



Standard Practice for Application of Direct-Applied Exterior Finish Systems¹

This standard is issued under the fixed designation C1516; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice covers the minimum requirements and procedures for field application of Direct-applied Exterior Finish Systems (DEFS). Direct-applied exterior finish systems are coating systems applied over various substrates with non-metallic reinforcing mesh, in which the base coat ranges from not less than 1/16 in. (1.6 mm) to 3/32 in. (2.4 mm) in dry thickness, depending on the mass of the reinforcing mesh. This base coat is subsequently covered with a finish coat that is available in a variety of textures and colors.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric values given in parentheses are approximate and are provided for information purposes only.

1.3 *This standard may involve hazardous materials, operations and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C11 Terminology Relating to Gypsum and Related Building Materials and Systems

C1063 Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster

C1177/C1177M Specification for Glass Mat Gypsum Substrate for Use as Sheathing

C1186 Specification for Flat Fiber-Cement Sheets

C1278/C1278M Specification for Fiber-Reinforced Gypsum Panel

C1325 Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units

E1825 Guide for Evaluation of Exterior Building Wall Materials, Products, and Systems

3. Terminology

3.1 Definitions used in this standard shall be in accordance with Terminology **C11**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *accessories, n*—preformed metal, fiberglass or plastic members used to form corners, edges, control joints, or decorative effects.

3.2.2 *back wrapping, n*—a deprecated term. See *wrap*.

3.2.3 *base coat, n*—a material, either factory or field-mixed, used to cover the substrate and to encapsulate the reinforcing mesh.

3.2.4 *cold joint, n*—the visible junction in an exterior finish.

3.2.5 *cure, v*—to develop the ultimate properties of a wet state material by a chemical process.

3.2.6 *dry, v*—to develop the ultimate properties of a wet state material solely by evaporation of volatile ingredients.

3.2.7 *durability, n*—the capability of a building, assembly, component, product, or construction to maintain serviceability over not less than a specified time.

3.2.8 *embed, v*—to encapsulate a non-metallic reinforcing mesh in either the joint compound or exterior finish.

3.2.9 *expansion joint, n*—a structural separation between building elements that allows independent movement without damage to the assembly.

3.2.10 *factory mixed, n*—a material that is prepared at the point of manufacture and is ready to use without the addition of other materials, except possibly water to adjust consistency.

3.2.11 *field mix, n*—a material that is mixed in the field with other components and/or water.

3.2.12 *finish coat, n*—the final wet state material, that provides color or additional texture, applied over the reinforced base coat.

3.2.13 *flash set (quick set), n*—the early hardening or stiffness in the working characteristics of a Portland-cement paste, mortar, or concrete, usually with the evolution of

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

considerable heat; stiffness cannot be dispelled nor the plasticity regained by further mixing without addition of water; also known as “quick set.”

3.2.14 *framing member, n*—studs, joist, runners (tracks), bridging, bracing, and related accessories manufactured or supplied in wood or hot or cold formed steel.

3.2.15 *initial grab, n*—the ability of a wet state material to remain in place initially after it has been applied.

3.2.16 *initial set, n*—a time related set caused by the hydration process.

3.2.17 *lamina, n*—composite of base coat, reinforcement, and finish coat.

3.2.18 *mechanical fastener, n*—corrosion resistant component used to attach the substrate to the framing member.

3.2.19 *reinforcing mesh, n*—a non-metallic component of the DEFS encapsulated in the base coat to strengthen the system.

3.2.19.1 *Discussion*—Non-metallic reinforcing mesh is available in various weights to achieve different levels of impact and stress resistance.

3.2.20 *pot life, n*—the duration of time that the wet state material remains workable after it has been mixed.

3.2.21 *primers, n*—liquid coatings applied to improve the adhesion of the DEFS to the substrate.

3.2.21.1 *Discussion*—Primers are sometimes applied to improve the water resistance of cementitious base coats.

3.2.22 *reinforced base coat, n*—base coat that has been reinforced with a non-metallic reinforcing mesh.

