



Gypsum Wallboard Assemblies – FCIA Barrier Management Symposium™

October 21, 2022

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Agenda

- Gypsum Mineral
- Types of Gypsum Panel Cores and Their Applications
- Test Standard and Method
- Common UL Designs and Acceptable Variations
- Repairs of Gypsum Wallboard



Gypsum Mineral

- Calcium Sulfate Dihydrate
 - $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- 20% water by weight
- Two forms
 - Natural
 - Synthetic (Recycled)

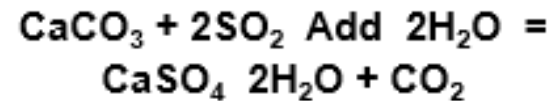


Natural Gypsum

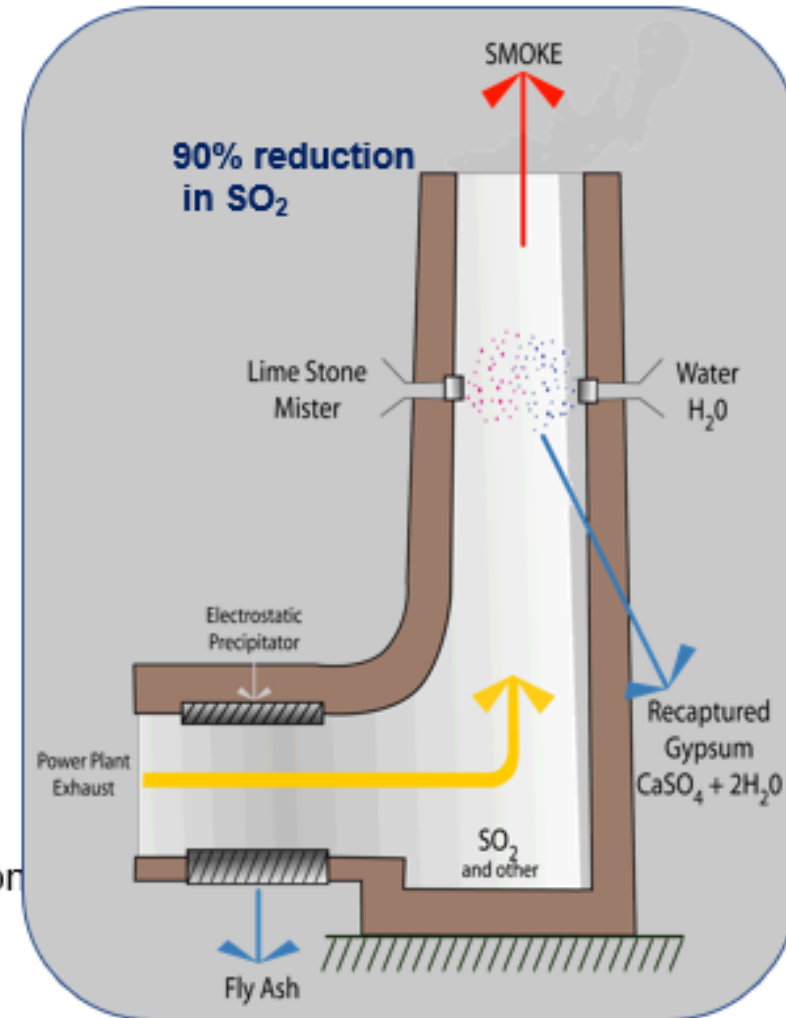


Synthetic (Recycled) Gypsum

- Recaptured Gypsum from Flue Gas Desulphurization



- Reduced Acidification (SO₂)
- Reduced Transportation
- Renewable raw material
- Reduce Extraction (Energy, Pollution)
- Increased GHG (CO₂)



Gypsum Calcination

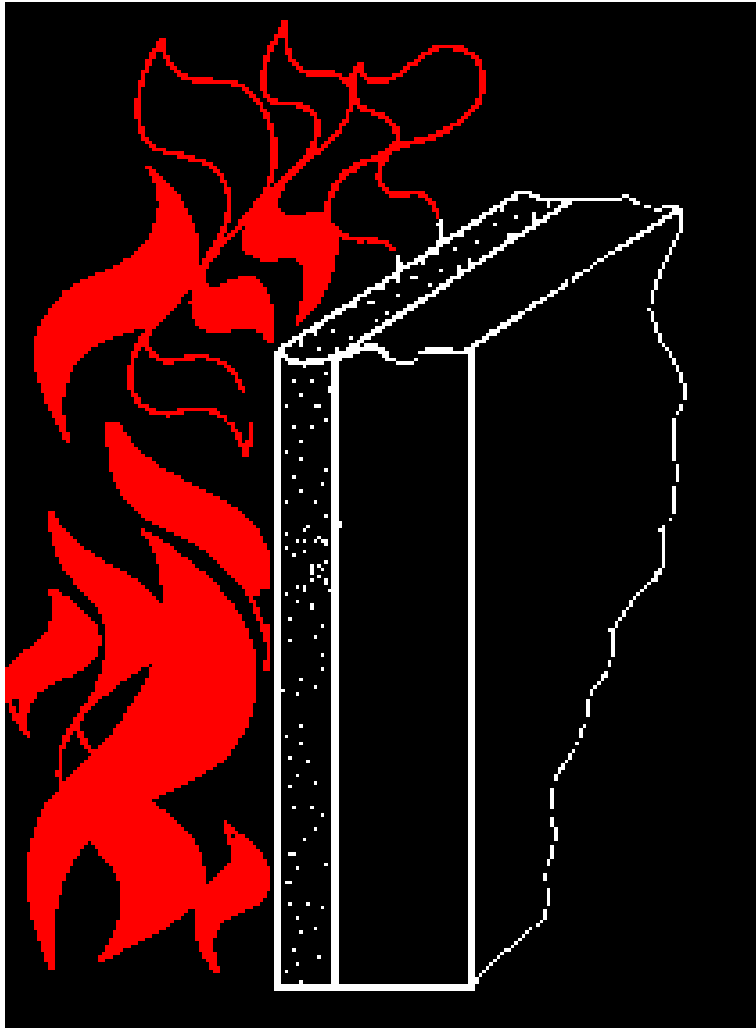
Dihydrate (Rock)



Hemi-hydrate (Plaster)

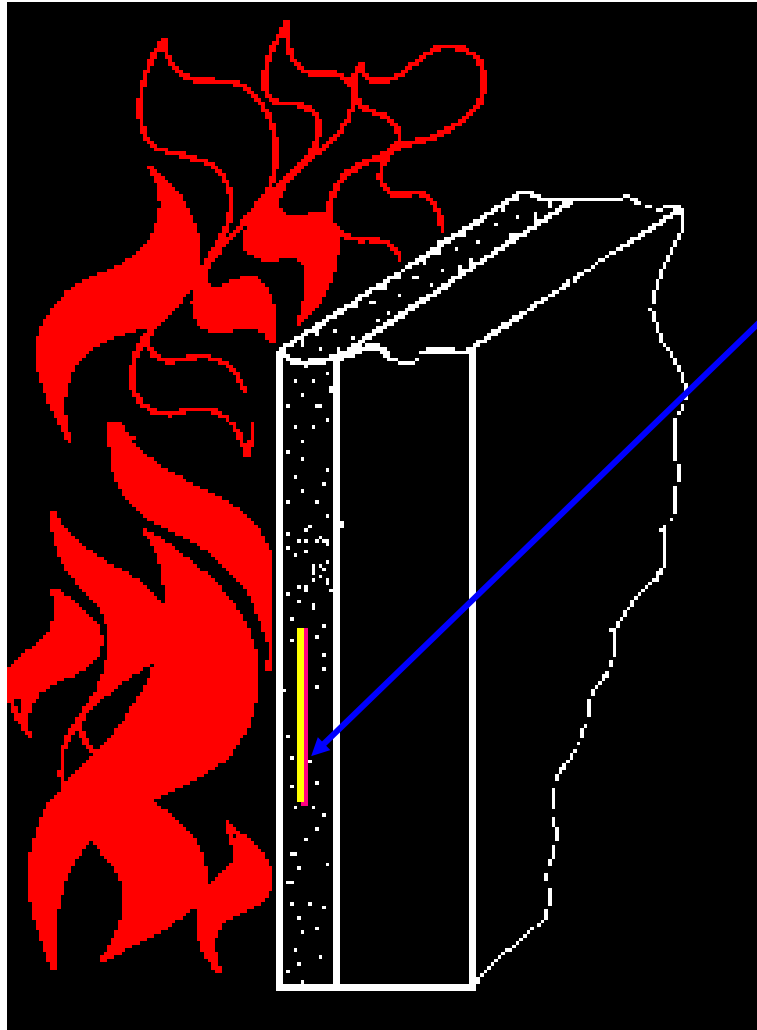


Gypsum Properties



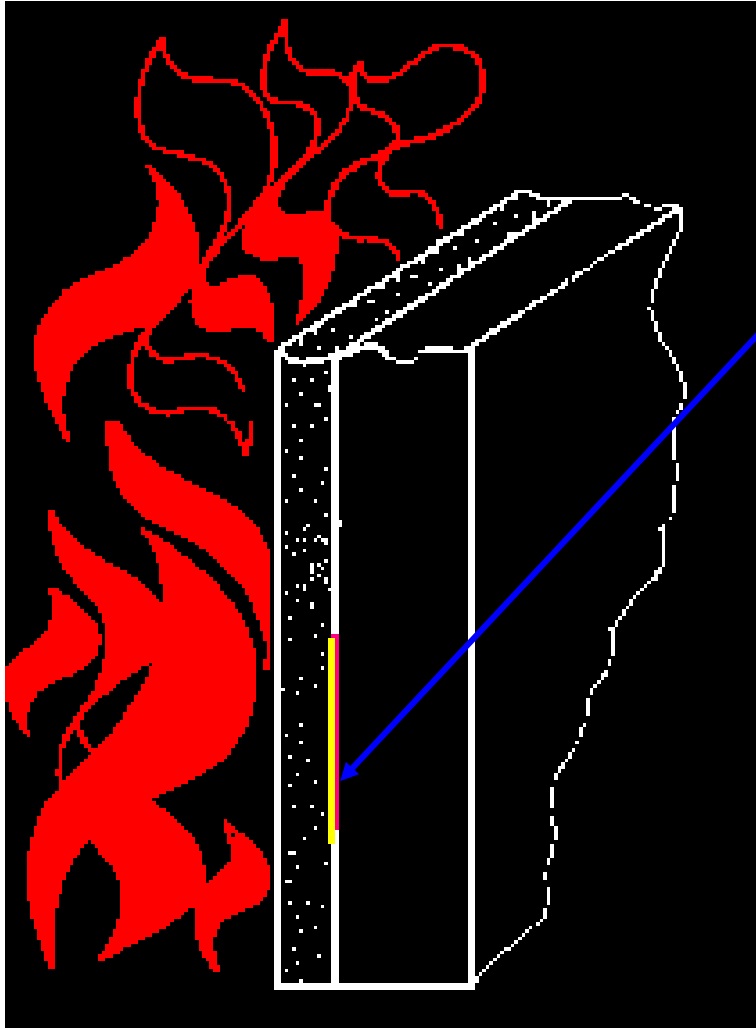
- ASTM E 119
- 2 hours of exposure equals 1850° F

