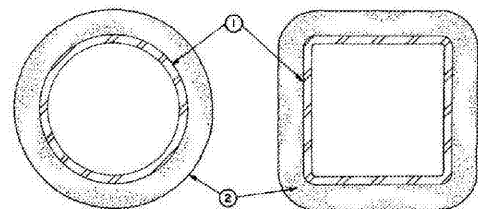


Restrained Assembly Ratings — 1, 1-1/2, 2, 3 and 4 Hr.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



1. **Steel Pipe or Tube Column** — Steel circular pipe (SP) with diameter (D) ranging from a minimum of 3 in. to a maximum of 32 in. with a minimum wall thickness of 3/16 in. Steel square or rectangular tube (ST) with outside wall dimensions ranging from minimum 3 in. to a maximum of 36 in. and a minimum wall thickness of 3/16 in.

2. **Spray-Applied Fire Resistant Materials** — Applied by spraying with water to the final thicknesses shown below. Crest areas shall be filled with Spray-Applied Fire Resistant Materials above the beam. Beam surfaces must be clean and free of dirt, loose scale and oil. Min average density of 13 pcf with min. ind density of 11 pcf for Types II, II HS, or DCF; Min avg and min ind densities of 22 and 19 pcf, respectively, for Type HP. For method of density determination, refer to Design Information Section. The min thickness of Spray-Applied Fire Resistant Material required for various fire resistance ratings of contour sprayed steel pipes or tubes are shown in the tables below.

Tube Steel Columns, Min Thkns, In.					
Min Column Size	A/P	Rating, Hr.			
		1	1-1/2	2	3
ST 3x3x0.188	0.18	1	1-1/2	2-0/16	...
ST 4x4x0.188	0.18	1-1/2	1-9/16	2-3/16	3-1/2
ST 4x4x0.25	0.24	3/4	1-5/16	1-15/16	3
ST 4x4x0.375	0.34	9/16	1-1/2	1-1/4	2-1/16
ST 4x4x0.5	0.44	7/16	3/4	1-1/16	1-1/16
ST 36x24x0.5	0.39	3/8	7/16	1-1/16	1-1/8

Pipe Columns, Min Thkns, In.					
Min Column Size	A/P	Rating, Hr.			
		1	1-1/2	2	3
SP 3x0.188	0.18	1	1-1/2	2-9/16	...
SP 4x0.237	0.22	13/16	1-7/16	2-1/16	3-3/8

ISOLATEK INTERNATIONAL — Type HP, D-C/F, II, or II HS. Investigated for exterior use. Type EBS or Type X adhesive/sealer optional.

As an alternate to the above tables, the required thickness of Spray-Applied Fire Resistant Materials to be applied to all surfaces of the steel pipes or tubes for all rating periods may be determined from the following equation: The thickness of sprayed for ratings of 1, 1-1/2, 2, 3, and 4 h of a steel pipe or tube may be determined by the equation:

$$R = \frac{0.38}{3.58 (A/P)}$$

Where:

R = the hourly rating (hrs),
t = the thickness of protection material, min 0.35 - max 3.50 in.,
A = the cross sectional area (sq in.),
P = the heated perimeter (in.),
The A/P ratio of the steel pipe or tube, (see Item 2) shall range from 0.18 to 2.0.
The A/P ratio of a circular pipe is determined by:

$$A/P = \frac{t(d - t)}{d}$$

Where:

d = the outer diameter of the pipe (in.),
t = the wall thickness of the pipe (in.),
The A/P ratio of a rectangular tube is determined by:

$$A/P = \frac{t(a + b - 2t)}{a + b}$$

Where:

a = the outer width of the tube (in.),
b = the outer length of the tube (in.),
t = the wall thickness of the tube (in.)