3.2.23 *substrate, n*—surface to which the DEFS is applied.

3.2.24 *surface sealer, n*—material used to enhance weather resistance.

3.2.25 *temper, v*—to bring to a workable state by adding water.

3.2.26 *texture, n*—any surface appearance as contrasted to a smooth surface.

3.2.27 *wet edge, n*—the leading edge of a continuously applied wet state material.

3.2.28 *wet state materials, n*—the adhesive, base coat and finish coat components applied in liquid or semi-liquid state.

4. Significance and Use

4.1 This practice provides minimum requirements for the application of Direct-applied Exterior Finish Systems. The requirements for materials, mixtures, and details shall be contained in the project plans and specifications.

5. Delivery of Materials

5.1 All materials shall be delivered in packages, containers, or bundles with the identification and markings intact.

6. Inspection

6.1 Inspection of the materials shall be agreed upon between the purchaser and the supplier as part of the purchase agreement.

7. Rejection

7.1 Materials that are damaged, frozen or in any way defective shall not be used. Rejection of materials shall be promptly reported verbally to the producer and immediately reported in writing. The notice of rejection shall contain a statement documenting the basis for material rejection.

8. Certification

8.1 When specified in the contract documents, the exterior finish producer shall furnish a report certifying that the materials are in conformance with product and material standards and contract documents.

8.2 The substrate panels shall be marked as complying with the applicable product specification.

9. Storage of Materials

9.1 All materials shall be kept dry by storage under cover and protected from the weather.

9.1.1 When outside storage is required, substrate panels shall be stacked flat with care taken to avoid damage to edges, ends, or surfaces.

9.1.2 All other DEFS components shall be stacked off the ground, supported on a level platform and protected from the direct sunlight, weather, surface contamination or physical damage in accordance with the DEFS producer's written instructions.

9.2 Materials shall be protected from exposure to temperatures less than 40 °F (4 °C), unless otherwise specified by the manufacturer.

9.3 Portland Cement shall be kept dry until ready for use. It shall be kept off the ground, under cover and away from damp walls and surfaces.

10. Environmental Conditions

10.1 Cold Weather Conditions:

10.1.1 Wet materials shall not be applied when the temperature is less than 40 °F (4 °C) unless temporary heat and enclosures are provided to maintain a minimum temperature of 40 °F (4 °C) for a minimum period of not less than 24 h before, during and after application or unless otherwise specified by the manufacturer.

10.1.2 Materials shall not be applied to a base containing frost. Substrate surface temperature shall be not less than 40 °F (4 °C) unless otherwise specified by the manufacturer. Mixtures for application shall not contain any frozen ingredients.

11. Assessment of Condition of Substrates to Receive Direct Exterior and Finish Systems

11.1 The substrate shall be as required by the project plans and specifications and as specified by the DEFS producer for the particular system.

11.2 The substrate shall be inspected by the applicator and general contractor to ensure that it meets the project plans and specifications and the requirements of 11.3 – 11.8.2.

11.3 Sheathing materials shall be inspected to ensure that:

11.3.1 The specified sheathing thickness has been installed for the stud spacing used.

11.3.2 Fastener type and fastener spacing are as specified.

11.3.3 Water-resistant exterior fiber-reinforced gypsum sheathing panels complying with Specification **C1278/C1278M**, shall be installed in accordance with the sheet producer's written installation instructions, which include details of framing type and spacing, fastener type and spacing, and sheet orientation and spacing.

11.3.4 Glass mat gypsum sheathing complying with Specification **C1177/C1177M**, shall be installed in accordance with the sheet producer's written installation instructions, which include details of framing type and spacing, fastener type and spacing, and sheet orientation and spacing.

11.3.5 Fiber-cement sheets complying with Specification **C1186**, Type A, shall be installed in accordance with the sheet producer's written installation instructions, which include details of framing type and spacing, fastener type and spacing, and sheet orientation and spacing.

11.3.6 Fiber-mat reinforced cement sheets complying with Specification **C1325**, type A, shall be installed in accordance with the sheet producer's written installation instructions, which include details of framing type and spacing, fastener type and spacing, and sheet orientation and spacing.

