

TYPE X VS. TYPE C

NOT ALL GYPSUM BOARDS ARE CREATED EQUAL!

It is a commonly held perception that there are just two basic kinds of gypsum board, regular and Type X, and that all gypsum board products of each type are the same regardless of the manufacturer. However, years of laboratory tests conducted by USG and tests by various independent testing organizations provide strong evidence that there can be significant fire-performance differences between various gypsum board manufacturers.

The fire performance of gypsum board is well recognized in the construction industry and one of its most important characteristics. This is attributable to the principal raw material used to manufacture the product, gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). As its chemical formula shows, gypsum contains chemically combined water (approximately 50% by volume). When gypsum panels are exposed to fire, heat is absorbed as a portion of the combined water is driven off as steam. This chemical process is called calcination. The thermal energy that converts the water to steam is thus diverted and absorbed, keeping the opposite side of the gypsum panels cool as long as there is crystalline water left to be converted into steam or until the gypsum panel is breached.

In the case of regular gypsum board, as the crystalline water is driven off, the reduction of volume within the gypsum core causes large cracks to form, eventually causing the panel to fail due to structural integrity. This is similar to the cracking that can be observed in a dry lake or river bed as shown in Figure 1. If such large cracks are permitted to form in the gypsum board, the board will quickly be breached by the fire's hot gases passing through the cracks.



Figure 1: Dry lake bed, Mojave Desert, Weather Underground wunderground.com

In Type X gypsum board, such as USG Sheetrock® Brand Firecode® X Gypsum Panels, special glass fibers are intermixed with the gypsum to reinforce the core of the panels. These fibers have the effect of reducing the size of the cracks that form as the water is driven off, thereby extending the length of time the gypsum panels resist fire without failure.

USG invented USG Sheetrock® Brand Firecode® C Gypsum Panels, which provides even greater fire resistance than Type X. As with the Type X panels, the core of the Type C panels contains glass fibers, only in a much higher percent by weight. In addition to the greater amount of glass fiber, the core of the Type C panels also contains vermiculite, which acts as a shrinkage-compensating additive that expands when exposed to elevated temperatures of a fire. This expansion occurs at roughly the same temperature as the calcination of the gypsum in the core. It allows the core of the Type C panels to remain dimensionally stable in the presence of fire, which in turn allows the panels to remain in place for a longer period of time even after the combined water has been driven off.

To demonstrate the performance differences between gypsum board Types, USG set up a unique small-scale fire test. This demonstration is not a recognized test standard and is not meant to show the fire-resistive capability of fire-resistive assemblies. It is simply to show the differences in behavior between Type X and Type C gypsum boards under fire exposure. The demonstration shows that the Type C panel resists the fire for over two hours, as compared to 57 minutes for Type X panel under the same elevated thermal conditions. Figures 2 and 3 show the time progression of the demonstration test conducted at the USG Corporate Innovation Center, in which USG Sheetrock® Brand Firecode® X Gypsum Panels (Type X) and USG Sheetrock® Brand Firecode® C Gypsum Panels (Type C) were compared. Both samples of gypsum board were exposed to a gas-fired burner producing a temperature of 1580°F (860°C). Each sample was 13" x 13" and had a 16 lb. 13 oz. weight located in the center of the panels to dramatize the point at which the samples failed.

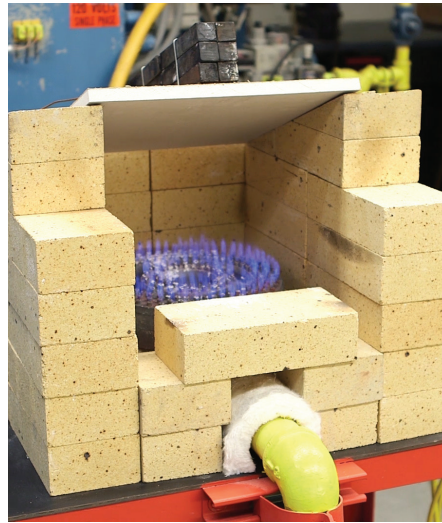


Figure 2: 13" x 13" sample of USG Sheetrock® Brand Firecode® X Gypsum Panel with a 16 lb. 13 oz. weight located in the center to dramatize the failure point.



Figure 3: 13" x 13" sample of USG Sheetrock® Brand Firecode® C Gypsum Panel with a 16 lb. 13 oz. weight located in the center to dramatize the failure point.

In Figure 4, the test has been in progress for 57 minutes, and the USG Sheetrock® Brand Firecode® X Gypsum Panel has collapsed due to the thermal exposure and the superimposed load. The glass fibers in the Type X panel have given it the strength to last nearly one hour under these severe conditions. In Figure 5, the test has been terminated at two hours two minutes with no sign of failure of the USG Sheetrock® Brand Firecode® C Gypsum Panel. The Type C panel resisted failure for over twice as long as the Type X panel.



Figure 4: After 57 minutes, the USG Sheetrock® Brand Firecode® X Gypsum Panel collapsed due to the thermal exposure and the superimposed load.