Gypsum Properties



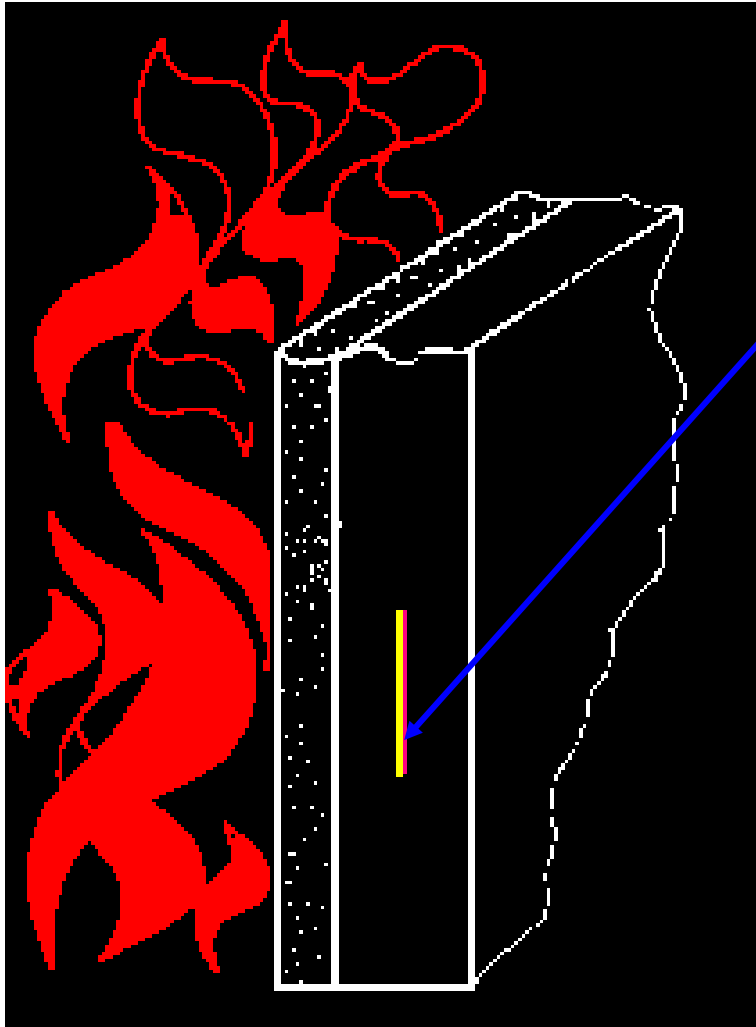
1" back 950° F

Gypsum Properties



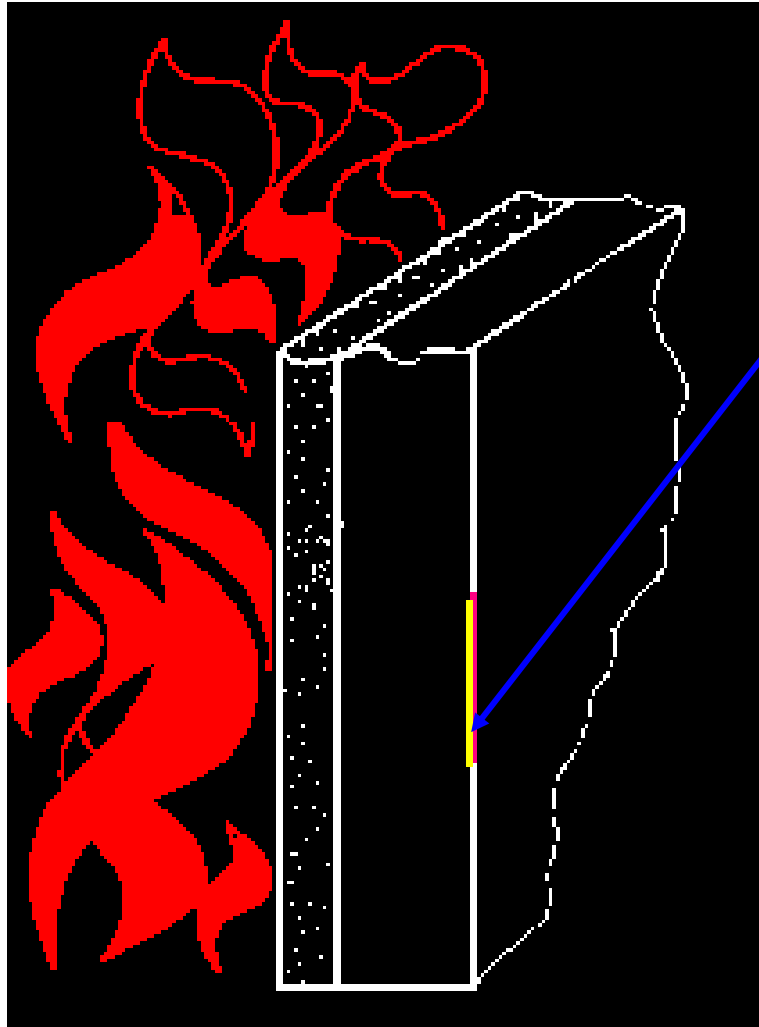
2" back 220° F

Gypsum Properties



4" back 180° F

Gypsum Properties



6" back 130° F

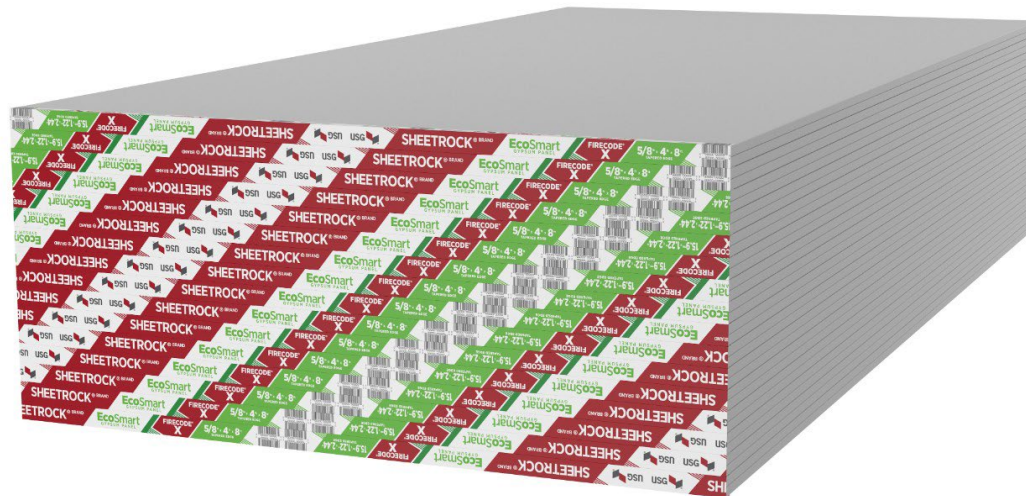
System Fire Rating

- The system of components determines the fire rating!
- A single piece of gypsum has no rating!



Gypsum Panel Core Types

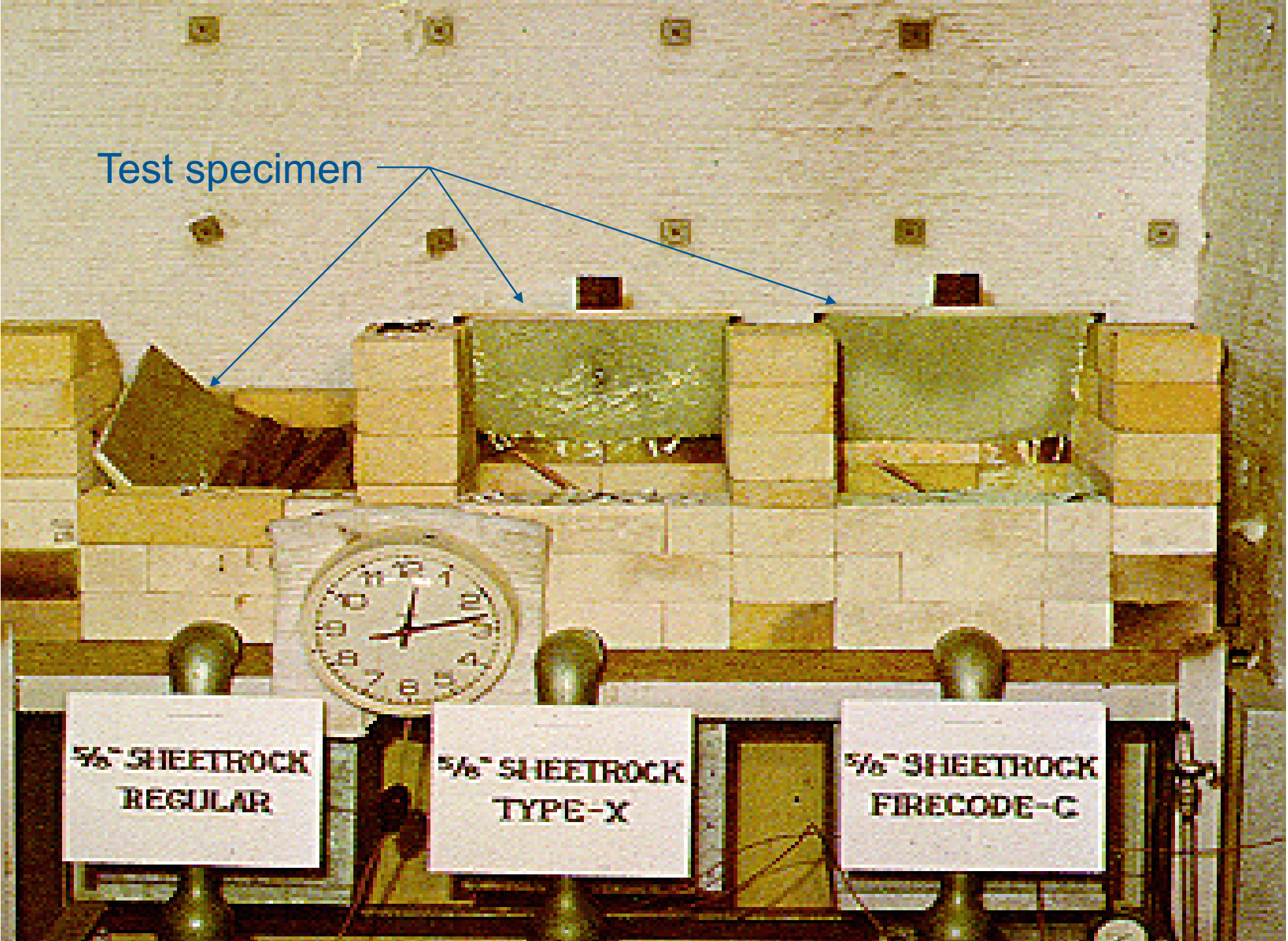
- Regular (ASTM Defined)
- Type X (ASTM Defined)
- Proprietary Enhanced (Non-defined, often called Type C)



Panel Core Comparison

- Simple Test @ 1850° F
- 13" x 13" x 5/8" Panels
- Regular, Type X & Type C Panels
- 12lb - 9oz. loading

Test specimen



5/8" SHEETROCK
REGULAR

5/8" SHEETROCK
TYPE-X

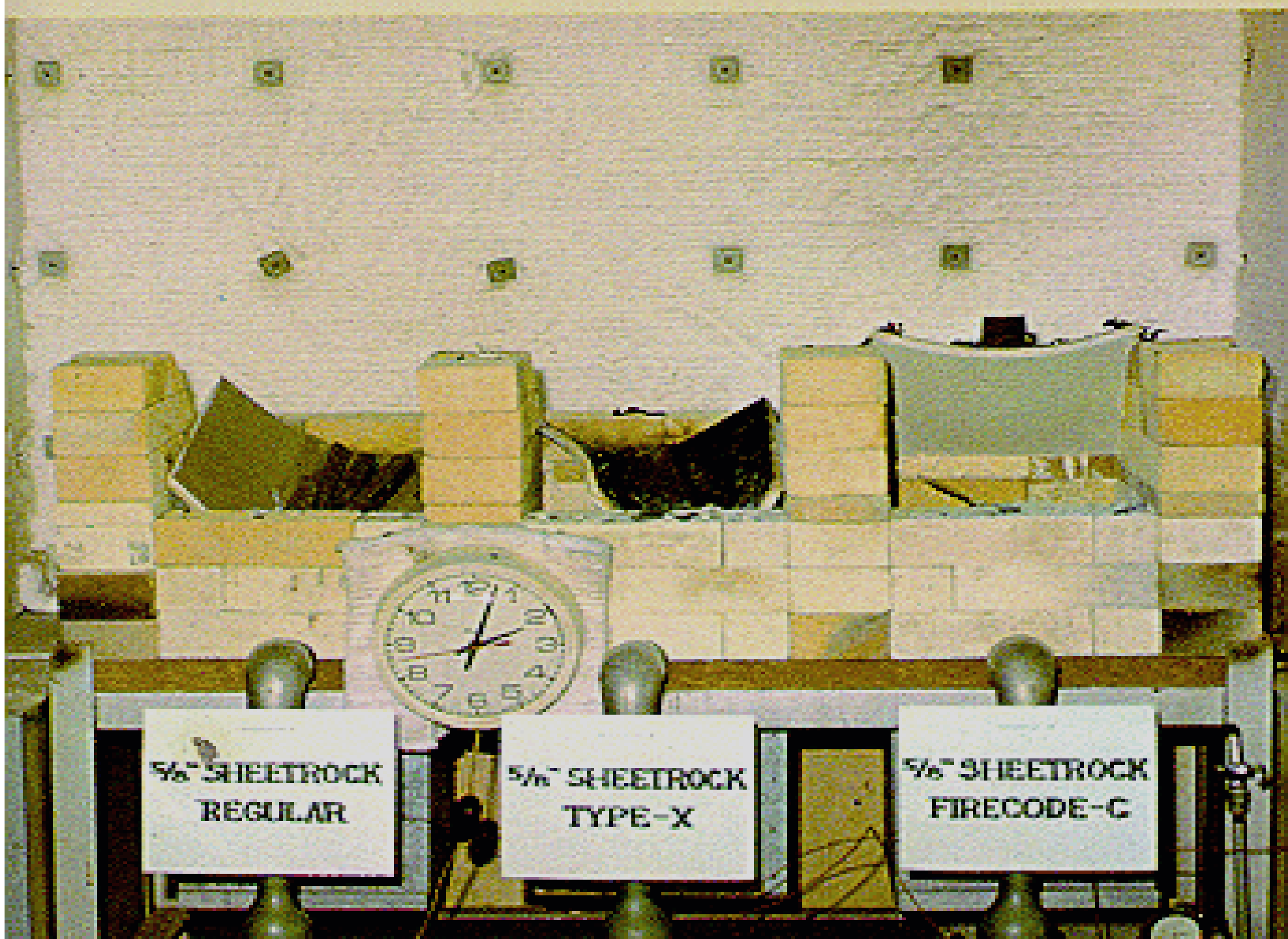
5/8" SHEETROCK
FIRECODE-C



5/8" SHEETROCK
REGULAR

5/8" SHEETROCK
TYPE-X

5/8" SHEETROCK
FIRECODE-C



5/8" SHEETROCK
REGULAR

5/8" SHEETROCK
TYPE-X

5/8" SHEETROCK
FIRECODE-C

Significance of Test

- Regular \neq Type X \neq Type C
- Specify panel type per the published design
- Panels **MUST** be installed per the published design

