

Filing Category: FIRE-RESISTIVE CONSTRUCTION—Other Fire-resistive Construction**ELECTRICAL NONMETALLIC TUBING, RIGID NONMETALLIC CONDUIT AND LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT****CARLON, LAMSON & SESSIONS**
25701 SCIENCE PARK DRIVE
CLEVELAND, OHIO 44122**1.0 SUBJECT**

Carlton Flex-Plus® Blue® ENT Electrical Nonmetallic Tubing, Carlton Plus 40® Rigid Nonmetallic Conduit, and Carlton Carflex® Liquidtight Flexible Nonmetallic Conduit.

2.0 DESCRIPTION**2.1 General:**

Carlton electrical nonmetallic tubing, rigid nonmetallic conduit and liquidtight flexible nonmetallic conduit described in this report are used in fire-resistive, load-bearing and nonload-bearing walls and floor-ceiling assemblies. Use of the tubing and conduit in the assemblies will not affect the fire-resistive assembly rating when installation is within the limits prescribed in this report.

2.2 Materials:

2.2.1 Electrical Nonmetallic Tubing: Carlton Flex-Plus® Blue® electrical nonmetallic tubing (ENT) is a polyvinyl chloride (PVC) tubing available in 1/2-inch (12.7 mm) and 3/4-inch (19.1 mm) trade sizes for wall assemblies, and 1/2-inch, 3/4-inch and 1-inch (12.7, 19.1, 25.4 mm) trade sizes for floor-ceiling assemblies.

2.2.2 Rigid Nonmetallic Conduit: Carlton Plus 40® nonmetallic conduit is a Schedule 40 PVC tubing available in nominal 1/2-inch (12.7 mm) and 3/4-inch (19.1 mm) trade sizes for wall assemblies and nominal 1/2-inch through 2-inch (12.7 to 51 mm) trade sizes for floor-ceiling assemblies.

2.2.3 Liquidtight Flexible Nonmetallic Conduit: The Carlton Carflex® is a liquidtight, flexible, nonmetallic conduit available in 3/8-inch, 1/2-inch, 3/4-inch and 1-inch (9.5, 12.7, 19.1, and 25.4 mm) trade sizes.

2.3 Installation:

2.3.1 Two-hour Fire-resistive Nonload-bearing Wall Assembly: Installation of the tubing and conduit in the fire-resistive assembly described below must comply with the *National Electrical Code* or *ICC Electrical Code*, as applicable, and is limited to a maximum of three runs in any 6-foot (1829 mm) length of wall, with a maximum of two tubes or conduits in any one stud cavity.

The tubing and conduit are installed within a two-hour fire-resistive nonload-bearing partition consisting of the following: A base layer of 5/8-inch (15.9 mm) Type X, gypsum wallboard or veneer base is applied on both sides of the wall, parallel

to minimum No. 25 gage, 3 5/8-inch (92 mm) steel studs spaced a maximum of 24 inches (610 mm) on center and attached with 1-inch (25.4 mm), Type S gypsum wallboard screws spaced 8 inches (203 mm) on center along the edges and 12 inches (305 mm) on center to intermediate studs.

The face layer consists of a second layer of 5/8-inch (15.9 mm) plain or predecorated Type X gypsum wallboard base, applied parallel to the studs and attached with 1 5/8-inch-long (41.3 mm) Type S gypsum wallboard screws spaced a maximum of 16 inches (406 mm) on center. The vertical joints of the face layer must be staggered a minimum of 24 inches (610 mm) on center from the vertical joint in the base layer. The top and bottom tracks must be fastened in place with recognized fasteners spaced a maximum of 24 inches (610 mm) on center to the top and bottom runners.

A uniform 1/4-inch (6.4 mm) end clearance must be maintained between the top and bottom tracks and each stud. Shims are used to attain the 1/4-inch (6.4 mm) clearance and are removed after the wallboard is fastened to the studs and tracks. Studs need not be attached to the top and bottom runners.

Nonmetallic electrical outlet boxes used in this assembly must be those described in ICBO ES evaluation report ER-5644. Precautions must be taken to assure that the wall openings are not oversized. Clearance between cutouts and outlet boxes must not exceed 1/8 inch (3.2 mm). Any gaps between the outlet box edges and the wall or ceiling openings shall be closed with wall taping compound or plaster spackling compound. The outlet 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 must be separated by firestopping materials as described in Section 708 of the *Uniform Building Code™* (UBC).

2.3.2 Two-hour Fire-resistive Limited Load-bearing Wall Assembly: Installation of Carlton Flex-Plus® Blue® electrical nonmetallic tubing in the fire-resistive assembly described in this section must comply with the *National Electrical Code* or *ICC Electrical Code*, as applicable, and is limited to a maximum of six tubes in any one stud cavity.