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2019-05-03

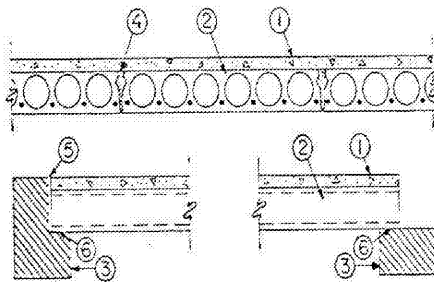
Restrained Assembly Ratings — 2 and 3 Hr. (See Item 1)

Unrestrained Assembly Rating — 1 and 2 Hr.

Unrestrained Beam Rating — 1, 1-1/2, 2, 3 (See Items 8, 8A)

This design was evaluated using a load design method other than the Limit States Design Method (e.g., Working Stress Design Method). For jurisdictions employing the Limit States Design Method, such as Canada, a load restriction factor shall be used — See Guide 830.1 or 830.1.1.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.



1. **Concrete Topping** — 3000 psi compressive strength, 110 to 153 pcf unit weight. Normal weight aggregate.

Rating Hr.	Min Thkns In.
2	0
3	1

1A. **Floor Topping Mixture** — Alternate to Item 1 - Min 1/2 in. thickness of floor topping mixture having a min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill 2010, Firm-Fill 3310, Firm-Fill 4010, Gyp-Span Radiant.

Floor Mat Materials — (Optional) — Floor mat material nom 1/8 in. (3 mm) thick loose laid over the precast concrete unit. Floor topping thickness shall be a min of 3/4 in. (19 mm).

HACKER INDUSTRIES INC — FIRM-FILL SCM 125

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 1/4 in. (6 mm) thick loose laid over the precast concrete unit. Floor topping thickness shall be a min of 1 in. (25 mm).

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 250

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. (10 mm) thick loose laid over the precast concrete unit. Floor topping thickness shall be a min of 1-1/4 in. (32 mm).

HACKER INDUSTRIES INC — FIRM-FILL SCM 400

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/4 in. (19 mm) thick loose laid over the precast concrete unit. Floor topping thickness shall be a min of 1-1/2 in. (38 mm).

HACKER INDUSTRIES INC — Type FIRM-FILL SCM 750

Metal Lath (Optional) — For use with 3/8 in. (10 mm), or greater, floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1 in. (25 mm) over the floor mat.

1B. **Floor Topping Mixture** — Alternate to Items 1 and 1A - Min 3/4 in. thickness of floor topping mixture having min compressive strength of 1100 psi. Mixture shall consist of 6.8 gal of water to 80 lbs of floor topping mixture to 1.9 cu ft of sand.

HACKER INDUSTRIES INC — Firm-Fill Gypsum Concrete, Firm-Fill High Strength, Gyp-Span Radiant.

Floor Mat Materials — (Optional) — Floor mat material nom 5/64 in. (2 mm) thick adhered to precast concrete unit with Hacker Floor Primer. Primer to be applied to the surface of the mat prior to the placement of floor topping mixture. Floor topping thickness a min 1 in. over the floor mat.

ECORE INTERNATIONAL INC — Type QT/rim 3006

HACKER INDUSTRIES INC — Type Hacker Sound-Mat II

Metal Lath (Optional) — For use with 3/8 in. (10 mm) floor mat materials, 3/8 in. expanded steel diamond mesh, 3.4 lbs/sq yd placed over the floor mat material. Hacker Floor Primer to be applied prior to the placement of the metal lath. When metal lath is used, floor topping thickness a nom 1-1/4 in. over the floor mat.

1C. **Finish Flooring** — **Floor Topping Mixture** — Min. 3/4 in. thickness of floor topping mixture having a minimum compressive strength of 1500 psi. Refer to manufacturer's instructions accompanying the material for specific mix design.

MAXXON CORP — Type D-C, CC, CC 2000, L-R, L-R CT, S

RAPID FLOOR SYSTEMS — Type RIF, RFP, RFU, Concrete.

Floor Mat Materials — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the thickness of floor topping over each floor mat material.

