Code Compliance and Field Modified Cable Tray

Gregory Camburn, RCDD
Wiremaid Products Division
Coral Springs, Florida
Agenda

• What is Cable Tray?
• National Electric Code (NEC)
• History & Types of Cable Tray
• Underwriters Labs Role
• Field Modification
• Code Problems
• Cross-Sectional Area
• AHJ’s
• Summary & Conclusion
What is Cable Tray?

- NFPA 70, National Electric Code (NEC) 2008:
  - NEC 392.2 Definition.
    - Cable Tray System. A unit or assembly of units or sections and associated fittings forming a structural system used to securely fasten or support cables and raceways.
  - NEC 392.3 Uses Permitted.
    - Cable tray shall be permitted to be used as a support system for service conductors, feeders, branch circuits, communications circuits, control circuits, and signaling circuits.
National Electric Code (NEC)

- NEC 392.5 Construction Specifications
  - (A) Strength and Rigidity. Cable trays shall have suitable strength and rigidity to provide adequate support for all contained wiring.
  - (B) Smooth Edges. Cable trays shall not have sharp edges, burrs, or projections that could damage the insulation or jackets of the wiring.
  - (C) Corrosion Protection. Cable tray systems shall be corrosion resistant. If made of ferrous material, the system shall be protected from corrosion as required by 300.6.
  - (D) Side Rails. Cable trays shall have side rails or equivalent structural members.
  - (E) Fittings. Cable trays shall include fittings or other suitable means for changes in direction and elevation of runs.

(Emphasis Added)
National Electric Code (NEC)

- NEC 392.3(A) Wiring Methods

Armored cable
CATV cables
CATV raceways
Class 2 and Class 3 cables
Communications cables
Communications raceways
Electrical metallic tubing
Electrical nonmetallic tubing
Fire alarm cables
Flexible metal conduit
Flexible metallic tubing
Instrumentation tray cable
Intermediate metal conduit
Liquidtight flexible metal conduit
Liquidtight flexible nonmetallic conduit
Metal-clad cable
Mineral-insulated, metal-sheathed cable

Multiconductor service-entrance cable
Multiconductor underground feeder and branch-circuit cable
Network-powered broadband communications cables
Nonmetallic-sheathed cable
Non-power-limited fire alarm cable
Optical fiber cables
Optical fiber raceways
Other factory-assembled, multiconductor control, signal, or power cables that are specifically approved for installation in cable trays
Polyvinyl chloride PVC conduit
Power and control tray cable
Power-limited fire alarm cable
Power-limited tray cable
Rigid metal conduit
Rigid nonmetallic conduit
RTRC
Signaling raceway
History & Types of Cable Tray

- Trough - Invented in 1951
History & Types of Cable Tray

• Ladder Type - Invented in 1955
History & Types of Cable Tray

- Wire Basket - Invented in 1956
History & Types of Cable Tray

- Center Spine - Invented 1968
History & Types of Cable Tray

• Wire Basket - Re-Introduced to USA in mid-1990’s
Underwriters Labs

• 1894
  – Underwriter’s Electrical Bureau Founded
    ▪ Electrical Bureau of the National Board of Fire Underwriters

• 1969
  – UL adds Classification Service using word “Classified” as an alternative to word “Listed” on labels when scope of product investigation has limitations.
Underwriters Labs Classification

• “Classified” versus “Listed”
  - “(Classified) Mark appears on representative samples of products that UL has evaluated but only with respect to specific properties, a limited range of hazards, or suitability for use under limited or special conditions. Typically, products Classified by UL fall into the general categories of building materials and industrial equipment. Examples of types of equipment Classified by UL include immersion suits, fire doors, protective gear for fire fighters and industrial trucks.”
UL’s CYNW Classification of Cable Tray

“‐ This category covers cable trays intended for assembly in the field and for use in accordance with Article 392 of ANSI/NFPA 70, “National Electric Code” (NEC). They have been Classified as to their suitability for use as equipment grounding conductors in accordance with Sections 392.3(C) and 392.7(B) of the NEC. The cable trays are marked on the outer surface of the sidewall of the tray indicating the cross-sectional area of the grounding metal.”

