nano Meter
Pin	Input Power
RL	Return Loss

5.0 TEST REQUIREMENTS FOR BUFFERED/PROTECTED FIBERS WITH ADHESIVE SYSTEMS FOR RESIDENTIAL USE

Verizon is considering using Buffered/Protected Optical Fiber that uses Adhesive materials as part of the installation process in such applications as ILUs. The following are test requirements for qualifying the protected fiber and adhesive assembly systems. All of the tests must be conducted at an ITL. It is assumed that fiber used in these cables is already Verizon TPR.9441 approved.

Description	Reference Specification	Test Condition	Test Method	Criterion
Adhesive Testing				
Curing Time			Verify the curing time during the adhesion tests. Curing times specified for some adhesive types may require several stages to achieve maximum strength. Curing time as defined in this document is the time required to achieve 90% of its final bonding strength.	Supplier Provided
1. Adhesion Test Wall Surfaces		**Surface Type: Wall Surfaces**[1] a. Paneling b. Sheetrock c. Lath and plaster d. Concrete block e. Brick f. Stucco g. Wall paper h. Texturing	Attach the DUT to the mounting surface following the manufacturer's instructions for surface preparation and product installation. Allow the adhesive to cure (follow the manufacturer's recommended curing procedure and curing time), (See figures A, B, C, D, and E for surface mounting guidelines and the definition of test pulling direction). Apply a force perpendicular to the cable axis and parallel to the mounting surface. Pull at a rate of 10 cm/min. Record the maximum and minimum force required to remove 25 cm of cable. Note and record adhesive bond or other de-attachment modes, e.g., if adhesive, surface or DUT fails. Repeat for three samples. Repeat for each surface type. Perform both end and (mid span) center pulls. (48 samples) All tests are performed at room temperature of 23° C ± 3°C. Note any manufacturer's special surface preparation requirements.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb

[1] Follow manufacturer's recommendations for surface preparation.

Description	Reference Specification	Test Condition	Test Method	Criterion
2. Adhesion Test Ceiling Surfaces		**Surface Type: Ceiling Surfaces**[2] a. Popcorn[3] b. Sheetrock c. Lath and plaster d. Stucco e. Suspended f. Texturing	Attach the DUT to the mounting surface following the manufacturer's instructions for surface preparation and product installation. Allow the adhesive to cure (follow the manufacturer's recommended curing procedure and curing time), (See figures A, B, C, D, and E for surface mounting guidelines and the definition of test pulling direction). Apply a force perpendicular to the cable axis and perpendicular to the mounting surface. Pull at a rate of 10 cm/min. Record the maximum and minimum force required to remove 25 cm of cable. Note and record adhesive bond or other de-attachment modes, e.g., if adhesive, surface or DUT fails. Repeat for three samples. Repeat for each surface type. Perform both end and (mid span) center pulls. (36 samples). All tests are performed at room temperature of 23° C ± 3°C. Note any manufacturer's special surface preparation requirements.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb

[2] Follow manufacturer's recommendations for surface preparation.
[3] May be worse case installation scenario.

Description	Reference Specification	Test Condition	Test Method	Criterion
3. Adhesion Test Moldings		**Moldings** – a. Crown molding b. Baseboard molding **Finish Type** a. Unfinished wood b. painted wood c. stained d. varnished e. shellac	The size and or recommendations of surface contour of crown and baseboard moldings suitable for mounting surfaces shall be as recommended by the device manufacturer. Preparation and attachment shall be as defined in tests one and two above. Attach the DUT to the mounting surface following the manufacturer's instructions for surface preparation and product installation. Allow the adhesive to cure (follow the manufacturer's recommended curing procedure and curing time), (See figures A, B, C, D, and E for surface mounting guidelines and the definition of test pulling direction). Apply a force perpendicular to the cable axis and perpendicular to the mounting surface. Pull at a rate of 10 cm/min. Record the maximum and minimum force required to remove 25 cm of cable. Note and record adhesive bond or other de-attachment modes, e.g., if adhesive, surface or DUT fails. Repeat for three samples. Repeat for each surface type. Perform both end and (mid span) center pulls. (30 samples). All tests are performed at room temperature of 23° C ± 3°C. Note any manufacturer's special surface preparation requirements.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb

