Verizon NEBS™ Compliance: Generic Requirements for Outdoor Fiber Distribution Hubs (FDH's)

Verizon Technical Purchasing Requirements

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CHANGE CONTROL RECORD:

Version	Date	Action*	Reason for Revision
1	*10/4/2007*	New	New Document
2	*11/26/2007*	Change	Change to Title
3	*2/27/2008*	Change	Multiple changes throughout the document
4	*4/3/2008*	Change Add	Changed section 5.5.2 Environmental Vibration to include the phrase "Random Profile" and modified the reference in Section 5.4.14 Fire Resistance from GR-487 to GR-13 for the test method reference. Added RL requirement for Craftsperson interaction testing with a max change of 2dB.
* **New, Add, Delete, Change, Reissue**			

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Table of Contents

1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to provide FOC testing requirements for Outdoor Fiber Distribution Hubs (FDH's).

2.0 SCOPE

FOC Products

3.0 REFERENCES

Verizon FOC Memo #3 Rev #2, June 2006	Various Items related go GR-326, 3120, 771, 3125/21/23 and 3122
Verizon FOC Memo #17 Rev 1, June 27 2005	GR-3125 Punch List Requirements for Outdoor Fiber Distribution Hubs (FDH)
Verizon FOC Memo #17 Rev 1, June 28 2005	GR-3125 Punch List Requirements for Outdoor Fiber Distribution Hubs (FDH)
Verizon FOC Memo #17 Rev 2, July 7 2005	GR-3125 Punch List Requirements for Outdoor Fiber Distribution Hubs (FDH)
Verizon FOC Memo #17 Rev 2, July 7 2005 - Punchlist	GR-3125-CORE Outdoor FDH - Punchlist
Verizon FOC Memo #17 Rev 3, Nov 11 2005 - Punchlist	GR-3125-CORE Outdoor FDH - Punchlist
Verizon FOC Memo # 26	Notes and Information – Various GR's
Verizon FOC Memo # 36, March 26 2005	Executive Summary of 17 GR's
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM G154	Standard Practice for Operating Fluorescent Lightning Apparatus for UV exposure of Nonmetallic Materials
ETSI EN 300 019 1-4 V2.1.2 (2003-4)	Environmental Engineering: Environmental Conditions and Environmental Tests for Telecommunications Equipment
GR-20-CORE, Issue 2, July 1998	Generic Requirements for Optical Fiber and Optical Fiber Cables
GR-63-CORE, Issue 3, March 2006	NEBS™ Requirements: Physical Protection
GR-209-CORE, Issue 5, February 2006	Generic Requirements for Product Change Notices (PCNs)

GR-326-CORE, Issue 3, September 1999	Generic Requirements for Singlemode Optical Connectors and Jumper Assemblies
GR-409-CORE, Issue 1, June 1994	Generic Requirements for Premises Fiber Optic Cable
GR-449-CORE, Issue 2, July 2003	Generic Requirements and Design Considerations for Fiber Distribution Hubs
GR-454-CORE, Issue 1, December 1997	Generic Requirements for Supplier Provided Documentation
GR-487-CORE, Issue 2, March 2000	Generic Requirements for Electronic Equipment Cabinets
GR-769-CORE, Issue 1, October 1994	Generic Requirements for Organizer Assemblies
GR-771-CORE, Issue 1, July 1994	Generic Requirements for Fiber Optic Splice Closures
GR-1081-CORE, Issue 1, January 1995	Generic Requirements for Field Mountable Optical Fiber Connectors
GR-1209-CORE, Issue 3, March 2001	Generic Requirements for Passive Optical Components
GR-1221-CORE, Issue 2, January 1999	Generic Reliability Assurance Requirements for Passive Optical Components
GR-2866-CORE, Issue 1, June 1995	Generic Requirements for Optical Fiber Ribbon Fanouts
GR-2919-CORE, Issue 1, December 1996	Generic Requirements for Hybrid Optical/Splice Connectors for Single-mode Optical Fibers
GR-3125-Core, Issue 1, March 2006	Generic Requirements for Outdoor Fiber Distribution Hubs (FDH's)

4.0 ACRONYMS

A	After
B	Before
D	During
DUT	Device Under Test
FOC	Fiber Optic Components
IL	Insertion Loss
ITL	Independent Testing Laboratory
FDH	Fiber Distribution Hub

5.0 TEST REQUIREMENTS FOR OUTDOOR FIBER DISTRIBUTION HUBS (FDH'S)

Verizon is considering using Outdoor Fiber Distribution Hubs (FDH's) for all applications as required. The following are the test requirements for qualifying Outdoor Fiber Distribution Hubs (FDH's). All the testing must be completed by a Verizon approved ITL.

