



**Verizon NEBS™ Compliance: Freeze/Thaw
Test Setup and Procedure**
Verizon Technical Purchasing Requirements
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Table of Contents

1.0	PURPOSE	5
2.0	SCOPE	5
3.0	REFERENCES	5
4.0	ACRONYMS	5
5.0	TEST SETUP AND PROCEDURE FOR FREEZE/THAW TEST	5



1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to provide test setup and procedure for Freeze/Thaw Test.

2.0 SCOPE

FOC- Outside Plant Products

3.0 REFERENCES

FOC Memo#7	Freeze Thaw Test Procedures for GR-771 (Closures/Terminals) - Below Grade
FOC Memo#7 Rev 1	, Freeze Thaw Test Procedures for GR-771 (Closures/Terminals) - Below Grade
FOC Memo #7 rev 2	FOC Memo #7 rev 2 2005

4.0 ACRONYMS

DUT	Device Under Test
FOC	Fiber Optic Components
ITL	Independent Testing Laboratory
SIT	System Integration & Testing
UTS	Universal Test Sets

5.0 TEST SETUP AND PROCEDURE FOR FREEZE/THAW TEST

The objective of the freeze thaw test is to evaluate the ability of a fiber optic closure to be used in a buried handhole environment. In normal environments, handholes become flooded and in many areas the water in the handhole will freeze. The test is intended to have the fiber optic closure mounted as intended in the smallest handhole that may be used by the service provider for that size fiber optic closure. The handhole is to be mounted in a tank filled with sand to simulate installation in the earth; the handhole and sand are filled with water. The freeze thaw cycles are



intended to place reasonable stresses on the product as it may encounter in the field. It is also intended that the freeze take place from the top down as might be seen in the field.

Samples:

Two closure samples shall be tested.

Handhole Selection and Sample Preparation:

The Closure using the Optical Connectors and or Cables deployed in the field by a service provider or recommended by the installer shall be mounted as shown in Figure 3 in a handhole that represents one that is deployed in the field by a service provider. If there is more than one type or size of handhole being used by the service provider, the worst case (i.e. the smallest size handhole that the closure can fit into) shall be selected for testing. The closure with optical cables shall be placed in the handhole following the procedures specified by the closure or handhole manufacturer and consistent with service provider installation practices. There shall be at least two inches of water space between the closure and the handhole sides and top. The optical cable and required thermocouples shall exit the handhole using the ports, if provided, in the handhole. The handhole shall be filled with normal tap water up to two inches from the top of the handhole when measured from the bottom of the handhole cover. The device under test shall be immersed with at least two inches of water on all sides of the samples being tested. The top cover of the handhole shall be removed.

The handhole shall be supported in a rigid manner so that the handhole is not damaged during the freeze thaw cycle. This may be accomplished by bracing the handhole in another closure with sand bracing, etc. This can be accomplished by placing the handhole into a larger container (stock watering tank for example) where there is a minimum of four inches of R-36 insulation below the bottom of the tank (to retard rapid freezing from the bottom-up). Two inches, minimum, of space shall be between the sides of the handhole and the sides of the water tank using sand to fill between the handhole and the sides of the water container. Metal panels may be placed so as to protrude from the sand-water areas to promote more rapid freezing and thawing at the top of the handhole. The cover of the handhole shall be removed as to not cause damage to the handhole. The sides of the tank used for testing shall be provided with a minimum of four inches insulation in order to achieve a R-36 rating to help promote top-down freezing. If provided with unterminated ("spare") optical connectors the test requires placing any additional cables containing optical connectors such that the connectors are close to, but not below, the Closure so that the connectors will be in the same "frozen water" zone as the enclosure. Plugs or seals shall be provided to restrict the sand from entering the handhole. Conduit may be placed in the handhole to facilitate optical cable entrance and removal from the test set-up. The product under test shall be rigidly fixed to the handhole. If the handhole is provided with a swing arm the swing arm shall be made secure so that it does not move during testing. If no swing arm is provided the fiber optic closure shall be mounted in the mid-point of the sidewall of the closure. If multiple closures are being tested in the same handhole, the closures may be placed in close



proximity to one another providing that two inches of water surrounds all the perimeter areas of the group.