Description	Reference Specification	Test Condition	Test Method	Criterion
4. Adhesion to Painted Surfaces		**Paints**[4] a. Latex (egg shell), b. Acrylic, c. Enamel (Glossy), d. Stain	Prepare two each of four types of mounting surface by applying 3 coats of one type of the indicated types of paints to a mounting base material of sanded pine plywood (11/32" minimum thickness) for each of the paint types. (Total samples = 2 Latex + 2 Acrylic + 2 Enamel + 2 Stain = 8). Perform a parallel and normal pull as defined in tests one (1) and two above (2) on one each of the surface types.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb
5. Adhesion after exposure to Chemicals		**Chemical Resistance-** to cleaning fluids 409 Fantastic Warm Soap and Water Murphy's Oil Soap Pledge	Prepare three mounting surface using one of each type of paint (8X5=40 samples) as described in the "Adhesion to Painted Surfaces Test" described above. Mount the samples and allow the adhesive to cure. Saturate the DUT and mounting surface with one each of the chemical types and allow the samples to sit at room temperature for 1 hour. Repeat the soak and 1 hour wait 3 more times. For handling purposes, The excess moisture can be wiped from the sample surface before testing. Perform the X -direction and the Z-direction adhesion end pull as described in test one (1) and test two (2) above.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb

[4] Home Depot Brand

Description	Reference Specification	Test Condition	Test Method	Criterion
6. Adhesion after Temperature and Humidity Exposure		GR-409 section 6.6.1 and 6.6.2. (General Purpose and Interconnect cable conditions.)	Prepare Eight (8) test samples as described in the "adhesion to painted surfaces" test above. Expose the cured samples to the temperature/Humidity and aging test as described in GR-409 section 6.6.1[5] and 6.6.2. (General Purpose and Interconnect cable conditions.) Perform the X - direction, and the Z-direction end pull test on one each of the four types of samples. Total of 8 samples.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb
7. Adhesion after sunlight Exposure	ASTM G.154	UVA 340 with Window Glass Filter, cycle 1 (1,080 hrs) Or Cycle 1 with UVA – 351 lamps without filtering. (1,080 hrs)	Prepare 6 test samples. Samples may be glued to a metallic or plastic form of sufficient size to fit the test apparatus. Expose the samples to sunlight simulation per ASTM G.155 Xenon arc, Cycle 1 with Glass filter (500 hrs) or ASTM G.154 UVA Cycle 1, with glass Filter,(1,080 hrs) or ASTM G.154 UVA 351, Cycle 1 no filter (1,080 hrs) or ASTM G.154 UVB-313, Cycle 3 without filter, (1,080 hrs). At the conclusion of the exposure inspect the sample and glue for degradation.	Aged samples shall not show signs of crazing or cracking.
	ASTM G.155 Xenon arc	Cycle 1 with window Glass filter. (500 hrs)		
	ASTM G.154	UVB-313 Lamps, Cycle 3 (1,080 hrs) Use of this lamp may result in over testing. Can		

[5] Conducted per GR-409 with the following addition. During the temperature cycle portion of the exposure the humidity shall be controlled to 95% during the max plateau excursion of the temperature cycle tests. The humidity is allowed to fluctuate during the rest of the cycle.

Description	Reference Specification	Test Condition	Test Method	Criterion
		be used without filter only if approved by the supplier. The use of a glass filter is not allowed with this lamp.		
8. Reactivation/Re-installation			Prepare eight (8) test sample by following the sample preparation procedure given in "Adhesion to Painted Surfaces". Allow the samples to cure. Remove and reattach the samples following the manufacturer's procedures. Perform the X -direction and the Z -direction pull test on one each of the four types of samples.	Determine the maximum and minimum force required to remove the sample after curing. All three samples must pass each surface pull test. Min force – 0.5 lb Max force 2.0 lb
9. Safety				Shall not be toxic or harm the environment.
10. UL Flame Tested as Appropriate			GR-63 section 4.2.3.1 (Sub section A) R4-43	Shall meet flame criteria as defined in GR-63 section 4.2.3.1 R4-43
Specific Buffered/Protected Fiber Tests				
11. Tensile Performance	FOTP-33 and FOTP38	Test Length - ≥ 50 m in length, Applied Force = weight of 1 km of cable or 5.0 N (1.12 lbs) whichever is	Fiber Strain Change in attenuation	Under rated tensile load the fiber strain shall not exceed 60% of the fiber proof strain. After removal of load, there shall be no change in attenuation[6]. Other criteria