Passive Protection - Compartmentalization



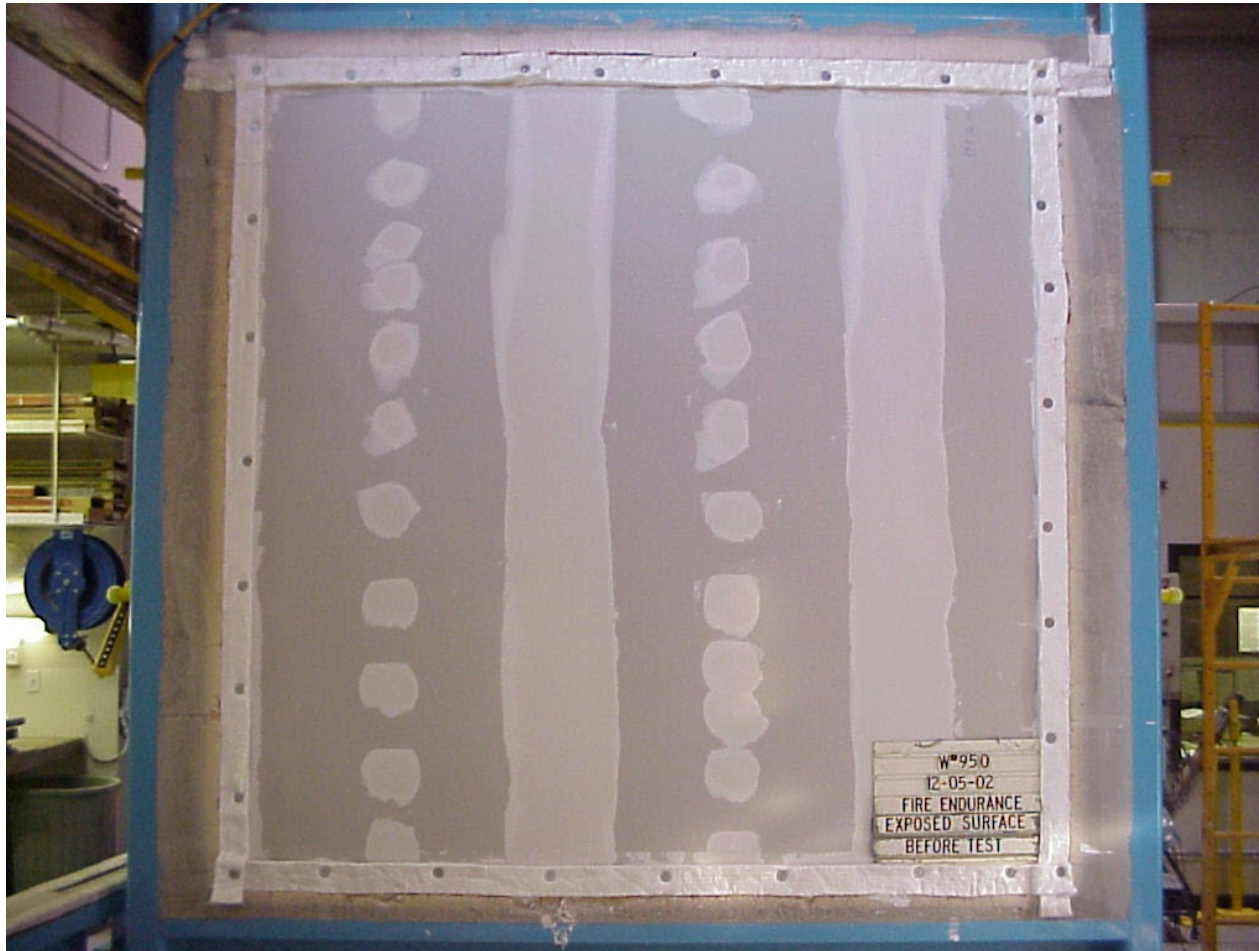
Wall Fire Test

- ASTM Test Procedures (E119)
- Aspects of fire test
 - 1) Heat transfer
 - 2) Structural integrity
 - 3) Hose stream – structural integrity
- *A single piece of gypsum has no fire rating*

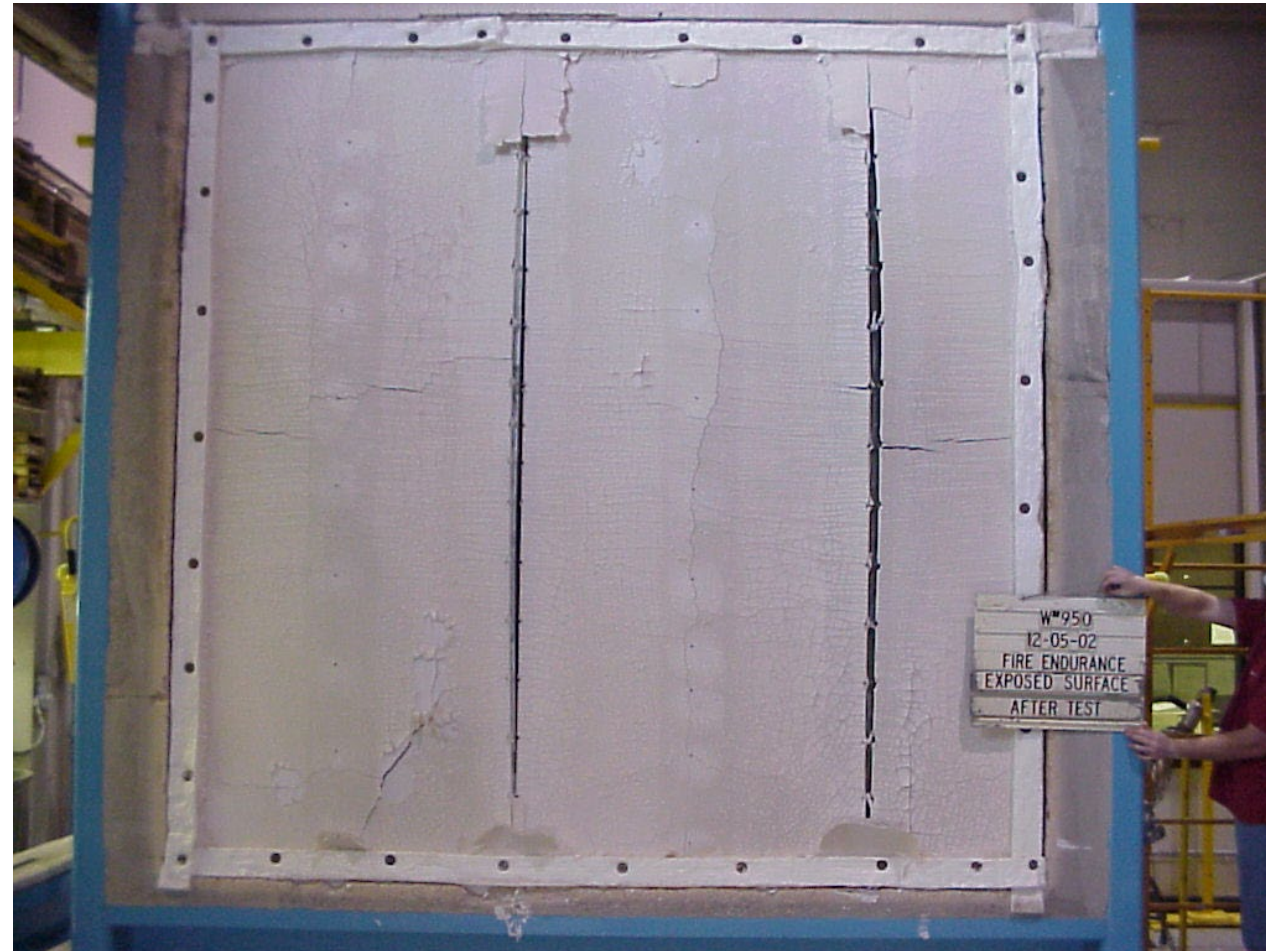
Wall Testing Furnace



Wall Assembly Prior to Test – Fire Exposed Side



Wall Assembly After Test – Fire Exposed Side

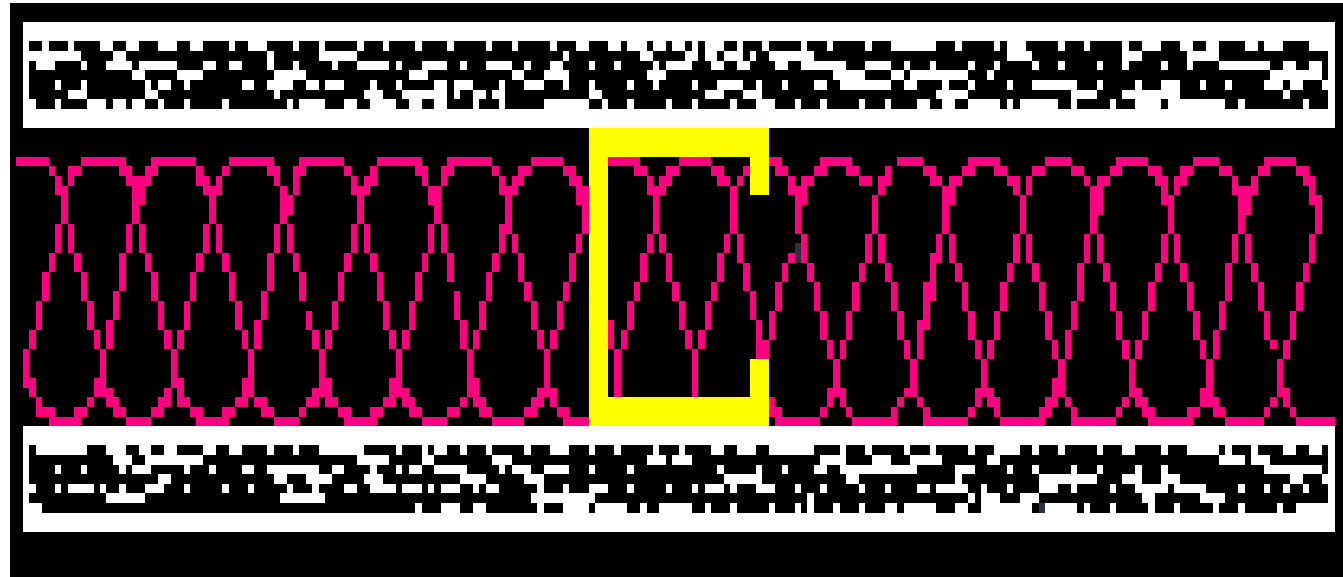


Hose Stream Test



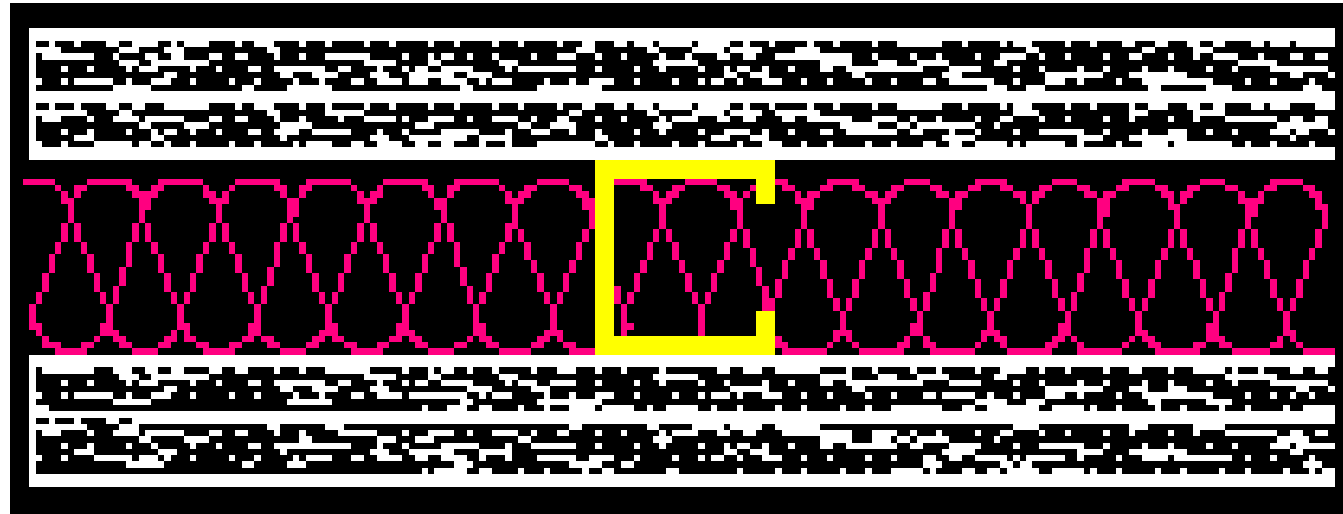
Gypsum Assemblies

U419 - 1 Hour (U465)



