Code Compliance
Issues Facing the
Steel Stud Industry
What Governs the Requirements of Cold-Formed Steel Studs?

We need to start with the big picture... the building code... and then drill down through the code provisions to determine what the requirements are for steel studs to be code compliant.
Chapter 22: This section of the code deals with steel as a framing system in general, and cold-formed steel in particular:

2210.1 General: The design, installation and construction of cold-formed carbon or low-alloy steel, structural and nonstructural steel framing shall be in accordance with AISI-General and AISI-S100.
2210.2 Headers. The design and installation of cold-formed steel box headers, back-to-back headers and single and double L-headers used in single-span conditions for load-carrying purposes shall be in accordance with **AISI-S212 Header Design**, subject to the limitations therein.

2210.3 Trusses. The design, quality assurance, installation and testing of cold-formed steel trusses shall be in accordance with **AISI-S214 – Truss Design**, subject to the limitations therein.
2210.4 Wall stud design. The design and installation of cold-formed steel studs for structural and nonstructural walls shall be in accordance with AISI-S211 – Wall Stud.

2210.5 Lateral design. The design of light-framed cold-formed steel walls and diaphragms to resist wind and seismic loads shall be in accordance with AISI-S213 - Lateral.
General Code references for Cold-Formed Studs as a Product:

Drilling down further into the code, cold-formed steel stud members are required to comply with the following standards:

Chapter 25: Gypsum Board: Section 2506
Chapter 25: Lath and Plaster: Section 2507

Nonstructural Studs:
- Materials: ASTM C 645
- Installation: ASTM C 754

Structural Studs:
- Materials: ASTM C 955
- Installation: ASTM C 1007
In cases of conflict between different sections of the code, provisions provided in Chapter 1 shall apply:

APPLICABILITY

102.1 General. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.
What are the Code Compliance Issues?

- Coatings
- Material Thicknesses
- Stud Physical Dimensions
- Marking & Identification
- Fire-Rating – Life Safety Issues
Coatings

Requirements for Studs

Nonstructural Studs: ASTM C645
Structural Studs: ASTM C955
C645: Section 4 Materials and Manufacture

- Paragraph 4.1 – “Members shall be manufactured from steel meeting the requirements of Specification A 1003.” (Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic - Coated for Cold-Formed Framing Members)
  - Specifies physical properties of steel sheet: Drywall Studs
    - Yield strength – 33 ksi minimum
    - Ductility – no elongation (ductility) requirement for nonstructural (drywall) studs
  - Specifies various permissible hot-dipped coatings for steel sheet
  - Specifies minimum hourly requirements for coatings
  - Specifies B117 salt-spray test procedure
Coatings – Salt Spray Testing

Test Requirements for the Steel Sheet per A1003:

• Steel for **nonstructural products** must survive a minimum of 75 hours in an ASTM B117 salt-spray test

• Steel for **structural products** must survive a minimum of 100 hours in an ASTM B117 salt-spray test

• In a B117 salt spray test a sample coupon with the coating standard you are testing against must be tested side-by-side with the tested specimens to ensure equivalent corrosion resistance.

• Failure is defined in A1003 as more than 10% loss of coating (surface rust).
Coatings – Nonstructural Studs

Section 4: Materials and Manufacture

- Paragraph 4.2: “Members shall have a protective coating conforming to ASTM A653 - G40 minimum - or shall have a protective coating with an equivalent corrosion resistance”

- ASTM A653
  - This is the specification for the general requirements for hot-dipped galvanized steel sheet
  - Only lists two types of galvanized coatings are listed
    - Hot-Dipped Galvanized
      - 99.9% zinc coating
    - Hot-Dipped Galvannealed
      - 8% to 12% iron alloy with the balance of the coating being zinc
Permissible Coatings per ASTM A653:

- **Hot-Dipped Galvanized (G-40)** – This is the standard coating referenced for use in C645. Any other coating used must prove “equivalent corrosion resistance”

- **Hot-Dipped Galvannealed**
  - This coating is intended to be painted
  - It is subject to red-rust when left exposed
  - Is *not* referenced in C645
  - Used extensively in the automotive industry
**Coatings – Nonstructural Studs**

Why does the Construction Market get galvannealed steel?