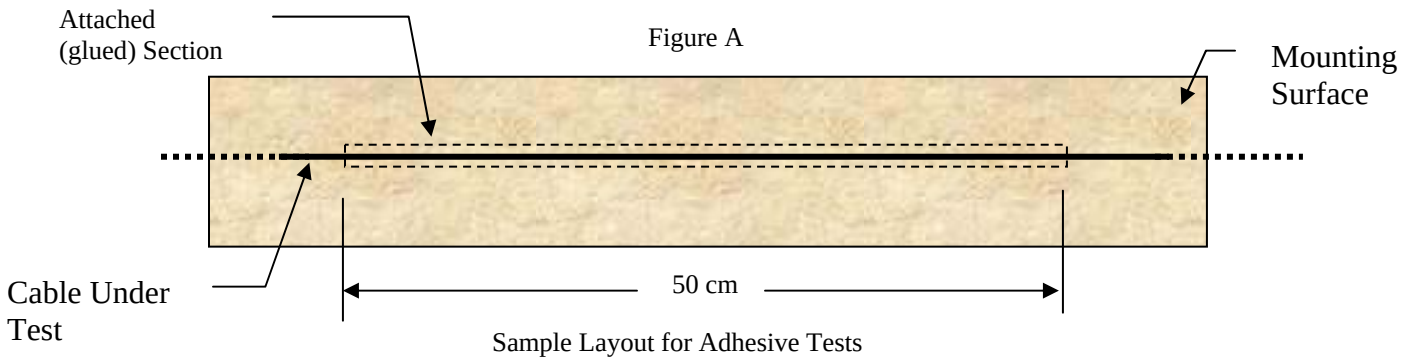
[6] The expression of "no change in attenuation" means that any change in measurement value, either positive or negative, within the uncertainty of measurement shall be ignored. Uncertainty ≤ 0.05 dB.

Description	Reference Specification	Test Condition	Test Method	Criterion
		greater. Bend Radius of coupling wheels is ≥ the minimum bend radius of the cable under tests		may be agreed between customer and supplier. Under visual examination without magnification there shall be no damage to the sheath or to the cable elements.
12. Repeated Bending (Cable Flexing)	FOTP-104	Bend Mandrel - 20 x cable diameter or 30 mm whichever is greater. Tension – sufficient to allow full contact with mandrel. Number of bends = 25. Cycle Duration approx 2 sec.		Under visual examination with 20X magnification there shall be no damage to the sheath and to the cable elements.
13. Bend	(IEC 60794-1-2)	Diameter of mandrel: ≤ 40 x cable diameter or 30 mm which ever is greater Number of cycles: 3	Method E11B	The change in attenuation when tested at -5° C shall be ≤0.1 dB
14. Crush	FOTP-41	Applied Force = 50 N Anvil shall be per FOTP-41 (Anvil		No degradation of optical transmittance or physical damage to the cable.