MAXXON CORP — Type Acousti-Mat I, Acousti-Mat II, Acousti-Mat III HP, Enkasonic 9110, Enkasonic 9110 HP, Acousti-Mat S, Acousti-Mat 3 HP, Acousti-Mat LP, Acousti-Mat LP-R, Acousti-Mat SD

Floor Mat Reinforcement — (Optional) — Refer to manufacturer's instructions regarding minimum thickness of floor topping over each floor mat material, primers, and use of crack suppression reinforcement.

MAXXON CORP — Crack Suppression Mat (CSM) or Maxxon Reinforcement (MR)

Metal Lath — (Optional) — For use with or as alternate to Crack Suppression Mat (CSM) or Maxxon Reinforcement (MR) — 3/8 in. expanded galvanized steel diamond mesh, 3.4 lbs/sq yd loose laid over the floor mat material. Floor topping thickness shall be min 1-1/2 in.

1E. **Alternate Floor Topping Mixture** — Compressive strength to be 1800 psi min. Min. thickness to be 3/4 in. Refer to manufacturer's instructions accompanying the material for specific mix design.

UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

USG MEXICO SA DE CV — Types LRK, HSLRK, CSD

Floor Mat Materials — (Optional) — Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

UNITED STATES GYPSUM CO — Types SAM, LEVELROCK® Brand Sound Reduction Board, LEVELROCK® Brand Floor Underlayment SRM-25.

Alternate Floor Mat Materials — (Optional) — Floor mat material nom 3/8 in. thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

ACG MATERIALS — Accu-Crete types NexGen, Green, Prime, B, M, and PreFour, AccuRadiant, AccuLevel types G40, SD30, and G50.

1E. **Alternate Floor Topping Mixture** — Compressive strength to be 1000 psi min. Thickness to be 3/4 in. min. Refer to manufacturer's instructions accompanying the material for specific mix design.

ACG MATERIALS — Accu-Crete types NexGen, Green, Prime, B, M, and PreFour, AccuRadiant, AccuLevel types G40, SD30, and G50.

1F. **Alternate Floor Topping Mixture** — Compressive strength to be 1000 psi min. Thickness to be 3/4 in. min. Refer to manufacturer's instructions accompanying the material for specific mix design.

FORMULATED MATERIALS LLC — Types FR-26, FR-30, SiteMat, and SiteMix SL.

Alternate Floor Mat Materials — (Optional) — Floor mat material nominal 2 - 9.5 mm thick loose laid over the subfloor. Floor topping shall be a min of 3/4 in.

FORMULATED MATERIALS LLC — Types M1, M2, M3, R1, and R2.

1G. **Alternate Floor Topping Mixture** — Compressive strength to be 2100 psi min. Thickness to be 3/4 in. min. Refer to manufacturer's instructions accompanying the material for specific mix design.

2. **Precast Concrete Units** — Nom 8, 10, 12 or 14 in. thick units. Normal weight aggregate. Cross section similar to the above illustration.

BOCCELLA PRECAST L L C

3. **End Details** — Restrained and unrestrained.

4. **Joint** — Clearance between slabs at bottom, full length, 1/16 in. min, 5/16 in. max, grouted full length with sand-cement grout (3500 psi min compressive strength) to a max depth of 4-1/2 in. This depth may be maintained by placing a compressible material in the bottom of the joint before applying grout.

Note: A 3/4 in. lateral expansion joint to be provided the full length and depth of the slabs every 14 ft. Expansion should be obtained with noncombustible, compressible material, for example, 24 sheets of 1/16 in. thick ceramic fiber paper (total thickness equals 1-1/2 in.).

5. **End Clearance** — Clearance for expansion at each end of slabs shall be equal to (3/16 plus or minus 1/16 in. L/17 in., where "L" is equal to length of span in feet).

6. **Min Bearing** — 1-1/2 in.

7. **Beam** — (Optional, Not Shown) — W8x28 min size. The Precast Concrete Units shall be welded to the top flange of the beam by means of weld plates (spaced 48 in. OC max) incorporated in the joints.

