



FIRE RESISTANCE PROVIDED BY GYPSUM BOARD MEMBRANE PROTECTION (GA-610-02)

Introduction

Dividing buildings into distinct fire-protected areas is typically accomplished by providing fire-resistance rated separations between those areas. This type of separation is easily achieved by the use of gypsum board applied to either wood or steel framing members. These fire-rated separations are usually provided as total assemblies, consisting of the structural member, the gypsum board and structural flooring material (if a floor/ceiling assembly). Listings of many fire-rated assemblies or Designs are found in the GA-600, UL Fire Resistance Directory, etc.

However, often no fire-rated assembly exists to match a particular configuration to be built. This is often the case for retrofit work, but may also occur in new construction. In this case **all** of the fire resistance may be provided by a gypsum board "membrane"; typically several layers of fire-rated (type X) gypsum board.

Fire Tests and Finish or Membrane Ratings

The finish rating is derived from the same test method (ASTM E 119) that establishes fire-resistance ratings for systems. The finish rating is the time necessary for an average rise in temperature of 250°F (140°C), or a maximum rise of 325°F (180°C), as measured on the face of the wood (i.e., framing) nearest the fire. In a gypsum board system, this is the time required for the back (unexposed) surface of the gypsum board to reach one of the limiting conditions as defined above.

Finish ratings have been established for most fire-resistance rated systems that incorporate combustible (i.e., wood) framing components. In gypsum board construction, the finish rating can be determined to be the fire-resistance rating provided by the gypsum board membrane on the fire exposed side. **While the use of finish rating data is a common and generally accepted practice to validate and document the required fire resistance of a membrane, its**

use must be approved by the authority having jurisdiction.

When to Use a Membrane Rating

Fire tests on floor-ceiling systems are historically conducted with fully loaded solid-sawn nominal 2x10 (38x235 mm) floor framing. Hundreds of fire tests were conducted prior to the development of engineered wood trusses, wood I-joists, and lightweight steel joists. In certain types of new construction, it may be neither practical nor economical to use the type of structural components found in tested and listed systems. In addition, engineered systems taking into account the actual loads and spans enable designers to specify systems that may not require 2x10 (38x235 mm) joists. These engineered systems often specify smaller dimension lumber, wood trusses, wood I-joists, other engineered lumber products, steel channel joists, or other materials as the structural framing.

The effect of using smaller lumber sizes where shorter spans and lower loads are encountered has not been documented by full-scale tests. Due to the larger size of the test specimen required in the ASTM E 119 fire test method, it may not be possible to evaluate such designs by full scale tests.

Retrofit construction often presents unique situations for designers, contractors, and building officials. Upgrading existing walls or floor-ceiling systems may involve limited access to the space or the presence of construction materials that may not be used in any currently available tested or listed system. When it is not possible to construct a specific tested system, the use of the finish rating of a system may be the only practical method to determine the rating.

Gypsum board membranes most commonly used to meet fire-resistance requirements in unique circumstances are described and shown herein; the details and sketches are based on UL Designs U301 and L556, and on GA File Nos. FC 5406 and RC 2601.

One-Hour Ceiling
(Based on GA File Nos. FC 5406 and RC 2601)

The ceiling membrane consists of two layers of 5/8" (15.9 mm) type X gypsum board directly applied to framing or furring. The base layer of gypsum board is applied at right angles to ceiling framing 24" (610 mm) o.c. and attached with 1" (25 mm) Type S or S-12 drywall screws (for steel framing) or 1-1/4" (32 mm) Type W or S drywall screws (for wood framing) spaced 24" (610 mm) o.c. The face layer of gypsum board is applied at right angles to the framing and attached with 1-5/8" (41 mm) Type S or S-12 drywall screws (for steel framing) or 1-7/8" (48 mm) Type W or S drywall screws (for wood framing) 12" (305 mm) o.c. at end joints and intermediate joists and 1-1/2" (38 mm) Type G drywall screws 12" (305 mm) o.c. placed 2" (50 mm) back on either side of end joints. Joints of the face layer are offset 24" (610 mm) from the joints in the base layer. Face layer joints and fasteners are finished to Level 1 as specified in GA-214, *Levels of Gypsum Board Finish*.



Two-Hour Ceiling
(Based on UL Design L556)

The ceiling membrane consists of four layers of 5/8" (15.9 mm) type X gypsum board applied to ceiling framing spaced 24" (610 mm) o.c. with a 7/8" (22 mm) hat-shaped steel furring channel located between the third and face layer. The base layer of gypsum board is applied at right angles to the ceiling framing and attached with 1-1/4" (32 mm) type S or W drywall screws spaced 12" (305 mm) o.c. The second layer of gypsum board is applied at right angles to the ceiling framing and attached with 2" (51 mm) type S or W drywall screws spaced 12" (305 mm) o.c. The third layer of gypsum board is applied at right angles to ceiling framing and attached with 2-1/2" (64 mm) type S or W drywall screws spaced 12" (305 mm) o.c. The joints in each layer are offset a minimum of 10" (250 mm) from the previous layer. The steel hat-shaped rigid furring channels are applied at right angles to the ceiling framing and spaced 24" (610 mm) o.c. The channels are attached to the ceiling framing at each framing member/furring channel intersection with two 2-1/2" (64 mm) Type S or W drywall screws. The face layer of gypsum board is applied at right angles to the furring channels and attached with 1-1/8" (28 mm) type S drywall screws spaced 12" (305 mm) o.c. Face layer joints and fasteners are finished to Level 1 as specified in GA-214, *Levels of Gypsum Board Finish*.



One-Hour Wall Membrane
(Based on UL Design U 301)

The membrane consists of two layers of 5/8" (15.9 mm) type X gypsum board directly applied to framing or furring. The base layer of gypsum board is applied either parallel or at right angles to wall or partition framing 16" (406 mm) o.c. and attached with 1" (25 mm) Type S or S-12 drywall screws (for steel framing) or 1-7/8" (48 mm) nails or 1-1/4" (32 mm) Type W or S drywall screws (for wood framing) spaced 6" (150 mm) o.c. The face layer of gypsum board is applied either parallel or at right angles to the framing and attached with 1-5/8" (41 mm) Type S or S-12 drywall screws (for steel framing) or 2-3/8" (60 mm) nails or 1-7/8" (48 mm) Type W or S drywall screws (for wood framing) spaced 8" (203 mm) o.c. Joints of the face layer are offset 24" (610 mm) from the joints in the base layer. Face layer joints and fasteners are finished to Level 1 as specified in GA-214, *Levels of Gypsum Board Finish*.