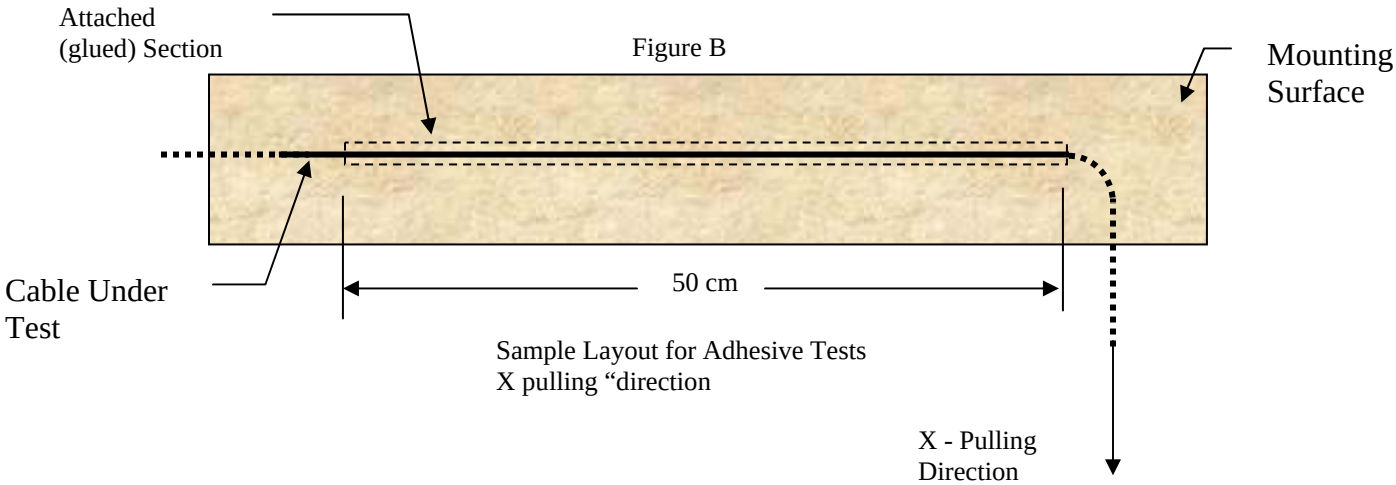
Description	Reference Specification	Test Condition	Test Method	Criterion
		Length is 87.3 mm, including end radius). Force is 5.0 N/cm or 50 N, Test at three (3) points separated by a minimum of 0.5 meters.		
15. Impact	FOTP-25	The ROC of the drop hammer shall be 12.5 mm per FOTP-25. Impact 1.0 NM. Impact energy = (1.0) NM.	One Impact per test point. Three different impact points separated by at least 0.5 meters	No physical damage to the cable. The increase in attenuation shall be less than 0.1 dB.