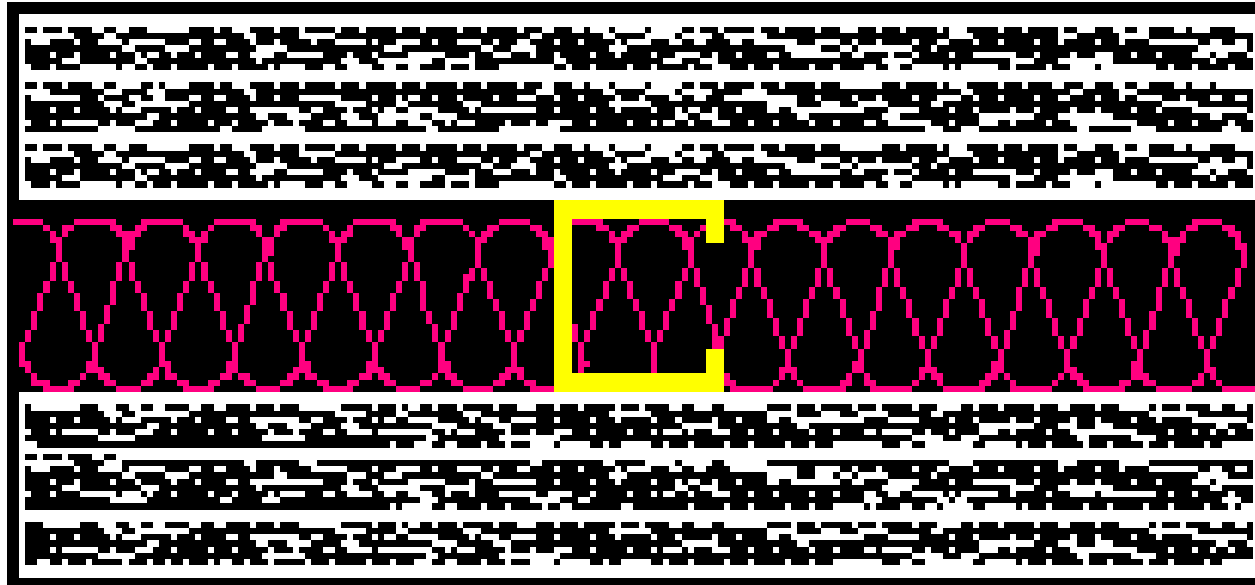
Gypsum Assemblies

U419 - 2 Hour (U411)



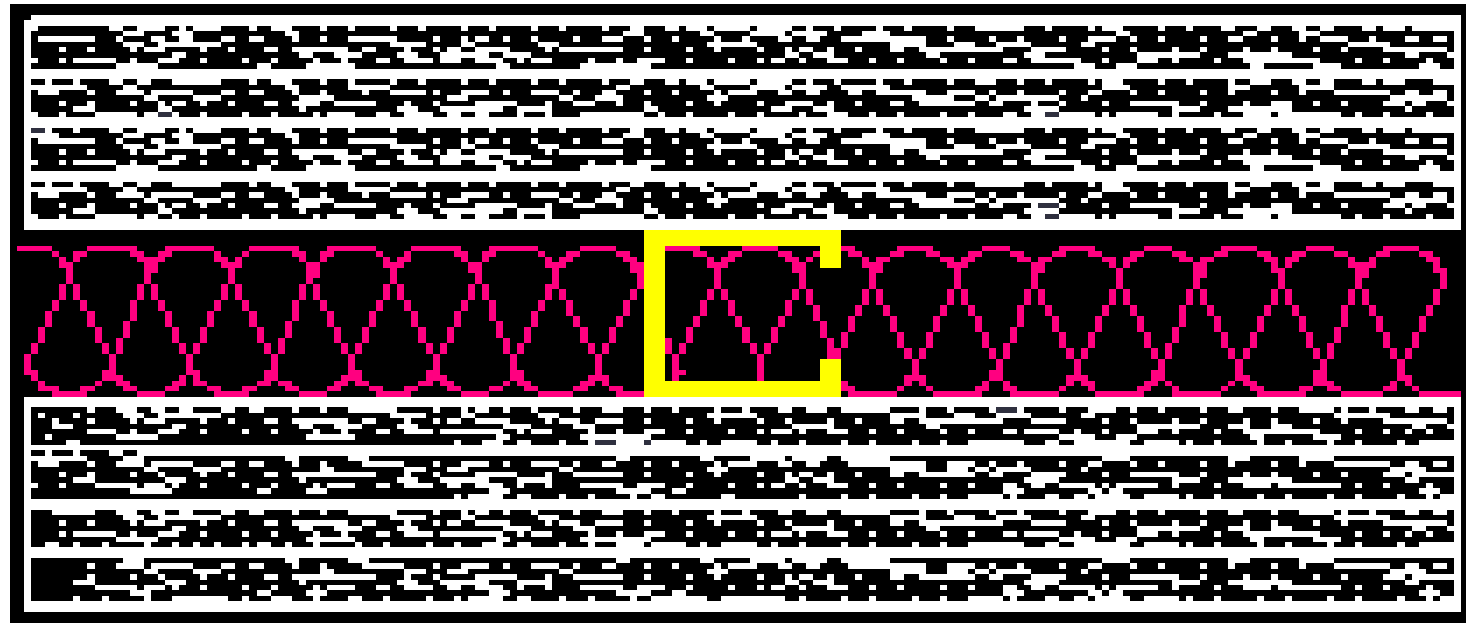
Gypsum Assemblies

U419 - 3 Hour



Gypsum Assemblies

U419 - 4 Hour



UL Design No. U419

5. **Gypsum Board*** — Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) with Type ULIX need not be staggered. The thickness and number of layers for the 1 hr, 2 hr, 3 hr and 4 hr ratings are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Items 2, 2C, 2D, 2F, 2G, 2O	No. of Layers & Thkns of Panel	Min Thkns of Insulation (Item 4)
1	3-1/2	1 layer, 5/8 in. thick	Optional
1	2-1/2	1 layer, 1/2 in. thick	1-1/2 in.
1	1-5/8	1 layer, 3/4 in. thick	Optional
2	1-5/8	2 layers, 1/2 in. thick	Optional
2	1-5/8	2 layers, 5/8 in. thick	Optional
2	3-1/2	1 layer, 3/4 in. thick	3 in.
3	1-5/8	3 layers, 1/2 in. thick	Optional
3	1-5/8	2 layers, 3/4 in. thick	Optional
3	1-5/8	3 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 1/2 in. thick	Optional
4	2-1/2	2 layers, 3/4 in. thick	2 in.

UL Design No. U419

4. **Batts and Blankets*** — (Required as indicated under Item 5) — Mineral wool batts, friction fitted between studs and runners. Min nom thickness as indicated under Item 5.

See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

4A. **Batts and Blankets*** — (Optional) — Placed in stud cavities, any glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance.

See **Batts and Blankets** (BKNV or BZJZ) Categories for names of Classified companies.

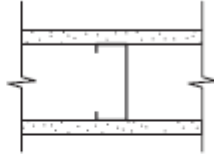
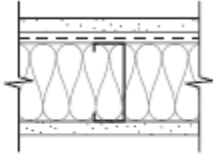
4B. **Fiber, Sprayed*** — (Optional, for use with Type ULIX) Where insulation is required - Spray applied granulated mineral fiber material. The fiber is applied with adhesive at a minimum density of 4.0 pcf to completely fill the wall cavity in accordance with the application instructions supplied with the product. See **Fiber, Sprayed** (CCAZ).

AMERICAN ROCKWOOL MANUFACTURING, LLC — Type Rockwool Premium Plus

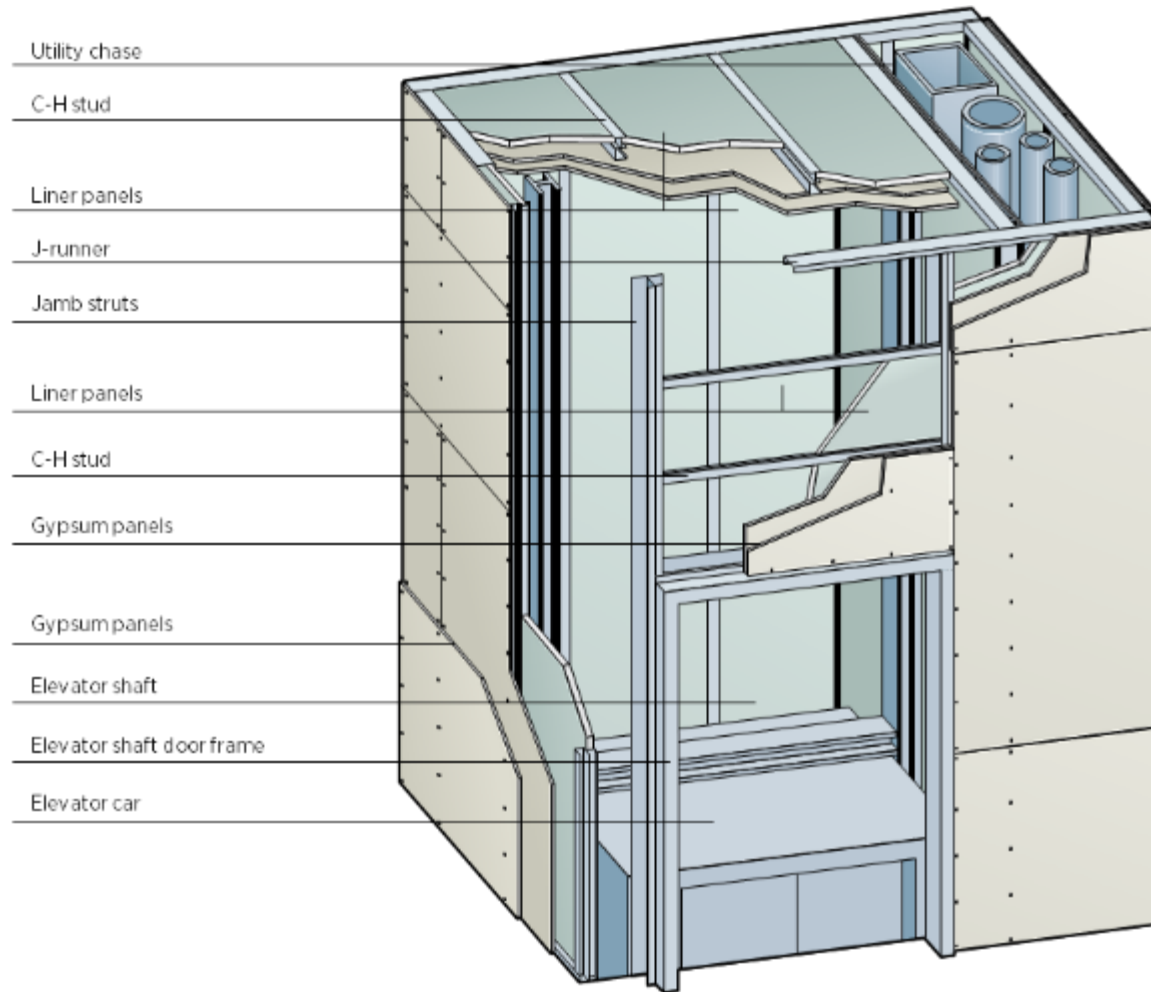
6. **Fasteners** — (Not Shown) — For use with Items 2 and 2F - Type S or S-12 steel screws used to attach panels to studs (Item 2) or furring channels (Item 7). **Single layer systems:** 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 8 in. OC when panels are applied horizontally, or 8 in. OC along vertical and bottom edges and 12 in. OC in the field when panels are applied vertically. **Single layer system with Type ULIX:** 1 in. long, spaced 12 in. OC in the field and perimeter, when panels are applied horizontally or vertically. **Two layer systems:** First layer- 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels or 2-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC with screws offset 8 in. from first layer. **Three-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in., 5/8 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below. **Four-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 24 in. OC. Fourth layer- 2-5/8 in. long for 1/2 in. thick panels or 3 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below.