(emphasis added)
Underwriters Labs Cable Tray

- UL Mark
  - Typical UL Classification label:

![UL Mark Label](image)
Field Modification

- Unique to Wire Mesh Basket Tray
- NEMA Recommended Method for Change in Direction or Elevation
Field Modification

- After Cutting – Tray is Patched Back Together in New Form
Code Problems

• UL & Field Modifications
  – When a UL-Listed product is modified after it leaves the factory, UL is unable to determine if the product continues to comply with the safety requirements used to certify the product without investigating the modified product.

• UL Field Evaluation Service
  – (I)ntended for evaluating installed equipment that has not been previously investigated by UL, or has been significantly modified in the field for specific installation or application, or modified by other than the original manufacturer.
Code Problems

• NEC 90.7
  – *construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory.*

• UL & Field Modifications
  – *it is the responsibility of the authority having jurisdiction (AHJ) to determine the acceptability of the modification, or if the modifications are severe enough to require one of UL’s Field Engineering Services members to evaluate the modified product.*
Code Problems

• NEC 392.5 Construction Specifications
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(Emphasis Added)
Cross-Sectional Area

- UL CYNW
  - They have been Classified as to their suitability for use as equipment grounding conductors in accordance with Sections 392.3(C) and 392.7(B) of the NEC. The cable trays are marked on the outer surface of the sidewall of the tray indicating the cross-sectional area of the grounding metal.”

- Original cross-section .43”
- Modified cross-section .11”

(emphasis added)
# Cross-Sectional Area

**Table 392.7(B) Metal Area Requirements for Cable Trays Used as Equipment Grounding Conductor**

<table>
<thead>
<tr>
<th>Maximum Fuse Ampere Rating, Circuit Breaker Ampere Trip Setting, or Circuit Breaker Protective Relay Ampere Trip Setting for Ground-Fault Protection of Any Cable Circuit in the Cable Tray System</th>
<th>Minimum Cross-Sectional Area of Metal(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Cable Trays</td>
</tr>
<tr>
<td>60</td>
<td>129 mm(^2)</td>
</tr>
<tr>
<td></td>
<td>0.20 in(^2)</td>
</tr>
<tr>
<td>100</td>
<td>258 mm(^2)</td>
</tr>
<tr>
<td></td>
<td>0.40 in(^2)</td>
</tr>
<tr>
<td>200</td>
<td>451.5 mm(^2)</td>
</tr>
<tr>
<td></td>
<td>0.70 in(^2)</td>
</tr>
<tr>
<td>400</td>
<td>645 mm(^2)</td>
</tr>
<tr>
<td></td>
<td>1.00 in(^2)</td>
</tr>
<tr>
<td>600</td>
<td>967.5 mm(^2)</td>
</tr>
<tr>
<td></td>
<td>1.50(^b) in(^2)</td>
</tr>
<tr>
<td>1000</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>—</td>
</tr>
<tr>
<td>1200</td>
<td>—</td>
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<td></td>
<td>—</td>
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<tr>
<td>1600</td>
<td>—</td>
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<td></td>
<td>—</td>
</tr>
<tr>
<td>2000</td>
<td>—</td>
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<tr>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>

\(^a\)Total cross-sectional area of both side rails for ladder or trough cable trays; or the minimum cross-sectional area of metal in channel cable trays or cable trays of one-piece construction.

\(^b\)Steel cable trays shall not be used as equipment grounding conductors for circuits with ground-fault protection above 600 amperes. Aluminum cable trays shall not be used as equipment grounding conductors for circuits with ground-fault protection above 2000 amperes.
NEC 250.96 Bonding Other Enclosures.

(A) General. Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, shall be bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings designed so as to make such removal unnecessary.

(emphasis added)
Power and Mixed Use

- Under NEC Cable Tray is Electrical Support Structure

- Under NEC 392.6 Communications Cabling Can Reside in Same Tray as Power
  - (F) Cables Rated over 600 Volts. Cables rated over 600 volts and those rated 600 volts or less installed in the same cable tray shall comply with either of the following:
    1. The cables rated over 600 volts are Type MC.
    2. The cables rated over 600 volts are separated from the cables rated 600 volts or less by a solid fixed barrier of a material compatible with the cable tray.
Publications

- **Cable Tray Field Modification and Code Compliance**
  - By Gregory Camburn, RCDD
  - Image of a cable tray structure

- **BICSI News Magazine**
  - Image of a campus building with trees in the background
  - Features:
    - Optical Fiber
    - Today's CCTV Systems
    - Field Modification of Cable Tray
  - Title: One University’s Journey
  - Standardizing on Category 6A

- **Wiremaid**
  - Image of a wiremaid product
AHJ’s

• ANY listed or classified product which has been altered from the original manufactured condition is unacceptable to the Colorado State Electrical Board. Listed fittings must be used for changes in direction or elevation per the 2008 NEC 392.5E. The contractor’s analogy to conduit does not work either as conduit or tubing are vastly different from cable tray. For all that the pictured field bend is ingenious, it is also a violation in that the product no longer has any listing (classification) and would be unacceptable as such.

J. Grant Hammett
Supervisor Electrical Inspector
Colorado Department of Regulatory Agencies

• All cable trays (must) have manufactured parts that are listed for negotiating bends or offsets in the run. This includes change of direction in the horizontal and vertical planes.

Ronald Bohne, P.E.
Senior Engineer, Electrical
Clark County Development Services
Building Division

• Comparing raceways with your product is a non-issue. Your product is classified as straight runs of continuous cable tray. Changes of direction are to be accomplished by the approved fittings and sections that apparently also carry the classified label. Therefore, field bending of the cable tray is not consistent with … the UL label.

Richard G. Alford
City of Seattle
Department of Planning and Development
Electrical Official
AHJ’s

- 392.5(E) (FITTINGS- Cable trays shall include fittings or other suitable means for changes in direction and elevation of runs) means approved fittings. This type of tray would be tough for the AHJ to make a call on if not made aware of the modification because it makes a neat corner, however I would make the call that the modified tray would be rejected.
  
  Ron Francis  
  Chief Electrical Inspector  
  State of Nebraska

- It is not our intention to approve field modifications to UL listed products. If this modification has happen in the past, we have simply assumed that it was factory installation approved. We agree that once you cut the wire mesh it loses its UL listing.

  Mark Tighe  
  Senior Electrical Inspector  
  Winston-Salem, NC

- In NO way shall the contractor deviate from or alter a UL listed and approved system. Doing so nullifies the test and the inspector will disapprove in the field.

  Robbie Sabbakhan  Deputy Division Chief  
  Permit Operations Division  
  Dept. of Consumer & Regulatory Affairs (DCRA)  
  Washington DC
AHJ’s

- 2005 NEC 392.5(E) which is currently adopted by the State of Florida … specifically calls for fittings to change direction … 392.5 (A), (B), (C), (D), (are) also affected by field modifications and would not be acceptable.

Victor Lombardi Acting Electrical Director
Miami-Dade County Building Department

- The City of Houston would not consider a field modification to a basket tray as shown in your attachments. This type of modification affects the structural integrity of the supports and would be deemed as violating the UL listing.

Sheila W. Blake CBO, MBA, LEED AP
Assistant Director
City of Houston Code Enforcement

- Chapter 56, “Dallas Electrical Code” requires electrical equipment to be listed and labeled. If a piece of equipment is altered in the field we require it to be recertified by a NRTL with proper documentation supplied to the chief’s office and field inspector.

Lawrence Heckler
Chief Electrical Inspector
City of Dallas

- The City of Fort Worth does not allow the installation of listed products that have been altered, but to an inspector this product may not appear to have been altered and I am not sure an inspector would catch this without your pointing this out.

Ronnie Roberts
Chief Electrical Inspector
City of Fort Worth
Summary & Conclusion

- Wire Mesh Basket Tray is Cable Tray Under NEC
- UL Does Not Recognize Field Modifications
- Cut and Bent Tray Has Potential NEC Violations
- AHJ Has Final Authority
- If Engineer or Owner Requires UL Product – Tray Must Be Field Evaluated
- Future Projects Should Use UL Classified Fittings