



REPUBLIC OF THE PHILIPPINES  
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
OFFICE OF THE SECRETARY  
MANILA

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DEPARTMENT ORDER )  
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No. **26** )  
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Series of 2017 *23.03.17* )

**SUBJECT: DPWH Standard Specification for  
ITEM 728 – High Flow Epoxy  
Mortar for Submerged and Wet  
Concrete Structures**

In line with the mandate of the Department in providing effective standard specifications in the implementation of various infrastructure projects and in view of the need of setting a standard specification for high flow epoxy mortar for submerged and wet concrete structures, the attached **DPWH Standard Specification for Item 728 – High Flow Epoxy Mortar for Submerged and Wet Concrete Structures** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II, 2012 Edition.

This Order shall take effect immediately.

  
**RAUL C. ASIS**

Undersecretary for Technical Services  
Officer-In-Charge

Department of Public Works and Highways  
Office of the Secretary



WIN7U01438

14.1.2 FET/RPF

## **DPWH STANDARD SPECIFICATION FOR ITEM 728 - HIGH FLOW EPOXY MORTAR FOR SUBMERGED AND WET CONCRETE STRUCTURES**

### **728.1 Description**

This item shall consist of repairing and re-casting of severely damaged reinforced concrete structures, in wet or submerged conditions such as pile, footing of pier and bottom of pile cap using High Flow Epoxy Mortar in accordance with these Specifications and as indicated on the Plans.

### **728.2 Material Requirements**

The high flow epoxy based mortar is characterized by good mechanical properties and adhesion both in dry, wet and underwater conditions. It shall be composed of three-component polymer grout consisting of modified epoxy resin, modified amine hardener and properly formulated aggregates.

#### **728.2.1 High Flow Epoxy Mortar Properties**

The supplier shall provide copies of certified tests of all the properties of high flow epoxy mortar for submerged and wet concrete structures being tested complying with the requirements of the ASTM standards as shown on Table 1.

Table 1 – Properties of High Flow Epoxy Mortar for Submerged and Wet Concrete Structures

<b>PROPERTY</b>	<b>TEST METHOD</b>	<b>UNIT</b>	<b>SPECIFICATION</b>
Specific Gravity	ASTM D 792	-	1.8 ± 0.2
Potlife	-	min.	40 Min
Consistency	-	-	Flowable
Compressive Strength	ASTM D 695	N/mm <sup>2</sup>	50 Min
Modulus of Elasticity	ASTM D 695	N/mm <sup>2</sup>	5000 Min
Flexural Strength	ASTM D 790M	N/mm <sup>2</sup>	20 Min
Linear Shrinkage	ASTM C 531	mm/mm	0.0015 Max
Coefficient of Thermal Expansion	ASTM C 531	mm/mm <sup>°C</sup>	0.00004 Max
Bond Strength (Concrete) <ul style="list-style-type: none"> <li>• Air-cured</li> <li>• Wet</li> <li>• Underwater-cured</li> </ul>	ASTM C 882	N/mm <sup>2</sup>	15 Min 15 Min 10 Min
Pull-Off Bond Strength to Concrete <ul style="list-style-type: none"> <li>• Dry</li> <li>• Wet</li> </ul>	ASTM D 7234	N/mm <sup>2</sup>	1.5 concrete failure (Min) 1.5 concrete failure (Min)

*The epoxy mortar shall be approved by the Engineer through Mill Certificate of the supplier.*

### **728.3 Construction Requirements**

#### **728.3.1 Removal of Damaged Concrete**

Damaged concrete within the marked out areas shall be removed using light mechanical breakers or hammer and chisel, cutting to expose the reinforcement and a sound concrete substrate to the satisfaction of the Engineer, without breaking out behind the reinforcement.

#### **728.3.2 Concrete Surface Preparation**

All concrete surfaces that are to be in contact and repaired with the epoxy grout shall be prepared by mechanical scrubbing to remove loose materials, surface laitance, organic contaminants and moss.

#### **728.3.3 Additional or Replacement of Rebar**

The Contractor shall report to the Engineer any rebar that has 10% or more section loss as a result of corrosion. Additional or replacement rebar shall be provided as instructed by the Engineer. The new rebar shall be cleaned to the same standard as the existing rebar and shall be lapped on the side of the existing bars and spot welded on one side. The new rebar may also be tied to the existing rebars using tie wires. It should be fixed along its length at suitable intervals to prevent sagging.

