What is Type X GYPSUM BOARD?

A Firm Understanding of Type X Gypsum Board is a Must as Emphasis on Fire Resistance Efficiency Continues to Grow

(NOTE: A frequent question asked of the Gypsum Association is some variation of the following: "What is the difference between regular and type X gypsum board, and why and when should I use the latter?" This kind of question is also asked of the contractor, and how it is answered can make the difference between proper or improper application of fire resistant gypsum products. In an effort to assure that the question is answered thoroughly and well, the Gypsum Association has prepared the following article. It discusses how and why type X board was developed and what this special product means to the gypsum industry.)

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Increasing fire resistance efficiency has been the prime concern of gypsum manufacturers as this industry has grown over the past five decades. Considerable developmental effort has gone into maximizing the inherent fire resistant qualities of gypsum board products. A main result of this effort has been the introduction of type X gypsum board.

Even in the early years of the industry, it was apparent that gypsum, by itself, or in combination with an aggregate, was a barrier to the passage of heat, fire and smoke for long periods of time. This was due to the chemical makeup of the material and its reaction under heat. Gypsum, (or as it is technically known, "dehydrous calcium sulphate"), is about 50% water by volume and about 20% water by weight. When subjected to heat, gypsum board goes through a process called calcination during which some of the water separates from the calcium sulphate, changes into steam, and is driven from the material. This requires heat at the surface and progressive action working from the surface exposed to the heat, back through the mass. As the water is driven out, the material remains noncombustible and offers good insulation to heat transfer. But, as the calcination proceeds through the gypsum product, shrinkage occurs and cracks develop because of the substantial loss of volume. These cracks ultimately permit the passage of fire and heat directly through the mass. If the material is in a ceiling installation, this would allow the material to drop. But with the development of type X gypsum board, this problem was greatly reduced.

The major factor contributing to the rapid increase in the use of gypsum board interiors in recent decades has been the development of a product with a core having greater fire-resistance than conventional gypsum board. In simple comparison, a 5/8" thick extra fire-resistant board gives fire-resistance in assemblies similar to the fire-resistance of gypsum or metal lath and plaster which, for years, was considered as the only acceptable one-hour fire-resistive construction.

The primary reason for the success of metal lath and gypsum plaster assemblies as a fire proofing, was the ability of the metal lath to reinforce the calcined material, holding it in place for a long period of time. This reinforcement prevented cracks from becoming large enough to allow passage of heat, smoke and flame. In the late 1930's and early 1940's it was the aim of industry chemists to incorporate similar characteristics in gypsum board that might accomplish the same results at less cost.

This research led to experiments in adding various noncombustible fibers to the gypsum core, including wood fibers, mineral wool, glass wool, and fiberglass strands. Unexpanded vermiculite particles, well distributed in the core, expand when heat is applied, counter-balancing the shrinkage of the gypsum which occurs as it loses its water. This provides a core more ther-