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
Optical Monitoring			OM - 24 fibers or 10% of the fibers, which ever is greater, No Concatenation unless other wise noted.
2. General Information			
2.1 Product Description			Provides general product description and use
2.2 Deployment Environments			Provides general description of OSP environment (-40C to +65C) 95% RH
2.3 Installation& Operating Environment			Installation (-18C to +40C), Operating (-30C to +40C)
2.3.1 Connector-Harsh Environment			Refers to GR-326, GR-1081, GR-1435, and GR-2919
2.4 Related Telcordia Documents			Includes other documents that might be helpful, GR-771, GR-950, GR-487 and GR-449
2.5 FDH Component Devices			Components must meet TPR's for 326, 2866, 1209, 1221, 20 and 409
3. General Requirements			
3.1 Documentation			
3.1.1 Practices			See GR-454
3.2 Marking, Packaging and Shipping	1 sample		
3.2.1 Identification			
3.2.1.1 General			Manufacturer. Name, Model, Date code, Network providers name and logo
3.2.1.2 Listing			Listed per NEC (National Electrical Code) NFPA70
3.2.2 Shipping Container			See GR-63.
3.2.3 Package Label			Same as 3.2. Also see GR-3125
3.3 Labels			See GR-499 section 12.1.3.1.C

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
3.4 Consumable Materials			See GR-3125
3.5 Product Change			See PCN GR-209
3.6 Safety and Reliability			No sharp objects or burrs or other hazards.
3.7 Installation Size and Weight			Can be assembled by a single trained person. If less than 48 fibers, less than 50 lbs.
3.8 Maintenance			Per GR-3125
3.9 Components			All fasteners shall be captive
3.10 Tools			No special tools shall be required
3.11 Quality			(TL9000)
3.12 Security			Per GR-3125
4. Functional Design Criteria			
4.1 Materials			
4.1.1 Metallic Materials		Includes testing in Sections 5.4.3 and 5.4.9	List of materials used available upon request, Threaded hardware shall be zinc-Plated per ASTM A 153, Should be corrosion resistant. No external coatings or wraps required for corrosion protection.
4.1.2 Polymeric and Other Non-Metallic Materials		5 - 2" x 2" samples per fluid	List of materials used available upon request, Materials shall be free of stress cracks, stripping, molting and texture color change after exposure to solvents. Materials shall be non-corrosive to metals. 94 V-1 Rated unless exterior housing, then 94-5VA

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
4.2 Cable Management			Access compartment must be secure. Cable entrance from two ports. Cables shall meet GR-20, 409. An FDH that is not full should accept other cables. Includes a Caution Marking if needed. Includes requirements for bonding and grounding
4.2.1 Cable Entrance Capacity			Min of 2 cable entrance ports (service provider and customer sides). One cable entrance port on top, bottom and each side.
4.2.2 Cable Compatibility			Capable of accepting any standard cable
4.2.3 Cable Termination Hardware			Per GR-3125
4.2.4 Bonding and Grounding Hardware		Includes testing in Section 5.2	Bonding and Grounding provision shall be addressed.
4.3 Service Provider Compartment			Splice organizer per GR-769, accept different splicing methods of single and ribbon fiber. Includes splice and bend radius protection 1.5 inches protection.
4.3.1 Splice Storage Capacity			Provide enough capacity for max fiber supported, Max capacity label shall be easily found on FDH
4.3.2 Fiber and Splice Protection			Per GR-3125
4.4 Connector Bulkhead			Minimum capacity 6 connections between service provider and customer. (O) For accepting modular packs of 6 or 12 connections. Connectors must met GR-326, 1081, 1435, 2919, pigtails shall meet GR-409
4.5 Fundamental FDH Requirements			