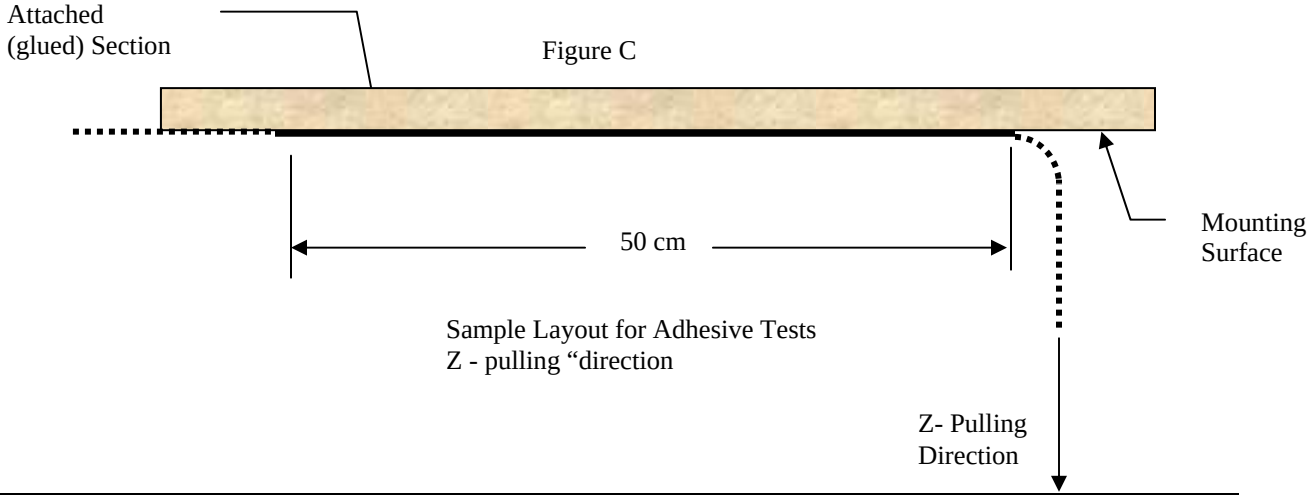
Buffered/Protected Fiber and Assembly Testing			
Description	**Reference Specification**	**Test Condition**	**Buffered/Protected Fiber Criterion**
Fiber Criteria			
TPR.9441			Must be qualified to TPR.9441.
Cable Construction			
Cable Core	GR-409, Section 6.1.1.		X
Number of Fibers per Cable	GR-409, Section 6.1.2.		X
Number of Fibers per Unit	GR-409, Section 6.1.3.		X
Sheath Removal	GR-409, Section 6.1.4.		X
Cable Marking, Packaging, and Shipping			
Cable Marking	GR-409, Section 6.2.1.	Marking for the buffered/protected fiber is application specific.	X
Cable Length and Length Markings	GR-409, Section 6.2.4.	Marking for the buffered/protected fiber is application specific.	X
Packaging	GR-409, Section 6.2.6.		X
Shipping	GR-409, Section 6.2.7.		X
Mechanical Requirements			
Tensile Strength of Cable	GR-409, Section 6.3.6.	Rated tensile load specified by cable design	See Test 11 above
Low and High Temperature Cable Bend	GR-409, Section 6.3.3.	Use Riser test criteria for Rugged cable designs and General Purpose Interconnect criteria for Compact cable designs	See Test 13 above
Impact Resistance	GR-409, Section 6.3.4.		See Test 15 above
Compressive Strength	GR-409, Section 6.3.5.		See Test 14 above
Cable Twist	GR-409, Section 6.3.7.		N/A
Cable Cyclic Flexing	GR-409, Section 6.3.8.		See Test 12 above
Cable Materials	GR-409, Section 6.4.		N/A
Jacket Requirements			
Outside Jacket Material	GR-409, Section 6.5.1.		N/A

Buffered/Protected Fiber and Assembly Testing			
Description	**Reference Specification**	**Test Condition**	**Buffered/Protected Fiber Criterion**
Cable Jacket Yield Strength and Ultimate Elongation	GR-409, Section 6.5.2.		N/A
Cable Outer Jacket Shrinkage	GR-409, Section 6.5.3.		X
Cable Jacket Thickness	GR-409, Section 6.4.4.		X
Environmental Requirements			
Temperature Cycling	GR-409, Section 6.6.1.	Use Interconnect/Outside Plant test criteria	X
Cable Aging	GR-409, Section 6.6.2.		X
Color Performance	GR-409, Section 6.6.3.		X
Flammability Listing of Premises Cables			
Plenum Cable	GR-409, Section 6.7.1.		
Riser Cable	GR-409, Section 6.7.2.		
General Purpose Cable	GR-409, Section 6.7.3.		X
Cordage Application Tests			
Corner Bend with radius < 1X cable BR 0.9 X BR 0.8 X BR 0.7 X BR 0.6 X BR Load – 0.7 kgf (1.54 lbs)	n/a	Apply load to cable to secure cable against fixture. Attenuation at 1550 nm should be ≤ 0.05 dB.	Determine loss at specified minimum bend radius
Mandrel wrap	n/a	5 wraps around a mandrel equal to the rated minimum bend radius of the cable. Attenuation at 1550 nm should be ≤ 0.1 dB/turn.	X