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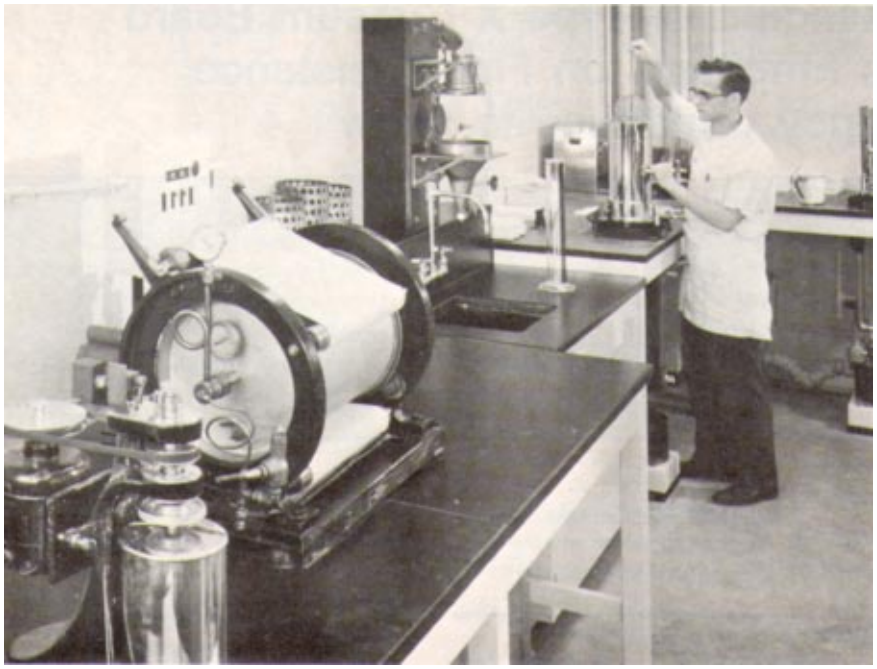
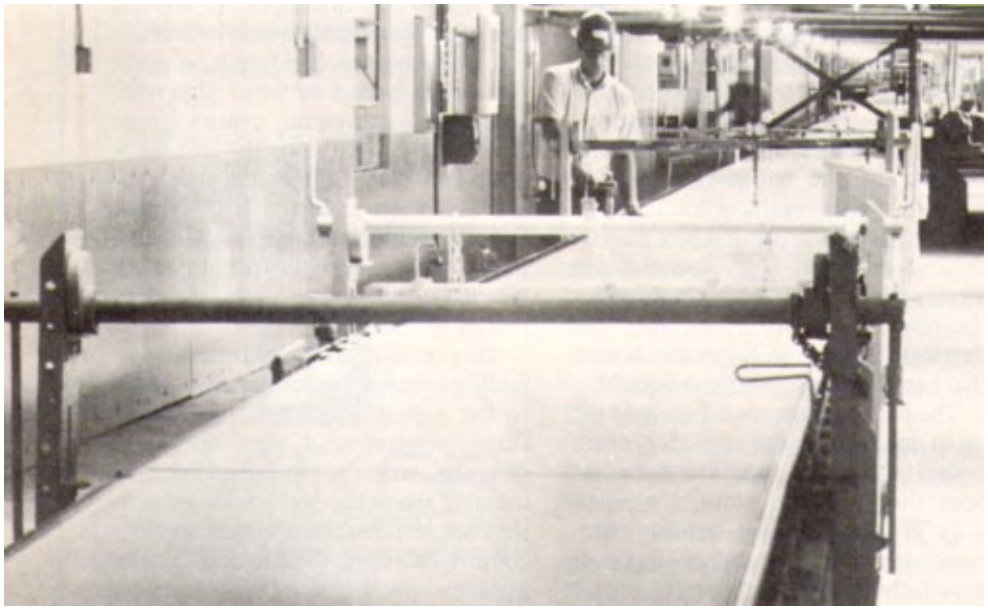


Many hours of research and development are invested . . .



. . . before a product such as type X gypsum board reaches the market.

mally stable under exposure to fire. Glass fibers, well dispersed throughout the core, serve as a reinforcing material holding the board core together.

The patent issued October 17, 1950 to Michael Croce of Bestwall was based on material filed originally in 1943. Fire tests on full scale wall panels at Underwriters' Laboratories resulted in the first listing of ½" special fire-resistant gypsum board in 1946. This was originally listed as Design #1-45 minutes, and currently is shown by UL as Design Number U 317. Further laboratory work improved the product, resulting in a board which, when used as the ceiling of a floor/ceiling assembly, gave fire protection equal to the standard lath and plaster assembly.

Experimentation involved addition to the core of various materials which expanded when exposed to heat. It was found that vermiculite of the proper grade appeared to be most suitable. The purpose of the vermiculite was to compensate for shrinkage in the core under heat. Fire tests of a floor/ceiling assembly with ½" board, incorporating the unexpanded vermiculite and the noncombustible fibers, developed a 45 minute fire-resistance rating equal to that developed in the wall.

A Major Advance . . .

This was a major step forward. Until this time, a partition surfaced on both sides with ½" regular gypsum board could provide up to 40 minutes fire-resistance—with a wood joist and floor assembly with ½" regular gypsum board as the ceiling, only 25 minutes. A wood floor-and-ceiling assembly with no fire protection, tested by the National Bureau of Standards (NBS), withheld the passage of fire and

heat and sustained the required load for 15 minutes. With ½" regular board added as a ceiling protection to this assembly, the fire-resistance increased to 25 minutes-an additional ten minutes of fire endurance. The ½" extra fire-resistant board developed by Bestwall produced 45 minutes of fire resistance, or added 30 minutes of protection to the assembly, or three times the protection offered by the ½" regular gypsum board.