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
4.5.1 Deployment Configurations		Per GR-3125	▪ An aerial FDH shall accommodate pole, strand, or outdoor wall mount configurations. ▪ Pole-mounted FDHs equipped with cable stubs shall provide mechanical strain relief to the cable stub to permit shipping, handling, and hoisting of the box without causing damage to the box or stub. ▪ Stub pole or wall-mounted FDHs shall be capable of resisting the turning moment resulting from a uniform wind load as defined in Section 5.4.8. ▪ A safety strap attachment point shall be provided on pole-mounted, aerial FDHs. This safety strap attachment point shall withstand the specified test load of Section5.4.16 without permanent deformation of any cabinet components. ▪ A ground-level FDH shall accommodate pedestal, pad, or outdoor wall mount configurations.
4.5.3 FDH Mounting Hardware			Mounting shall be secure for frame and all interior components. Mount FDH as intended, Fully loaded, 600lbs on top of FDH, 1 hour, no damage. Must permit attachment to a handhole. Vapor barrier grommets provided, floor attachment to withstand 1000lbs pull
4.5.4 Door Restrainers			▪ FDH doors shall be equipped with a device that restrains the door(s) in the open position to facilitate craft/customer access. (FDHs may incorporate multiple open positions.) ▪ The door-restraining device shall be self-activating when the doors are opened and shall be released manually to close the doors. Door restrainers shall be designed to minimize audible “rattling” when

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
			in the engaged position. ▪ These door restraints shall be capable of resisting the opening and closing forces resulting from wind gust without mechanical damage or loss of function.
4.5.5 Drainage and Condensate			▪ FDHs shall provide a means for the drainage of condensate. Consideration shall be given in the design of the FDH to manage the flow of condensate away from the splice organizer assembly, connectors, and other optical components that may be present. ▪ The manufacturer shall provide instructions and procedures to prevent the formation of condensation on installed telecommunications equipment prior to turn-up and when the equipment is in operation. These procedures shall be documented in the FDH installation and maintenance practices.
4.5.6 Insect Resistance			Not allow entrance of insects or vermin, be replaceable,
4.5.7 Fire resistance			FDHs designed for use in the outside plant environment shall maintain internal temperatures that preclude ignition of equipment inside the box (cable, organizer splices, and optical components) when subjected to a simulated brush fire test. See the Fire Resistance Test in Section 5.4.14.
4.6 Finish		2 - 8" x 8" samples	Includes color requirements, paint adhesion, flexibility, gloss, and UV. See GR-3125.
5. Application-Specific Requirements			
5.1 General			Includes general information on Outdoor FDH use.
5.2 Electrical	2 Samples		Includes bond clamp retention. AC fault Test 1KA ac 20 sec
5.3 Mechanical Criteria			(See Mechanical Criteria Notes following table)

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
5.3.1 Cable Clamping	2 / Group A	IL - B/D/A	-30C +/-2C and 40C +/- 2C
5.3.2 Sheath Retention	2 / Group A	IL - B/D/A	100 lbs Distribution and OSP, 50lbs General Purpose; 1/2 hr; OM, (-30, +40C)
5.3.3 Cable Flexing	2 / Group A	IL - B/D/A	90 degree flexing for 8 cycles OM, (-30, +40C)
5.3.4 Cable Torsion**	2 / Group A	IL - B/D/A	10 cycles of torsion loading OM, (-30, +40C) **
5.3.5 Vertical Drop	2 / Group A		Follow GR-63 for packaged and unpackaged drop test.
5.3.6 Impact	2 / Group A		(-30, +40C) 100 ft-lbs pad mounted, 50 pole or wall mount (Top & Side) – Pendulum and Drop Tube (per GR-3125: Bowling Ball)
5.3.7 Central Member Protrusion	1 / Group A		100-lb pull @ 23C +/-5 RH 30-70%
5.4 Environmental Criteria			
5.4.1 Aging	2 / Group B		Seals and gaskets 30 days, 90C
5.4.2 Assembly	2 / Group B		(0C +40C)
5.4.3 Temperature/Humidity	2 / Group B	IL - B/D/A	30 days total (-40C to +65C), OM - B, D, A all wavelengths; See GR-3125
5.4.4 Weather Tightness	2 / Group B		Dust testing per GR-3125
5.4.5 Water Resistance	2 / Group B		**Ground level FDH (flood resistant):** 3 ft water head for 1 days, and maximum total accumulation of water in the FDH shall not exceed 1 cm3 (1 gram of water) per 0.028 m3 (1 ft3) of FDH volume. **Ground level FDH (rain resistant), Pole Mount or Aerial:** Subject to WDR per GR-3125
5.4.6 Wind Resistance Vertical Doors	2 Samples		See GR-487
5.4.7 Wind Resistance Horizontal Doors	2 Samples		See GR-487
5.4.8 Wind Resistance	2 Samples		See GR-3125