11.4 *Alignment*—All substrate surfaces shall be straight and true within $\frac{1}{4}$ in. in 10 ft. (2 mm/m). More stringent requirements by the DEFS producer shall supersede the above stated requirements.

11.5 *Suitability for Use*—The substrate surface shall be firm, sound, and undamaged in order to receive the exterior finish.

11.5.1 Broken, cracked or delaminated substrate boards shall be replaced or restored to a condition equal to adjacent undamaged boards.

11.6 *Cleanliness*—The surface of all substrates shall be clean and free from any foreign materials such as form release agents, curing compounds, dust, dirt, frost, oil or grease, efflorescence and laitance.

11.6.1 All substrate panels shall have all loose dirt and dust removed by cleaning methods appropriate for the job and job conditions.

11.6.2 Efflorescence and laitance on substrate panels shall be removed prior to exterior finish application. Heavy deposits shall be removed using hand or power impact tools followed by washing with an appropriate cleaner. Light deposits shall be removed by washing with an appropriate cleaner. All loose particles and cleaner residue shall be removed by washing with clean, potable water. The surface shall be allowed to dry.

11.7 *Substrate Condition*—There shall be no visible water.

11.8 If furring or accessories are used, they shall be installed in conformance with Specification **C1063**.

11.8.1 These members shall be properly attached, straight, and true unless required by the system design.

11.8.2 All accessories shall be free of rust, oil, or other foreign matter or contaminants, which cause bond failure or unsightly discoloration.

12. Reinforced Base Coat Application

12.1 Inspect the substrate panel surface to ensure that it is clean, dry, free of all foreign materials, and damage of any

type. Substrate panel planar irregularities of more than $\frac{1}{16}$ in. (1.6 mm) shall be corrected. All panel joints shall be tightly abutted or shall be filled with recommended joint bedding material.

12.2 *Base Coat Preparation*—All materials requiring field preparation shall be mixed in accordance with the DEFS producer's specifications.

12.3 *Base Coat Application*—The prepared base coat shall be uniformly spread over the entire surface of the substrate panel.

12.4 *Reinforcing Mesh*—The single layer reinforcing mesh, when specified, shall be fully encapsulated in the field of the wall, at corners, edges, and joints. Trowel from the center to the edge of the reinforcing mesh to avoid wrinkles. The single layer reinforcing mesh shall be continuous at all corners.

NOTE 1—The recommended method is to apply the base coat in two applications.

12.4.1 The surface shall be free of voids, projections, trowel marks and other surface irregularities. The base coat thickness shall be not less than $\frac{1}{16}$ in. (1.6 mm) dry as measured from the surface of the substrate panel.

12.5 *Reinforcing Mesh Overlap*—All reinforcing mesh edges shall be overlapped not less than $2\frac{1}{2}$ in. (64 mm).

12.6 *Impact Layers*—When required, higher impact performance shall be achieved with multiple layers of reinforcing mesh or by incorporating heavier weight reinforcing mesh. All areas requiring higher impact performance shall be detailed on the project plans and specifications. When overlapping of high impact mesh is not required, a complete second layer of reinforcing mesh shall be applied over the layer of high impact mesh.

12.7 *Corners*—Reinforcing mesh shall not be lapped within 8 in. (204 mm) of any corner.

12.8 *Wall Penetrations*—All edges of the substrate panel board at penetrations of the DEFS, such as at windows, doors, Heating, Ventilation and Air Conditioning (HVAC) sleeves, pipes, duct, electrical boxes, and at the base of the wall shall be wrapped with either the base coat and reinforcing mesh or trim, or as specified by the project plans and specifications. Wall openings such as doors, windows, HVAC sleeves, shall be diagonally reinforced at corners with mesh not less than 9 in. (230 mm) by 12 in. (305 mm).

12.8.1 The corners of returns to windows, doors, and similar wall openings shall have reinforcing mesh the full width of the return and extending not less than $2\frac{1}{2}$ in. (64 mm) on both sides of the corner.