The Bestwall chemists continued to improve the core formulation to increase the performance of the board. This led to additional patents being granted to Michael Croce and Clarence G. Shuttleworth in June of 1954. The patent was based on original applications made in July of 1951 and represented the primary development incorporating glass fibers in gypsum. It had been found from experiments that while several other fibers could perform satisfactorily to attain fire resistance products, all but one resulted in some sort of difficulty.

Many types of glass fibers were checked before the chemists found a satisfactory one. The most successful consisted of drawn, textile glass fibers formed into strands with a water-soluable binder. The binder was strong enough to hold the fibers together in the glass fiber manufacturing process during which the filaments were gathered into strands and rovings. When the strands were cut into short pieces and agitated in a wet plaster slurry the binder softened and permitted the individual filaments to separate and disperse rapidly throughout the mix.

At about the same time, Committee C-11 on Gypsum of the American Society for Testing and Materials (ASTM) finalized a standard definition for this new extra fire-resistant gypsum wallboard. The ASTM Standard, C 36, includes the definition of a product designated as "type X" gypsum wallboard. It reads: "Type X (Special Fire-Retardant) designates gypsum wallboard complying with this specification that provides at least one-hour fire retardant rating for boards 5/8" (16 mm) thick, or ¾-hour fire retardant rating for boards ½" (13 mm) thick, applied to a partition in single-layer nail application on each face of load-bearing wood framing members, when tested in accordance with the requirements of methods E 119."

The gypsum industry was not entirely convinced of the usefulness of the type X product when it was first introduced. Some gypsum manufacturers wanted to do their own experimenting and testing and did not, at that time, take advantage of innovative development work done by the Certain-teed Products Corporation in the early 1940's. However, architects welcomed the type X product as it enabled them to meet the one-hour fire-resistance requirements with a wider choice of assemblies. The manufacture of type X board under the UL reexamination service, was accepted and approved under the Uniform Building Code in 1951 (first Research Report No. 296, September, 1951). By 1955, there was acceptance by over 250 major cities throughout the United States. As the importance of the type X product developed, other gypsum manufacturers began to market competitive materials. However, in view of the acceptance of Bestwall's "Firestop," these manufacturers found it advisable to have their products also officially fire tested at Underwriters' Laboratories. Through the early years, other test facilities included Ohio State University, University of California (Berkeley), and the Fire Prevention Research Center (Gardena, California).

in 1956, the Bestwall Gypsum Company was formed to take over the gypsum operations of Certain-teed. Bestwall continued to test additional assemblies with their 5/8" type X product. These tests proved 2- and 3-hour fire resistive partition assemblies. Later, up to 2-hour fire-resistive floor and ceiling assemblies with single layer applications, 2- and 3-hour column fire proofing, and other assemblies with metal framing, were tested successfully.

After a significant number of gypsum manufacturers had the extra fire-resistive board on the market, with proven performance in several standard assemblies, the Gypsum Association began to push for industry standards that would be acceptable to building code officials, testing organizations, and the manufacturers. This was essentially accomplished in 1955 with the addition of the definition for type X to the ASTM Standard C 36 on Gypsum Board.

This was a major development in the history of this remarkable building material. Remember that when gyp sum board first appeared in the early years of this century, it was relatively crude, consisting of several layers of roofing felt spaced with thin layers of cast gypsum. Over the years, a great many improvements have been made to achieve a stronger, yet lower cost, high quality, fire-resistant building material, 4' wide with a highly calendered, smooth-face paper, strong back paper and tapered longitudinal edges to facilitate finishing of the joints between the panels.

Proving through testing that these fire ratings are possible with assemblies using type X gypsum board from all manufacturers has led to a great increase in the use of gypsum board in multi-story dwellings, and in institutional, commercial and industrial buildings which formerly used other materials to provide fire resistance required by building codes and insurance companies. The entire construction industry and the general public owe a debt of gratitude to the gypsum industry and the early gypsum pioneers for their substantial contributions to fire safety through the development and testing of numerous assemblies constructed with type X gypsum products.