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
5.4.9 Corrosion Resistance	2 Samples		ASTM B117 Salt fog 30
5.4.10 Chemical Resistance	5 test bars per material		See GR-3125 for chemicals, 3 point test fixture, 30day @ ambient
5.4.11 UV	5 test bars per material		ASTM G-154 90 days or ASTM G-155 for 30 days.
5.4.12 Fungus	3 test plaques, 2 x 2 inches.		Fungus rating of zero from ASTM G-21
5.4.13 Firearms Resistance	1 Sample		12 gauge shotgun blast from 50 feet. See GR-487
5.4.14 Fire Resistance	1 Sample	IL B/A	Brush Fire - Visual Inspection and OM Before & After IL Readings (all wavelengths) on 24 fibers, see GR-13 for test method. Optical Performance Criteria: 0.05-dB change in IL per fiber for 90% of the fibers monitored and up to 0.15-dB channel (Test product as configured for Verizon – Splitters included)
5.4.15 Rodent Resistance	5 test bars per material		Rockwell hardness R-87
5.4.16 Pole Mounted FDH	2 Samples		See GR-487, 300-lb safety strap drop test
5.4.17 Lifting Details	2 Samples		See GR-487
5.4.18 Steam Resistance	2 Samples		14 day steam exposure, Conditional Requirement
5.4.19 Core Blocking	1 Sample		No evidence of water in cable after 10 foot water head for 14 days
5.5 Earthquake, Environmental Vibration, and Transportation Vibration			Optical Performance Criteria: 0.05-dB change in IL per fiber for 90% of the fibers monitored and up to 0.15-dB change in IL for 10% of the fibers monitored.

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
5.5.1 Earthquake	1 Sample	IL - B/D*/A	Visual inspection and OM @ four wavelengths see GR-63 zone 4, A Minimum of 24 fibers monitored for IL before and after; one fiber monitored @1625 nm for IL during the tests **(No concatenation)**. *Pad Mount* - Mount directly to table, *Pole mounted FDH on 9 inch steel pole (1/2 in thick) 6 feet off table to the base of FDH*
5.5.2 Environmental Vibration	1 Sample	IL - B/D*/A	ETSI EN 300 019 2-4 V2.2.2 (2003-4) Mechanical Class 4M5 – Random Profile.
5.5.3 Transportation Vibration	1 Sample	IL - B/A	See GR-63 Section 5.4.3 Random Transportation Vibration (see Table 5-4 and Figure 5-19). Visual inspection and OM @ four wavelengths, A Minimum of 24 fibers monitored for IL before and after; No con
5.5.4 Installation Shock	2 Samples		Not required if performed in section 5.3.5.2
5.6 Craft Interaction			Follow GR-449 for a concatenated network. See Section 5.4.3.4.
5.6.1 Front Plane Connector Disconnect and Reconnect	1 Sample	IL- B/D*/A RL – D*	See GR-449 OM before and after (1310, 1490. 1550, 1625), during 1625. Before and After IL readings with the combined IL increase of < 0.25 dB of adjacent connector ports. During the test, an IL increase of 1.5 dB is allowed and an increase of 2dB in RL is allowed.
5.6.2 Rear Plane FOT Jumper Disconnect, Adaptor replacement	1 Sample	IL- B/D*/A RL – D*	See GR-449 OM before and after (1310, 1490. 1550, 1625), during 1625. Before and After IL readings with the combined IL increase of < 0.25 dB of adjacent connector ports. During the test, an IL increase of 1.5 dB is allowed and an increase of 2dB in RL is allowed.

FOC Test Plan for Outdoor Fiber Distribution Hubs (FDHs) – based on GR-3125			
Name	**Samples**	**Optical Monitoring**	**Comments**
Verizon Special Test: GR449 Fiber Accessibility: Handling Test - OM	2 Sample	IL - B/D*/A	This test looks at the result of accessing fiber on products with multiple splice trays. For example if there is a product that has three splice trays, are the customers on splice tray one effected if the craft has to access splice tray three. 50 cycles of handling with OM - IL 1625 wavelength before, during and after 1 sample at -5C and +40C. Applies only to closures with splice trays. 200 ms sweep rate needed. Concatenation using one fiber.
6. Component Qualification			
6.1 Components			Connectors GR-326, Fanouts GR-2866, Splitters (GR-1209, 1221), Cable (GR-20, 409)

Optical Measurements

B & A – Before and After	IL Testing @ (1310, 1490, 1550 and 1625nm)
D – During	IL Testing @ (1310, 1490, 1550 and 1625nm)
D* - During (1 wavelength)	IL Testing @ 1625nm (200ms sweep rate) Concatenation using one fiber RL is also to be performed for craftsperson interaction testing only – max change of 2dB.