12.9 *Expansion Joints*—All edges of the substrate panels at expansion joints shall be wrapped with either the base coat and reinforcing mesh or trim as specified by the DEFS producer for the particular system. The reinforcing mesh shall be fully encapsulated.

12.10 *Reinforcing Mesh*—The reinforcing mesh shall be fully encapsulated in the base coat throughout the field of the wall, at corners, edges, and joints. The surface shall be free of voids, projections, trowel marks and other surface irregularities.

12.11 *Special Architectural Shapes*—When special EPS (expanded polystyrene) architectural shapes are installed, glass fiber reinforcing mesh encapsulated in the base coat shall be used.

13. Finish Coat Application

13.1 The reinforced base coat shall be allowed to dry and harden for not less than 24 h prior to finish coat application.

13.2 *Material Preparation*—The finish coat shall be mixed in accordance with the DEFS producer's specifications. Only clean potable water shall be added to adjust workability. Always add the same amount of water to each container within a given lot of finish.

13.3 *Execution*—Reinforcing base coat and finish coats shall be applied with a stainless steel trowel or appropriate equipment as specified by the DEFS producer. Tools and equipment shall be kept clean. Finish coat shall be applied continuously to a natural break such as corners, joints or tape line. Apply supplementary finishes to the exterior finish maintaining a wet edge. Sufficient manpower and scaffolding shall be provided to continuously finish a distinct wall area. Scaffolding shall be spaced a distance from the wall, consistent with safety standards, that allows uniform texturing of the finish without staging marks. On hot windy days, it shall be permitted to fog the wall with clean, potable water to cool the wall. Work shall precede the sun whenever possible. Water shall not be added to the finish once it is applied to the wall. Use the same tool and hand motion and match the texture of the

surrounding area. The finish coat thickness shall be as specified by the DEFS producer. Protect all finish work from damage until fully dried.

13.4 *Joints*—The application of finish coat into the joints shall be as required by the project plans and specifications.

14. Curing Time Between Application Steps

14.1 Manufacturer's recommendations for climatic conditions, mixing and application practices to allow respective coats sufficient time to cure or dry before any subsequent coats are applied shall be followed. Each application step shall be permitted to cure or dry to prevent degradation to the system integrity with subsequent steps.

14.2 Auxiliary protection (tenting, supplemental heat, shading) from adverse environmental conditions shall be utilized to provide expected curing or drying conditions as recommended by the DEFS manufacturer.

14.3 All substrates shall be sound and cured or dry before continuing on to the next application step.

15. Clean Up

15.1 Adjacent materials, surfaces and the work area shall be cleaned of foreign materials resulting from the work.

15.2 All excess DEFS materials shall be removed from the job site.

16. Keywords

16.1 DEFS; direct-applied; exterior finish

APPENDICES

(Nonmandatory Information)

X1. GENERAL INFORMATION

INTRODUCTION

These Appendixes give general information and also suggestions for inclusions to be made elsewhere by the specifier. They are not part of this practice.

X1.1 General

X1.1.1 The work includes all labor, materials, services, equipment and scaffolding required to complete the DEFS installation on the project in accordance with the project drawings and specifications, except electrical power and potable water.

X1.1.2 Where a specific fire resistance rating is required for the DEFS assemblies and construction, details of construction shall be in accordance with official reports of tests conducted by recognized testing laboratories and a part of approved plans and specifications.

X1.1.3 The installation of the DEFS is to be coordinated by the owner's authorized agent with work of other trades.

X1.1.4 Surfaces and accessories to receive DEFS components shall be examined and accepted as provided in 11.1

before the DEFS components are installed thereto. The proper authorities shall be notified about unacceptable conditions. The unsatisfactory conditions shall be corrected prior to the application of the DEFS components. Unsatisfactory conditions shall be corrected by the party(ies) responsible for such conditions.

X1.1.5 The construction specifier shall describe, in the proper section of the project specifications, the physical characteristics of the surfaces to receive the DEFS.