8. **Spray-Applied Fire Resistant Materials** — (Not Shown) — Applied by mixing with water and spraying in one or more coats the final thicknesses as shown in the table below, on the steel beam following the beam contour. Surfaces of the beam shall be clean and free of dirt, loose scale and oil. Min avg and min ind density of 15/14 pcf, respectively. Min avg and min ind density of 22/19 pcf, respectively, for Types Z-106, Z-106G, Z-106HY. Min avg and min ind density of 19/16 pcf, respectively, for Type 7G and 7HD. For method of density determination, refer to Design Information Section.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Thkns on Beam In.
2	1	1	7/16
2	1-1/2	1-1/2	3/4
3	2	2	1
3	2	1-1/2	3/4
3	2	2	1
3	2	3	1-5/16

HACKER INDUSTRIES INC — Types MK-10 HB, MK-10 HB Extended Set, MK-6/ED, MK-6/ED, MK-6/HY, MK-6/HB, MK-6, MK-10 HB, MK-10 HB Extended Set, Monokote Acoustic 5, Z-106, Z-106G.

TYROK INC

OUTWEST FIRE PROTECTING PRODUCTS CO — Types 4, 5, 5EF, 5GP, 5MD, 7GP, 7HD, 8EF, 8GP, 8MD, 8FF, 8GP, 8MD.

GCP APPLIED TECHNOLOGIES INC — Types MK-6/HY, MK-6/HB, MK-6A, MK-10 HB, MK-10 HB Extended Set, Monokote Acoustic 1, Monokote Acoustic 5, RG, Z-106, Z-106G, Z-106HY.

Spray-Applied Fire Resistant Materials — (Not Shown) — As an alternate to Item 8 — Applied by spraying water to the final thickness as shown in the table below, to the steel beam following the beam contour. Surfaces of the beam shall be clean and free of dirt, loose scale and oil. Min avg and min ind density of 13 and 11 pcf, respectively, for Type D-C/F, II, or II HS. Min avg and min ind densities of 22 and 19 pcf, respectively, for Type HP. For method of density determination, refer to Design Information Section, Sprayed Material.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Thkns on Beam In.
2	1	1	3/8
2	1-1/2	1-1/2	11/16
2	2	2	1
3	1-1/2	1-1/2	11/16
3	2	2	1
3	2	3	1-5/8

ISOLATEK INTERNATIONAL — Type D-C/F, HP, II, or II HS.

8B. **Spray-Applied Fire Resistant Materials** — (Not Shown) — As an alternate to Item 8 and 8A — Applied by spraying with water to the final thickness as shown in the table below, to the steel beam following the beam contour. Surfaces of the beam shall be clean and free of dirt, loose scale and oil. Minimum average and minimum individual density of 15 and 14 pcf, respectively, for Types 300, 300AC, 300ES, 300HS, 300N, 300O, 300OES and 300S. For Types 400AC and 400ES min average and min individual density of 22 and 19 pcf, respectively. For method of density determination, refer to Design Information Section, Sprayed Material.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Min Thkns On Beam In.
2	1	1	5/16
2	1-1/2	1-1/2	1/2

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Min Thkns On Beam In.
2	1	1	11/16
2	1-1/2	1-1/2	1/2
3	2	2	11/16
3	2	3	1-1/16

BERLIN CO LTD — Types 300, 300ES, 300N or SB

GREENTECH THERMAL INSULATION PRODUCTS MFG CO L L C — Types 300, 300AC, or 400AC.

ISOLATEK INTERNATIONAL — Types 300, 300AC, 300ES, 300HS, 300N, SB, 400AC, 400ES, 300O or 300OES.

NEWKEM PRODUCTS CORP — Types 300, 300ES, 300N or SB.