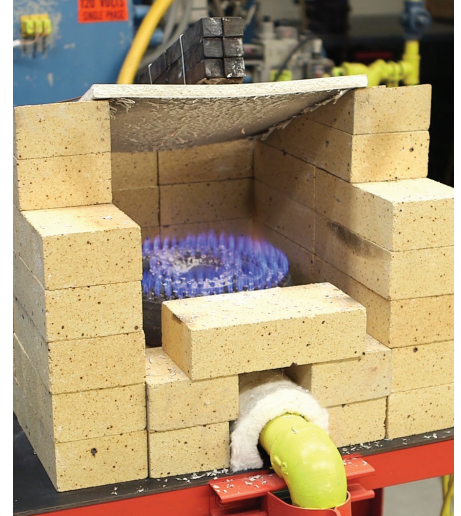


Figure 5: After two hours two minutes, the USG Sheetrock® Brand Firecode® C Gypsum Panel showed no signs of failure and the test was terminated. The Type C panel resisted failure for over twice as long as the Type X panel.

INDEPENDENT TESTING SUPPORTS PERFORMANCE CLAIM

Over the years numerous USG gypsum board assemblies have been tested by independent fire-testing organizations such as Underwriters Laboratories Inc., The Ohio State University, University of California and Western Fire Center, resulting in hundreds of fire-rated assemblies unique to USG. Other manufacturers have developed some of their own fire-resistance designs, but USG offers the most comprehensive coverage. USG has developed a wide variety of systems ranging from wood or steel stud walls, shaftwall assemblies, wood or steel floor/ceiling assemblies, and even column and beam assemblies.

It is extremely important to realize each component within a tested assembly is considered a critical component. From the fastener spacing to the location, thickness and density of insulation to, most importantly, the specific type of gypsum board required, all components specified in a fire-resistive design should be carefully considered. The tested assemblies have been engineered to provide protection to occupants from heat and fire and are tested as full systems. It is critical to realize that no single component provides a fire-resistive rating. The fire-resistive rating, measured in time, is provided by the performance of the system as a whole.

When looking at wall assemblies, the typical gypsum board type used in these assemblies is Type X gypsum board. The option to use a Type C product is usually included in these designs as well. When considering floor/ceiling assemblies, whether steel and concrete or wood construction, the required gypsum board type to be used as the ceiling membrane is Type C. Looking back at the ideas previously presented in this paper, we showed that Type C products are specially engineered to be placed in a horizontal orientation as a ceiling. The easiest way to remember this idea is to think Type C for ceilings. Although in some applications Type X may be used in a ceiling application, typically it takes multiple layers of Type X to achieve the same rating in which only a single layer of Type C can be used.

ARCHITECTS AND CONTRACTORS

The fire-performance features of USG Sheetrock® Brand Firecode® X and Firecode® C gypsum core formulations, together with the independent fire tests, provide several advantages for architects. First, since the independent testing organizations are widely recognized by federal, state and municipal authorities as well as insurance inspection agencies, it makes building approvals much easier. Specifications using independent fire tests allow for fewer delays and problems and are typically required to obtain permits. Secondly, architects can simply utilize existing fire-test designs to obtain the correct materials and construction details to provide the fire-resistance ratings required. Thirdly, architects can have confidence when specifying a fire-resistance system published by a third-party testing agency that all components have been tested together and the conformance to the test standard has been evaluated by an impartial party. Lastly, as a result of USG's own tests and those of other organizations, an architect can feel confident that his/her specified partition will perform as expected. Where fewer layers of gypsum board can be used to provide the same fire rating, significant amounts of dead weight as well as material costs can be saved.

The advantages in producing a specified fire-resistive design with fewer layers of gypsum panels are even more beneficial to the drywall contractor. It reduces both labor and material costs and eases the need to stock more product. The use of USG fire-rated assemblies can save money for a drywall contractor because the assemblies are often lighter in weight, require fewer components and/or are easier to install.

The fact that most architects are specifying ceiling and wall assemblies by the UL design number leaves no doubt about what specific materials the drywall contractor must use to construct them. That also makes it easier for the drywall contractor to bid the project.

RUNDOWN

In conclusion, it has been demonstrated that not all gypsum board products are created equal. There is a significant fire-performance difference between Type X gypsum board and Type C gypsum board and in which applications each should be used. The benefits and critical nature of using the proper components was also discussed: Remember Type C for ceilings. USG has been designing and testing fire-resistance assemblies for use in commercial and residential construction for over 100 years. When specifying or installing USG products and solutions, you can have confidence and trust that our systems have been engineered to be the strongest, lightest and highest-performing systems on the market.

PRODUCT INFORMATION

See usg.com for the most up-to-date product information.

CAUTION

Dust may cause irritation to eyes, skin, nose, throat and upper respiratory tract. Cut and trim with a utility knife or hand saw to minimize dust levels. Power tools must be equipped with a dust collection system. Wear eye, skin and respiratory protection if necessary. If eye contact occurs, flush thoroughly with water for 15 minutes. If irritation persists, call a physician. Do not swallow. If swallowed, call a physician.

For more information call Product Safety: 800 507-8899 or see the SDS at usg.com.

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SAFETY FIRST!

Follow good safety/industrial hygiene practices during installation. Wear appropriate personal protective equipment. Read SDS and literature before specification and installation.

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