Rejected steel is sold into the secondary market

- Wrong yield strength
- Typically it is the wrong decimal thickness
- Damaged coils
- Wrong coating type or weight
- Improper application of coating

Determining galvannealed coating

- Flat, dull gray appearance; no spangle on surface
- Simple field test – Copper sulfate can be used to identify galvannealed steel
Copper Sulfate Test to Determine if Metal is Galvannealed

Disks prior to testing

Apply a drop of copper sulfate to disk

Wait 10 seconds and then wick off excess copper sulfate with a tissue or paper towel

Results:
The galvannealed disk has a brownish color where the copper sulfate was applied.
The galvanized disk has a black color where the copper sulfate was applied.
Coatings – Nonstructural Studs

A40 Hot-Dipped Galvannealed: Why it is not used!

24 hrs. exposure

48 hrs. exposure

Note: Samples already failing at less than the required 75 hours

96 hrs. exposure
Coatings – Nonstructural Studs

G40 Hot-Dipped Galvanized: Why it is used!

24 hrs. exposure

72 hrs. exposure

100 hrs. exposure
Paragraph 4.4: “Members shall have a protective coating in accordance with Table 1, CP 60 minimum.”

<table>
<thead>
<tr>
<th>Coating Classification</th>
<th>Coating Designator</th>
<th>Minimum Coating Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Zinc-Coated</td>
</tr>
<tr>
<td>Metallic Coated</td>
<td>CP 40</td>
<td>G 40</td>
</tr>
<tr>
<td></td>
<td>CP 60</td>
<td>G 60</td>
</tr>
<tr>
<td></td>
<td>CP 90</td>
<td>G 90</td>
</tr>
<tr>
<td>Painted Metallic</td>
<td>PM</td>
<td>The metallic coated substrate shall meet the requirements of metallic coated. In addition, the paint film shall have a minimum thickness of 0.5 mil per side (primer plus topcoat) with a minimum primer thickness of 0.1 mil per side.</td>
</tr>
<tr>
<td>Painted</td>
<td>PTD</td>
<td>Non-metallic coated substrate shall be painted after roll forming and shall have a minimum paint thickness of 1.0 mil on all surfaces including edges. Use of painted product is limited to environments where the rate of corrosion is low; typically areas such as interiors of buildings and areas of low rainfall and low humidity as defined by ISO 9223, Category 1 and 2.</td>
</tr>
</tbody>
</table>

A. Zinc-coated steel sheet as described in Specification A 653/A 653M.
B. Zinc-iron alloy-coated steel sheet as described in Specification A 653/A 653M.
C. 55% Aluminum-zinc alloy-coated steel sheet as described in Specification A 792/A 792M.
D. 5% Al-Zinc alloy-coated steel sheet as described in Specification A 875/A 875M.
E. In accordance with the requirements of A 1003.
Per Table 1 there are only four acceptable coatings that may be used:

- G60 Hot-dipped Galvanized coated
- A60 Hot-dipped Galvannealed coated
- AZ50 55% Aluminum - zinc alloy coated
- GF30 Zinc - 5% Aluminum alloy coated

If any other coating is used, the provisions of the specification are not met and the material is therefore not code compliant.
Summary: To be code compliant to IBC 2012:

For drywall studs, per ASTM C645, paragraph 4.2: “Members shall have a protective coating conforming to specification A653 – G40 minimum or shall have a protective coating with an equivalent corrosion resistance.

For structural studs, per ASTM C955, the provisions of paragraph 4.3 and Table 1: Coating protection level of CP 60 and one of the four permissible coatings in the applicable coating weight specified in the table must be used.
What are the Code Compliance Issues?