Configurations –

- The allowable IL deltas of a connection consisting of several series optical components is a function of the DUT and is dependent on the number and types of series optical component in the monitoring path (Environmental Testing, Vibration). For these situations, the insertions loss criteria are defined as equal to the sum of the individual allowable IL deltas of each series device. For example, during temperature cycling, the IL criteria of a monitored path that consists of a series connection of a connector, splitter, and length of cable (assuming IL connector = 0.3 and IL splitter = 0.2dB) shall be IL (0.3 + 0.2 + 0.05 or 0.55) dB for 90% of monitored fibers and (0.3 + 0.2 + 0.15 or 0.65) dB for the remaining 10% of the fibers The allowable change in IL per fiber is dependent on the number and types of series component in the monitoring path. The allowable IL deltas of a connection consisting of a number of series optical components are equal to the sum of the individual allowable IL deltas of each series device
- Optical Monitoring is required before, during and after many of the environmental and vibration tests. Due to limitations in test system repeatability, the insertion loss criteria has been defined for many of the test as 0.05 dB on each monitored fiber with 10% of the fibers not measuring a change greater than 0.15 dB

Sample Configurations

2 products per group

Mechanical Testing Requirements: (Section 5.3)

Number of Fibers to Monitor

Use the same number as required for temperature and humidity testing which is 24 fibers monitored up to 144 fiber capacity, 42 fibers monitored up to 432 fiber capacity and 10% of fibers monitored for capacities over 432 fibers. Capacity is the size of the cabinet. If feeder cables do not have the required number of fibers, monitor all fibers available in the feeder cable that are connected to the rear plane of the connector field for factory stubbed units or all feeder fibers that can be spliced in non-factory stubbed units.

Location of Fibers to Monitor

For ribbon cables use the layout shown in Figure 6-2 of GR-771 where fibers are selected in the corners, along the edges and in the center of the stack of fiber ribbons, with 2 fibers located in the center of small cables and 4 in the center of cables with 24 or more fibers to be monitored. For cables with buffer tubes select most of the fibers evenly distributed throughout the buffer tubes located in the outer areas of the cable with 2 fibers located in the center buffer tubes of small cables and 4 in the center buffer tubes of cables with 24 or more fibers to be monitored.

Optical Criteria

Individual fibers are to be monitored at 1310, 1490, 1550 and 1625 nm before, during and after the application of mechanical stress at the required temperatures. The maximum change in insertion loss allowed is 0.05dB/fiber for 90% of the fibers monitored and 0.15dB/fiber for 10% of fibers monitored. If necessary, hold the stress condition as required to collect at least 2 data points for during measurements.

Optional Test Method

Concatenated circuits up to 24 fibers may be monitored but the optical criterion is not increased above that allowed for single fiber circuits. Circuits with 20 to 24 fibers can have no more than 0.15dB total change in insertion loss and circuits with 10 to 19 fibers can have no more than 0.10dB total change in insertion loss. Circuits with less than 10 fibers can have no more than 0.05dB change in insertion loss. RL changes of no more than 2dB are allowed. More than one concatenated circuit will be used to monitor the required number of fibers when that number is greater than 24.

Method of Concatenation

Fusion splices will be used at the end of the cable outside the cabinet to join fibers on that end, including the launch and detect pigtails. For field-installed cables, fusion splices will be used inside the cabinet to complete the concatenated circuit. In order for standard, factory stubbed products to be tested; jumpers will be used on the front plane to complete the circuit.

****Cable Torsion:** Mount the closure used in the cable flex test in a fixture, which restrains the closure and permits rotation of the cable at a distance of 1 m ± 0.03 m (39 in ±0.5 in) from the closure/cable interface. Additionally, ensure the cable is restrained at a distance of 4 meters ± 0.03 m from the point of torsion application. (See GR-771, Section 6.3.4; Figure 6-5 for further information).

Notes:

- Groups are to be tested in sequence, top to bottom.
  Assumes GR-326 Connector, Assumes GR-20 Cable