X1.2 Design Considerations

X1.2.1 Guidance, for design professionals, for determining the suitability and use of direct-applied exterior finish systems, as an exterior building wall, is contained in Guide E1825. DEFS are attached to outside substrates of all types of structures to provide weather resistant and durable surfaces.

The surfaces will be subjected to various exposures such as abrasion, vibration, moisture, freezing, thawing, negative and positive wind loading, ultraviolet light, acid rain, thermally induced expansion and contraction, and impact.

X1.2.2 Provide sufficient slope on faces of DEFS surfaces to prevent water, snow or ice from accumulating or standing. A minimum 6 in. (152 mm) in 12 in. (305 mm) (1:2) pitch is recommended. Length of sloped surfaces shall not be more than 12 in. (305 mm).

X1.2.3 Provide parapet cap made only from corrosion resistant materials. The parapet cap shall extend not less than 2½ in. (64 mm) over the faces of the DEFS, not including wood blocking and include a drip edge detail. Detailed requirements for furnishing and installing the parapet cap shall be in the appropriate section of the project specifications. Parapet caps shall be clearly shown in large scale details. Parapet caps shall be installed as soon as practical after the installation of the DEFS.

X1.2.4 Provide for sealing of expansion joints, panel joints, system terminations and all interfaces of the DEFS with other building components.

X1.2.5 At soffits, window and door heads provide for a drip edge.

X1.2.6 Sills and headers shall be flashed.

X1.2.7 Windows installed in DEFS walls shall have sill pan flashing of corrosion-resistant material.

X1.2.8 The specifier shall evaluate the potential of the DEFS surface being subjected to abnormal stresses or impacts.

X1.2.9 Wall assemblies have properties that in certain applications make a dew point analysis critical to ensure successful performance of the wall system. The specifier shall evaluate these conditions.

X1.2.10 Substrate panels must be continuous over floor slabs, intersecting walls, columns, beams and similar constructions. The DEFS shall not be installed over areas without substrate panels.

X1.2.11 Where the substrate panel is interrupted or out of plane, corrections must be made prior to DEFS application. If the substrate panel cannot be continuous, the installation of expansion joints shall be considered.

X1.3 Relief From Stress

X1.3.1 Where the DEFS and dissimilar types of substrates, materials and building components interface, provide for appropriate size and location of expansion joints.

X1.3.2 Where roof elevations change, provide for appropriate size and location of expansion joints.

X1.4 Bonding Agents

X1.4.1 Bonding compounds or agents are sometimes applied to a substrate panel surface to receive exterior finish. Follow the DEFS producer's instructions and specifications for their use.

X1.5 Mechanical Fasteners

X1.5.1 The types of mechanical fasteners used and the methods of installation will vary depending on the framing to which the substrate panels are to be fastened.

X1.6 Reinforced Exterior Finish

X1.6.1 The basecoat thickness is permitted to exceed ⅜ in. (2.4 mm) dry depending on the type of reinforcing mesh and number of layers.

X1.6.2 A small amount of basecoat shrinkage is normal. Bare mesh shall not be visible.

X1.6.3 The proper portioning of hydraulic cement-based material is important. The producer's instructions shall be followed to ensure that the base coat cement is properly proportioned.

X1.6.4 The minimum amount of mix water to form a workable mix shall be used. Excess mix water causes the base coat to be porous and less weather resistant. Never add more water than recommended by the producer. Measure water in containers of known volume.

X1.6.5 Mix materials only at low speed with paddles designed to reduce air entrapment.

X1.6.6 Generally, the finish coat is applied after the base coat has sufficiently cured.

X1.7 Finish Textures

X1.7.1 Textures, as a description of surface appearance, generally are identified with the method and tools used to achieve the finish appearance. Texture is sometimes varied by the size and shape of the aggregate contained in the finish, equipment or tools employed, the consistency of the finish mix, the condition of the base to which it is applied and by decorative and protective treatments.