- Coatings
- Material Thicknesses
- Stud Physical Dimensions
- Marking & Identification
- Fire-Rating – Life Safety Issues
Material Thickness - Nonstructural

Section 4: Materials and Manufacture: Thickness

Paragraph 4.3: The minimum base metal thickness of the steel prior to the application of any protective coating is 0.0179”

- The minimum thickness of the delivered product to the field, including the thickness of a G40 coating is 0.019”

How is this derived?
1 ounce per sq. ft. of zinc coating = 0.0017”
G-40 coating requirement = 4/10ths of an ounce per sq. ft.
0.0017” x 0.4 requirement = 0.00068” coating thickness
0.0179” base metal + 0.00068” coating = 0.01858 ~ 0.019” total
Material Thickness - Nonstructural

The base metal thickness of nonstructural members will range between 0.0179” (18 mil) to 0.0296” (30-mil).

Any thickness greater than 0.0296” (30-mil) base metal thickness would then fall into the category of a structural member per the minimum thickness requirements of ASTM C955.
20-gauge Studs:

Two thicknesses of 20-gauge products exist today

<table>
<thead>
<tr>
<th>Thickness Property</th>
<th>Drywall 20-gauge</th>
<th>Structural 20-gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mil Thickness</td>
<td>30-mil</td>
<td>33-mil</td>
</tr>
<tr>
<td>Design Thickness</td>
<td>0.0312”</td>
<td>0.0346”</td>
</tr>
<tr>
<td>Minimum Delivered Base Steel Thickness*</td>
<td>0.0296”</td>
<td>0.0329”</td>
</tr>
<tr>
<td>Minimum Delivered Coated Thickness</td>
<td>0.0302”</td>
<td>0.0339”</td>
</tr>
</tbody>
</table>

* Minimum base metal thickness represents 95% design thickness
Paragraph 4.2 - The minimum steel thickness (base steel) shall not be less than 0.0329” (prior to application of coating)

- The minimum thickness of the delivered product to the field, including the thickness of a G60 coating is 0.034”

How is this derived?
1 ounce per sq. ft. of zinc coating = 0.0017”
G-60 coating requirement = 6/10ths of an ounce per sq. ft.
0.0017” x 0.6 requirement = 0.00102” coating thickness
0.0329” base metal + 0.00102” coating = 0.03392 ~ 0.034” total
<table>
<thead>
<tr>
<th>Old Gauge Reference</th>
<th>Mils</th>
<th>Minimum Base Steel Thickness*</th>
<th>Minimum Coated Thickness (G60 Coating)</th>
<th>Design Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>33</td>
<td>0.0329”</td>
<td>0.0339”</td>
<td>0.0346”</td>
</tr>
<tr>
<td>18</td>
<td>43</td>
<td>0.0428”</td>
<td>0.0438”</td>
<td>0.0451”</td>
</tr>
<tr>
<td>16</td>
<td>54</td>
<td>0.0538”</td>
<td>0.0548”</td>
<td>0.0566”</td>
</tr>
<tr>
<td>14</td>
<td>68</td>
<td>0.0677”</td>
<td>0.0687”</td>
<td>0.0713”</td>
</tr>
<tr>
<td>12</td>
<td>97</td>
<td>0.0966”</td>
<td>0.0976”</td>
<td>0.1017”</td>
</tr>
</tbody>
</table>

* Minimum base steel thickness represents 95% design thickness
Summary: To be code compliant to **IBC 2012**:  

**For Nonstructural Studs:**  
- For traditional flat steel studs, a minimum 0.0179” uncoated base metal thickness and a 0.019” delivered thickness is required.  
- For other than traditional flat steel studs the manufacturer must supply sufficient data such that the product will carry the design transverse loads without exceeding the allowable stress or design deflection.  

**For Structural Studs:**  
- Minimum structural thickness is 0.0329” uncoated base metal thickness and 0.034” coated thickness.
What are the Code Compliance Issues?

• Coatings
• Material Thicknesses
• **Stud Physical Dimensions**
• Marking & Identification
• **Fire-Rating – Life Safety Issues**
Stud Physical Dimensions

Nonstructural Stud:
Minimum flange width and return lip dimensions are specified in C645.