Note: If the water container is placed directly on the floor of an environmental chamber, four inches of R-36 of insulation is optional under the water container.

The handhole and equipment inside should be in its installed operating condition and is now ready for testing. The next step is to establish the freeze thaw cycle.

Cycle Profile:

The freeze/thaw cycle shall follow the profile shown in figure 2 and shall be controlled using thermocouples in the area of the test sample to insure complete freezing and thawing of water around the test sample. The cycle time is a function of the volume of water and the time it takes the water to freeze and thaw. Different size handholds will accommodate different volumes of water that will determine the freeze thaw cycle. Therefore, the actual cycle based on the figure will vary for different size handholds. For example, a larger handhole will have a longer T_0 to T_1 time than a smaller handhole. Test times for T_2 to T_3 and T_5 to T_6 of the cycle are fixed at two hours. The initial freeze from room temperature to the first -5 degrees C will take the longest time. Once the samples have been through one freeze and thaw cycle, subsequent freeze cycles should be shorter, while the thawing part of the cycle should remain the same. So the only change in subsequent freeze thaw cycles after the initial cycle is the freeze time from time T_0 to T_1 . The figure with the temperatures noted was developed to aid in reducing the total time of the test without placing undue stress on the products under test. It is allowed to control the humidity of the system if needed. Water may need to be added during testing to compensate for evaporation during the thaw cycle in order to keep the overall water level constant at 2 inches below the handhole cover.

Figure 2 provides an example of how to program the temperature chamber for this test. The test requirement for conditioning is that a freeze is defined at - 5 degrees C and a thaw is defined at +5 degrees C. This is noted in Figure 2 as **Required DUT Thermocouple Temperature**.

Thermocouples to Identify Freeze/Thaw:

Thermocouples shall be used to determine when the water is frozen and when it is thawed. The thermocouple readings will be used to determine the length of time for components of the freeze thaw cycle. Therefore, the test set-up should have the thermocouple readings used to drive the temperature controller of the test chamber.

Four thermocouples shall be placed in a horizontal plane coincident with the bottom (or lowest) surface of the closure under test with one thermocouple located in each of the four locations along the center of both sides and both ends and shall be spaced one inch from the closure. A fifth thermocouple shall be placed one inch below and located at the center of the bottom of the closure under test. Freezing is considered to occur when all thermocouples reach -5 degrees C.



Once freezing occurs, the samples shall then be kept at -5 degrees C or colder (as measured by the thermocouples) for 2 hours. The sample shall then be thawed. Thaw is considered to occur when all thermocouples reach +5 degrees C. After thaw the samples shall be kept at +5 degrees C or higher (as measured by the thermocouples) for 2 hours. This is considered one freeze thaw cycle of the required ten freeze thaw cycles.

Number of Cycles:

The samples under test shall be subjected to the required ten freeze thaw cycles.

Optical Monitoring:

The closure samples under test shall be optically monitored before, during, and after testing at 1625 nm for Insertion Loss that shall not change by more than plus or minus 0.3 dB per fiber.

End of Test Examination:

No water is allowed inside the Closure as a result of the freeze thaw exposure. Examination shall be after the 10 freeze thaw cycles.

System Calibration:

Five thermocouples and sample product shall be as shown in Figure 1 to determine of a proper top down freeze is being obtained. The thermocouples shall freeze in numerical order 1 to 6. These thermocouples shall be used on each test set-up even if multiple tanks are being used within a test chamber. They need not be included in the actual test.