The tubing is installed within a two-hour fire-resistive limited-load-bearing partition consisting of nominal 2-by-4 wood stud kiln dry No. 2 Douglas fir lumber, positioned in two rows, with the studs within each row spaced 16 inches (406 mm) on center. The studs must be staggered 8 inches (203 mm) on center between adjacent rows. The top and bottom plates must be secured at 24 inches (610 mm) on center, maximum.

A UL classified 4-inch-thick (102 mm) mineral wool batt insulation with a density of 2.54 pcf (40.69 kg/m³) is fitted into each of the stud cavities on both sides of the assembly.

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A base layer of $\frac{5}{8}$ -inch-thick (15.9 mm), Type X gypsum wallboard is applied parallel to nominal 2-by-4 wood studs and attached with 6d nails spaced 6 inches (152 mm) on center.

A face layer consisting of a second layer of $\frac{5}{8}$ -inch-thick (15.9 mm), Type X gypsum wallboard is applied parallel to the studs with 8d nails spaced 8 inches (203 mm) on center.

Nonmetallic electrical outlet boxes used in this assembly must be those described in ICBO ES evaluation report ER-5644. Precautions must be taken to assure that the wall openings are not oversized. Clearance between cutouts and outlet boxes must not exceed $\frac{1}{8}$ inch (3.2 mm). Any gaps between the outlet box edges and the wall or ceiling openings must be closed with wall taping compound or plaster spackling compound. The outlet 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 must be separated by firestopping materials as described in Section 708 of the UBC.

The wood stud axial stress is limited to $0.78 F_c$ and must not exceed $0.78 F_c$ at an l_e/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 purposes of design:

F_c = Allowable unit stress in compression parallel to the grain adjusted for l_e/d ratio.

l_e = Effective length of compression member, inches.

d = Least dimension, inches.

2.3.3 One-hour Fire-resistive Nonload-bearing Wall Assembly: Installation of $\frac{1}{2}$ -inch or $\frac{3}{4}$ -inch (12.7 or 19.1 mm) trade size Carlon Flex-Plus® ENT tubing in the one-hour fire-resistive assembly described in this section must comply with the *National Electrical Code* or *ICC Electrical Code*, as applicable, and is limited to a maximum of two tubes in any one stud cavity.

The tubing is installed within a one-hour fire-resistive nonload-bearing partition consisting of the following: A single layer of $\frac{5}{8}$ -inch-thick (15.9 mm) Type X gypsum wallboard is applied to each side of No. 20 gage steel studs, $3\frac{3}{8}$ inches (86 mm) wide by $1\frac{3}{8}$ inches (35 mm) deep, having $\frac{5}{16}$ -inch (7.9 mm) folded-back return-flange legs, with No. 6 by $1\frac{1}{8}$ -inch-long (28.6 mm), buglehead drywall screws spaced 8 inches (203 mm) on center along the perimeter of the board and intermediate studs. The gypsum boards are applied with the long dimension parallel to the studs. Joints of the boards and screw heads must be covered with paper tape and wall compound. Top and bottom tracks must be fastened with approved fasteners spaced a maximum of 24 inches (610 mm) on center.

A uniform $\frac{1}{4}$ -inch (6.4 mm) end clearance must be maintained between the top and bottom tracks and each stud. Shims are used to attain the $\frac{1}{4}$ -inch (6.4 mm) clearance and are removed after the wallboard is fastened to the studs and tracks. Studs need not be attached to the top and bottom runners.

The tubing must be surrounded with a 6-inch-wide (152 mm) strip of Owens-Corning Fiberglas All Service Faced Duct Wrap insulation, Type 75, $1\frac{1}{2}$ inches (38 mm) thick and with a $\frac{3}{4}$ pcf (12 kg/m³) density, wrapped with faced surface outwards and stapled with standard $\frac{1}{2}$ -inch (12.7 mm) staples, $\frac{1}{4}$ inch (6.4 mm) long, spaced 3 inches (76 mm) on center. At the duct wrap section joints, a minimum of 3 inches (76 mm) of overlap is used. A 24-inch-by-24-inch-by-3-inch-thick (610 by 610 by 76 mm) mineral fiber unfaced-batt

insulation blanket is placed behind each electrical outlet box, and a 2-inch-by-3-inch-by-24-inch (51 by 76 by 610 mm) piece of the same material 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 U.S. Gypsum Company.

Nonmetallic electrical outlet boxes used in this assembly must be those described in ICBO ES evaluation report ER-5644 and installed as noted in ER-5644 and in Section 2.3.1 of this report.

2.3.4 Fire-resistive Floor-Ceiling Assembly: The Carlon Plus 40® rigid nonmetallic Schedule 40 conduit, Carlon Flex-Plus® Blue® ENT electrical nonmetallic tubing and Carlon Carflex® liquidtight, flexible, nonmetallic conduit with necessary fittings and outlet boxes are permitted to be installed in fire-resistive floor-ceiling assemblies with a rating of three hours or less, without affecting the rating, with the following limitations and requirements:

1. The total volume of rigid nonmetallic conduit, electrical nonmetallic tubing, and liquidtight flexible nonmetallic conduit must not exceed 380 cubic inches per 100 square feet (670 cm³/m²) of ceiling area. This value also takes into account the volume of fittings and junction boxes necessary for installation. Table 1 gives the volume per linear foot and maximum linear feet per 100 square feet (9.29 m²) of ceiling area for various sizes of raceways.
2. All raceways are installed with metallic fasteners or hangers at a spacing in compliance with the spacing requirements of the *National Electrical Code* or *ICC Electrical Code*, as applicable.
3. The conduits do not penetrate the suspended ceiling membrane.
4. The raceway systems are installed in compliance with the *National Electrical Code* or *ICC Electrical Code*, as applicable.
5. The distance from the top of the ceiling membrane to the bottom of the floor or roof deck above is not less than $16\frac{3}{8}$ inches (416 mm).

2.4 Identification:

The tubing and conduit are identified by the Carlon, Lamsom & Sessions name and trademark; the UL listing mark, which includes the name and/or symbol of Underwriters Laboratories Inc. together with words "Listed," a control number, and the appropriate name "Electrical Nonmetallic Tubing," "Rigid Nonmetallic Conduit Above Ground and Underground" or "Liquidtight Flexible Nonmetallic Conduit." Additionally, the evaluation report number (ICBO ES ER-5639 or NER-290) appears on the label.

3.0 EVIDENCE SUBMITTED

Reports of tests in accordance with ASTM E 119 (UBC Standard 7-1).

4.0 FINDINGS

That the tubing and conduit described in this report comply with the 1997 *Uniform Building Code*™ (UBC), the 2000 *International Building Code*® (IBC) and the 2000 *International Residential Code*® (IRC), provided the installation is in accordance with this report, and either the *National Electrical Code* 1996 when installed in areas enforcing the UBC or the *ICC Electrical Code* when installed in areas enforcing the IBC or IRC.

This report is subject to re-examination in two years.

**TABLE 1—ALLOWABLE QUANTITY OF PRODUCT IN THE FIRE-RESISTIVE FLOOR-CEILING ASSEMBLY
DESCRIBED IN SECTION 2.3.4 OF THIS REPORT**

NONMETALLIC RACEWAY TYPE AND SIZE	CUBIC INCHES PER LINEAL FOOT	MAXIMUM LINEAL FEET PER 100 SQUARE FEET OF CEILING AREA
1/2-inch Schedule 40 conduit	3.0	127
1/2-inch Liquidtight	3.0	127
1/2-inch ENT	2.0	190
3/4-inch Schedule 40 conduit	3.99	95
3/4-inch Liquidtight	3.99	95
3/4-inch ENT	2.66	143
1-inch Schedule 40 conduit	5.93	64
1-inch Liquidtight	5.93	64
1-inch ENT	3.95	96
1 1/4-inch Schedule 40 conduit	8.02	47
1 1/2-inch Schedule 40 conduit	9.59	40
2-inch Schedule 40 conduit	12.89	30

For SI: 1 inch = 25.4 mm, 1 foot = 0.3 m, 1 inch³ = 16.39 cm³, 1 foot² = 0.093 m².

Note: Where various sizes of conduit are used, the volume in cubic inches is added to ensure the total is less than 380 cubic inches. For example, if a given 100-square-foot section has 30 feet of 3/4-inch ENT, 6 feet of 1/2-inch Liquidtight, 10 feet of 1-inch Schedule 40 PVC and 10 feet of 2-inch Schedule 40 PVC:

$$\begin{aligned}
 30 \text{ feet of } 3/4\text{-inch ENT} \times 2.66 \text{ inch}^3/\text{foot} &= 79.8 \text{ inch}^3 \\
 6 \text{ feet of } 1/2\text{-inch Liquidtight} \times 3.0 \text{ inch}^3/\text{foot} &= 18.0 \text{ inch}^3 \\
 10 \text{ feet 1 inch of Schedule 40 PVC} \times 5.93 \text{ inch}^3/\text{foot} &= 59.3 \text{ inch}^3 \\
 10 \text{ feet 2 inches of Schedule 40 PVC} \times 12.89 \text{ inch}^3/\text{foot} &= 128.9 \text{ inch}^3 \\
 \text{Total} &= 286.0 \text{ inch}^3
 \end{aligned}$$

This amount of conduit is within prescribed limit because the total of 286 cubic inches per 100 square feet is under the allowable amount of 380 cubic inches per 100 square feet, and the lineal feet per 100 square feet of ceiling area is less than that given in Table 1.