- FLANGE: 1 1/4" MIN.
- LIP: 3/16" MIN.
Structural Stud:
Only the minimum flange width dimension is specified in C955.
Section 7: Cutouts

- Industry standards:
  - 24” center-to-center spacing
  - \( \frac{3}{4} \)” wide for 1-5/8” & 2 ½ ” studs
  - 1 ½” wide for 3 ½” thru 6” studs
  - 4 ½” long
  - 10” from end of stud to edge of cutout
Section 4: Punch-outs

- locate along the centerline of the webs
- minimum 24” center-to-center spacing
- maximum width = ½ the member depth, but not more than 2½ wide”
- maximum 4 ½” long
- minimum 10” from the end of the stud to edge of the cutout
Summary: To be code compliant to **IBC 2012**: 

For nonstructural studs: The stud must have a minimum 1-1/4” flange and a minimum 3/16” return lip. Track must have a minimum 1” leg.

For structural studs: The stud must have a minimum 1-1/4” flange. Track must have a minimum 3/4” leg.
What are the Code Compliance Issues?

- Coatings
- Material Thicknesses
- Stud Physical Dimensions
- Marking & Identification
- Fire-Rating – Life Safety Issues
Marking and Identification

Both nonstructural and structural studs are required to be marked on the bundles of like members as well as on the individual members themselves.
Marking and Identification

Skids or like bundles of members must be marked with:

- Roll former’s name
- Length of member
- Quantity
- Member designator indicating:
  - Depth, Flange width, Minimum steel thickness
Individual members must be marked with:

- Roll former’s name
- Thickness without coating
- Yield strength
  - Nonstructural – required if other than 33 ksi
  - Structural – required for any ksi
- Protective coating weight
  - Nonstructural – required if other than G-40
  - Structural – required for any coating weight
Marking and Id – Nonstructural

<table>
<thead>
<tr>
<th>Roll former’s Name</th>
<th>Minimum Thickness</th>
<th>Protective Coating</th>
<th>Yield Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Markings required by ASTM (48” o.c. maximum) are shown in RED. Additional markings shown in BLACK.
Marking and Identification Summary

**Summary:** To be code compliant to **IBC 2012:**

For both nonstructural studs and structural studs:

- Bundles of like members need to be marked.
- Individual members need to be marked
Material Summary Checklists

The following two slides are checklists that can be taken into the field and used as a guide when examining cold-formed steel stud framing.
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Code Reference</th>
<th>Specification Requirements</th>
<th>How to Inspect</th>
<th>Misc.</th>
<th>Compliant</th>
</tr>
</thead>
</table>
| Protective Coating           | IBC 2012 - Table 2506.2 which then directs the user to ASTM C645 | 4.2 Members shall have a protective coating conforming to Specification A 653/A 653M-04, – G40 minimum or shall have a protective coating with an equivalent corrosion resistance.                                                                                   | * Request mfrs. certification  
* Copper sulfate test to verify use of hot dipped galvanized coating  
* Elcometer test to measure proper thickness of coating                                           | Copper sulfate reacts black with hot dipped galvanize. Reacts greenish brown with galvannealed.  
___ yes  
___ no                                                                                     |           |
| Base Metal Thickness         | IBC 2012 - Table 2506.2 which then directs the user to ASTM C645 | 4.3 Members shall be manufactured from steel having a minimum thickness, individual measurement of 0.0179 in. before application of protective coating                                                                                                        | * Measure with micrometer  
* Check manufacture’s literature  
* Check marking on the members  
* Request manufacture’s certification  
* Verify proper minimum thickness based on independent test report to verify required minimum thickness. | Thickness with G-40 coating = 0.0187”  
___ yes  
___ no                                                                                     |           |
| Marking & Identification     | IBC 2012 - Table 2506.2 which then directs the user to ASTM C645 | 5.1 Studs and rigid furring channels shall have a configuration and steel thickness such that the system in which they are used will carry the design transverse loads without exceeding either the allowable stress of the steel or the allowable design deflection.  
12.2.2 The minimum steel thickness, in mils or inches, exclusive of protective coating.  
12.2.3 The minimum yield strength in ksi  
12.2.4 The minimum protective coating weight, shall be indicated with the appropriate coating designator in accordance with Table 1.  
12.3 Individual members or bundles of like members shall be color-coated in accordance with Table 3. | * Check manufacture’s literature  
* Check marking on the members  
* Request manufacture’s certification  
* Verify proper minimum thickness based on independent test report to verify required minimum thickness. | If less than C645 minimum requirements manufacturer shall provide an independent test report to verify required minimum thickness.  
___ yes  
___ no                                                                                     |           |
| Yield Strength                | IBC 2012 - Section 2210.4 which directs the user to the AISI - General Provisions which in turn points to ASTM A1003 | 8.1 The mechanical properties of the steel sheet shall conform to the requirements shown in Table 2. Table 2 requires type “NS” studs (Non Structural) to have a minimum 33 ksi. There a  
* Check manufacture’s literature  
* Check marking on the members  
* Request manufacture’s certification  
* Only means to verify is through a destructive test ASTM A370  
___ yes  
___ no                                                                                     |                                                                                                  |                                                                                             |           |