Adhesive Tests Sample Layout





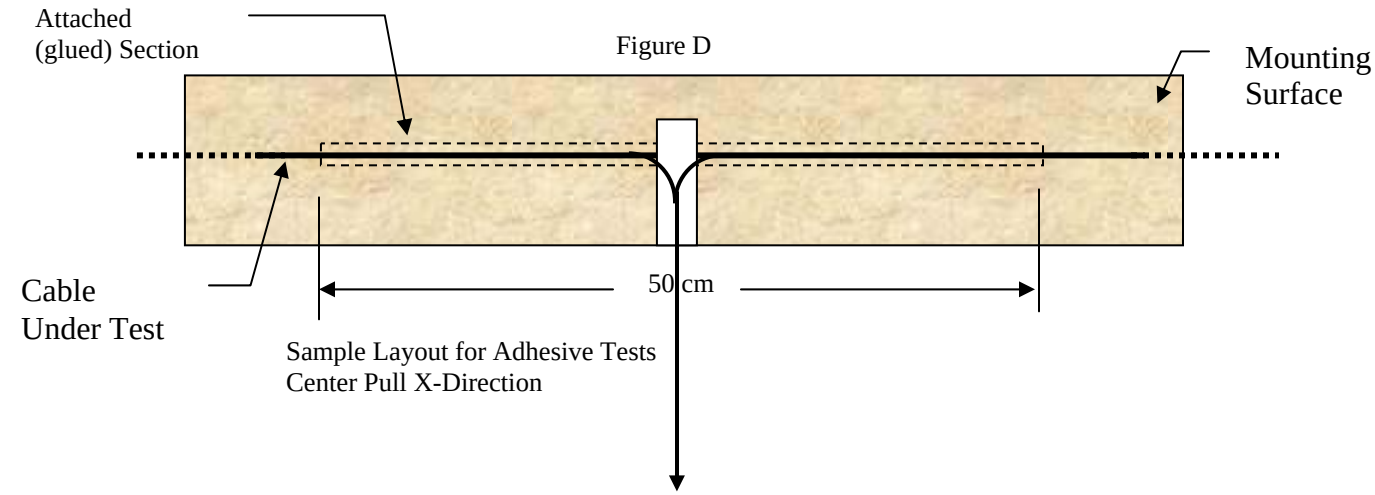


Figure D

Sample Layout for Adhesive Tests
Center Pull X-Direction

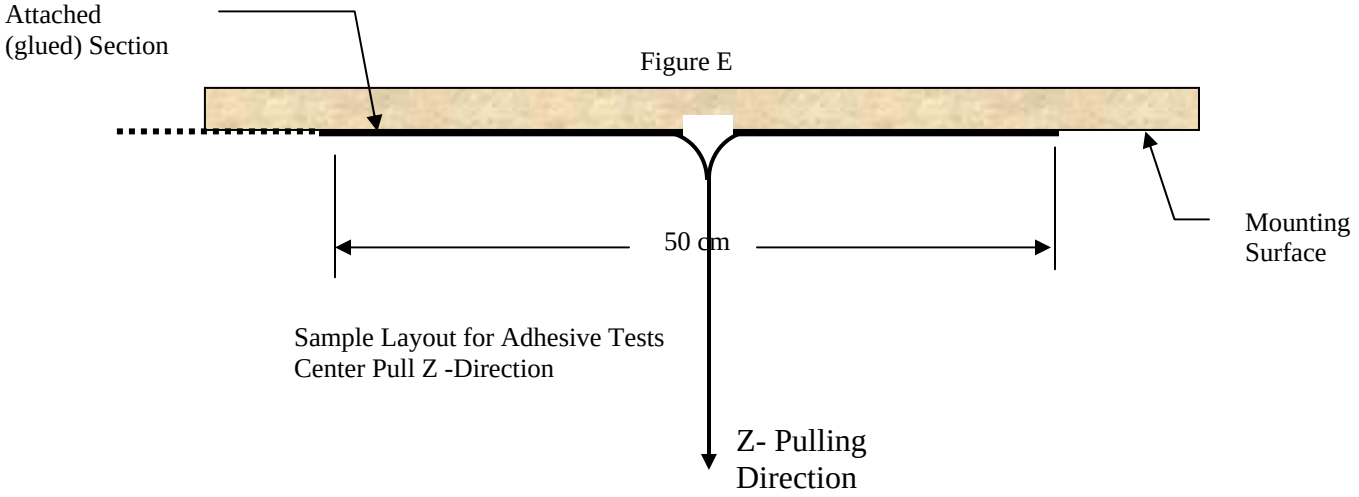


Figure E

Sample Layout for Adhesive Tests
Center Pull Z -Direction