Gypsum Association GA-600



GA FILE NO. WP 1058	PROPRIETARY	1 HOUR FIRE	50 to 54 STC SOUND
<p style="text-align: center;">GYPSUM PANELS, STEEL STUDS</p> <p>Fire Design: One layer 5/8" proprietary type X gypsum panels applied parallel or at right angles to each side of 3-1/2", 15 mil steel studs 24" o.c. with 1" Type S screws 12" o.c.</p> <p>Vertical joints centered over studs and staggered one stud cavity on opposite sides. Horizontal joints need not be staggered or backed. (NLB)</p> <p>Sound Design: Sound tested on 3-5/8" steel studs with resilient channels 24" o.c. on ONE SIDE with gypsum panels applied at right angles to resilient channels and 3-1/2" glass fiber insulation in stud cavity.</p> <p>PROPRIETARY GYPSUM PANEL United States Gypsum Company - 5/8" Sheetrock® Brand EcoSmart Panels Firecode® X</p>		 <p>Thickness: 4-3/4" (Fire) 5-3/8" (Sound)</p> <p>Approx. Weight: 3.8 psf (Fire) 4 psf (Sound)</p> <p>Fire Test: UL R1319, 4789485517, 7-31-20 UL Design U419</p> <p>Sound Test: USG-151202, 12-1-15</p>	

Shaft Walls



Cross-Section of Elevator Shaft Assembly

Classified by UL

- Can be used in any assembly where Type SLX panels are listed

UL Assemblies

- U415 1-4 hour rated shaft wall assemblies
- Unsupported horizontal butt joints
- U336 2 hour rated area separation wall

Area Separation Walls

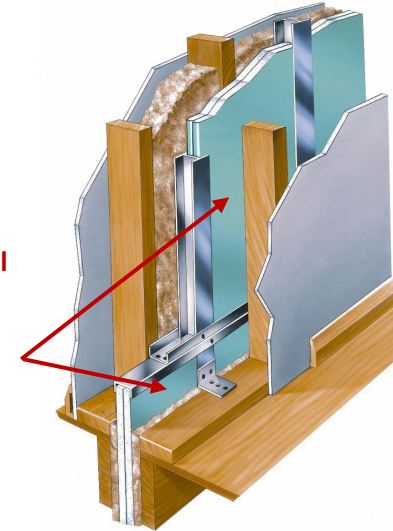


Multi-Family Fire Resistance

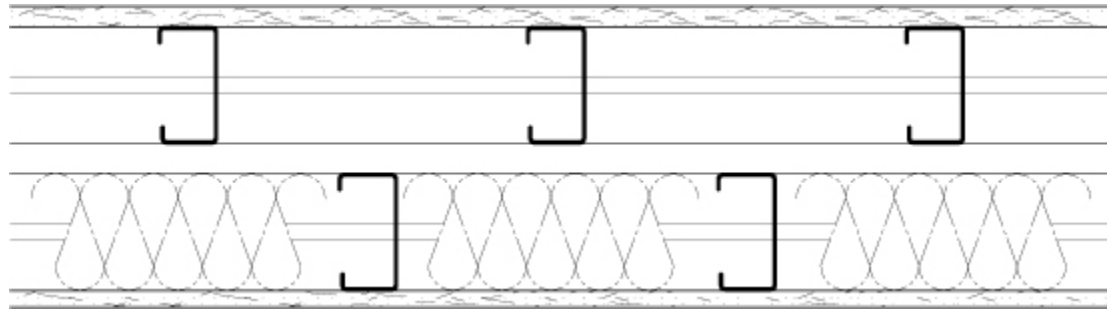
- Designed for townhouses that share a common wall
- Up to 4 stories
- Allows for collapse of fire-exposed construction while maintaining integrity of unexposed side

Area Separation Wall
Cross-Section

Gypsum Liner Panels



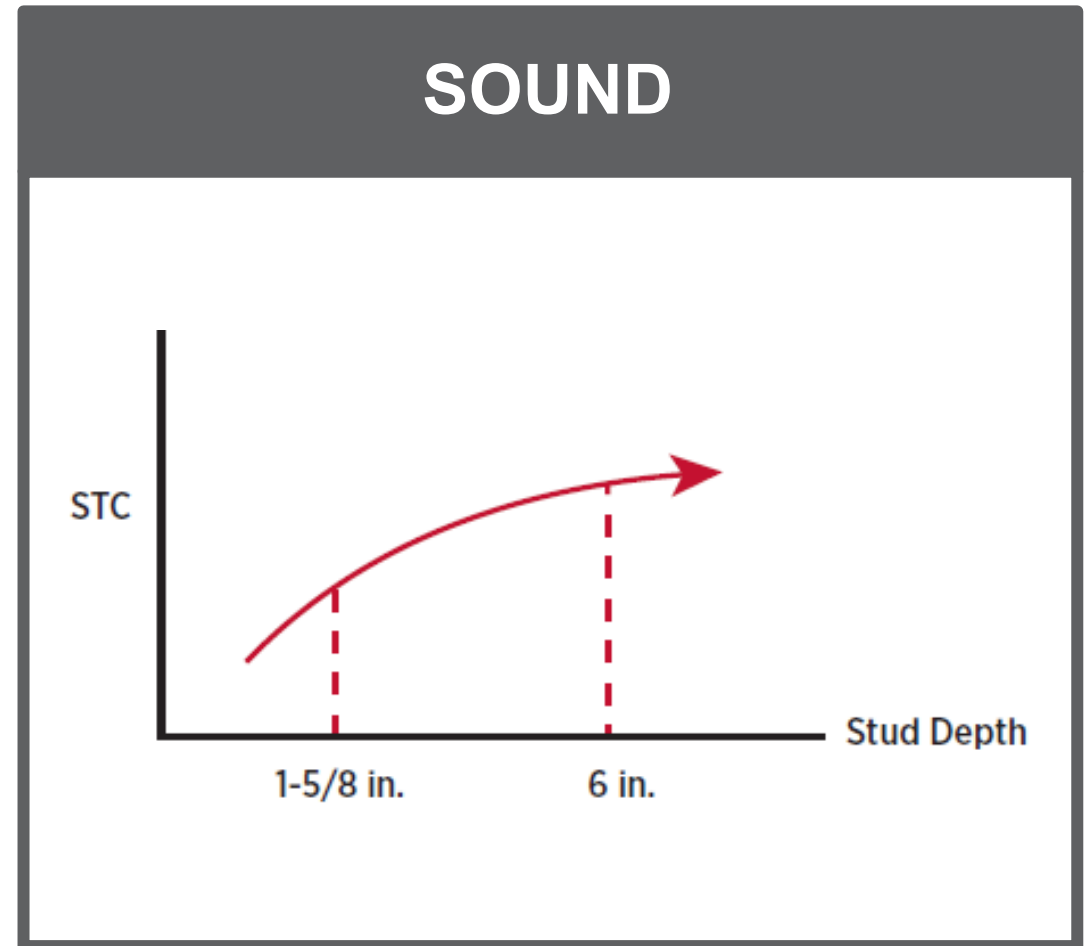
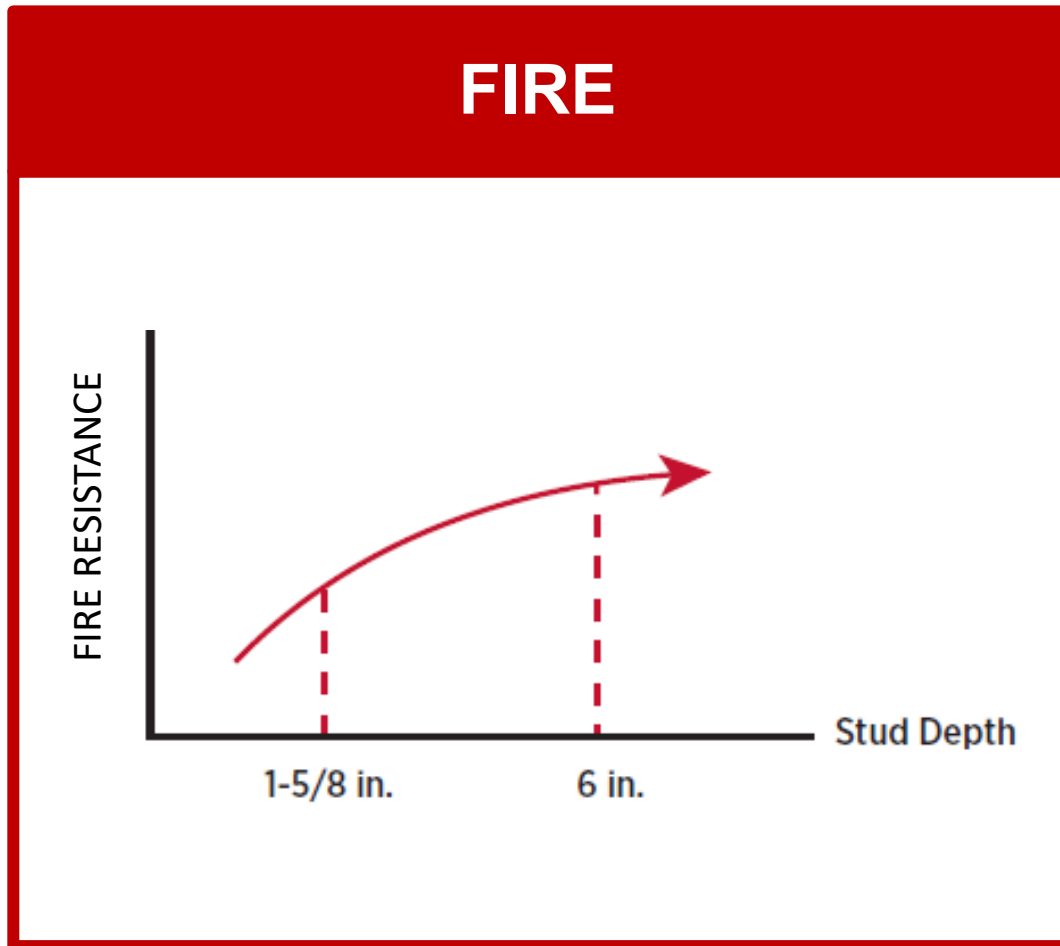
UL Design No. U493



- Unique Chase Wall Design
- No connection of opposite studs
- Acoustically better

