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

Verizon Technical Purchasing Requirements

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CHANGE CONTROL RECORD:

Version	Date	Action*	Reason for Revision
1	*10/8/2007*	New	New Document
2	*4/3/2008*	Change Add	Modified Section 5.5.2 Environment Vibration to include a new vibration profile Added RL requirement for Craftsperson interaction testing with a max change of 2dB.

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

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1.0 PURPOSE

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

2.0 SCOPE

FOC Products

3.0 REFERENCES

Verizon PFOC Memo #3 Rev #2, June 2006	Various Items related go GR-326, 3120, 771, 3125/21/23 and 3122
Verizon PFOC Memo #26	Notes and Information – Various GR's
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-771-CORE, Issue 1, July 1994	Generic Requirements for Fiber Optic Splice Closures
GR-950-CORE, Issue 2, December 1998	Generic Requirements for Optical Network Unit (ONU) 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-1435-CORE, Issue 1, October 1994	Generic Requirements for Multi-Fiber Optical Connectors
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-3121-Core – Issue 1, March 2006	Generic Requirements for Below-Grade Fiber Distribution Hubs (FDH's)
GR-3125-Core, Issue 1, March 2006	Generic Requirements for Outdoor Fiber Distribution Hubs (FDH's)
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM G154	Standard Practice for Operating Fluorescent Lightning Apparatus for UV exposure of Nonmetallic Materials

4.0 ACRONYMS

A	After
B	Before
D	During
FOC	Fiber Optic Components
IL	Insertion Loss
ITL	Independent Testing Laboratory
FDH	Fiber Distribution Hub
OM	Optical Monitoring

5.0 TEST REQUIREMENTS FOR BELOW-GRADE FIBER DISTRIBUTION HUBS (FDH'S)

Verizon is considering using Below-Grade Fiber Distribution Hubs (FDH's) for all applications as required. All testing is to be performed per GR-3121-CORE: Generic Requirements for Below-Grade Fiber Distribution Hubs (FDH's) with the exceptions listed below. All the testing must be completed by a Verizon approved ITL.

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**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 +50C @ 95% RH)
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			
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-3121
3.3 Labels			See GR-449 section 12.1.3.1.C
3.4 Consumable Materials			See GR-3121
3.5 Product Change			See PCN GR-209
3.6 Safety and Reliability			No sharp objects or burrs or other hazards.

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
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-3121
3.9 Components			All components shall be captive
3.10 Tools			No special tools shall be required
3.11 Quality			(TL9000)
3.12 Security			Per GR-3121
4. Functional Design Criteria			
4.1 Materials			
4.1.1 Metallic Materials		Includes testing in Sections 5.4.7	List of materials used available upon request, Threaded hardware shall be 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.
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-3121
4.2.4 Bonding and Grounding Hardware		Includes testing in Section 5.2	Bonding and Grounding provision shall be addressed.

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
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-3121
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			
4.5.1 Deployment Configurations		Per GR-3125	Locked in place, below ground storage and above ground maintenance
4.5.2 Optical Power Monitoring			Shall be provided without service interruption
4.5.3 FDH Mounting Hardware			Mounting shall be secure for frame and all interior components. Mount FDH as intended, Fully loaded, 300lbs on top of FDH, 1 hour, no damage. Must permit attachment to a handhole. Vapor barrier grommets provided, floor attachment to withstand 1000lbs pullout force for 10 minutes. Wall attachment, min pull force of 2000lbs for 10 min.
4.5.4 Door Restrainers		Includes testing in Sections 5.4.5 and 5.4.6	Self-activating door restrainers must be provided and meet the wind resistance requirements.
4.5.5 Insect Resistance			not allow entrance of insects or vermin, be replaceable, max hole size of 1/8 inch (3mm)
4.6 Finish		2 - 8" x 8" samples	Includes color requirements, paint adhesion, flexibility, gloss, Illumination and UV. See GR-3121.
5. Application-Specific Requirements			