The corroded rebars shall be cleaned and then applied with anti-corrosion primer to prevent further corrosion. The Contractor shall obtain the Engineer's approval for the rebar prior to proceeding with application of the epoxy grout.

#### **728.3.4 Setting Formworks**

Formworks for re-casting of concrete structures must be very rigid and well-supported to prevent the sagging of the mortar due to its own weight. The formworks shall withstand the pumping forces if the mortar is to be pumped into the forms.

#### **728.3.5 Mixing and Placing of Epoxy Mortar**

The epoxy mortar shall be mixed in accordance to the procedures specified by the manufacturer. A recommended method of mixing is the use of a pail can mixer or an electric mixer with a jiffy type blade that prevents whipping of air into the mixture.

The hardener component is added and then mixed to the base resin component for two (2) minutes or until the mixture becomes uniformly mixed. The aggregate is then gradually added into the resin mixture and mixed until uniform mortar is obtained.

The mixed epoxy mortar should be used within the prescribed working time of the manufacturer.

The epoxy mortar is pumped into the entry port of the formworks using a grout pump, until the mortar outflows from the exit port.

### **728.3.6 Curing of Epoxy Grout**

The epoxy mortar shall be cured for at least three (3) days before the removal of formworks.

### **728.3.7 Field Test**

Compressive tests and preparations of specimens shall be performed as specified by ASTM D 695 with curing time of seven (7) days.

### **728.3.8 Delivery and Packaging**

High Flow Epoxy Mortar for Submerged and Wet Concrete Structures shall be delivered in a pre – packed packaging to project site in original packages, containers, labeled with the name of the manufacturer and lot number.

### **728.3.9 Handling and Storage**

Wear suitable mask, gloves, boots and protective glasses to avoid ingestion, inhalation, skin and eye contact. Mix and use in a well ventilated area.

Containers of materials such as base resin and hardener shall be tightly closed and stored in a dry and cool shaded place. It shall not be stored near acids.

### **728.3.10 Equipment**

Grout pump suitable for epoxy mortars shall be used for placing of grout. Specifications of grout pump shall be in accordance to the recommendation of the manufacturer of the epoxy mortar.

Below are the recommended specifications of grout pump:

<b>PROPERTY</b>	<b>REQUIREMENT</b>
Discharge	2.2 L ~ 10.3 L / min.
Discharge Pressure	Max 1.4 MPa
Hopper Capacity	7.5 L ~ 27 L

### **728.4 Method of Measurement**

The quantity to be paid for shall be based on the number of cubic meters of high flow epoxy mortar placed on the repaired/ re-casted structures and accepted by the Engineer. The measurement made for rebar shall be in accordance to Item 404 – Reinforcing Steel.

### 728.5 Basis of Payment

The accepted works, as prescribed in Section 728.4, Method of Measurement, shall be paid for at the contract unit price for high flow epoxy mortar. Removal and disposal of existing rebar and furnishing and installing of new rebar shall be paid for as specified in Item 404 – Reinforcing Steel. The unit price of High Flow Epoxy Mortar shall cover full compensation for all materials, labor, equipment, supervision and related necessary works, necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
728 (1)	High Flow Epoxy Mortar for Submerged and Wet Concrete Structures	Cubic Meter

#### References:

1. *Alphatec 841 High Flow Underwater Cure Epoxy Grout* Alpha Kogyo KK Yokohama, Japan
2. *Repairs of Underwater Structures* Alpha Kogyo KK Yokohama, Japan
3. *Japan Industrial Standards (JIS)*
4. *Bridge Repair Manual 2<sup>nd</sup> Edition (Improvement of Quality Management for Highways and Bridge Construction and Maintenance, Phase II)*, Department of Public Works and Highways (DPWH) and Japan International Corporation Agency (JICA)
5. *American Society for Testing Materials (ASTM)*
  - *ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement*
  - *ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics*
  - *ASTM D 790M - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials*
  - *ASTM C 531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes*
  - *ASTM C 882M - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear*
  - *ASTM D 7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers*