ENGINEERING ASSESSMENT:

CARLON ELECTRICAL NONMETALLIC TUBING, LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT AND NONMETALLIC ELECTRICAL OUTLET BOXES IN FIRE-RESISTANCE RATED WALLS AND FLOOR/CEILING ASSEMBLIES

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July 23, 2016

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1.0. INTRODUCTION

This report provides a fire safety engineering assessment describing the fire performance properties of Carlon electrical products as tested and/or otherwise evaluated for use in construction assemblies commonly found in fire resistive construction.

The specific Carlon products and applications addressed in this report are listed below:

1.1. Electrical Nonmetallic Tubing: Carlon Flex-Plus® Blue™ ENT.
1.2. Liquidtight Flexible Nonmetallic Conduit (LFNC-B): Carlon Carflex®.
1.3. Nonmetallic Electrical outlet and switch boxes in fire- resistance rated walls and floor/ceiling assemblies: Carlon Blue™ and SuperBlue™
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This report provides explicit information and guidance based on standard fire endurance testing carried out according to ASTM, UL and ANSI standards of typical non-combustible and combustible fire resistive walls and floor/ceiling assemblies. These are commonly specified for and used in the construction of buildings of Types I thru Type V according to Chapter 6 of the International Building Code published by the International Code Consortium.

Related provisions governing allowable uses and installation of electrical nonmetallic tubing (ENT) and associated fittings are addressed in the most current version of Article 362 of the NFPA 70, the **National Electrical Code (the "NEC")** promulgated by the National Fire Protection Association and/or the locally adopted electrical code.

Actual fire resistive assemblies - as designed and built for use in the field - rarely are *identical* to a specific, tested assembly in *all* design aspects. For that reason, guidance to be applied when interpreting the information in this report is provided along with historical fire safety engineering data to address attainable fire performance levels using the referenced products and design data. These are provided since - in most cases - a specific fire resistive assembly being designed and built will have its own combination or set of unique details and features required to comply with the intent of the [model] code provisions.

For these reasons, discussions to assist in such interpretations are provided in section 3.7 of this report. These discussions are based on engineering interpretations and judgment as well as extensive knowledge as to the impact of these products on fire performance of fire-resistance rated assemblies in the field documented thru fire incidence data.

It is the objective of this report to provide necessary information and due diligence review of relevant fire performance properties which are of interest to building officials, fire officials, designers, architects and contractors involved with use of these products.

The specific applications addressed in this report include installation and use of the Carlon products listed above in fire-resistive floor/ceiling assemblies and other fire- resistive constructions including fire rated walls.

2.0. DESCRIPTION

2.1. Carlon Nonmetallic Raceway Products Addressed

The specific applications incorporating Carlon raceway products described below are addressed in this report:

2.1.1. General

Carlon electrical nonmetallic tubing (ENT) and liquidtight flexible nonmetallic conduit, type B (LFNC-B) described in this report shall be used in noncombustible and combustible, fire-resistive load-bearing and non-load-bearing walls and floor/ceiling assemblies. As demonstrated by the standard fire tests cited here, use of the tubing and conduit in assemblies will not affect fire-resistive assembly ratings when installed within the limits prescribed by this report.

2.1.2. Electrical Nonmetallic Tubing Described

The Carlon Flex-Plus® Blue™ electrical nonmetallic tubing (ENT) is a polyvinyl chloride (PVC) tubing available in Trade Sizes (Metric Designator) ½ (16) or ¾ (21) for wall assemblies and ½ (16), ¾ (21) or 1(27) for floor/ceiling assemblies. These products are manufactured and listed to meet the requirements of UL 1653 – *Electrical Nonmetallic Tubing* in accordance to the National Electrical Code, Article 362.

2.1.3. Liquidtight Flexible Nonmetallic Conduit Described

The Carlon Carflex® is a liquidtight flexible nonmetallic conduit, type B (LFNC-B) available in Trade Sizes (Metric Designator) 3/8 (12), ½ (16), ¾ (21) or 1 (27) for wall and floor/ceiling assemblies. These products are manufactured and listed to meet the requirements of UL 1660 – *Liquidtight Flexible Nonmetallic Conduit* in accordance to the National Electrical Code, Article 356.

2.2. Wall Assembly

Specific wall assembly applications incorporating Carlon outlet boxes with the raceways described above are described here.

For such uses, electrical outlet boxes shall consist of single-, two-, three- and four-gang configurations with a maximum surface area of 26.5 square inches. The boxes are constructed from 3/32-inch-thick (2.4 mm) nominal PVC or polycarbonate materials. The boxes are to be used with listed cover plates in bearing or nonbearing wood or steel stud walls with fire-resistance ratings of up to two hours including staggered stud assemblies.

2.3. Floor/Ceiling Assembly

Specific floor/ceiling assembly applications incorporating Carlon ceiling or outlet boxes with the raceways detailed above are described here.

For such uses, the electrical ceiling or outlet boxes shall be circular in shape with a maximum diameter of 4 inches (102 mm) and are constructed from the same material as described above. The maximum surface area of individual boxes shall not exceed 13 square inches (8387 mm^2). The electrical ceiling or outlet boxes are designed to be used with light fixtures, ceiling fans, floor boxes, outlet receptacle boxes or listed cover plates in combustible floor/ceiling assemblies with fire-resistance ratings of up to two hours. The assemblies shall consist of gypsum wallboard attached directly to solid-wood ceiling joists. When resilient channels are used in the assembly, they shall be installed between layers of gypsum wallboard.

3.0. INSTALLATION

This section provides detailed information describing how the fire resistive assemblies described – including the associated Carlon products - shall be assembled.

Additional product installation information based on CSI MasterFormat Section 26 05 33.03 Electrical Nonmetallic Tubing (ENT) is included in the appendix.

3.1. Boxes

In *all* cases - precautions shall be taken to ensure the wall openings are not oversized.

Clearance between cutouts in gypsum wallboard and outlet boxes shall not exceed 1/8 inch (3.2 mm).

Any gaps between the box edges and the wall or ceiling openings shall be closed with a wall taping compound or a plaster spackling compound.

The electrical boxes shall be attached to the studs or joists using two nails, hangers or brackets.

Electrical outlet boxes installed, less than 24 inches apart, on opposite sides of staggered wood stud walls shall be separated by approved fire-stopping materials as specified in (the) applicable building code section(s). 2015 IBC Section 714.3.2 provides an example of such model building code requirements.

3.2. Two-hour Fire-Resistive Wall Assemblies

3.2.1. Two-Hour Fire-Resistive Non-Load Bearing Wall Assembly:

Installation of the tubing in the fire-resistive assembly described below shall comply with the applicable Electrical Code and is limited to a maximum of three runs in any 6 foot (1828.8 mm) length of wall, with a maximum of two tubes or conduits in any one stud cavity.

The tubing is installed within a noncombustible two-hour fire-resistive non-load-bearing partition consisting of the following: A base layer of 5/8 inch (15.88 mm) Type X gypsum wallboard or veneer base applied parallel to minimum No. 25 gauge, 3-5/8 inch (92.08 mm) steel- studs spaced a maximum of 24 inches (609.6 mm) on center with 1-inch (25.4 mm) Type S gypsum wallboard screws spaced 8 inches (203.2 mm) on center along the edges and 12 inches (304.8 mm) on center to intermediate studs.

The face layer consists of a second layer of 5/8 inch (15.88 mm) plain or pre-decorated Type X gypsum wallboard base, applied parallel to the studs with 1 5/8 inch-long (41.28 mm) Type S gypsum wall board screws spaced a maximum of 16 inches (406.4 mm) on center. The vertical joints shall be staggered a minimum of 24 inches (609.6 mm) on center from the vertical joint in the first layer. The top and bottom tracks shall be fastened in place with recognized fasteners spaced a maximum of 24 inches (609.6 mm) on center to the top and bottom runners.

A uniform ¼ inch (6.35 mm) end clearance is maintained between the top and bottom tracks and each stud. Shims are used to attain the ¼ inch (6.35 mm) clearance and then removed after the wallboard is fastened to the studs and tracks. Studs need not be attached to the top and bottom runners.

Any nonmetallic electrical outlet boxes used in this assembly shall be those described in Thomas & Betts's UL Classification for Fire Resistive Outlet Boxes R9140.[1] Precautions shall be taken to assure that wall openings are not oversized. Clearance between cutouts and outlet boxes shall not exceed 1/8 inch (3.18 mm). Any gaps between box edges and wall or ceiling openings shall be closed with wall taping compound or plaster spackling compound. Electrical boxes are attached to the studs or joists with two nails, hangers or brackets. Electrical outlet boxes installed on

[*] A summary of current UL listing data well as CSI specification data for these products are included in the Appendix.

opposite sides of staggered wood stud walls shall be separated by fire- stopping materials as described in Section 714.3.2 of the 2015 **International Building Code**.

3.2.2. Two-Hour Fire-Resistive Limited Load-Bearing Wall Assembly:

Installation of Carlon Flex-Plus® Blue® electrical nonmetallic tubing in fire-resistive assembly described below shall comply with the applicable Electrical Code and is limited to a maximum number of six tubes in any one stud cavity.

The tubing is installed within a two-hour fire-resistive load bearing partition consisting of the following: 2 by 4 inch (50.8 x 101.6 mm) nominal wood stud kiln dry number 2 Douglas-Fir lumber, cut into 9 foot - 7 ½ inch (2933.7 mm) lengths, and the three bearing plates cut into 10 foot-1 inch (3073.4 mm) lengths. The two lower bearing plates are nailed together with 16d steel nails 16 inches (406.4 mm) on center. The upper and lower bearing plates are to be secured to the top and bottom of the masonry opening, respectively, with ¼ -20 by 2 ½ inch (63.5 mm) long steel screws spaced 24 inches (609.6 mm) on center.

Each stud is toe-nailed to the upper bearing plate and the top lower bearing plate with four 16d steel nails per stud end. The studs are positioned in two rows, with the studs within each row spaced 16 inches (406.4 mm) on center. Studs are to be staggered *8* inches (203.2 mm) on center between adjacent rows.

A UL-Classified 4 inch (101.6 mm) thick mineral wool batt insulation with a density of 2.54 pcf (40.69 kg/m^3) is cut to length and fitted into each of the stud cavities on both sides of the assembly.

A base layer of 5/8 inch (15.88 mm) thick Type X gypsum wallboard is applied parallel to nominal 2 by 4 inch *(*50.8 x 101.6 mm*)* wood with 6d nails spaced 6 inches (152.4 mm) on center.

A face layer consisting of a second layer of 5/8 inch (15.88 mm) thick Type X gypsum wallboard is applied parallel to the studs with 8d nails spaced 8 inches (203.2 mm) on center.

Nonmetallic electrical outlet boxes used in this assembly shall be those described in Thomas & Betts's UL Classification for Fire Resistive Outlet Boxes R9140. Precautions shall be taken to assure that the wall openings are not oversized. Clearance between cutouts and outlet boxes shall not exceed 1/8 inch (3.18 mm). Any gaps between the box edges and the wall or ceiling openings shall be closed with wall taping compound or plaster spackling compound. The electrical boxes are attached to the studs or joists with two nails, hangers or brackets. Electrical outlet boxes installed on opposite sides of staggered wood stud walls shall be separated by firestopping materials as described in Section 714.3.2 of the 2015 International Building Code.

The wood stud axial stress is limited to 0.78 F'$_a$ and shall not exceed 0.78 F'_a at an *I/d* ratio of 33. The maximum load on the system described in this section of the

report is 1,100 pounds (4950 N) per stud or 50% of the allowable axial stress. For purpose of design:

F = Allowable unit stress in compression parallel to the grain adjusted for l/d ratio. l = Effective length of compression member, inches. d = Least dimension, inches.

3.3. One-hour Fire-resistive Non-Loadbearing Wall Assembly:

Installation of ½ inch or ¾ inch (12.7 or 19.05 mm) trade size Carlon Flex-Plus® ENT tubing in the one-hour fire-resistive assembly described below shall comply with the applicable Electrical Code and is limited to a maximum of two tubes in any one stud cavity.

The tubing is installed within a noncombustible one-hour fire-resistive non-loadbearing partition consisting of the following: A single layer of 5/8 Inch (15.88 mm) thick Type X gypsum wallboard is applied to each side of No. 20-gauge steel studs. 3 3/8 inches (85.73 mm) wide by 1 3/8 inches (34.93 mm) deep, having 5/16 inch (7.94 mm) folded-back return-flange legs, with No. 6 by 1 1/8 inch-long (28.58 mm), buglehead drywall screws spaced 8 inches (203.2 mm) on center along the perimeter of the board and intermediate studs. The wallboards are applied with long dimension parallel to the studs. Joints of the boards and screw heads are covered with paper tape and wall compound. Top and bottom tracks are fastened with approved fasteners spaced a maximum of 24 inches (609.6 mm) on center.

A uniform ¼ inch (6.35 mm) end clearance is maintained between the top and bottom tracks and each stud. Shims are used to attain the ¼ inch (6.35 mm) clearance and removed after the wallboard is fastened to the studs and tracks. Studs need not be attached to the top and bottom runners.

The tubing is surrounded with a 6-inch wide strip of Owens-Corning Fiberglass All Service Faced Duct Wrap insulation, Type 75, 1 ½ inches (38.1 mm) thick and with a ¾ pcf (12.01 kg/m3) density, wrapped with faced surface outwards and stapled with standard ½ inch (12.7 mm) office staples, ¼ inch long (6.35 mm), spaced 3 inches (76.2 mm) of center. At the duct wrap section joints, a minimum of 3 inches (76.2 mm) of overlap is used. A 24 inch by 24 inch by 3 inch (609.6 x 609.6 x 76.2 mm) thick mineral fiber unfaced-batt insulation blanket is placed behind each electrical outlet box and a 2 inch by 3 inch by 24 inch (50.8 x 76.2 x 609.6 mm) piece of the same mineral fiber insulation is stuffed into the open side of the stud supporting the outlet box on the exposed side of the wall. The mineral fiber insulation is Thermafiber Sound Attenuation Fire Blanket manufactured by US Gypsum Company.

Any nonmetallic electrical outlet boxes used in this assembly shall be those described in Carlon's UL Classification for Fire Resistive Outlet Boxes R8326 and in Section 3.1 of this report.

3.4. Fire-resistive Floor/ceiling Assembly

Carlon Flex-Plus® Blue™ ENT electrical nonmetallic tubing and Carlon Carflex® Liquidtight flexible nonmetallic conduit with necessary fittings and boxes are permitted to be installed in fire-resistance rated floor/ceiling assemblies with a rating of three hours or less, without affecting the rating, with the following limitations and requirements:

3.4.1. The total volume of electrical nonmetallic tubing and Liquidtight flexible nonmetallic conduit shall not exceed 380 cubic inches (6227.08 cm3) per 100 square feet (9.29 m2) of ceiling area. This value also takes into account the amount of fittings and junction boxes necessary for installation. Table 1 gives the volume per linear foot and maximum linear feel per 100 square feet (9.29 m2) of ceiling area for various sizes of raceways.

3.4.2. All raceways shall he installed with metallic fasteners or hangers at a spacing in compliance with the spacing requirements of the applicable Electrical Code.

3.4.3. The tubing or conduits shall not penetrate the dropped ceiling membrane.

3.4.4. The raceway systems shall he installed in compliance with the applicable Electrical Code.

3.4.5. The distance from the top of the ceiling membrane to the bottom of the floor or roof deck above shall not be less than 16-3/8 inches (4 15.93 mm).

Additional guidance for installations of these materials in joist-based horizontal assemblies (floor/ceiling assemblies) can be found in 2012 IBC Section 714.4.and in particular for membrane penetrations, 2012 IBC Section 714.4.1.2.

3.5. Use of Floor and Ceiling Boxes with Carlon and other approved Raceways and wiring methods in Floor/ceiling Assemblies

Carlon Floor Boxes with necessary fittings and raceways have been successfully tested and are permitted in 2-hour fire resistive horizontal slabs using either normal density concrete [minimum slab thickness - 4-1/2” or lightweight concrete installed on a fluted metal deck [minimum slab thickness - 3-1/2” installed on a 2” deep fluted metal deck] with a minimum cover for boxes of 1-1/2”.

Carlon Ceiling Boxes with necessary fittings and raceways have been successfully tested and are permitted in 2-hour fire resistive horizontal slabs using normal density concrete with minimum slab thickness - 5” with intumescent pads installed above boxes and minimum slab thickness – 6” without intumescent pads installed above boxes.

In addition, Carlon non-metallic electrical outlet boxes with a variety of joist attachment methods have been successfully tested as components of a two-hour fire endurance rated wood framed floor/ceiling assembly of 12” nominal thickness. The tested assembly included a lower membrane consisting of 2 layers of 5/8” Type X generic gypsum

wallboard mounted to resilient channels, 2" x 10" nominal wood joists and an upper membrane composed of a ¾" thick layer of plywood sub-flooring and a ¾" thick layer of plywood flooring.

3.6. Placement of PVC Electrical Raceways in Concrete Slabs

It is important to determine safe depths for placement of PVC electrical raceways and conduits in reinforced concrete slabs. Examples of such uses include suspended concrete slabs found in parking structures and tall buildings.

The model building codes [for example American Concrete Institute, ACI 318-11 as referenced in the 2012 IBC] do *not* require that conduit be placed at mid-depth of a slab. While the codes do *not* specifically prescribe placement of the conduit in terms of slab depth they do require that conduit *diameter* not exceed 1/3 of the slab depth. Nonetheless, "typical" details provided as part of project structural drawings frequently do direct that conduit be placed at or near the centerline of the slab depth[1].

In some cases, placement of a conduit atop the lower reinforcement mat results in its being placed very close to the center of the slab. If, for example, in a 5 in. thick slab with #4 reinforcement bars laid in each direction over ¾ in. of bottom cover, the centerline of a ¾ in. nominal diameter conduit (1.05 in. true outside diameter), will be 2.3 in. above the bottom of the slab. This is within 0.2 in. of the slab centerline, and hence in general conformance with a project requirement that conduit be placed at the slab center. If, on the other hand, the slab is 8 in. in thickness and has a bottom #4 reinforcement that is only in one direction, the centerline of the ¾ in. nominal conduit will be 1.8 in. above the bottom of the slab – well below the slab centerline located 4 in. above the bottom. Such a slab would require supplementary chairing of the conduit to place it at the higher elevation and create a consequent susceptibility to damage as well.

A slab under vertical load experiences internal stresses that vary from maximum tension at one face of the concrete to maximum compression at the opposite face. Typically, tension occurs on the top of the slab near the slab supports and on the bottom of the slab near the center of the span (see Figure 1). Because concrete is much stronger in compression than in tension, and because slab cracking results in the total loss of concrete tensile strength at a cracked location, it is generally assumed that such concrete has, in fact, cracked, and that resistance to tensile stresses is provided by the reinforcement alone. As a result, the loss of concrete cross-sectional area due to conduit placement in the "tension zone" of the concrete slab has no significant effect on the strength of the slab.

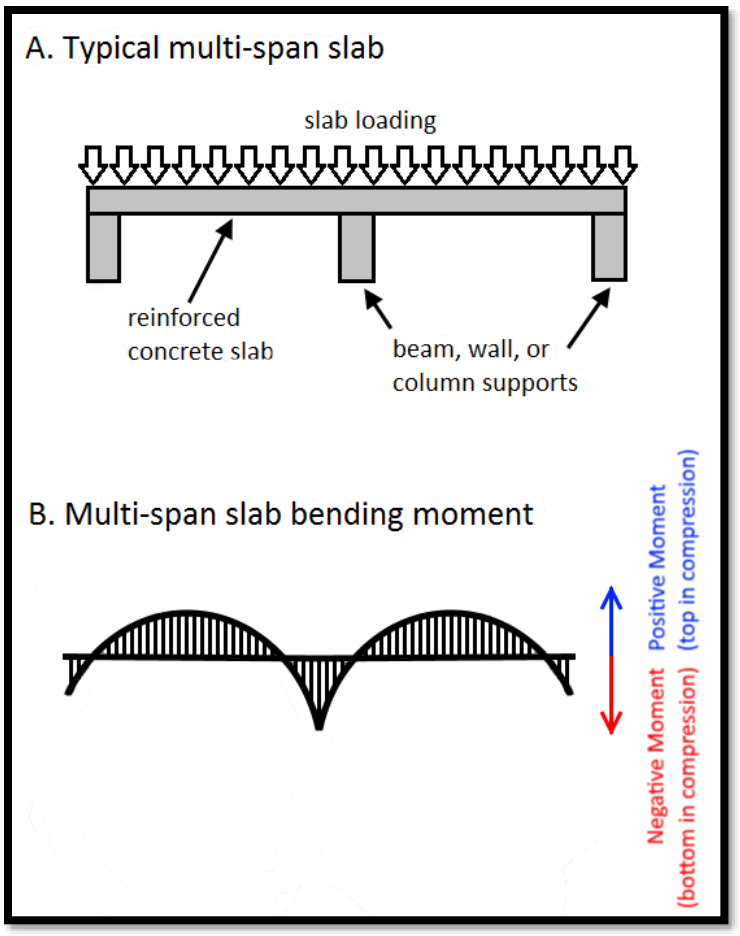


Figure 1. Multi-Slab Loading and Bending

Because the tension zone is at the bottom of the slab near mid-span, conduit placed near the slab bottom in the mid span area will not significantly affect slab strength, and the discussion that follows is applicable where the bottom of the slab is in compression, typically near the supports. In order to determine whether or not placement of the conduit directly atop the bottom reinforcement will have an impact on the structural integrity of the slab, analyses have been conducted to determine the extent of the slab compression block in a range of possible configurations, ranging from thin (4 in.) to thick (8 in.) slabs.[2]

[1] Experience from the field – referring to *all* electrical conduits, whether metallic or non-metallic – suggests that they are susceptible to damage when placed at the mid-point of slab depth. This is the result of large downward deflections that may occur when workers step on conduits placed in this manner.

[2] Code limited extremes of both light reinforcement (0.18% of the total slab cross sectional area) and heavy reinforcement (2.14% of effective slab area from the compression face to the center of the tension reinforcement) have also been considered.

Results show that such conduit/raceways will not fall within the compression block in thin (4 in.) reinforced concrete slabs, regardless of reinforcement ratio. In thick (8 in.) slabs, the conduit does not fall within the compression block in lightly reinforced slabs although it falls partially within it where the slab is reinforced to the *maximum* level permitted by code where the adverse impact of the conduit yields a strength reduction of only 1.0%.

The assumptions and methodology of the slab analysis conducted are shown in Table 1 below, with the associated geometric parameters. The purpose of the analysis is to compare the clear height to the raceway in Figure 2a with the height of the compression block in Figure 2b, and thereby to determine whether or not the conduit is either partially or entirely within the concrete compression block, and whether or not placement of the conduit directly atop the bottom reinforcement will therefore have an effect on the slab bending strength.

Assumptions and Methodology:

Concrete Strength $(f'_c) = 4{,}000$ lb. per sq.in.

Reinforcement strength $(f_y) = 60{,}000$ lb. per sq. in.

Concrete cover on reinforcement $= 3/4$ in.

Reinforcement ratio $(\rho_{max}) = A_s / bd$

where b = width of slab under consideration

Min. reinforcement $Q_{min} = 0.18\%$ x gross slab area

(ref./ACI 318-11, Sect.7.12.21)

Max. reinforcement ratio (ρ_{max}))

$$= 0.75 \times \frac{(0.85 \times 0.85 \times 4{,}000)}{60{,}000} \times \frac{87{,}000}{(87{,}000 + 60{,}000)}$$

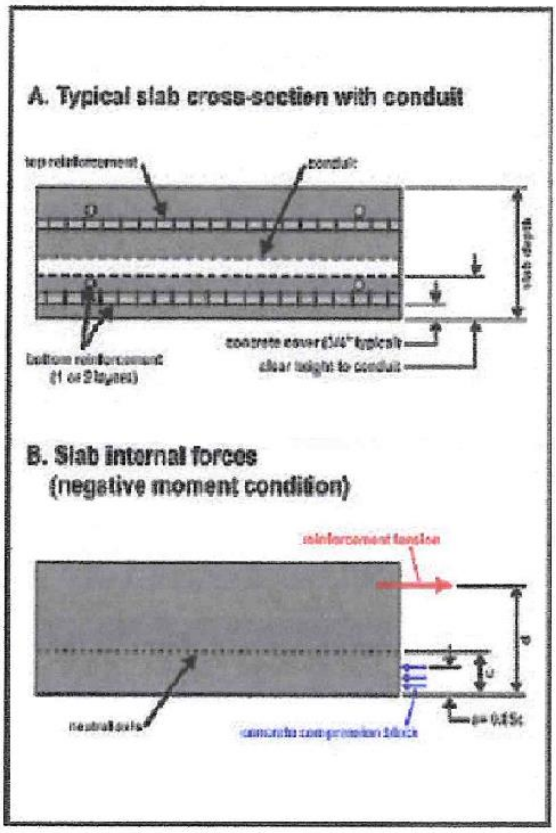
$= 0.0214 \times b \times d$

(Ref. ACI 318-11, Sect10.3.5)

Ht. Of compression block (a) $= \dfrac{A_s f_y}{0.85 f'_c b} = \dfrac{\rho d f_y}{0.85 f'_c} = 17.7 \rho d$

Table 1

In thick (8 in. or greater) slabs, the conduit does not fall within the compression block in lightly reinforced slabs, but it falls partially within it where the slab is reinforced to the maximum level permitted by code. Based on this finding, further analyses were performed to determine the magnitude of the adverse impact of the conduit under this worst-case condition which indicate a



strength reduction of only 1.0%.

Figure 2

Based on this analysis, including worst-case situations, conduits can be placed in reinforced concrete slabs 4 in. to 8 in. thick directly atop reinforcement including those having a double mat of bottom reinforcements at all reinforcement ratios permitted by code without creating adverse significant effects in slab bending resistance.

Slab Thickness	Reinforcement	Clear Height to Conduit	Compression Block Height
4 "	#3 @ 18" (min.)	1.50"	0.11"
	#5 @ 5" (max. reinforcement)	2.00"	1.08"
8"	#4 @ 16" (min.	1.75 "	0.22"
	#6 @ 3" (max. reinforcement)	2.25"	2.56"

Table 2. Block Height for Representative Slab Assemblies

The above discussion addresses only reinforced concrete slabs that have not been post-tensioned. Post-tensioning of a slab causes it to be pre-compressed in a manner that offsets the tension that a portion of the slab cross section experiences under load because tension stresses are limited in post-tensioned slabs; the tension zone of such concrete is generally not assumed to be cracked, so that placement of conduit in either the tension or compression zone influences the bending strength of the slab. It is therefore not readily possible to define slab thickness and reinforcement parameters under which conduit can be placed directly atop the bottom reinforcement without adverse effect on the slab strength. Detailed consideration of the effects of conduit voids in post-tensioned slabs can be made but is beyond the scope of this report3.7. Use of Carlon Boxes, fittings and raceways in generic fire resistance rated walls and floor/ceiling assemblies.

Literally hundreds of combinations of membranes and framing systems - with and without approved thermal insulations - have been fire endurance tested for applications in fire resistance rated walls and floor – ceiling assemblies.
Reports on such testing can be found in the various Tables associated with fire resistive construction assemblies in the model building code chapters addressing fire resistance rated constructions.[4]

It is a fundamental assumption in the building codes that a variety of raceway materials, cable types and metallic and plastic boxes can - when used according to listing instructions - be installed without compromising the fire endurance rating of the assemblies in which they are installed. This includes metal outlet boxes which have been accepted for applications with cable, tubing and conduit of all types.

This preceding statement is supported by results of standardized fire testing according to ASTM-E-119, UL-263 and ASTM E-814 and UL-1479 in which fire endurance rated wall designs incorporating a range of Carlon electrical components have been evaluated. Testing of model/generic assembly designs on which these comments are based are referenced at the end of this report. The appendices also contain references to additional testing conducted.

[3] The above discussion addresses only reinforced concrete slabs that have not been post-tensioned. Post- tensioning of a slab causes it to be pre-compressed in a manner that offsets the tension that a portion of the slab cross section experiences under load and requires additional analyses.

[4] Additional references such as the Gypsum Association Manual, the UL Fire Resistance Directory and the ETL Directory of Listed Building Products and Accessories include information describing numerous designs tested by accredited third party laboratories.

For field applications of such generic designs, it is not practical from both cost and convenience perspectives to test *each and every possible combination of claddings, structural elements, insulations and wiring methods used in fire resistive construction designs*. For that reason, generalizations – arrived at either formally or informally over time – relevant to the overall, expected behavior of fire resistance rated assemblies are frequently relied upon to review proposed designs. For these reasons, underlying fire safety engineering assumptions are discussed in the following sections.

3.7.1 Engineering Assumptions for Generic Fire Resistive Applications:

When introduced in the1960's, PVC based electrical raceways and accessories were carefully scrutinized to ensure that their use did not compromise – or de-rate - the fire performance of assemblies in which they were installed. Independent engineering reviews from this early period included those in the 1990's by the National Evaluation Service (NES) which produced the [now expired] NER-140 and NER – 290 National Evaluation Service, Inc. reports.

Since that period, additional detailed installation methodologies were developed and were approved following proof testing by third party testing labs. Moving to the present, there has been a continual evolution of designs and systems for installing and fire stopping and nonmetallic raceways that continues. The numbers of acceptable designs continues to grow as detailed in system listings recognized by testing labs and AHJ's.

As noted in the preceding sections, testing of each and every structural and fire protective cladding system with included elements such as pipe and tube is not practical. Thus, to make interpretations and predictions of how designs would perform, fire endurance "rules of thumb" were applied. These were based on logic and assumptions such as "t*hicker or deeper versions of the same wall and floor/ ceiling designs show greater fire endurance than thinner versions of the same designs*" and "*insulated versions of wall and floor/ceiling designs show greater fire endurance than un-insulated ones*."

Support for such generalizations was provided in the 1960's when a formalized analysis was published in a peer reviewed journal for the first time. Those comments are to be found in the article entitled "Ten Rules of Fire Endurance Ratings" compiled by noted fire scientist Tibor Harmathy (1965) of the National Research Council of Canada. These guidelines have proven useful for five decades for those considering and striving to predict engineered fire performance of assemblies built in the field.

In 1980, an adaptation of the "Ten Rules" was published as Part 8 of the **HUD Rehabilitation Guidelines: Fire Ratings of Archaic Materials and Assemblies**. Application of the techniques in the "Guideline" assisted in fostering cost effective construction approaches and methods to assure adequate fire safety levels in associated rehabilitation projects. The Part 8 "Fire Rating guideline" has been referenced in various model codes and associated standards in particular for existing building applications since its original publication in 1980.

Examples of these include citation as "Resource A" of the **2003 ICC International Existing Buildings Code** [IEBC], as well as earlier model building codes addressing the

fire safety engineering treatments of existing buildings.[2]

The same "Ten Rules" approach has also been included in NFPA Standard 909 addressing Museums, Libraries and Places of Worship and NFPA Standard 914 for historic buildings as well in AICE guidance documents.

By combining fire endurance testing results for generic wall and floor/ceiling assemblies in which electrical components had been installed, guidance from the "Ten Rules" approaches can be derived and continue to be conservatively applied to field use of the Carlon boxes and necessary fittings and raceways addressed in this report for generic walls and floor ceilings.

Building on these fire performance concepts - *and* incorporating specific fire endurance testing results with generic wall and floor/ceiling assemblies containing electrical components - Harmathy's generalizations can be applied to generic walls and floor/ceilings which include Carlon boxes, fittings and raceways addressed in this report.

From fire endurance test results and application of the "10 Rules" the following inferences can be derived:

Concerning Assembly Thickness:

Generic walls and floor/ceiling assemblies successfully tested at a specific, given thickness for fire endurance can be built and utilized at thicknesses *greater than* the minimum thickness exemplified by the tested assembly. Thickness increases may come in the form of additional slab thickness, use of deeper framing members or the addition of thicker layers of the cladding materials. Tested examples consistent with these specifications include studs, joists and claddings which may all be thicker or deeper – *but NOT more shallow or thinner* - than functionally similar tested materials.

Concerning Effects of Thermal Insulation:

Generic walls and floor/ceiling assemblies successfully tested at a specific, given thickness for fire endurance without thermal insulations can be safely built with thermal insulations at equal or greater thickness than the tested assembly.

Commentary: Since thermal insulations add to the thermal resistance of assemblies, addition of such insulations to assemblies originally tested *without insulation* is permissible and can be expected to increase fire resistance.

Concerning layers of cladding(s):

Specific claddings and combinations of claddings on generic walls and floor/ceiling assemblies successfully tested for fire endurance may be replaced by multiple thinner individual layers of the same material of equal or greater total

thickness. Such assemblies will have the same or greater fire endurance than the originally tested assembly.

> Commentary: Thus, if a single 5/8" layer of gypsum wallboard is used in the tested assembly, two layers totaling 5/8" or greater in thickness can also be used as well. The latter version will provide significantly enhanced fire endurance as opposed to the version with a single layer.

Concerning openings in assemblies:

Openings in such assemblies must be treated with care. They *must not be oversized* and they must be carefully firestopped. Use of multiple or large or repetitive openings shall only take place if supported by appropriate analysis, mitigation features and/or test results.

In general, and based on current Fire Safety Engineering techniques such as those found in the **SFPE Handbook of Fire Protection Engineering** and the **SFPE Guide to Performance-Based Fire Protection** formalized processes are available to support the generalized fire performance concepts discussed above.[3] The second of these references includes detailed descriptions describing how to develop scope of work statements and effectively use performance based design techniques in support of innovative design concepts such as those potentially effecting fire endurance of rated assemblies.

Impact on electrical system safety: Consistently system safety techniques are applied to identify problems areas. In the case of electrical systems, the NFIRS system collects data on fire causes which are reviewed and evaluated by the National Fire Protection Association. Such a review published by the NFPA in 2013 includes data showing overall fire occurrences linked to *all* electrical sources to have been declining steadily for decades, including the time period during which ENT and associated accessories were introduced and their use expanded to all classes of structures and building types (NFPA, 2013). As such, if there were systematic problems with currently available electrical systems, these would have been identified.

4.0. IDENTIFICATION

The electrical boxes, tubing and conduit shall be identified by Carlon name and trademark, the listing mark which includes the name and/or symbol of Nationally Recognized Testing Laboratories (NRTL) together with words "Listed", or Classified.

[3-1] **SFPE Handbook of Fire Protection Engineering**, 2015. 5th edition. NFPA, Quincy, Massachusetts.
[3-2] **SFPE Guide to Performance-Based Fire Protection**, 2007. 2nd edition. NFPA, Quincy, Massachusetts.
[3-3] **Performance-Based Fire Protection**, 2007. 2nd edition. NFPA, Quincy, Massachusetts.
[4] John Hall, Jr., 2013. "Home Electrical Fires" NFPA Fire Analysis Research Division.

5.0. CONDITIONS OF USE

When used consistent with the descriptions and specifications in this report, noncombustible and combustible, fire-resistance-rated wall and fire- resistance-rated floor/ceiling assemblies are intended to comply with the current **International Building Code** provided that those installations are in accordance with the content of this report and the applicable Electrical Code.

6.0. OPINIONS

Consistent with the preceding comments, it is our opinion that the Carlon nonmetallic electrical outlet boxes described in this report meet all requirements for acceptance as alternative products to those specified in the most current/adopted **International Building Code** for fire-resistance rated wall and floor/ceiling assemblies with fire-resistance ratings up to two hours, subject to the following conditions:

6.1. Boxes and raceways are installed in accordance with this report.

6.2. No more than two wall boxes are located in each stud space on the same side of fire-resistance rated walls.

6.3. The electrical outlet boxes may be installed on opposite sides of wall assemblies having a fire-resistance rating of two hours or less, as described below:

6.3.1. Boxes installed on opposite sides of load-bearing and non-load-bearing wood stud assemblies and non-load-bearing steel-stud assemblies, without the use of mineral wool ban insulation, shall be separated by a horizontal separation distance of at least 24 inches (610 mm).

6.3.2. Boxes installed on opposite sides of a non-load-bearing fire-resistive wall assembly that contains 3 1/2-inch-thick (89 mm) mineral wool batt insulation having a density of 2.5 pcf (40 kg/m3) between the boxes are permitted when the horizontal separation distance is at least 7 inches (178 mm) and the insulation is continuous for the entire width of the fire resistance rated assembly.

6.3.3. ENT boxes installed with ENT on opposite sides of a load-bearing fire- resistive wall assembly containing a minimum of 4-inch-thick (102 mm) mineral wool batt insulation having a minimum density of 2.5 pcf (40 kg/m3) between the boxes are permitted when the horizontal separation distance is 24 inches (610 mm) and the insulation is continuous for the entire width of the fire-resistance rated assembly.

6.3.4. Per IBC Sections 714.3.2(2)(2.2) and (2.3) boxes shall be protected by solid fire-blocking and/or listed putty pads as appropriate.

6.4. Cover plates, other covers and canopies complying with Section 314.25 of the National Electrical Code, when used with ceiling boxes: Wall boxes with listed plastic cover

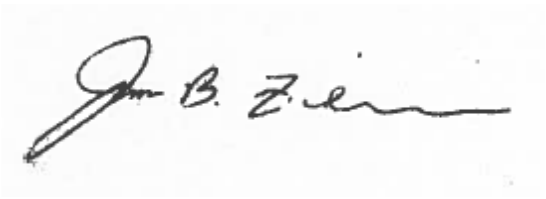
plates (complying with UL Standard No. 514C), or listed steel cover plates (complying with Section 314.25 of the National Electrical Code) are required.

6.5. The surface area of the wall and ceiling outlet boxes are limited to a maximum of 21.2 and 13 square inches (13,677 and 8,387 mm^2), respectively.

6.6. Ceiling boxes are separated from each other by a minimum of 4.5 feet (1,372 mm).

6.7. Aggregate surface area of the outlet boxes in walls or ceilings on one face of the fire-resistance rated assembly do not exceed 100 square inches (64,516 mm2) or 31square inches (20,000 mm2) for any 100 square feet (9.29 m2) of wall or ceiling area, respectively.

For Berkeley Engineering And Research, Inc.:



Joseph B. Zicherman, Ph.D., SFPE

Craig Huntington, MS, SE[4]

[4] Contact Point:
Huntington Design
6768 Thornhill Drive
Oakland, California 94611
craig@huntingtondesign.com

7.0. REFERENCE MATERIALS:

Test data, references and other source materials upon which these findings are based are as follows:

Harmathy, T.Z., 1965. "Ten Rules of Fire Endurance Ratings", Fire Technology V. 1, No. 2: 93.

Joseph B. Zicherman, Ph.D., SFPE, 1990. "Engineering report on fire-resistive floor/ceiling assemblies with Carlon tubing and conduit."

International Building Code for Existing Buildings, 2003. International Code Council, Country Club Hills, Illinois.

National Evaluation Service, Inc., 1999. National Evaluation Report NER 140 – "Nonmetallic Electrical Boxes in Fire-Resistance Rated Wall and Floor/ceiling Assemblies" *[expired]*.

National Evaluation Service, Inc., 1998. National Evaluation Report NER 290 – "Electrical Nonmetallic Tubing, Rigid Nonmetallic Conduit and Liquidtight Flexible Nonmetallic Conduit" *[expired]*.

Omega Point Laboratories, 1992. Report No. 1149-92509, dated January 27.1992 from Omega Point Laboratories on fire tests conducted on a one-hour wall assembly using Carlon ENT tubing.

Underwriters Laboratories Inc., 2002. Letter to David Kendall of Carlon, Lamson & Sessions regarding Small-Scale Fire Test Investigation on Floor Outlet Box Model B121BFB for Hourly Ratings up to 2 H. August 24, 2002.

Underwriter Laboratories Inc., 2006. UL 1653 Standard for Safety Electrical Nonmetallic Tubing.

Underwriters Laboratories Inc., 1994. Fact finding report on load-bearing wall assembly with nonmetallic outlet boxes and tubing, File No. R8326, Project No. 94NK17350, dated November 21, 1994, Test was conducted in accordance with ANSI-UL263, ASTM E 119, NFPA 252.

Underwriters Laboratories Inc., 1994. Report of fire tests, File R8326, Project 93NK19678, dated November 8,1994, conducted in accordance with ASTM E-119.

Underwriters Laboratories Inc., 1989. Fact Finding Report on Metallic and Nonmetallic Tubing, Conduits and Boxes in the Conduits and Boxes in the Concealed Space of Floor/ceiling Assemblies with Suspended Ceiling, File No. NC546- 5, Project. No. 87NK27319, dated March 30, 1989. The fire exposure was in accordance with the time-temperature relationships described in the test standard, Fire Tests of Building Construction and Materials, ASTM E119.

Underwriters Laboratories Inc., 1986. Engineering Analysis, File No. R8326 dated December 21, 1986.

Underwriters Laboratories Inc., 1985. Details Substantiation an Increase in Conduit and Tubing Sizes, dated February 20, 1985.

Underwriters Laboratories Inc., 1981, “Fire Endurance Test of a Floor/ceiling Assembly Containing Nonmetallic Electrical Outlet Boxes”, National Electrical Manufacturers Association. File NC546-3, Project 81NK10903, December 4, 1981.

Underwriters Laboratories Inc., 1980. Fact Finding Report on Electrical Nonmetallic Tubing (ENMT), Electrical Metallic Tubing (EMT), and Metallic Outlet Boxes in a Nonbearing Fire Resistive Partition Assembly, File No. R8326- 4, dated September 17, 1980, prepared by Underwriters Laboratories Inc. Tests were conducted in accordance with ASTM E 119.

Underwriters Laboratories Inc., 1980. Report of fire tests, File No. 8326-3, dated April 10.1980, conducted in accordance with ASTM E 119.

Underwriters Laboratories Inc., 1973. Fact Finding Report on PVC and Rigid Metallic Conduits and Metallic Outlet Boxes in Nonbearing Fire Resistive Assembly, File No. NC 646-1, -2, Dated December 21, 1973, prepared Underwriters Laboratories Inc. Tests were conducted in accordance with ASTM E 119.

Zicherman, J.B., “Performance of Plastic Plumbing and Electrical Products in Fire Resistive Assemblies,” Fire Hazard and Fire Risk Assessment, ASTM STP 1150, Marcelo M. Hirschler, Editor, American Society for Testing Materials, Philadelphia 1992, pp. 66-83.

8.0. APPENDIX

A. CSI Data

B. UL Listing data (April, 2016)

APPENDIX A

CSI Data

Specifier Notes: This product guide specification is written according to the Construction Specifications Institute (CSI) 3-Part Format, including *MasterFormat, SectionFormat,* and *PageFormat,* as described in *The Project Resource Manual—CSI Manual of Practice, Fifth Edition.*

This section must be carefully reviewed and edited by the Architect or Engineer to meet the requirements of the project and local building code. Coordinate this section with other specification sections and the Drawings. Delete all "Specifier Notes" after editing this section.

Section numbers are from *MasterFormat 2010 Update.*

SECTION 26 05 33.03
ELECTRICAL NONMETALLIC TUBING (ENT)

Specifier Notes: Delete any information below in Parts 1, 2 or 3 which is not required or relevant for the project.

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes Electrical Nonmetallic Tubing (ENT), fittings, boxes and support hardware. Fitting types for both snap and solvent cement connections with ENT. ENT is a nonmetallic, non-conductive, non-corrosive pliable raceway system.

1.02 REFERENCES

A. Underwriters Laboratories, Inc. (UL):
1. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
2. UL1479 Fire Tests of Through-Penetration Firestops
3. UL1653 Electrical Nonmetallic Tubing

B. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA)
1. NEMA OS-2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
2. NEMA TC-13 Electrical Nonmetallic Tubing

D. Canadian Standards Association (CSA):
1. CSA C22.1 Canadian Electrical Code Part I (CEC)
2. CSA C22.2 No. 227.1 Electrical Nonmetallic Tubing

1.03 SUBMITTALS

A. Comply with Section 01 33 00 – Submittal Procedures.

B. Product Data:
1. Submit manufacturer's descriptive literature and product specifications for each product.
2. Manufacturer's product drawings.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Products shall be free of defects in material and workmanship.

B. Furnished ENT, fittings and boxes are listed and/or certified by third party agencies as suitable for the intended purpose.

1.05 WARRANTY

A. Product is warranted free of defects in material and workmanship.

B. Product is warranted to perform the intended function within design limits.

PART 2 – PRODUCTS

2.01 GENERAL

A. ENT shall be UL Listed and CSA Certified.

B. Fitting and boxes shall be UL, cULus Listed and/or CSA Certified.

2.02 MANUFACTURERS

A. Acceptable Manufacturers:
Thomas & Betts, a Member of the ABB Group
8155 T&B Blvd
Memphis, TN 38125
800-816-7809, 901-252-5000
www.tnb.com

Product: Carlon® ENT

2.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. ENT Raceway

1. ENT Raceway shall be available blue, red, or yellow polyvinyl chloride (PVC).
2. ENT Raceway shall be available in trade size ½ through 2-½.
3. ENT Raceway shall be easily cut to length using shear type cutters.
4. ENT Raceway shall be hand bendable, corrugated of circular cross section. No special tools needed for bending.
5. ENT Raceway, Fittings, Boxes and Accessories shall not rust.
6. ENT shall provide protection for power wiring and communication conductors.
7. ENT shall have a maximum ambient temperature 122º F unless otherwise listed (See Item k. in Section 3.01 K.)
8. ENT shall meet requirements of NEC for Electrical Nonmetallic Tubing.
9. Single manufacture shall provide ENT, Fittings, Boxes and Accessories to form a complete integrated raceway system.
10. ENT shall be listed to the requirements of UL Standard UL 1653 in accordance with Article 362 of the NEC and Section 12-1500 of the CEC.
11. ENT shall meet the requirements of BI National Standard CAN/CSA-C22.2 No. 227.1 - UL1653 and shall be Listed/Certified in accordance to the Electrical Codes.
12. ENT Raceway has been investigated for use in 2-hour fire resistive nonload bearing and load bearing wall assemblies.
13. ENT Raceway has been investigated for use in 1-hour fire resistive nonload bearing wall assemblies.
14. ENT Raceway has been investigated for use in a fire resistive floor/ceiling assembly (up to 3 hours).

15. ENT Raceway shall be acceptable for through-penetrations when used with a Through-Penetration Firestop system classified by UL or a recognized listing agency to meet ICC building codes.
16. ENT Raceway shall be recognized for use with PVC rigid nonmetallic conduit fittings.
17. ENT Raceway shall be rated for 90°C conductors US, and 75°C Canada.
18. Conductors shall easily push through the raceway (up to approximately 50 feet).
19. Outside Diameters of raceway shall meet IPS Dimensions.
20. ENT Raceway shall be available in sticks, coils and reels.

B. Fittings
1. Fittings used with ENT shall be listed and/or certified.
2. One piece ENT Coupling, Threaded Terminator and RNC Transition Fittings shall be rated concrete tight without tape.
3. Vertical and 45º Stub Downs shall be made available in 1/2" through 1" trade sizes. (Molded part to retain ENT for concrete pour and provides clearance for attaching fittings to ENT).
4. Vertical and 90º Stub Down Transition Adapter shall be made available in 1/2" through 1" trade sizes (Molded part to retain ENT for concrete pour and provides threaded port for transitioning to other conduit systems).
5. Quick Connect Couplings shall be available in 1/2"-1" trade sizes (Molded part which allows two pieces of ENT to be quickly coupled).
6. Quick Connect Male Threaded Adapter shall be available in 1/2"-1" trade sizes (Molded part which snaps onto a piece of ENT to allow it to have a male threaded end).
7. Quick Connect Male Snap-in Adapters shall be available in 1/2"-1" trade sizes (Molded part which snaps onto a piece of ENT to allow it to connect to an outlet or switch box).
8. Rigid Nonmetallic PVC Male Terminal Adapter shall be available (Molded fitting which is solvent cemented to a piece of ENT to provide a male threaded end).
9. Rigid Nonmetallic PVC Nonmetallic Couplings shall be available (Molded part which allows two pieces of ENT to be connected together with solvent cement).
10. Rigid Nonmetallic PVC ENT Transition Adapters shall be available
    a. ENT to Schedule 40 & 80 PVC Conduit
    b. ENT to EMT
    c. Reducers, ¾" to ½" ENT and 1" to ¾" ENT

C. Boxes
1. Boxes used with ENT shall be listed and/or certified.
2. Nonmetallic Mud Boxes shall be available.
    a. Mud Boxes with two 1", four ½" and six ¾" ports shall be available
    b. Mud Boxes with quick connect ports shall be molded out of Polycarbonate
    c. Mud Boxes with removable back shall be available
    d. Mud Box types shall include;
        1) Ceiling Box listed for fixture support up to 50 lbs. and ceiling fan support up to 35 lbs
        2) One Gang
        3) Two Gang
        4) 4 Square
3. Nonmetallic Outlet and Switch Box shall be available in Single and Two Gang
    a. Boxes shall have eccentric knockouts
    b. Two gang shall have dual voltage capability
    c. Optional dual voltage divider shall be available
4. Nonmetallic Box Extenders shall be available.
5. Nonmetallic Plaster Rings shall be available.
6. Nonmetallic Blank Covers shall be available.
7. Nonmetallic 4" Octagon Ceiling Boxes shall be available

PART 3 – EXECUTION

3.01 INSTALLATION

A. Store products away from sunlight in manufacturer's unopened package at -4°F to 158°F until installation.

B. Verify that dimensions are correct and site is in proper condition. Make sure that application of ENT is allowed by NEC.

C. Do not proceed with installation until all unsatisfactory conditions have been corrected.

D. Verify that product is listed and is properly marked.

E. ENT shall be installed per the engineer assessment (investigation) prepared by Berkeley Engineering and Research for use in 1-hour and 2-hour rated construction.

F. ENT shall be installed in accordance with manufacturer's instruction, Article 362 of the National Electrical Code, Section 12-1500 of CEC, other applicable sections of the Code and local codes.

G. Only Carlon® ENT Blue cement recommended specifically for use with ENT and rigid nonmetallic PVC fittings shall be used.

H. Handling and installation temperature; -4°F to 104°F

I. Penetration of fire rated walls, floors or ceilings shall use Classified Through-Penetration Firestop Systems described in the current Underwriters Laboratories Fire Resistance Directory.

J. Install boxes, fittings, accessories, etc., as necessary for a complete system.

K. APPROVED USES:
   a. Concrete slab – NEC Article 362 / CEC Section 12-1500
   b. Walls - wood stud, masonry and metal stud – NEC Article 362 / CEC Section 12-1500
   c. Ceilings - permanent or dropped (free air only) – NEC Article 362 / CEC Section 12-1500
   d. Exposed – NEC Article 362 / CEC Section 12-1500
   e. Public Assembly – NEC Section 518.4, in nonfire rated and certain five rated structures
   f. Prewired – NEC Article 362 / CEC Section 12-1500
   g. Classified by UL 1479 for Through Penetration Firestop Systems in UL Guide Category XHEZ and current UL Fire Resistance Directory
   h. Three hour rated floor/ceiling assemble
   i. Raised Floors – NEC Section 645.5(D)(2)
   j. Exposed or concealed in building above three floors when a fire sprinkler system is installed in accordance with NFPA 13 – NEC Section 362.10(2)
   k. For use in residential attics up to 3 feet above the bottom of the ceiling joist. Maximum ambient temperature 140°F (60°C)

END OF SECTION

APPENDIX B

UL Listing Data

UL Online Certifications Directory

Home Quick Guide Contact Us UL.com

CEYY.R9140
Outlet Boxes and Fittings Certified for Fire Resistance

Page Bottom

Outlet Boxes and Fittings Certified for Fire Resistance

See General Information for Outlet Boxes and Fittings Certified for Fire Resistance

THOMAS & BETTS CORP R9140
8155 T & B Blvd
Memphis, TN 38125 USA

Types 3051, 4041, 4022-12, 4042-12, -14, -34, 4043, 4051, 4052, 4061, 4062, 5052, 5053, 5054, 5055 accessories.

Types 1010, 1030, 1030-F, -FT, 1032, 1032-C, -F, -FT, -FTC, -F-C, 1040, 1040-F, -FT, 1043, 1043-C, -FTC, 1050, 1050-F, -FT, 1052, 1052-C, -FT, -FTC, 1063, 1063-C, 1072, 1072-C, 1140, 1240, 1250, 1250-FT, -112, -112-11-TB, -112-TB, -114, -138, 1260, 1260-138, 2000, 2000-6, -112-02FT, -38, 114-02-FT, -138, -283, -R-C, 2000-11-02, -112-02, -114-02, -738, 2000-F, -FT, -F-11-02, -F-114-02, 2002-R, -RC, -R02, -138, -238, -738, -738C, 2022, 2022-112, -112C, -114, -114C, -R, 2030, 2030-F, -FT, -502, -502F, -502FT, -702, -702F, -702FT, -38, 2050, 2050-N02, 2060, 2070, 2070-F, -FT, -N02, -2080; 3000, 3000-02, -40, -02-40, 3020, -02, -02-40 , 3030, 3030-02, -40, -02-40, 3080, -02, -40, -02-40, 3090, 3090-02, -02-40, -3, -3-40, -6, -6-40, -40, -94, -94-40, -95, -95-40, -302, -302-40, -602, -602-40, -9402, -9402-40, -9502, -9502-40, -N, -N-40, -N02, -N02-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 3160, -C, -40, -C-40, -94, -94-40, -C-94, -C-94-40, -95, -95-40, -C-95, -C-95-40, -CFB, -02-CFB, -3-CFB, -302-CFB, -3190, -C, -40, -C-40, -94, -94-40, -C-94, -C-94-40, -95, -95-40, -C-95, -C-95-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 4000-1, -1-02, -N, -N02, -R-02, -02, -2, -2-40, -302, -602, -94, -95, -9402, -9502, 4020, -02, -R, -R02, 4022-12, 4030, 4030-40, 4040, 4040-1, -1-02, -2, -3, -4, -6, -94, -95, -602, -9402, -9502, 4060, 4060-40, 4060-3, -3-40, -02, -02-40, -94, -94-40, -95, -95-40, -302, -302-40, -9402, -9402-40, -9502, -9502-40, -N02, -N02-40, -N, -N-40, -R, -R-40, -R02, -R02-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 4062, 4070, 4070-02, -3, -40, -94, -95, -302, -302-40, -02-40, -3-40, -6-40, -94-40, -95-40, -602-40, -9402, -9402-40, -9502, -9502-40, -N, -N02, -N-40, -N02-40, -R02, -CFB, -02-CFB, -3-CFB, -302-CFB, 4100, -02, 4160, 4160-40, 4160-C, 4160-C-40, 4160-C-94, -C-94-40, -94, -94-40, -C-95, -C-95-40, -95, -95-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 4170, 4170-40, -C, -C-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 6063, -02, 5020, 5060, 5070, 6010, -02, -4, -402, 6020-4, -402, -402F, -402FT, -412,

6022-4, -402, -422, 6023, 6023-02, -4, -402, 6030-2, -202, 6040, 6050, -01, -02, -4, -4012, -402, 6060-02, -4, -402, -402F, -402FT, -402-114, 6062, 6062-02, -4, -402, -402F, -402FT, 6063, -02, -4, -402, -402FT, 6070, -02, -4, -402, 6080, -02, -4, -402, -402F, 6090, 6090-4, -402, -402F, -402FT, 7000-202, 7002-2, -202, -11-02, 7010, -02, -8, -C, -C-8, 7020, -02, -8, -2 -81, -81-02, -802, -C, -C-8, -C-81, 7022, -02, -4, -402, -4022, 7030, 7032, 7032-02, -4, -402, 7040, 7052-202, -502, -702, -112-02, -114-02, -N02, -R02, 7060, 7062-2, 7072, 7072-01, -02, -102, -138, -2, -202, -238, -111, -111-02, -112, -112-02, -114, -114-02, -211, -211-02, -212, -212-02, -214, -214-02, -N, -N02, -R, -R02, -138-02, -238-02, -111-02, -114-02, -211-02, -214-02, 7073, 7073-2, -202, -211, -211-02, -212, -212-02, -214, -214-02, -238-02, 211-2, -238-02, -11-02-BH, -114-02-BH, -112-02-BH, -138-BH, -138-02-BH, 7074, 7074-02, -211, -211-02, -214, -212, -11-02-BH, -114-BH, -112-BH, -BH, -02-BH, -212-02, -214-02, -238, -238-02, -11-BH, -114-02-BH, -112-02-BH, -138-BH, -138-02-BH, 7080-202, 7082-02, -2, 7090, 8040, -02, -4, -402, 8050, 8050-402, 8060, 8090, 8090-402, 9010-7, -702, 9030-7, -702, 9040-702, 9050-702, 9060-7, -702, 9070-7, -702, A04-12, A04-34 nonmetallic outlet and switch boxes. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by a horizontal distance of not less than 3 in. provided that the boxes are not installed back-to-back. Boxes are also suitable for installation in staggered stud wall configuration.

Outlet boxes, Model NH40-712, all followed by C, -16C, -24C, -G16C, -G24C or MRC; N40-712, -1412, NS30-914, all followed by -C or -GC; N40-712-MRC, N40-712-RC. Models N-321, -423, all followed by C, GC, C-94, GC-94, C-95, GC-95.

The above catalog numbers may or may not contain the suffix "BP", "UB", "P", "CP", "M", "WON", "WSW", "WSWN", "F-WSW", "2-WSW", "2-FWSW", "PC" or the prefix "P", which may be followed by one or more numeric characters. The above catalog numbers may or may not contain the suffix "K". For use in fire resistance assemblies, with 2 hr or less classification period, consisting of wood joists and gypsum wallboard ceilings or walls constructed of wood or nonbearing steel studs and gypsum wallboard. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 20 sq in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 6 ft of another. The area of openings for boxes used in wall or partition assemblies shall not aggregate more than 100 sq in per 100 sq ft of wall or partition area with no opening exceeding 25.0 sq in.

Types 3000-9, 3000-902, 3000-9-40, 3000-902-40, 3020-9, 3020-902, 3020-9-40, 3020-908-40, 3030-9, 3030-902, 3030-9-40, 3030-902-40, 3080-9, 3080-902, 3080-9-40 and 3080-902-40 nonmetallic outlet and switch boxes.

Flush device boxes, Models "F-WOCT" and WOCT.

The above catalog numbers may or may not contain the suffix "BP", "UB", "P", "CP", "M", "WON", "PC" or the prefix "P", which may be followed by one or more numeric characters. The above catalog numbers may or may not contain the suffix "K". For use in fire resistance assemblies, with 2 hr or less classification period, consisting of wood joists and gypsum wallboard ceilings. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 20 sq in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 6 ft of another. The above catalog numbers can be used for fixture support not exceeding 15 lbs.

Types SB-18, -18FS, -18FT, -236, -236-FS, -241, -241-FS, -346, -346FS, -357, -357-FS, SN-16, -16F, -16FS, -16FT, -16R, -16R-FS, -18, -18F, -18FS, -18FT, -18R, -18R-FS, -21, -21-DV, -21FS, -21FT, -21R, -21R-FS, -232, -232FS, -232FT, -234, -236, -236FS, -236-FT, -241, -241-FS, -343, -343FS, -343FT, -346, -346FS, -346-FT, -357, -357-FS, -418, -418FS, -418B, -418B-FS, SN0-18, SB2-236, -236FS, -236-FT, -241, -241-FS,

-346, -346FS, -346-FT, -357, -357-FS, SS-16, -16-F, -16-FT, -16-R, -18, -18-F, -18-FT, 18-R, -21, -21-FT, -21-R, -236, -234, -236-FT, -241, -241-FS, -346, -346-FT, -357, -357-FS, FN-23, RN-23, SN-21, DV.SNO-18, nonmetallic outlet and switch boxes. These catalog numbers may or may not contain the suffix "BP", "CP", "M ", "PC", "WON", "UB", "F-OCT", "F-OCT" or the prefix "P", which may be followed by one or more numeric characters. Also, Types RD-30, RDS-30, RN-18, -18FS, -18-M, -18FS-M; MB-18, MB-18FS, RN-21, -21-M, -21FS, -21FS-M, -23, -23-M, -23FS, -23FS-M, RS-18, -18FS, -18-M, -18FS-M, -21, -21-M, -21FS, -21FS-M, -23, -23-M, -23FS, -23FS-M, E-14-4, E-14-8, E-14-8-1, E-16-8, E16-8-1, E18-4-V, E-21, E-21-4, E-232-4, nonmetallic outlet and switch boxes. For use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum wallboard with 2 hr or less Classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 20.6 sq in. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by a horizontal distance of not less than 24 in. Types 1010, 1030, 1030-F, -FT, 1040, 1040-F, -FT, 1050, 1050-F, -FT, 1140, 1240, 1250, 1250-FT, 1260, 1260-138, 2000, 2000-112-02, -114-02, 11-02, -F, -FT, -6, -112-02-FT, -38, -114-02-FT, -738.

Types 2030, 2030-F, -FT, -38, -502, -502F, -502FT, -702, -702F, -702FT, 2050, 2060, 2070, 2070-F, -FT, 2080, 3000, 3000-02, -02-04, -9-40; 3020, -C, -40, -C-40, 3030, 3030-02, -02-40, -40, -9-40, 3050-02-40, 3051, 3060, 3090, 3090-02, -40, -02-40, -N, -N-40, -N02, -N02-40, -94, -94-40, -9402, -9402-40, -95, -95-40, -9502, -9502-40, -6-40, -602-40, -6, -602, -3, -302, -3-40, -302-40, CFB, -02-CFB, -3-CFB, -302-CFB, 3160, -C, -40, -C-40, -94, -94-40, -C-94, -C-94-40, -95, -95-40, -C-95, -C-95-40, CFB, -02-CFB, -3-CFB, -302-CFB, 3190, 3190-40, -C, -C-40, -94, -94-40, -C-94, -C-94-40, -95, -95-40, -C-95, -C-95-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 4051, 4052, 4060, 4060-40, -R, -R-40, -R02, -R02-40, -N02, -N02-40, -02, -02-40, -3, -3-40, -302, -302-40, -94, -94-40, -9402, -9402-40, -95, -95-40, -9502, -9502-40, -N, -N-40, -6, -602, -CFB, -02-CFB, -3-CFB, -302-CFB, 4061, 4070, 4070-N, -N-40, -N02, -N02-40, -02, -302, -40, -3-40, -302-40, -94, -94-40, -9402, -9402-40, -95, -95-40, -9502, -9502-40, -02-40, -3, -R, -R02, -6-40, -302, -602-40, -C, -C-40, -3-40, -302-40, -CFB, -02-CFB, -3-CFB, -302-CFB, 4100, 4100-02, 4160-C-94, -C-94-40, -94, -94-40, -C-95, -C-95-40, -95, -95-40, CFB, -02-CFB, -3-CFB, -302-CFB, 4170, -40, 4170-C, 4170-C-40, CFB, -02-CFB, -3-CFB, -302-CFB, 5060, 5070, 6020, -02, -4, -402, -402F, -402FT, -412, -6030-2, 6030-202, 6040, 6050, 6050-01, -02, -4, -402, -4012, 6060, 6060-02, -402, -402F, -402FT, 6070.

-02, -4, -402, 6080, -02, -04, -402, 6090, -402, -402F, -402FT, 7000-202, 7010, -02, -8, -802, 7010C, -8, 7020, -02, -8, -802, -81, -81-02, 7020C, -8, -81, 7040, 7060, 7090, 8040, -02, -4, -402, 8050, -402, 8060, 8090, -402, 9030-7, 9030-702, 9040-702, 9050-702, 9060-7, 9060-702, 9070-7, 9070-702, FN-23, RN-23, SN-21, DV.SNO-18 nonmetallic outlet boxes. Outlet boxes, Models N40-712, NS30-914, SS30-914, followed by -C or -GC; N40-712, S40-712, followed by C, -GC, -MRC, -RC, GRC; Models N-321, -423, S-321, -423, all followed by C, GC, C-94, GC-94, C-95, GC-95.

The above catalog numbers may or may not contain the suffixes "BP", "K", "P", "CP", "M", "PC", "WON", or "UB" or the prefix "P" which may be followed by one or more numeric characters. For use in fire resistance assemblies, with 2 hr or less classification period, consisting of wood joists and gypsum wallboard ceilings or walls constructed of wood or nonbearing steel studs and gypsum wallboard. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 20.0 sq in per 100 sq ft of wall or partition area with no opening exceeding 13.0 sq in.

Flush device boxes, Models E01-712, E1-612, -614, -712 all with or without suffixes -01, -02 or -03; E1-612, -614, -712, -814 all followed by letter I; N01-712, N1-614, -710, -712, S01-712, S1-614, -710, -712 all followed by suffixes -M or -R; IN01-712, SN1-710, N2-1614-MNC, -RNC, S2-1614-MNC, -RNC, SS1-710, 4S-1310C, 4S-812C, 4SS-1310C, 4SS-812C, 4SPB, 4SP1-214, 4SP2-312. The above catalog numbers may

or may not contain the suffix "FS", "P", "PC", "CP", "M" or "UB".

For use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum wallboard with 2 hrs or less classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 20.6 sq in. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by horizontal distance of not less than 24 in.

Types 2004, -02, -238, -02-238, -BH, -02BH, -BH-N, -02-BH-N, nonmetallic outlet and switch boxes and covers. The above catalog numbers may or may not contain the suffix "P", "CP", "M", "PC", "WON" or "UB". For use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum wallboard with 2 hrs or less classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 28.0 sq in. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by horizontal distance of not less than 24 in.

Types 3000-9, -902, 09-40, -902-40; 3020-9, -C-9, -9-40, -C-9-40; 3030-9, -902, -9-40, -902-40; 3080-9; 3080-9, -902, -9-40, -902-40 nonmetallic outlet boxes for use as splice, junction or device boxes with covers. The above catalog numbers may or may not contain the suffixes "BP", "P", "PC", "CP", "M", "WON" or "UB", or prefix "P" which may be followed by one or more numeric characters. For use in fire resistance assemblies, with 2 hr or less classification period, consisting of wood joists and gypsum wallboard ceilings or walls constructed of wood or nonbearing steel studs and gypsum wallboard. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 20 sq in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No. box shall be located within 6 ft of another. The area of openings for boxes used in wall or partition assemblies shall not aggregate more than 100 sq in per 100 sq ft of wall or partition area with no opening exceeding 25.0 sq in.

Types E01-712, -712-01, -712-02, -712-03; E1-612, -612-01, -612-02, -612-03, -612-I, -614, -614-01, -614-02, -614-03, -614-I, -712, -712-01, -712-02, -712-03, -712-I; N01-712-M, -712-R; S01-712M, -712R; N1-D14-M, -614-R, -710-M, -710-R, -712-M, -712-R; S1-614 M, -614-R, -710-M, -710-R, -712-M, -712-R; SN1-710; SS1-710 nonmetallic outlet switch boxes, not intended for fixture support. These catalog numbers may or may not contain the suffix "FS" or "UB". Types SN-16, -16-F, -16-FT, -16-R, -18, -18-F, -18-FT, 18-R, -21, -21-FT, -21-R; SB-18, -18-FT; SS-16, -16F, -16-FT, -16-R, -18, -18-F, -18-FT, -18-R, -21, -21-FT, -21-R; RD-30; RDS-30; RN-18, -18FS, -18-M, -18FS-M, -21, -21-M, -21FS, -21FS-M, -23, -23M, -23FS, 23FS-M, -21FS-M, -23, -23-M, -23FS, -23FS-M; RS-18, -18FS, -18-M, -18FS-M, -21, -21M, -21FS, -21FS-M, -23, -23-M, -23FS, -23FS-M; MB-18, -18FS; E16-8, -8-1, -14-4, -21, -21-4, -14-8, -14-8-1, FN426-CV, FN426-CV-BH, FN-CFB, NG-CFB, nonmetallic outlet switch boxes, not intended for fixture support. These catalog numbers may or may not contain the suffix "BP", "CP", "M", "P", "PC", "WON" or "UB", or the prefix "P" which may be followed by one or more numeric characters. For use in fire resistance floor-ceiling assemblies, constructed with wood joists, wood flooring and gypsum wallboard ceilings with 2 hr or less Classification periods. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31 sq. in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 4.5 ft of another.

The boxes are intended to be installed in accordance with ANSI/NFPA 70, "National Electrical Code."

Types 108E, 108FB, 114-OW, 232-OW, 116-LB, 116-N, 118-LB, 118-LBP, 118-N, 118-NP, 118-OW, 120-LB, 120-LBP, 120-N, 120-NP, 122-LB, 122-LBP, 122-N, 122-NP, 234-LB, 234-LBP, 234-N, 234-NP, 345-

LB, 345-N, 4S-32LB, 4S-32N, FN-18-OWV, FN-236-V, NG-236-V, nonmetallic outlet and switch boxes. For use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum wallboard with 2 hrs or less Classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 22.0 sq in. Outlet boxes on opposite sides of wall or partition shall be separated by a horizontal distance of not less than 24 in.

Types GO-23 and GO-23-FS nonmetallic outlet and switch boxes. For use in fire resistance walls constructed of wood studs and gypsum wallboard with 2 hrs or less Classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 9.0 sq in. Outlet boxes on opposite sides of wall or partition shall be separated by a horizontal distance of not less than 24 in.

Types 4S-B, -1G, -1GP, -2G, -2GP covers and extension rings intended for use with 4 in. square wall outlet and switch boxes.

Types 114-OW, 116-N, 118-LB, 118-LBP, 118-N, 118-NP, 120-N, 120-NP, 122-N nonmetallic outlet boxes not intended for fixture support.

For use in fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum wallboard ceilings with 2 hr or less Classification periods. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31.0 sq in per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 4.5 ft of another box.

Type 3R, followed by -16BH, -16BHGP, -16N, -16NGP, 160W or -160WGP; Type 4R, followed by -20BH, -20BHGP, -20N or -20NGP nonmetallic outlet boxes for fixture support. Boxes may be followed by -CP (identifying customer package).

For use in fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum wallboard ceilings or walls constructed of wood or nonbearing steel studs and gypsum wallboard with 2 hr or less Classification periods. Clearance between boxes and cutouts in ceiling and walls or partition assemblies shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31.0 sq in per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 4.5 ft of another box. The area of openings for boxes used in wall or partition assemblies shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 25.0 sq in.

Type 8200 poke through fitting for use with Types 8201, 8205, 8206, 8207, 8208 service fittings. Factory assembled units Type EZE-1000 which may be followed by suffix, -BR, -BS, -GR, -IV. Type 8204 poke through fitting for use with Types 8203, 8209, 8210, 8211, 8212 service fittings. Factory assembled units type Furniture Feed-BR, -BS, -C, -GR, -IV. Type 8202 abandonment parts for use with the above service fittings or factory assembled units. The above mentioned poke-through fittings and service head fittings are for use in 1, 1-1/2, 2, 3 and 4 hr rated unprotected, reinforced concrete floors, and in 1, 1-1/2 and 2 hr rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below poke-through fittings.)

The assembled outlet box and poke-through fittings will not reduce the ratings of the floor assembly when the thickness and type or concrete (required for a specific rating) are within the specified limits and the fittings

are installed as specified.

1. **Concrete —** Minimum thickness of structural concrete topping of 2-1/4 in. on steel deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 100 to 155 pcf.

2. **Installation —** Mounted in 3 in. diameter core-drilled hole in concrete per installation instructions accompanying fittings.

A. Three No. 12 AWG power circuits.

B. Two 6 pair or smaller size telephone cable per telephone opening used with the outlet boxes and fittings.

The boxes are intended to be installed in accordance with ANSI/NFPA 70, "National Electrical Code."

C. One 2 pair telephone cable.

D. Two 1/2 in. and one 3/4 in. flexible conduits and fittings per conduit adaptor plate opening, with a max. of 8 No. 12 power circuits may be used with Types 8204-8203, -8209, -8210, -8211, 8212 or factory assembled unit Type Furniture Feed-BR, -BS, -C, -GR, -IV furniture feed outlet boxes and fittings.

E. One Type 106 or 110 communication duplex with a max. of 32 No. 22 AWG telephone/data cables as an alternate to the duplex receptacle with 3 No. 12 AWG power circuits.

3. **Spacing — Minimum of 2 ft OC and not more than one insert per 65 sq ft of floor area in each span.**

The boxes are intended to be installed in accordance with ANSI/NFPA 70, "National Electrical Code."

Type FCTRBCT concrete tight floor transition box with Type FCTRBCT-1, FCTRBCT-2, FCTB fittings for use in Floor-Ceiling Design No. D712.

Type FPT400 poke-through fitting for use with Type FPT401, FPT421 or FPT430 service fitting or Type FPT415 abandonment kit.

Type FPT400A poke-through fitting for use with Type DLP1PT, DLP2PT, DLP3PT, FPT401A, FPT421 or FPT430 outlet box service fitting or Type FPT415 abandonment kit.

Type FPT400B poke-through fitting for use with Type DLP1PT, DLP2PT, DLP3PT, FPT401A, FPT421, FPT430, FPT441 or FPT442 service fitting or FPT415 abandonment kit.

Type FPT440 poke-through fitting with flush mount single duplex power plus tele/data service fitting. The Type FPT440 poke-through fitting lower unit

(FPT400B) is also intended for use with Type DLP1PT, DLP2PT, DLP3PT, FPT401A, FPT421, FPT430 or FPT442 service fitting or Type FPT415 abandonment kit.

Type FPT409 extension tube kit for use with Type FPT400, FPT400A, FPT400B or FPT440 poke-through

fitting.

Type FPT410 or FPT410A abandonment plug.

The above fittings are for use in 1, 1-1/2, 2, 3 or 4 hr rated unprotected reinforced concrete floors and in 1, 1-1/2, 2 or 3 hr rated floors employing unprotected steel floor units and concrete topping (D900 Series Designs), or concrete floors with suspended ceilings. (Fire Resistance Designs with suspended ceilings should have provisions for accessibility in the ceiling area below poke-through fittings.)

The assembled outlet box and poke-through fitting or abandonment plug will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for a specific rating) are within the specified limits and the device is installed as specified:

1. **Concrete—**Minimum thickness of structural concrete topping of 2-1/2 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 110 to 155 pcf.

2. **Installation—**Mounted in core-drilled hole in concrete per instructions accompanying the poke-through fitting or abandonment plug. Diameter of core-drilled hole for Type FPT400 poke-through fitting, Type FPT400A poke-through fitting or Type FPT410 abandonment plug shall be 2-1/2 in. Diameter of core-drilled hole for Type FPT400B poke-through fitting or Type FPT440 poke-through fitting shall be 3 in. Diameter of core-drilled hole for Type FPT410A abandonment plug shall be in the range of 2 in. to 3 in. For use with power circuits, data cables and max 50 pair size telephone cable as tabulated below:

Poke Through Fitting Type	Service Fitting Type	Power Cond (a)	Tele/Data Cond (b)
FPT400	FPT401, FPT421	3	100
	FPT430		
FPT400A, FPT400B	FPT401A	4	100
FPT400A, FPT400B	DLP2PT	4	69
FPT400A, FPT400B	DLP1PT, DLP3PT	8	69
FPT400A, FPT400B	FPT421, FPT430	12	100
FPT400B	FPT441	4	54
FPT400B	FPT442	8	88
FPT440	—	4	54

(a) Max number of No. 12 AWG Type THHN conductors in power compartment of poke-through fitting in addition to integral ground wire.

(b) Max number of No. 24 AWG conductors in low voltage compartment of poke-through fitting (25 pair telephone cable has 50 conductors). When conductors larger than No. 24 AWG are used,

the aggregate cross-sectional area of the copper conductors shall not exceed the aggregate cross-sectional area of No. 24 AWG copper conductors permitted in the low voltage compartment.

3. **Spacing—** Minimum of 2 ft OC and not more than one unit per each 65 sq ft of floor area in each span.

Types RPT-4P-2RJ, RPT-2P-4RJ or RPT-6RJ poke-through fitting for use with Types RPT-BRS, RPT-AL service fittings or abandonment fitting Type RPT-4A.

Factory assembled Types RPT-4P-2RJ-BRS, RPT-4-2RJ-AL, RPT-2P-4RJ-BRS, RPT-2P-4RJ-AL, RPT-6RJ-BRS and RPT-6RJ-AL poke-through electrical inserts or Type RPT-4A abandonment fittings. The above fittings are for use in 1, 1-1/2 or 2 hr rated unprotected reinforced concrete floors and in 1, 1-1/2 or 2 hr rated floors employing unprotected steel floor units and concrete topping (D900 Series Designs), or concrete floors with suspended ceilings. (Fire Resistance Designs with suspended ceilings should have provisions for accessibility in the ceiling area below poke-through fittings.) The assembled outlet box and poke-through fitting or abandonment fitting will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for a specific rating) are within the specified limits and the device is installed as specified:

1. **Concrete—** Minimum thickness of structural concrete topping of 2-1/2 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 110 to 155 pcf.

2. **Installation—** Mounted in core-drilled hole in concrete per instructions accompanying the poke-through fitting or abandonment fitting. Diameter of core-drilled hole shall be 4 in. For use with power circuits, data cables and max 50 pair size telephone cable as tabulated below:

Poke Through Fitting Type	Service Fitting Type	Power Cond (a)	Tele/Data Cond (b)
RPT-4P-2RJ	RPT-BRS, -AL	6	16
RPT-2P-4RJ	RPT-BRS, -AL	3	32
RPT-6RJ	RPT-BRS, -AL	—	48
RPT-4P-2RJ-BRS	—	6	16
RPT-4P-2RJ-AL	—	6	16
RPT-2P-4RJ-BRS	—	3	32
RPT-2P-4RJ-AL	—	3	32
RPT-6RJ-BRS	—	—	48
RPT-6RJ-AL	—	—	48

(a) Max number of No. 12 AWG Type THHN conductors in power compartment of poke-through fitting in addition to integral ground wire.

(b) Max number of No. 24 AWG conductors in low voltage compartment of poke-through fitting

(25 pair telephone cable has 50 conductors). When conductors larger than No. 24 AWG are used, the aggregate cross-sectional area of the copper conductors shall not exceed the aggregate cross-sectional area of No. 24 AWG copper conductors permitted in the low voltage compartment.

3. **Spacing—** Minimum of 2 ft OC and not more than one unit per each 65 sq ft of floor area in each span.

Type FPT4-4P-4C-P"x", FPT4 4P-4C-C"x", FPT4 2P-6C, FPT4 2P 6C-C, FPT4 8C, FPT4 8C-C, FPT4 1TL21-2C, FPT4 1TL21-2C-C, FPT4 1TL22-2C, FPT4 1TL22 2C C, FPT4 1TL31-2C-C, FPT4 1TL32-2C and FPT4 1TL32-2C-C poke-through electrical inserts poke-through electrical inserts with Type FPT4-CVR-BRS, -ALM, -BLK, -BGE, -BRN, -GRY, -TBRS, -TALM, -TBLK, -TBGE, or -TBRN service fitting covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings). The "x" will be a number indicating the length in feet of the insulated conductor leads (max length 25 ft).

The assembled poke-through electrical insert and service head fittings will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 4 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits, data and/or telephone cables. The FPT4-4P-4C-P"x", FPT4-2P-6C and FPT4-1TL-2C Series of poke-through electrical inserts are provided with pre-wired electrical receptacles. The maximum allowable cross-sectional area of copper for communications cabling in each Series of poke-through electrical inserts is tabulated below:

Poke Through Electrical Insert Series	Tele/Data Cable Allowable Copper Area, sq in.(a)
FPT4-4P-4C-P"x"	0.0163
FPT4-2P-6C	0.0317
FPT4-8C	0.0470
FPT4-1TL-2C	0.0154

(a). Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each span.

Type FPT3-2P-2C and FPT3 2P-2C-C poke-through electrical inserts poke-through electrical inserts with Type FPT3-CVR-BRS, -ALM, -BLK, -BGE, -BRN and -GRY service fitting covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings).

The assembled poke-through electrical insert and service head fittings will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 3 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits, data and/or telephone cables. The FPT3-2P-2C Series of poke-through electrical inserts are provided with a pre-wired electrical receptacle. The maximum allowable cross-sectional area of copper for data or communications cabling in each side hole of the poke-through electrical insert is 0.00321 sq in. Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each span.

Type FFPT3 poke-through electrical inserts with Type FFPT3 CVR ALM, FFPT3 CVR BRS, FFPT3 CVR BLK, FFPT3 CVR BGE, FFPT3 CVR BRN and FFPT3 CVR GRY service fitting covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings).

The assembled poke-through electrical insert and service fitting cover will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 3 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits or communication cables. The maximum allowable cross-sectional area of copper for power or communications cabling in each poke-through electrical insert is 0.1024 sq in. Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG. Cross-sectional area of commonly-used solid copper conductors in power cable is 0.0051 sq in. for No. 12 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each

span.

Type FFPT4 poke-through electrical inserts with Type FFPT4 CVR ALM, FFPT4 CVR BRS, FFPT4 CVR BLK, FFPT4 CVR BGE, FFPT4 CVR BRN and FFPT3 CVR GRY service fitting covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings).

The assembled poke-through electrical insert and service fitting cover will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 4 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits, data and/or telephone cables. The maximum allowable cross-sectional area of copper for power circuits in each poke-through electrical insert is 0.0819 sq in. Cross-sectional area of commonly-used solid copper conductors in power cable is 0.0051 sq in. for No. 12 AWG. The maximum allowable cross-sectional area of copper for data or communication cabling in each poke-through electrical insert is 0.0717 sq in. Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each span.

Types FFPT6-3G-BRS, FFPT6-3G-ALM and FFPT6-3G-BLK -poke-through fittings with Types FFPT6-CVR-BRS, FFPT6-CVR-ALM and FFPT6-CVR-BLK poke through covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings).

The assembled poke-through electrical insert and service fitting cover will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 6 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits, data and/or telephone cables. The maximum allowable cross-sectional area of copper for power circuits in each poke-through electrical insert is 0.0815 sq in. Cross-sectional area of commonly-used solid copper conductors in power cable is 0.0051 sq in. for No. 12 AWG. The maximum allowable cross-sectional area of copper for data or communication cabling in each poke-through electrical

insert is 0.0960 sq in. Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each span.

Types RPT6-3G-BRS, RPT6-3G-ALM and RPT6-3G-BLK -poke-through fittings with Types RPT6-CVR-BRS, RPT6-CVR-ALM and RPT6-CVR-BLK poke through covers for use in 1, 1-1/2 or 2 hr fire rated unprotected reinforced concrete floors, in 1, 1 1/2 or 2 hr fire rated floors employing unprotected steel floor units and concrete topping (D900-Series designs), or in 1, 1-1/2 or 2 hr fire rated concrete floors with suspended ceilings. (Fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling area below the poke-through fittings).

The assembled poke-through electrical insert and service fitting cover will not reduce the ratings of the floor assembly when the thickness and type of concrete (required for the specific rating) are within the specified limits and the fittings are installed as specified.

1. Concrete — Minimum thickness of structural concrete topping of 2-1/4 in. over metal deck or a minimum 3 in. thick reinforced concrete slab. Unit weight of concrete to be 105 to 155 pcf.

2. Installation — Mounted in a 6 in. diameter core-drilled hole in concrete per instructions accompanying the poke-through electrical insert. For use with power circuits, data and/or telephone cables. The maximum allowable cross-sectional area of copper for power circuits in each poke-through electrical insert is 0.06285 sq in. Cross-sectional area of commonly-used solid copper conductors in communications cable is 0.00032 sq in. for No. 24 AWG and 0.00050 sq in. for No. 22 AWG. Cross-sectional area of commonly-used solid copper conductors in power cable is 0.0051 sq in. for No. 12 AWG.

3. Spacing — Minimum of 2 ft OC and not more than one unit per 65 sq ft of floor area in each span.

Types A521DE, A615D, -DE, -DEH, -DEJ, -DEL, -DH, -DL, -DJ, -E, -EH, -EJ, -EL, A5215ER, A5217DE, A5329DE, A5836DR, A52151-D, -DE, -E, A52171-B, -D, -DE, -E, -F, A58361, A58381-D, -E, -F, A122, A238, B108B, B108R, B114R, B116-A, -B, -F, B117RSW, B118-A, -B, -B2, -F, B120-A, -B, -F, -R , B121BFB, B122A, B225R, B232-A, -B, -B2, -F, B344-A, -F, B355R, BH118R, BH234R, BH353A, -S, BH354A, BH464A, -S, B468R, B455F, B455A, -AH, B418A, B432A, B112HB, BH120A, BH120S, BH235A-S, B518A, -P, B520A, -P, B618L, -G, -J, -JG, -H, -HG, -K, -KG, -R, B620L, -LG, -J, -JG, -H, -HG, -K, -KG, B708-SHK, B720-SHK, BH525A, -S, E972-NN, -NNB, SC200DV, nonmetallic outlet and switch boxes for use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum board with 2 hr or less classification periods. Clearance between boxes and cut-outs in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 21.0 sq in. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by a horizontal distance of not less than 24 in. In walls containing 3-1/2 in. thick, minimum 2.5 pcf mineral wool batt insulation the horizontal separation between outlet and switch boxes on opposite sides of the wall or partition may be reduced to 7 in.

Types A521DE, A5215ER, A5217DE, A5329DE, A5836DR, A52151-D, -DE, -E, A52171-B, -D, -DE, -E, -F, B122A, B232-A, -B, -B2, -F, B418A, B432A, B112HB , E972-NN, -NNB, nonmetallic outlet and switch

boxes for use in Design No. U351 incorporating staggered studs and mineral wool cavity infill. Clearance between boxes and cut-outs in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 16.0 sq in. Outlet and switch boxes on opposite sides of a wall or partition shall be separated by a horizontal distance of not less than 20 in.

Types A400, A410, A411, A412, A413, A414, A419, A420, A421, A422, A423, A429, E410, E420, E460 nonmetallic covers for use with above boxes.

Type B1EXTB nonmetallic box extender for use with single gang nonmetallic boxes described above.

Types A615D, -DE, -DEH, -DEJ, -DEL, -DH, -DL, -DJ, -E, -EH, -EJ, -EL, B518A, -P, B520A, -P, B618L, -G, -J, -JG, -H, -HG, -K, -KG, -R, B620L, -LG, -J, -JG, -H, -HG, -K, -KG, B708-SHK, B720-SHK, BH525A, -S, nonmetallic outlet boxes intended for fixture support. For use in fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum board ceilings with 2 hrs or less classification periods. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31.0 sq in per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within, 4-5 ft of another box.

Types A861, A862D, -E, A863BC, A863CF(+), A863CFG(+), A863S(+), A863SG(+), A863D(+), A863DG(+), A863-4SQ(+), A864D, -E, -F nonmetallic outlet boxes intended for fixture support. For use in fire resistance floor-ceiling assemblies constructed with normal weight concrete with minimum of 1-7/8 in. of concrete cover over the top of the box and with 2 hrs or less classification periods. The spacing between boxes shall be a minimum of 2 ft OC with not more than one box per each 65 sq ft of floor area in each span.

Types B116A, -B, B118A, -B, -B2, B120A, B122A, B618R, B112HB, BH122A, BH122S nonmetallic outlet boxes not intended for fixture support. For use in fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum board ceilings with 2 hrs or less classification periods. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31.0 sq in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 4.5 ft of another box.

Types B121ADJ, B121ADJH single gang nonmetallic outlet boxes not intended for fixture support. For use in the ceiling of fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum board ceilings with 2 hr or less classification periods. Clearance between boxes and cutouts in ceiling shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 31.0 sq in. per 100 sq ft of ceiling area with no opening exceeding 13.0 sq in. No box shall be located within 4.5 ft of another box.

Types B121ADJ, B121ADJH single gang, B234ADJ, -C double gang and B349ADJ three gang nonmetallic outlet boxes. For use in fire resistance walls constructed of wood or nonbearing steel studs and gypsum board with 2 hr or less classification periods. Clearance between boxes and cutouts in wall shall not exceed 1/8 in. The area of openings for boxes shall not aggregate more than 100 sq in. per 100 sq ft of wall or partition area with no opening exceeding 22.0 sq. in. Outlet boxes on opposite sides of wall or partition shall be separated by a horizontal distance of not less than 24 in.

Type B121BFB nonmetallic outlet box. For use in fire resistance floor-ceiling assemblies constructed with wood joists, wood flooring and gypsum board ceilings with 2 hr or less classification periods. Clearance between boxes and cutouts in floor shall not exceed 1/8 in. The area of openings for boxes shall not aggregate

more than 31 sq. in. per 100 sq. ft. of floor area with no opening exceeding 13 sq. in. No box shall be located within 4.5 ft. of another box.

Types A470, A470D, A471, A472 nonmetallic covers for use with above boxes.

(+) - With or without additional suffix "F".

The boxes are intended to be installed in accordance with ANSI/NFPA 70, "National Electrical Code."

Trademark and/or Tradename: "Bowers", "Patriot", "Steel City", "T&B"

Last Updated on 2015-11-10

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