Notes: 1) Check project specifications - They may have newer versions of ASTM specifications and / or stricter requirements.
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Code Reference</th>
<th>Specification Requirements</th>
<th>How to Inspect</th>
<th>Misc.</th>
<th>Compliant</th>
</tr>
</thead>
</table>
| Protective Coating           | IBC 2012 - Table 2506.2 which then directs the user to ASTM C955 | 4.4 Members shall have a protective coating in accordance with Table 1, CP 60 minimum. (Table 1 - CP 60 lists 4 options: G60; A60; AZ50; or GF30.) | * Request mfgrs. certification  
* Copper sulfate test to verify use of hot dipped galvanized coating  
* Elcometer test to measure proper thickness of coating | Copper sulfate reacts black with hot dipped galvanize. Reacts greenish brown with galvannealed. | ____ yes  
____ no |
| Base Metal Thickness         | IBC 2012 - Table 2506.2 which then directs the user to ASTM C955 | 4.2 The minimum steel thickness (base steel) shall be not less than 0.0329".               | * Measure with micrometer  
** Measure with G60 coating = 0.0338" | Thickness with G60 coating = 0.0338" | ____ yes  
____ no |
| Marking & Identification (Individual Members) | IBC 2012 - Table 2506.2 which then directs the user to ASTM C955 | 12.2 …individual members shall have a legible label, stencil, or embossment, at a maximum distance of 96 in.on center, on the web of the member, with the following minimum information:  
12.2.1 The rollformer’s identification (that is, name, logo or initials).  
12.2.2 The minimum steel thickness, in mils or inches, exclusive of protective coating.  
12.2.3 The minimum yield strength in ksi  
12.2.4 The minimum protective coating weight, shall be indicated with the appropriate coating designator in accordance with Table 1.  
12.3 Individual members or bundles of like members shall be color-coated in accordance with Table 3. | 48" on center repeated pattern  
Manufacturers name or logo | Minimum steel thickness exclusive of coating  
minimum should be 0.0329" if G60 coating overall thickness should be 0.0338" | ____ yes  
____ no  
____ yes  
____ no  
____ yes  
____ no  
____ yes  
____ no |
| Yield Strength               | IBC 2012 - Section 2210.4 which directs the user to the AISI - General Provisions which in turn points to ASTM A1003 | 8.1 The mechanical properties of the steel sheet shall conform to the requirements shown in Table 2. Table 2 gives the options of ST33H, ST37H, ST40H, ST50H. Each of these has a minimum yield strength equal to the number, for example ST33H has a minimum y | * Check manufacture's literature  
* Check marking on the members  
* Request manufacture's certification | * Only means to verify is through a destructive test ASTM A370 | ____ yes  
____ no |

Notes: 1) Check project specifications - They may have newer versions of ASTM specifications and / or stricter requirements.
What are the Code Compliance Issues?