**FREEZE-THAW:
HANDHOLE TEMPERATURE CALIBRATION**

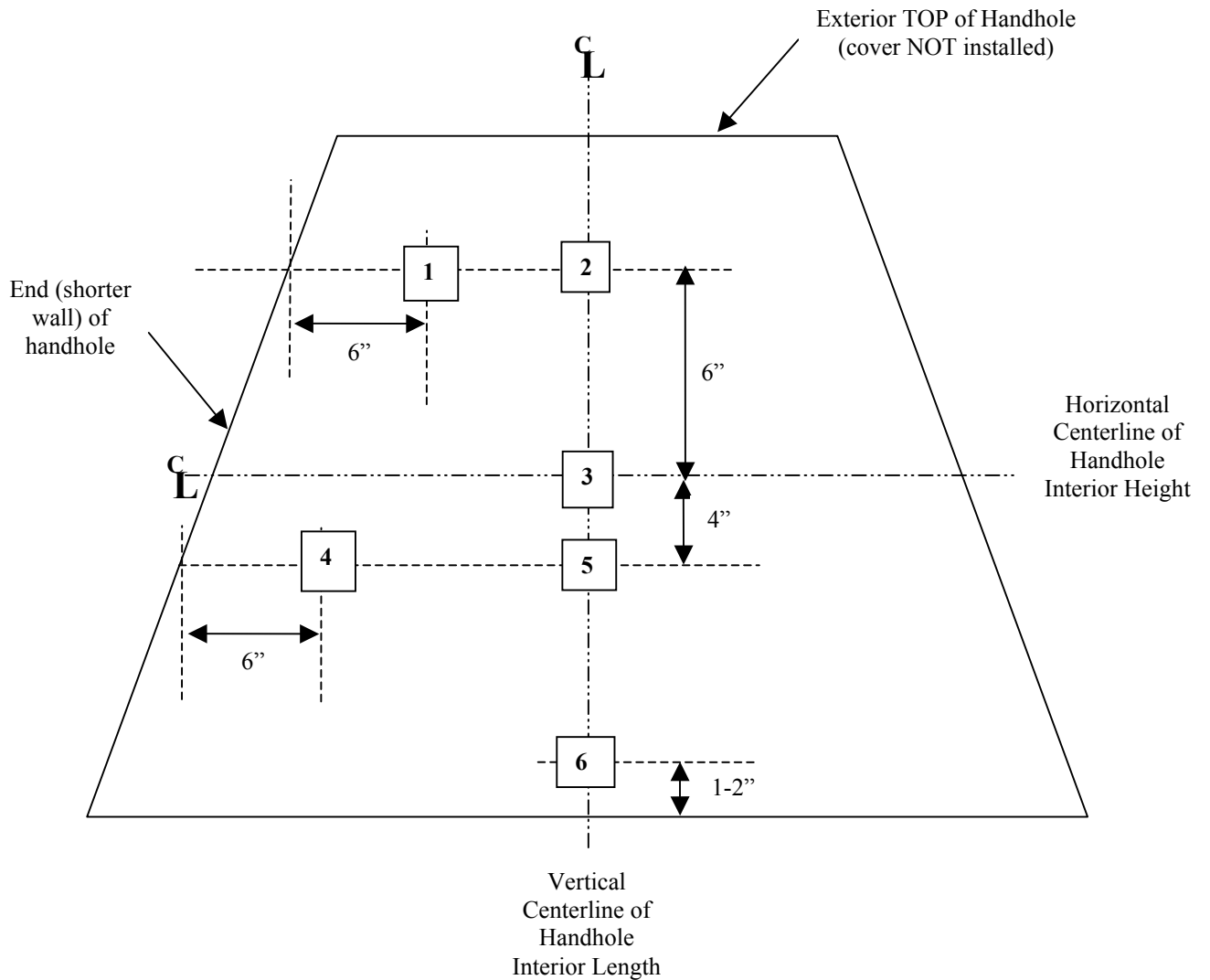


Figure 1 - Freeze/Thaw Calibration



Locations of Thermocouples:

- Thermocouple #1 is located 6” directly above the intersection of the centerlines of the handhole interior height, length and width. Thermocouple #2 is at the intersection of handhole interior height, width, and length.
- Thermocouple #3 is located 4” directly below thermocouple #2.
- Thermocouple #4 is located directly below thermocouple #3 and is 1” to 2” above the bottom/base of the handhole.
- Thermocouple #5 is located 6” from one interior end (shorter wall) of the handhole directly opposite from thermocouple #1.
- Thermocouple #6 is located 6” from one interior end (shorter wall) of the handhole directly opposite from thermocouple #3.
- Thermocouple #1 thru #5 shall freeze in numerical order. Freeze is defined for the calibration at -2 degrees C for 2 hours.
- Thermocouple #6 shall not freeze.

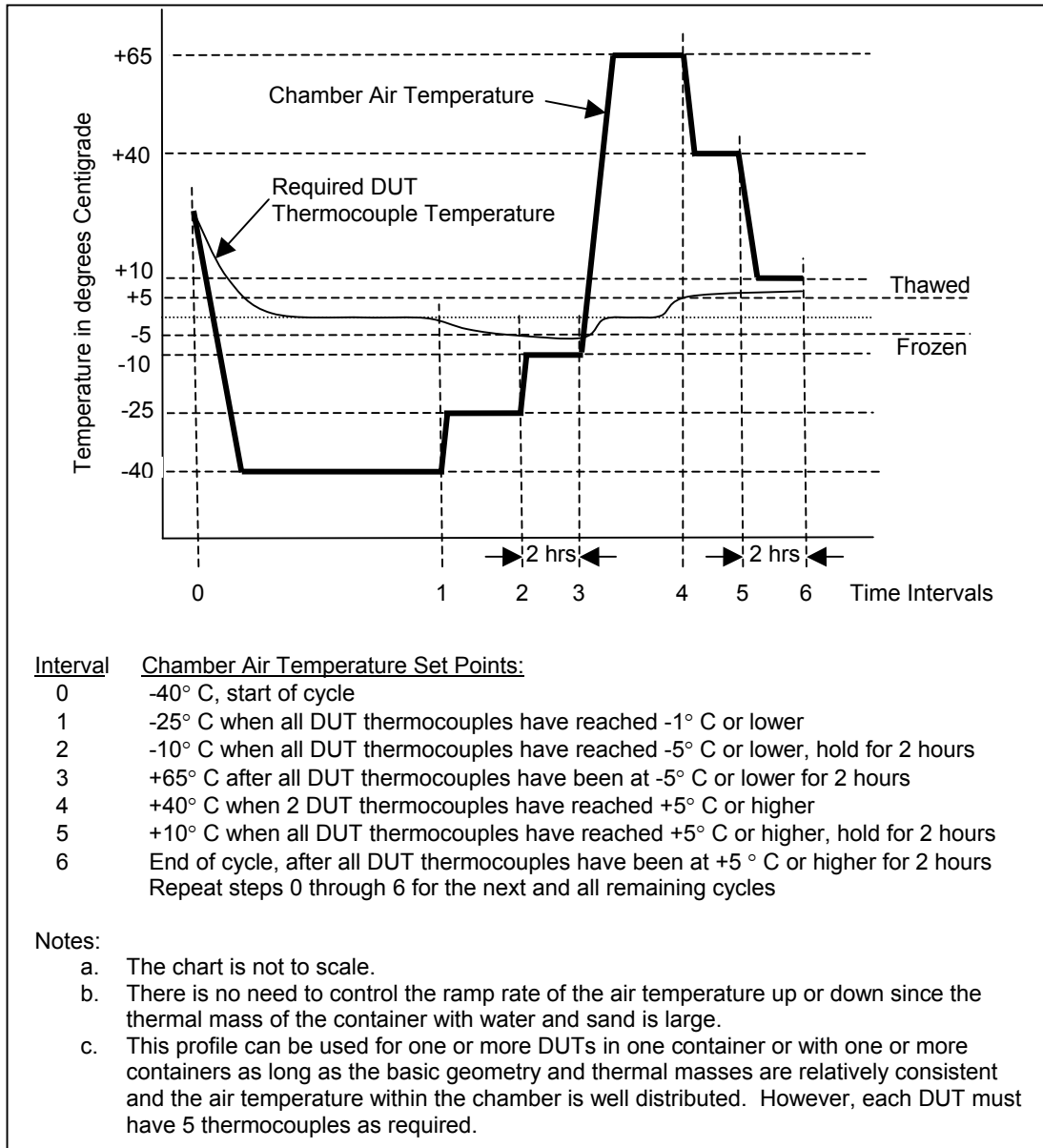


Figure 2 - Freeze/Thaw Cycle