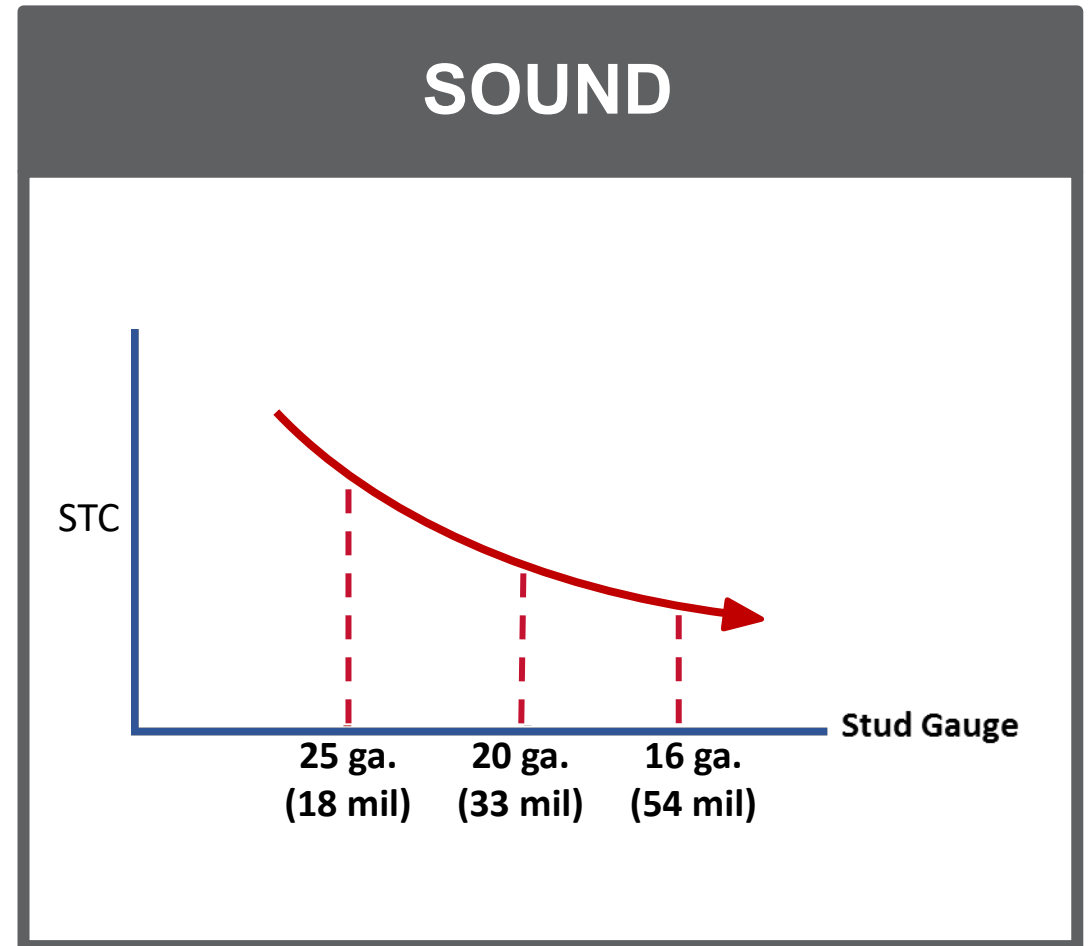
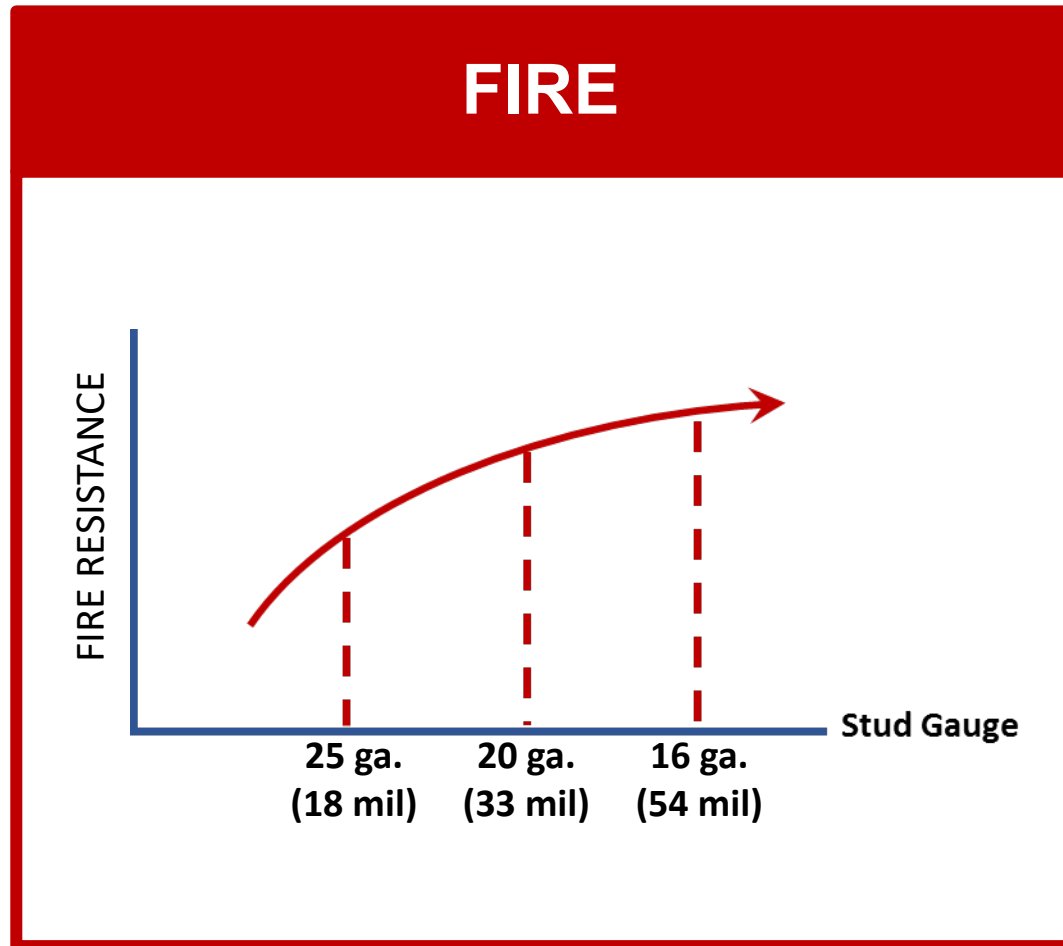
Influencing Factors

FRAMING MATERIAL DEPTH



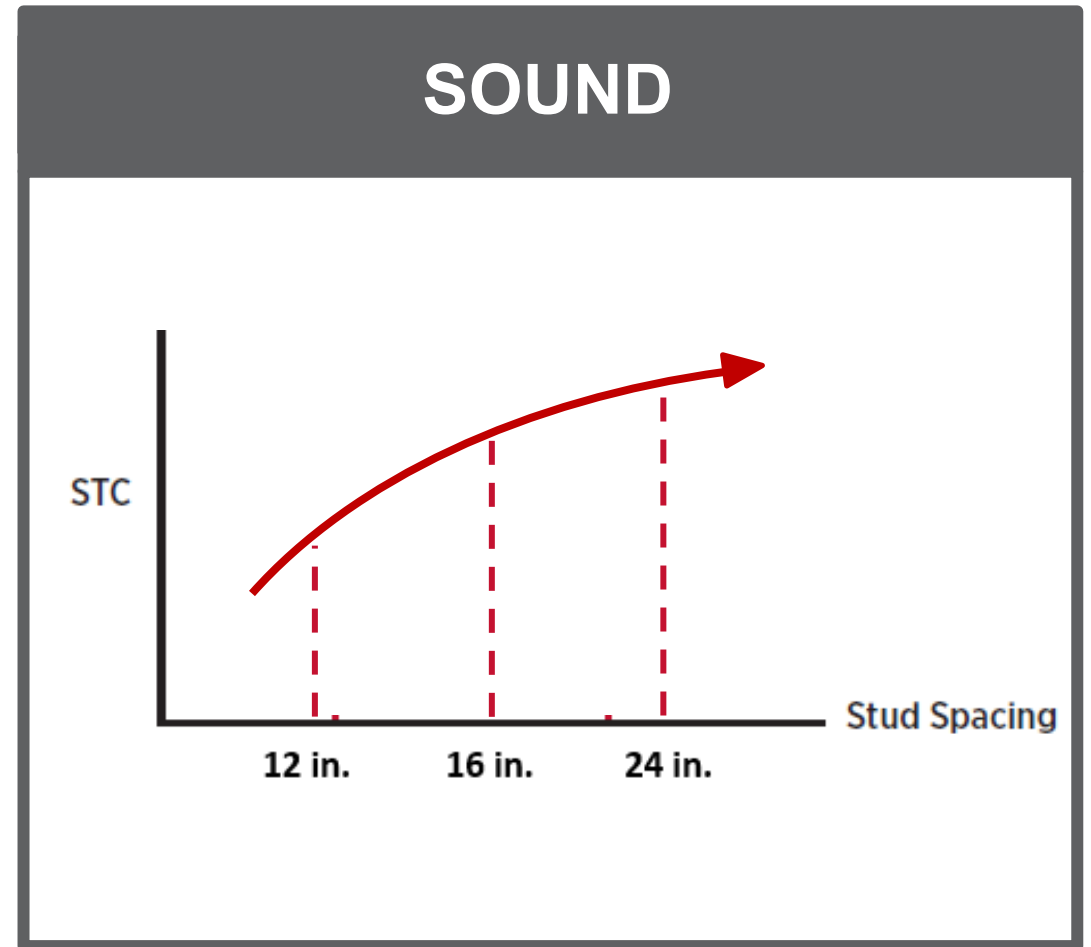
Influencing Factors

FRAMING MATERIAL THICKNESS



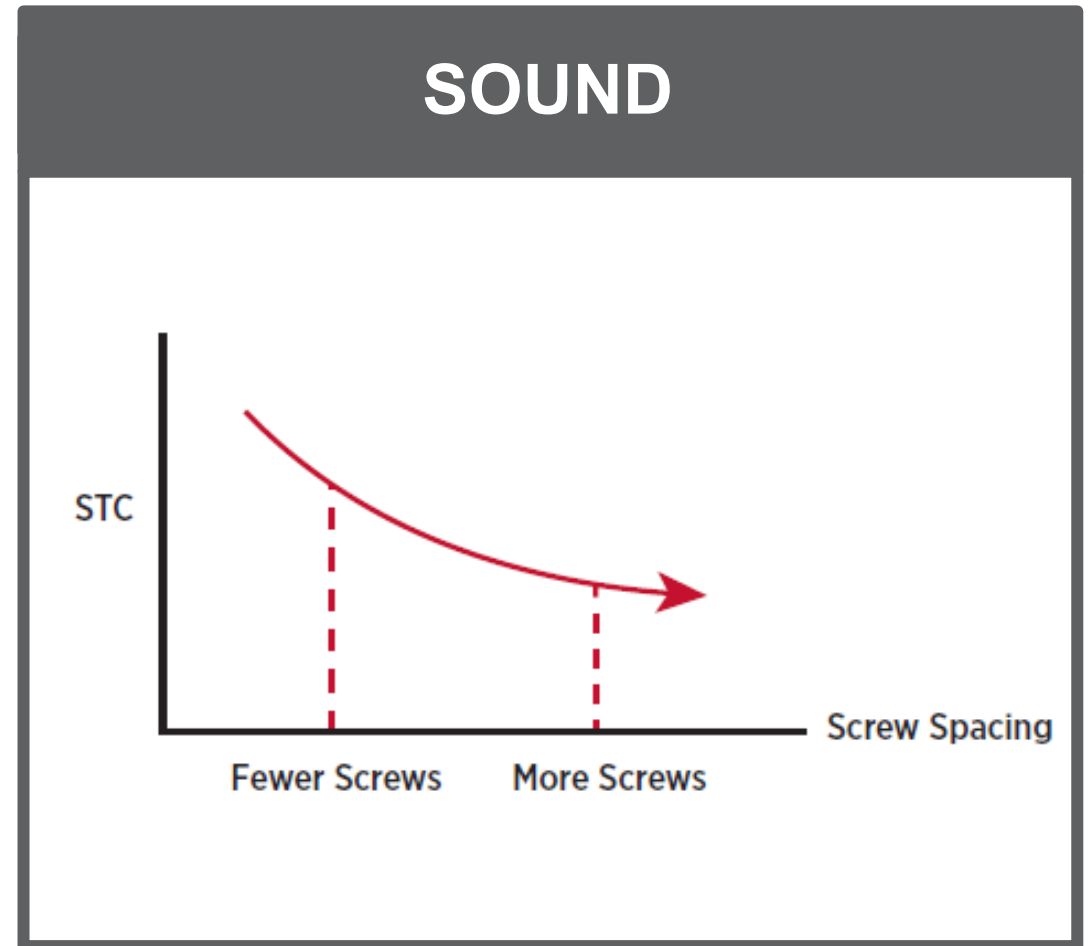
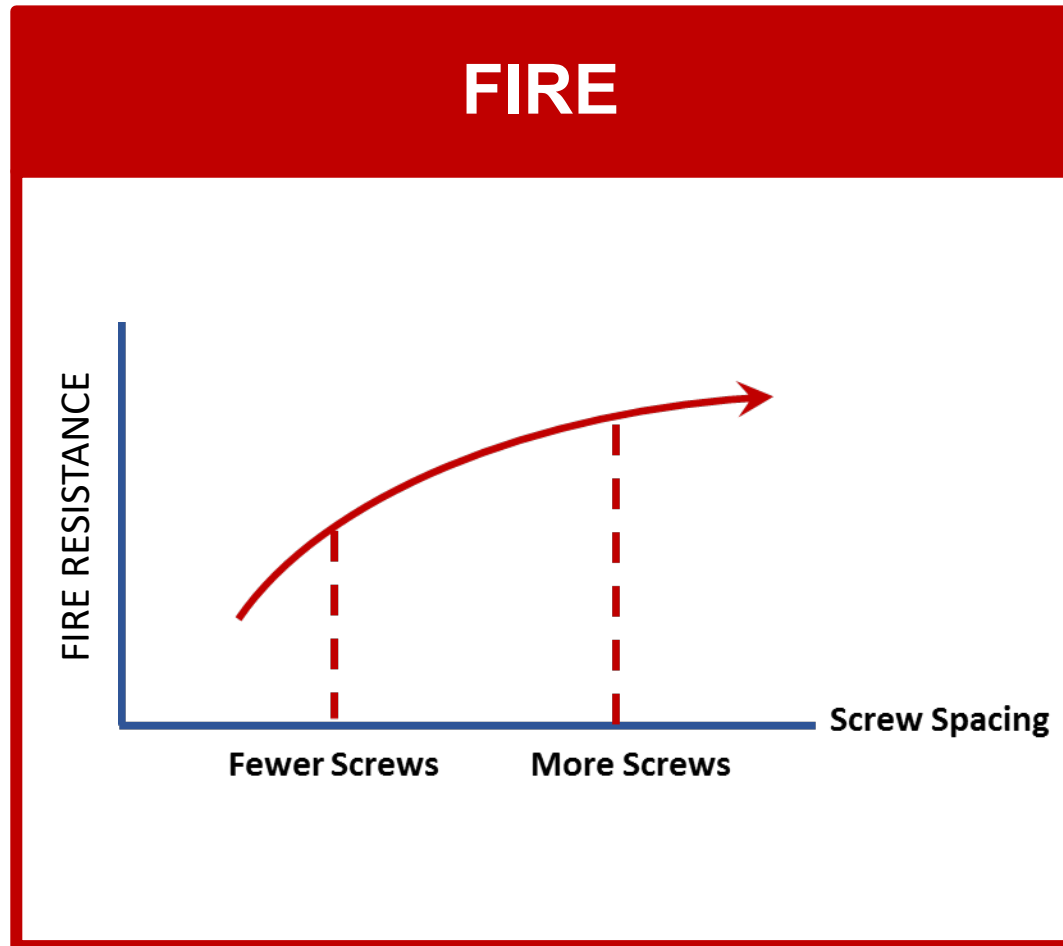
Influencing Factors