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
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)
5.3.1 Cable Clamping	2 / Group A	IL - B/A: Min	-30C +/-2C and 40C +/- 2C
5.3.2 Sheath Retention	2 / Group A	IL - B/D/A: Min	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: Min	90 degree flexing for 8 cycles OM, (-30, +40C)
5.3.4 Cable Torsion**	2 / Group A	IL - B/D/A: Min	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 Resistance	2 / Group A		(-30, +40C) 100lbs Pendulum & Drop, Top & Side
5.3.7 Central Member Protrusion	2 / 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		Assembled at temperatures of 0°C ± 2°C and 40°C ± 2°C
5.4.3 Temperature/Humidity	2 / Group B	IL - B/D/A: Min	30 days total (-40C +/-2C uncontrolled RH to +65C +/-2C @ 95%RH), Minimum of 24 fibers OM at (1310, 1490, 1550, 1625nm) max change 0.05dB/fiber 90% of fibers tested remaining 10% not greater than 0.15dB. FDH must be fully loaded. (A separate out of sequence sample can be used for OM. An empty sample can be used for the sequence tests)

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
5.4.4 Water Resistance	2 / Group B	N/R	1 ft water around all sides, 20 ft water head for 7 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.
5.4.5 Wind Resistance Vertical Doors	2 Samples		See GR-487
5.4.6 Wind Resistance Horizontal Doors	2 Samples		See GR-487
5.4.7 Corrosion Resistance	2 Samples		ASTM B117 Salt fog 30 or 60 days
5.4.8 Chemical Resistance	5 test bars per material		See GR-3121 for chemicals, 3 point test fixture
5.4.9 UV	5 test bars per material		ASTM G-154 90 days or ASTM G-155 for 30 days, followed by tensile testing.
5.4.10 Fungus	5 test bars per material		Fungus readings guide: #0 - ok pass; #1 SIT to review pictures; and #2 and above - replace the plastic. (ASTM G-21)
5.4.11 Rodent Resistance	5 test bars per material		Rockwell hardness R-87
5.4.12 Compression	2 Samples		300 lbs for 1 hour on top of FDH, FDH fully loaded
5.4.13 Lifting Details	2 Samples		See GR-3121
5.4.14 Operational Movement	2 Samples		FDH and all mechanisms, shall withstand, without damage, 500 operations from the fully stored and maintenance positions.

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
5.4.15 External Icing	2 Samples		NEMA 250, section 5.6 (External Icing), while in stored position. Must be able to access after.
5.4.12 Steam Resistance	2 Samples		14 day steam exposure, Conditional Requirement
5.4.13 Core Blocking	2 Samples		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.
5.5.1 Earthquake	2 Samples	IL - B/D*/A: Min	Visual inspection and OM @ four wavelengths see GR-63 zone 4, Visual inspection and OM @ four wavelengths, A Minimum of 24 fibers monitored for IL before and after; one fiber monitored @1625 nm for IL during the tests; No concatenation.
5.5.2 Environmental Vibration	2 Samples	IL - B/D*/A: Min	ETSI EN 300 019 2-4 V2.2.2 (2003-4) Mechanical Class 4M5 – Random Profile.
5.5.3 Transportation Vibration	2 Samples	IL - B/D*/A: Min	GR-63, Issue 3, Section 5.4.3 - Transportation Vibration on packaged product. Visual inspection and OM @ four wavelengths, A Minimum of 24 fibers monitored for IL before and after; one fiber monitored @1625 nm for IL during the tests; No concatenation.
5.5.4 Installation Shock			GR63 section 5.3.2
5.6 Airborne Contaminants	2 Samples		See GR-63. Waived if acceptable results for salt fog
5.7 Craft Interaction			Follow GR-449 for a concatenated network. See Section 5.4.3.4.

FOC Test Plan for Below-Grade Fiber Distribution Hubs (FDHs) – based on GR-3121			
Name	**Samples / Group**	**Optical Monitoring**	**Comments**
5.7.1 Front Plane Connector Disconnect and Reconnect	2 Samples	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.
5.7.2 Rear Plane FOT Jumper Disconnect, Adaptor replacement	2 Samples	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.
GR449 Fiber Accessibility Handling Test - OM	2 Samples	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 2 Samples at -5C and +40C. Applies only to closures with splice trays. 200 ms sweep rate needed. Concatenation using one fiber. See Note: 3, 4
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 closure/cable interface. (See GR-771, Section 6.3.4; Figure 6-5 for further information).

Notes:

- Groups are to be testing in sequence, top to bottom.
  Assumes GR326 Connector, Assumes GR20 Cable