X1.7.2 With almost limitless variations possible for finish appearance or texture, the same term sometimes does not have the same meaning to the specifier, contractor or applicator. Sample panels of sufficient size including components and features specified shall be constructed using the methods, tools and techniques to be used in the actual construction.

X1.7.3 To provide some guidance, the following categories are generally understood and recognized to imply a particular method of application or finished appearance.

X1.7.3.1 *Sand Finish*—A finish material devoid of coarse aggregate applied in a thin coat completely covering the base coat and floated to a true plane, yielding a relatively fine-textured finish.

X1.7.3.2 *Trowel Texture*—A freshly applied finish is given various textures, designs or stippled effects by hand motion and trowel used. The effects achieved are individualized and it is sometimes difficult for different applicators to duplicate.

X1.7.3.3 *Standard Finish*—A finish with various size aggregates, applied in a thin coat completely covering the base coat and floated in a random pattern. The applicators are cautioned to use the same type texturing tools to help ensure a consistent texture.

X1.7.3.4 Exposed Aggregate—Varying sizes of natural or manufactured stone, gravel, shell or ceramic aggregates are embedded by hand or by machine propulsion into a freshly applied “bed coat.” The size of the aggregate shall not be more than ½ in. (12.7 mm) diameter. The size of the aggregate determines the thickness of the bedding coat. The bedding coat shall be no less than one-half the thickness of the aggregate to be embedded.

X1.7.3.5 Spray Texture—A machine applied finish material. The texture achieved depends on many factors some of which are the consistency of the sprayed mixture, the angle and distance of the spray nozzle to the surface, the pressure of the machine, orifice size used, operator expertise, climatic conditions (wind specifically), and base coat conditions.

X1.7.3.6 Miscellaneous Types—Similar to trowel textures except that the freshly applied finish is textured with instruments other than a trowel, such as swept with a broom or brush, or corrugated by raking or combing. A variation of texturing a finish involves waiting until the applied finish has partially dried and then lightly troweling the unevenly applied finish. The effects achieved are sometimes difficult for different applicators to duplicate.

X1.8 Conditions for DEFS Application

X1.8.1 The amount of water used to mix materials is to be within the allowable range published by the DEFS producer.

Factors such as the drying conditions and finishing operations must be considered in determining water usage. The applicator is cautioned that the use of excessive water results in fall off or slide off, excessive shrinkage, higher porosity, lower strength, and inconsistent color.

X1.8.2 Timing between coats varies with climatic conditions and types of materials used. Temperature and relative humidity extend or reduce the curing and drying times. Cold or wet weather lengthens and hot or dry weather shortens these periods. Moderate changes in temperature and relative humidity are overcome by providing additional heating during cold weather and by pre-wetting the base during hot, dry weather.

X1.8.3 Heated enclosures require adequate air circulation to prevent hot or cold spots that allow too rapid drying or freezing. When using heated enclosures it is important to control the relative humidity as well as the temperature. Maintain relative humidity at not more than 90 percent.

X1.8.4 Staining and discoloration of finishes or other building components that are caused by free water draining from one plane to another, dissimilar materials, or other building components, are minimized by providing sufficient depth and angle for drip caps and drip edges.

X2. SEALANT SYSTEMS

X2.1 The size and location of joints and selection of the sealant to be used is responsibility of the Design Professional and shall be consistent with project conditions and guidelines of the DEFS producer.

X2.2 The sealant system must be tested for compatibility with the specified DEFS by an independent laboratory and found to be compatible with the DEFS.

X2.3 The sealant system is recommended by the DEFS and Sealant producer. Non recommended sealant systems must be

jointly approved by the Architect and the sealant producer.

X2.4 Base the joint design and surface preparation on the sealant producer’s recommendations and project conditions.

X2.5 Allow the DEFS material to cure prior to sealant system installation.

SUMMARY OF CHANGES

Committee C11 has identified the location of selected changes to this practice since the last issue, C1516 – 02, that may impact the use of this practice. (Approved October 1, 2005)

(1) Added Specification **C1325** to Referenced Documents.

(2) Added new paragraph **11.3.6**.

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