FRAMING SPACING



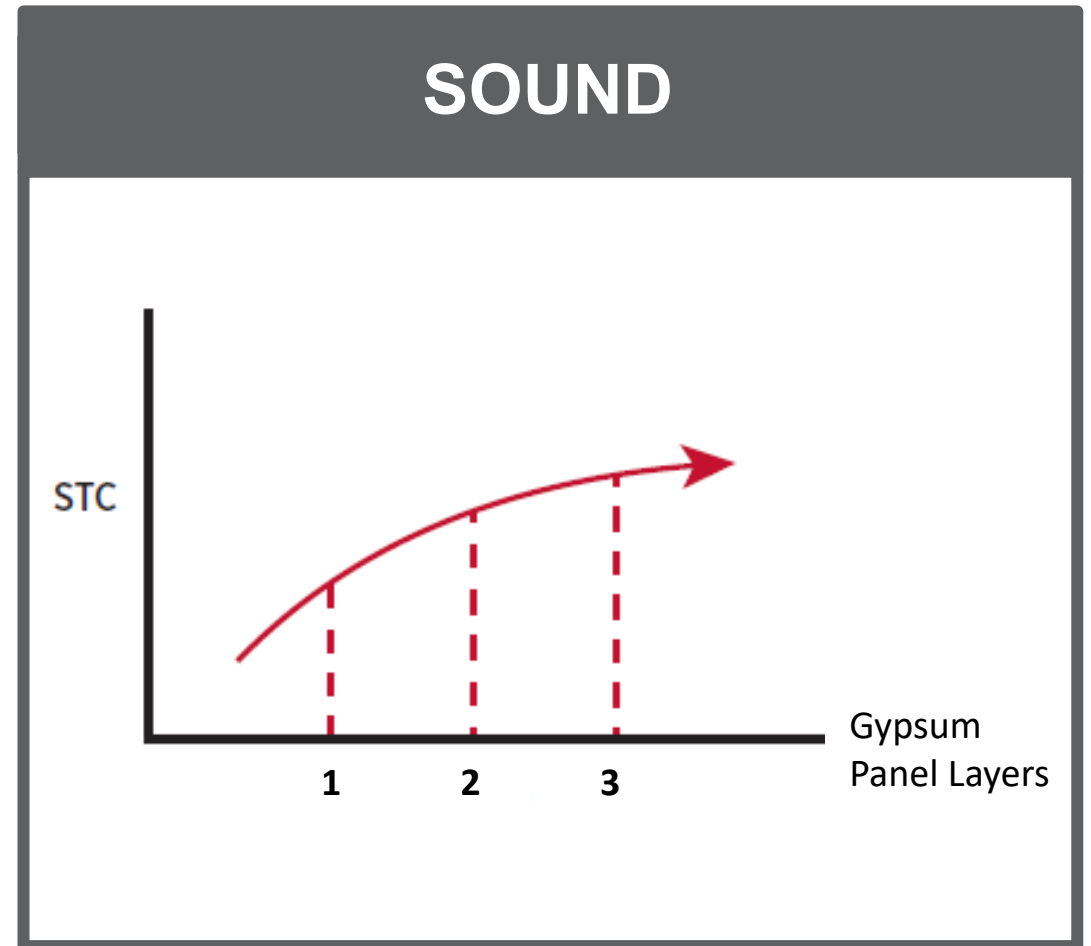
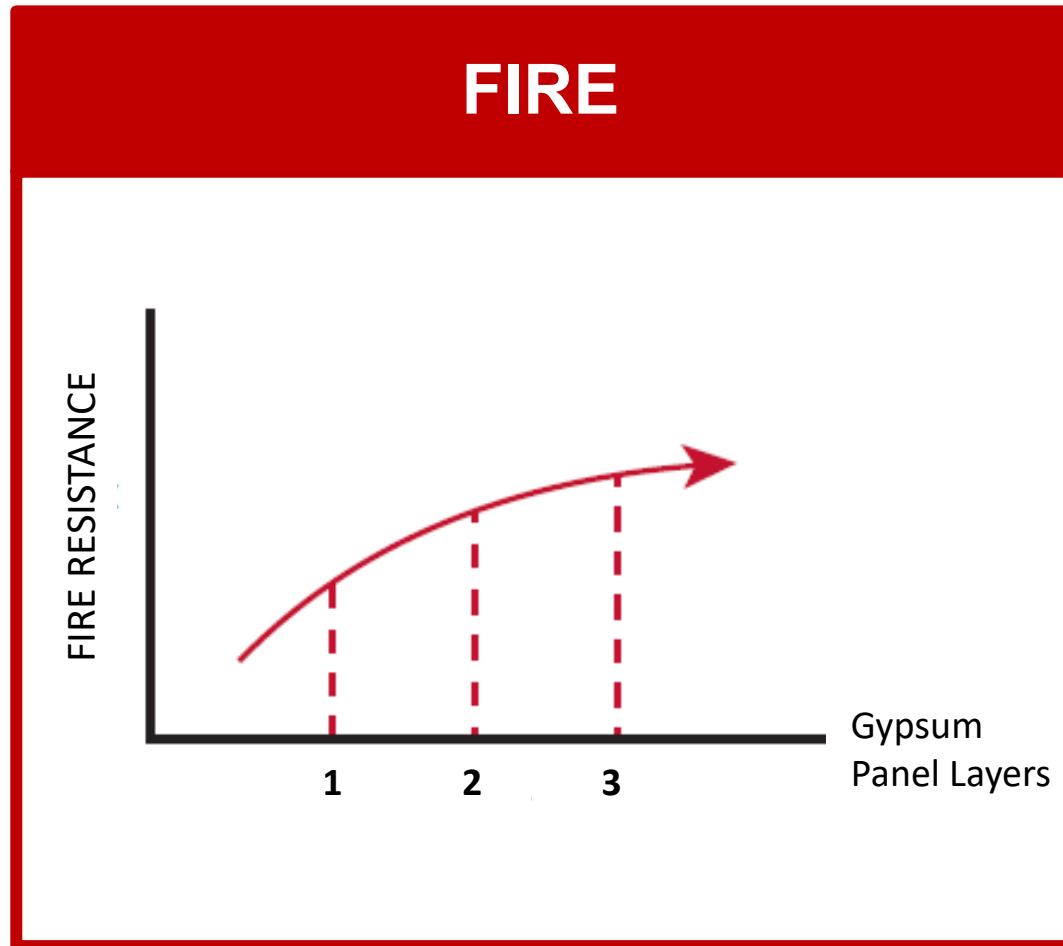
Influencing Factors

SCREW SPACING



Influencing Factors

GYPSUM PANEL LAYERS



Dos & Don'ts

DO

- Add layers of gypsum
- Add fibrous insulation to walls
- Add resilient channels to walls
- Add materials on top of the flooring system
- Add sheathing (e.g. plywood) within walls



DON'T

- Don't add insulation to floor- and roof-ceilings without consulting published design
- Don't add spray foam insulation to walls or ceilings without consulting published design
- Don't construct steel stud chase walls with a common runner



Repairs

- Simply covering a hole or damaged area **is not a repair**
- Repair procedure must take into consideration:
 - Size of the affected area
 - Hourly rating of assembly
 - Framing: type, size and spacing
 - Gypsum: type, number of layers and orientation
 - Accessibility: Can the repair be made from both sides?
 - Other: fastening method, location of repair, etc.
- NFPA 1:
 - 12.3.3.2 Where required, **fire-rated gypsum wallboard** walls or ceilings that are damaged to the extent that through openings exist, the damaged gypsum wallboard shall be **replaced or returned to the required level of fire resistance using a listed repair system or using materials and methods equivalent to the original construction.**
- **Must contact manufacturer to verify listed repair method**

Repairs

- GA-225 – Repair of Fire-Rated Gypsum Panel Product Systems



Figure 1: Damaged Gypsum Panel



Figure 2: Square Off Damaged Area



Figure 3: Frame Opening



Figure 4: Apply Gypsum Panel Patch



Figure 5: Tape and Finish Patched Area

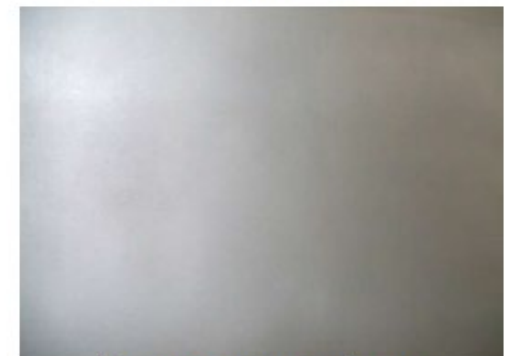
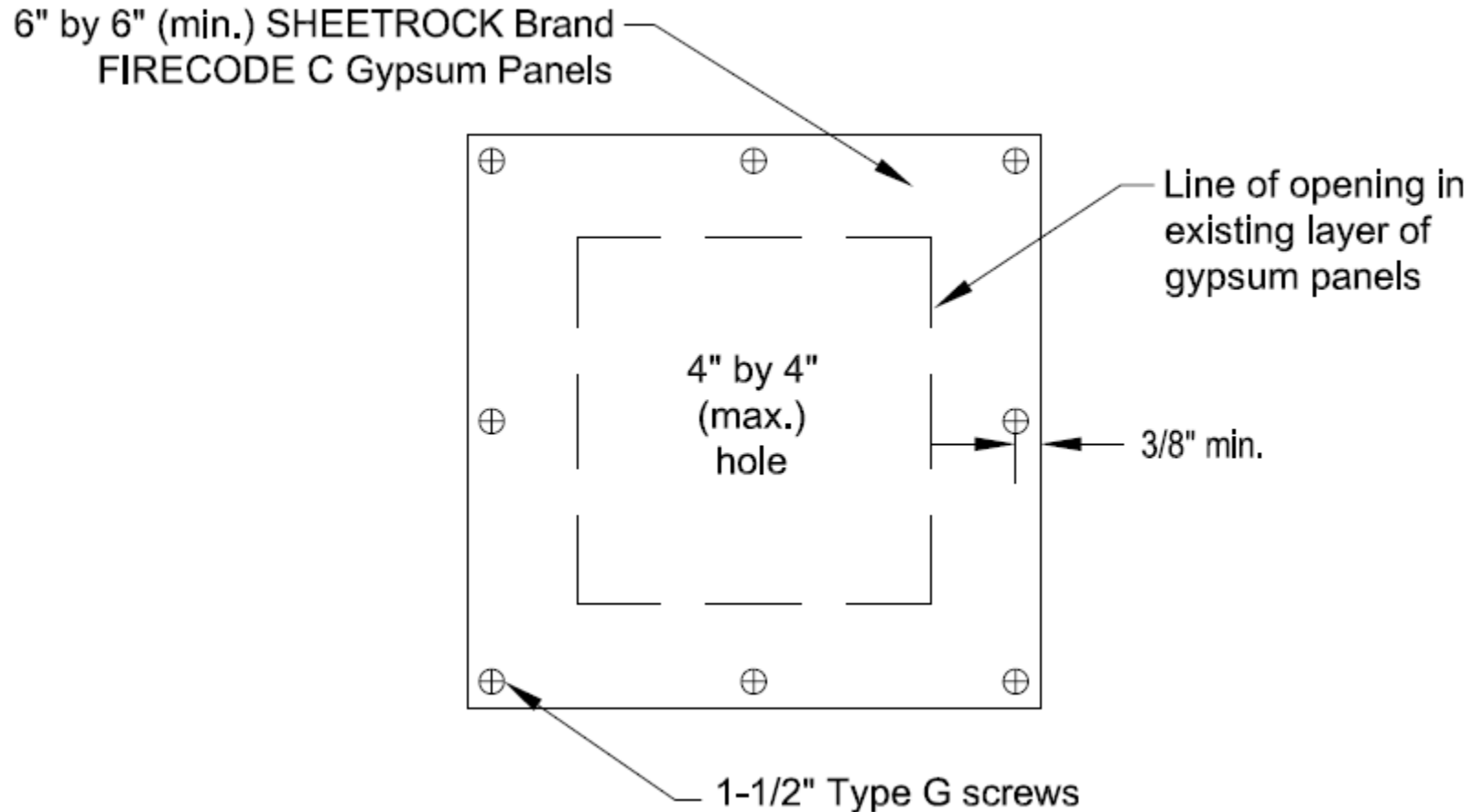