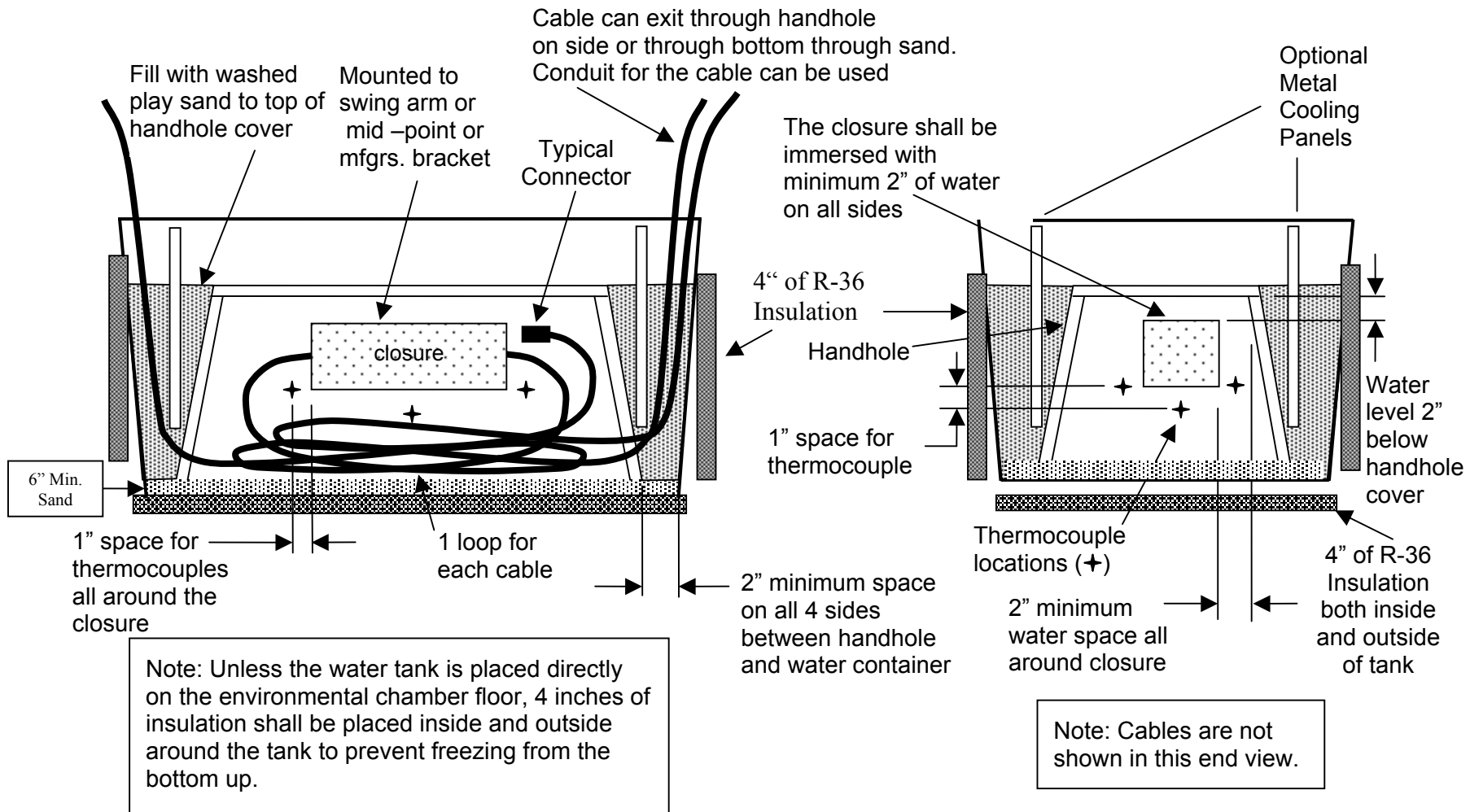


Figure 3 -Freeze Thaw Test Set-Up