8C. **Spray-Applied Fire Resistant Materials** — (Not Shown) — As an alternate to Item 8, 8A, and 8B — Applied by spraying with water to the final thickness as shown in the table below, to the steel beam following the beam contour. Surfaces of the beam shall be clean and free of dirt, loose scale and oil. Minimum average and minimum individual density of 17.5 and 16 pcf, respectively, for Type 300TW. Minimum average and minimum individual density of 22 and 19 pcf, respectively, for Type 400. For method of density determination, refer to Design Information Section, Sprayed Material.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Min Thkns On Beam In.
2	1	1	5/16
2	1-1/2	1-1/2	1/2
2	2	2	11/16
3	1-1/2	1-1/2	1/2
3	2	2	11/16
3	2	3	1-1/16

GREENTECH THERMAL INSULATION PRODUCTS MFG CO L L C — Type 300TW

ISOLATEK INTERNATIONAL — Type 300TW or Type 400.

NEWKEM PRODUCTS CORP — Type 400.

The thickness of Spray-Applied Fire Resistant Materials shown in the table below is applicable when the beams are supporting solid subfloors. Floor assemblies containing only fuses, joists or joist units.

Rating Hr.	Restrained Beam Rating Hr.	Unrestrained Beam Rating Hr.	Min Thkns On Beam In.
1	1	1	7/16
1-1/2	1-1/2	1-1/2	3/4
2	2	2	1
2	1-1/2	1-1/2	3/4
2	1-5/16	1-5/16	1-5/16
3	1-5/8	1-5/8	1-5/8

CAROLINE CO — Types 15HY, 22.

8D. **Spray-Applied Fire Resistant Materials** — (Not Shown) — As an alternate to Item 8, 8A, 8B and 8C — Applied by mixing with water and spraying in one or more coats the final thicknesses as shown in the table below, on the steel beam following the beam contour. Surfaces of the beam shall be clean and free of dirt, loose scale and oil. Min avg and min ind density of 15/14 pcf, respectively. Min avg and min ind density of 22/19 pcf, respectively, for Types Z-106, Z-106G, Z-100HY. For method of density determination, refer to Design Information Section.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Thkns on Beam In.
2	1	1	3/8
2	1-1/2	1-1/2	5/8
2	2	2	7/8
3	1-1/2	1-1/2	5/8
3	2	2	7/8
3	2	3	1-7/16

GCP KOREA INC — Types MK-6CBE, MK-6ED, MK-6HY, MK-6HY Extended Set, MK-6HB, MK-6s, MK-10 HB, MK-10 HB Extended Set, Z-106, Z-106G.

GCP APPLIED TECHNOLOGIES INC — MK-6/HY, MK-6/HY Extended Set, MK-6/HB, MK-6s, MK-10 HB, MK-10 HB Extended Set, RG, Z-106, Z-106G, Z-106HY.

8E. **Spray-Applied Fire Resistant Materials** — (Not Shown) — As an alternate to Item 8, 8A, 8B, 8C and 8D — Applied to wetted steel surfaces which are free of dirt, oil or loose scale by spraying with water to the final thickness shown below. The use of adhesive and sealer and the tamping of fiber are optional. The min ind density of the finished floor should be 11 pcf and the specified fiber thicknesses require a min fiber density of 11 pcf. For areas where the fiber density is between 8 and 11 pcf, the fiber thickness shall be increased in accordance with the following formula:

$$T = \frac{11}{D} \times T_{min}$$

Fiber density shall not be less than 8 pcf. For method of density determination, see Design Information Section.

Restrained Assembly Rating Hr.	Unrestrained Assembly Rating Hr.	Unrestrained Beam Rating Hr.	Thkns on Beam In.
2	1	1	9/16
2	1-1/2	1-1/2	13/16
2	2	2	7/8

A/D FIRE PROTECTION SYSTEMS INC — A/D Type FP.

9. **Metal Lath** — (Not Shown) — Required when Type 7HD is applied - Metal lath shall be 3/8 in. expanded diamond mesh, weighing 3.4 lb per sq yd. Secured to underside through steel washers with an outside diam of 1/2 in., with fasteners spaced 12 in. OC in both directions with lath edges overlapped approx 3 in.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

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