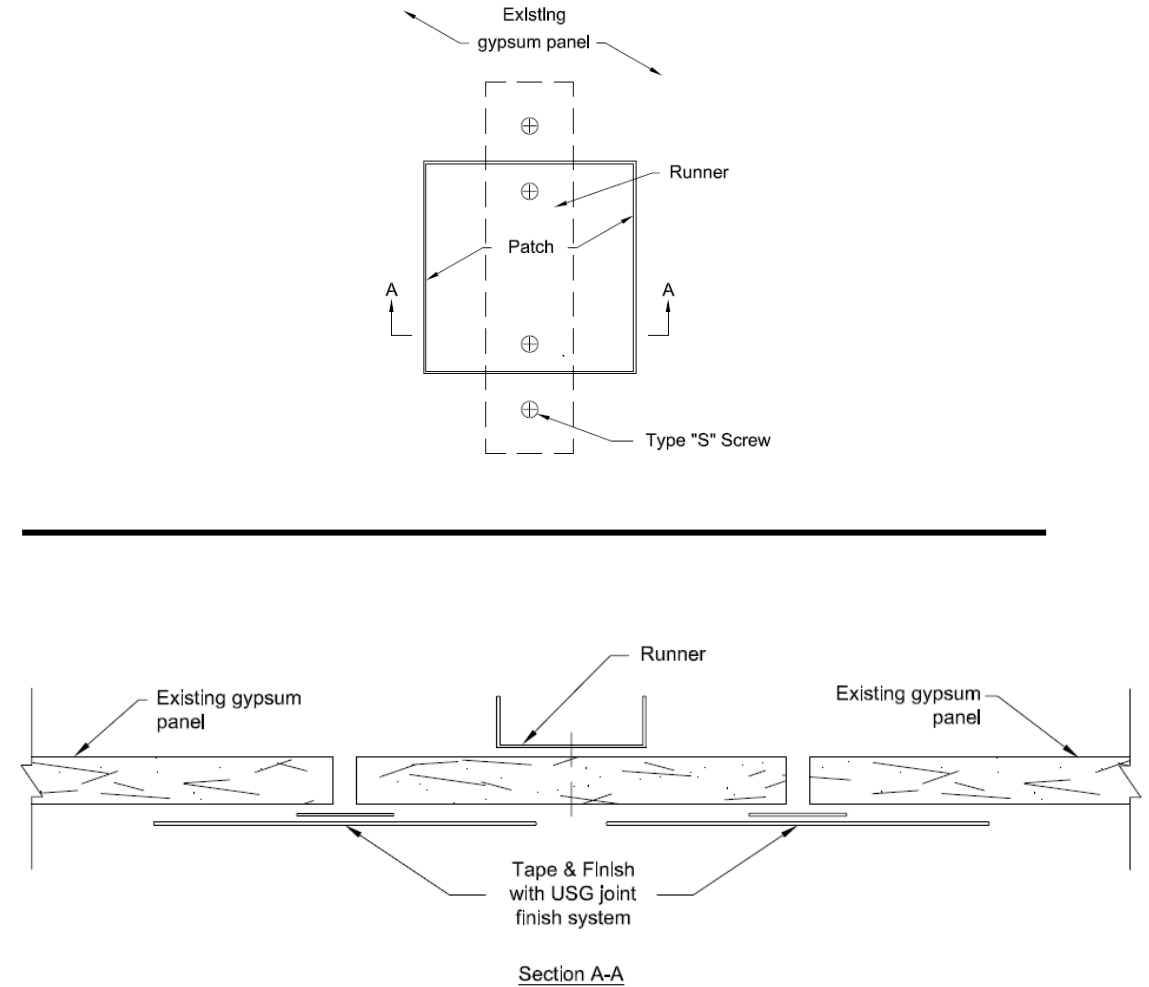
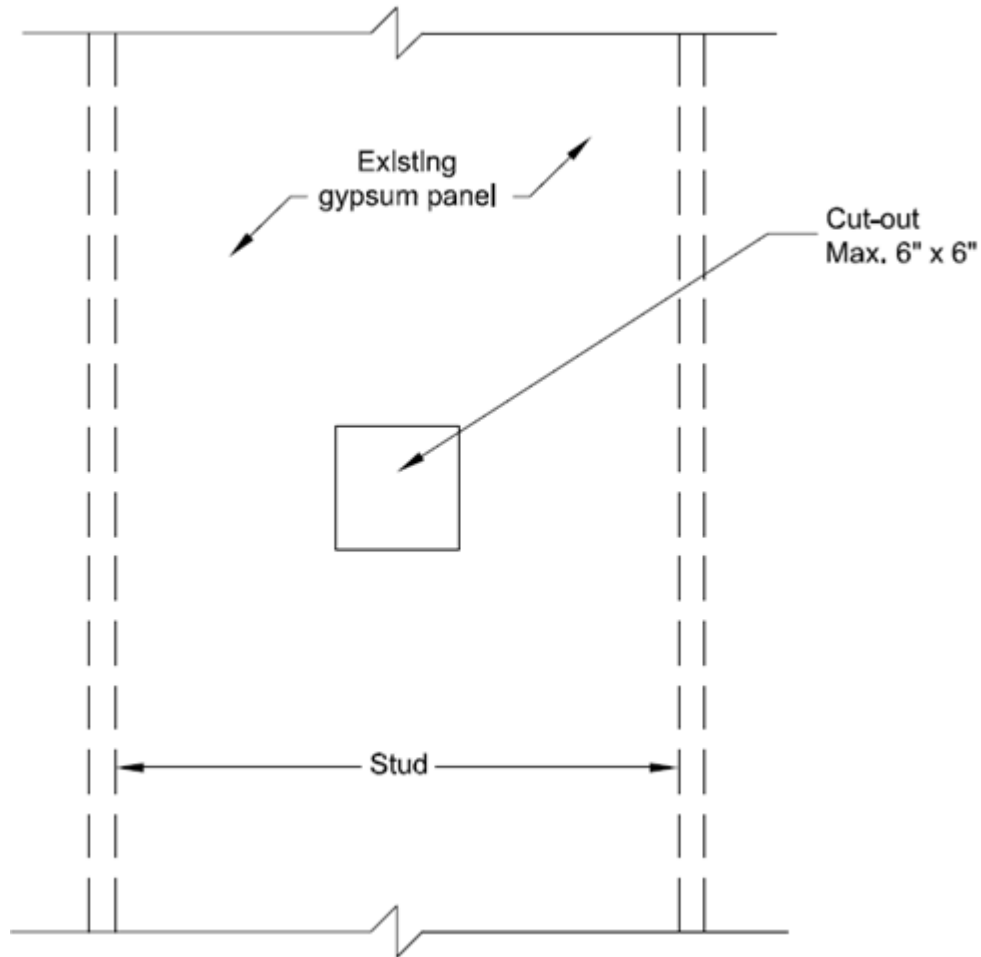
Figure 6: Redecorate Repaired Area

Repairs – Small Surface (Tested)



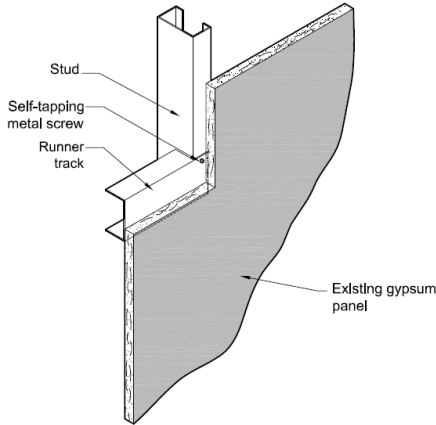
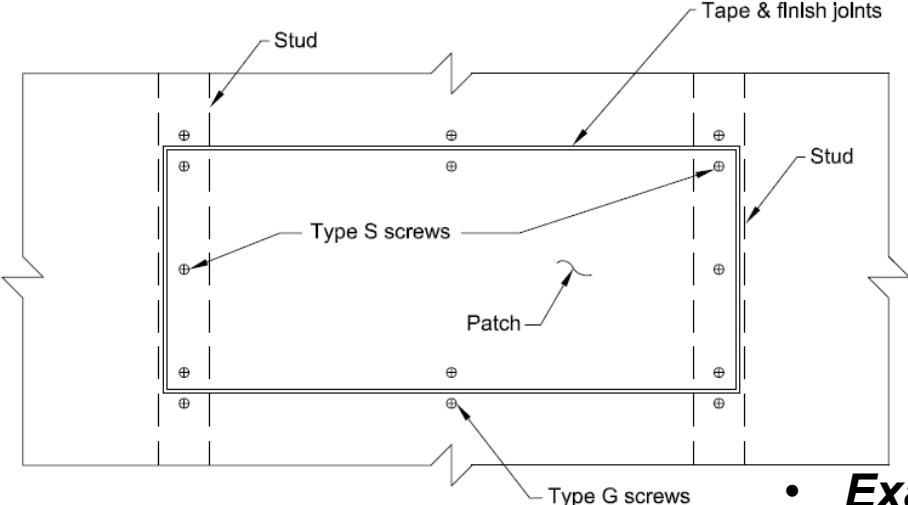
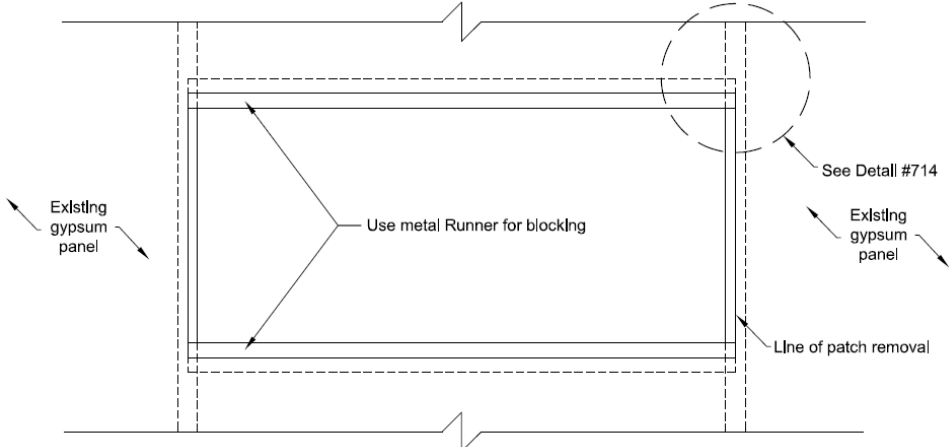
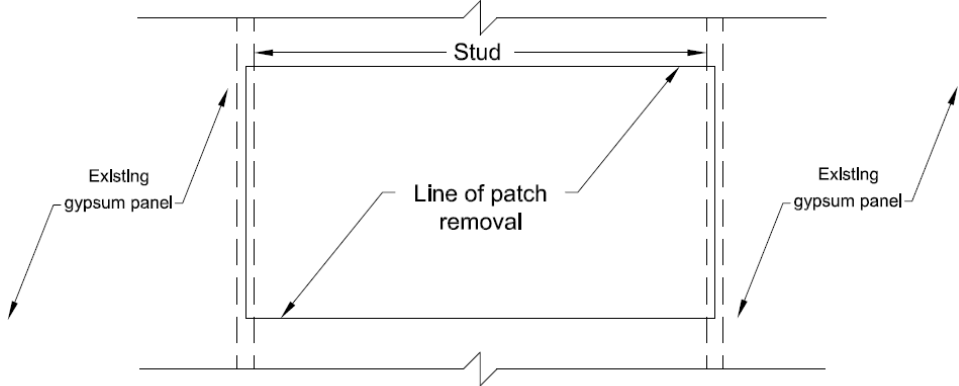
- **Example of USG Repair**
- **Must contact manufacturer to verify listed repair method**

Repairs – Small Flush (Tested)



- **Example of USG Repair**
- **Must contact manufacturer to verify listed repair method**

Repairs – Large Flush (Tested)



- **Example of USG Repair**
- **Must contact manufacturer to verify listed repair method**

Questions?

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Firestop Contractors International Association

