

1. Scope

This specification covers the technical requirements for formulation, production, installation and testing of high-strength and low-strength fluidized thermal backfill (FTB) used in the construction of encased electrical power conduits (duct banks).

2. Reference Standards

Unless otherwise stated in this specification, fluidized thermal backfill shall comply with the latest revisions of the following standards:

District Standards

T&D Guideline 4-24-6.0 Encasement of Non-Metallic Conduit

Industry Standards

ASTM C31/C31M - 08a Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C33-07 Standard Specification for Concrete Aggregates

ASTM C39/C39M - 05e1 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C94/C94M - 07 Standard Specification for Ready-Mixed Concrete

ASTM C136 - 06 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C143/C143M - 08 Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C150 - 07 Standard Specification for Portland Cement

ASTM C172 - 08 Standard Practice for Sampling Freshly Mixed Concrete

ASTM C595 - 08 Standard Specification for Blended Hydraulic Cements

ASTM C618 - 08 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C989/C989-18a Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1157 - 08 Standard Performance Specification for Hydraulic Cement

IEEE 442 Guide for Soil Thermal Resistivity Measurements

3. General

Fluidized thermal backfill (FTB) is used to encase and cover medium or high voltage underground cables. FTB has a lower thermal resistivity than conventional concrete or controlled density fill (CDF) which allows power cables to run at higher ampacities without exceeding their temperature rating.

3.1 Low-Strength FTB

Low-strength FTB, like CDF, is used wherever a flowable, self-compacting backfill is required. With a maximum compressive strength of 150 psi, low-strength FTB may be easily excavated but provides little mechanical protection.

3.2 High-Strength FTB

High-strength FTB is equivalent in strength to 4,000 psi concrete and provides a very high level of mechanical protection. In general, high-strength FTB is more thermally conductive than low-strength FTB.

4. Mix Design

4.1 Low-strength and high-strength mix designs given in Table 4.1 may be used by any ready-mix concrete supplier to produce District approved FTB mixes. Alternate mixes are allowable provided the mix meets the requirements of Table 5.1 via laboratory tests outlined in Section 8.

Table 4.1-District Approved FTB Mix Designs		
Component	Low-Strength	High-Strength
Medium Aggregate	1,800 lb/yd ³	1,515 lb/yd ³
Fine Aggregate	1,400* lb/yd ³	1,422* lb/yd ³
Medium/Fine Ratio	56/44 %	52/48 %
Fluidizer	300 lb/yd ³	100 lb/yd ³
Portland Cement	50 lb/yd ³	520 lb/yd ³
Water	305 lb/yd ³	360 lb/yd ³
Red Dye	5-10 lb/yd ³	5-10 lb/yd ³
*may be adjustable for unit yield		

4.2 Medium aggregate shall meet ASTM C33-07 grading requirement for number 8 aggregate.

4.3 Fine aggregate shall meet ASTM C33-07 sieve analysis requirements for fine aggregate.

4.4 Fluidizer shall be Class F fly ash per ASTM C618-05. Class C fly ash is not acceptable.

4.5 Portland Cement shall be type I per ASTM C150-07.

4.6 Water, as required, shall be clean and potable.

4.7 Total air content of any FTB mix shall not exceed 2% by volume.

4.8 Admixtures

4.8.1 The District requires the use of non-chloride accelerators:

4.8.2 No air entraining admixtures may be used under any circumstance.

5. FTB Properties

FTB mechanical and thermal property benchmarks are listed in Table 5.1.

Table 5.1-Mix Design and Field Test FTB Properties				
Property	Low-Strength FTB		High-Strength FTB	
	Mix Design*	Field Test	Mix Design*	Field Test
Thermal Resistivity — Maximum at 0% Moisture Content	100 (C°-cm)/W	110 (C°-cm)/W	75 (C°-cm)/W	75 (C°-cm)/W
Thermal Resistivity — Maximum at Critical Moisture Content	70 (C°-cm)/W @ 3% moisture content	80 (C°-cm)/W @ 3% moisture content	60 (C°-cm)/W @ 2% moisture content	65 (C°-cm)/W @ 2% moisture content
Minimum 28-day Compressive Strength	none	none	3,000 psi	3,000 psi
Maximum 28-day Compressive Strength	100 psi	150 psi	none	none
Minimum Slump	4 in	4 in	4 in	4 in
Maximum Slump	6 in	6 in	6 in	6 in

*Mix design properties are equal to or stricter than field test criteria because of expected variation among production batches.

6. Placement

FTB shall be placed per District T&D Guideline 4-24-6.0, Encasement of Nonmetallic Conduit.

7. Delivery

Each truckload of FTB shall include a Manufacturer's Certificate of Compliance and delivery ticket. The ticket shall include:

- Delivery location.
- Quantity of water added to mix after batching.

8. Testing

Testing for thermal resistivity and/or compressive strength may be required. All testing will be performed by a District approved testing laboratory in accordance with IEEE 442 and ASTM C39.