- Coatings
- Material Thicknesses
- Stud Physical Dimensions
- Marking & Identification
- Fire-Rating – Life Safety Issues
Fire-Rated Partitions

What You Need to Know
Fire-Rated Partitions

General:

• A fire-rated partition must adhere to the actual tested assembly or it is not in conformance!

• Common fire-rated assemblies used today were tested decades ago

• There is no requirement for re-testing

• The metal framing members originally tested have changed
  ➢ May not be the same thickness or configuration
Fire-Rated Partitions

General:

• Per C754 – Details of construction for a specific assembly to achieve the fire resistance shall be obtained from the reports of fire resistance tests, engineering evaluations, or listings from recognized fire testing laboratories

• This over-rides ASTM C645 minimum stud requirements

• There are traditional flat steel studs as well as proprietary studs with up-to-date 1-hour and 2-hour fire-rated assemblies

• Members in assemblies are permitted to be deeper in depth and/or thicker than tested
Fire-Rated Partitions

Steel Thickness for Studs in UL Tested Assemblies:

UL tests call for “MSG” = manufacturers standard gauge

- See table below for the UL ‘MSG” bare metal and coated thickness
- For 25 MSG this means 0.018” base metal / 0.019” with coating
- For 20 MSG this means 0.033” base metal / 0.034” with coating

> If today’s drywall-20 gauge product is used it does not meet the requirements of the UL “20 MSG” material that was tested!

<table>
<thead>
<tr>
<th>Gauge</th>
<th>Minimum Base Metal Thickness (in.)</th>
<th>Overall Delivered Thickness with G-40 Coating (min base metal thkns + 0.00068” (in.))</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.018</td>
<td>0.019</td>
</tr>
<tr>
<td>24</td>
<td>0.021</td>
<td>0.022</td>
</tr>
<tr>
<td>22</td>
<td>0.027</td>
<td>0.028</td>
</tr>
<tr>
<td>20</td>
<td>0.033</td>
<td>0.034</td>
</tr>
<tr>
<td>18</td>
<td>0.044</td>
<td>0.045</td>
</tr>
<tr>
<td>16</td>
<td>0.055</td>
<td>0.056</td>
</tr>
</tbody>
</table>
Fire-Rated Partitions

Stud configuration:

**FLANGE**

$1 \frac{1}{4} \ " \ MIN.$

**LIP**

$\frac{3}{16} \ " \ MIN.$

ASTM C645 requirements
Fire-Rated Partitions

Examples of UL Designs:

<table>
<thead>
<tr>
<th>Design Number</th>
<th>Hourly Rating</th>
<th>Steel Thickness</th>
<th>Flange Width</th>
<th>Return Lip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design No. U405</td>
<td>Nonbearing 1-hr. wall</td>
<td>25 MSG</td>
<td>1 3/8&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>Design No. U412</td>
<td>Nonbearing 2-hr. wall</td>
<td>25 MSG</td>
<td>1 1/4&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>Design No. U466</td>
<td>Nonbearing 1-hr. chase wall</td>
<td>25 MSG</td>
<td>1 1/4&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>Design No. U495</td>
<td>Nonbearing 1 or 2-hr. wall</td>
<td>25 MSG</td>
<td>1 1/4&quot;</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>Design No. V444</td>
<td>Nonbearing 1-hr. wall</td>
<td>25 MSG</td>
<td>1 1/4&quot;</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>

- **Red** indicates minimum ASTM stud does not meet the UL tested stud configuration
- **Blue** indicates that the gauge requires verification that it meets the thickness requirement
- We will now look at UL fire assembly U412 in detail
1. **Floor and Ceiling Runner** — (Not Shown) — Min. 25 MSG galv steel 1 in. high, return legs 1-5/8 in. wide (min), attached to floor and ceiling with fasteners 24 in. OC.

2. **Steel Studs** -1-5/8 in. wide, 1-1/4 in. legs, 1/4 in. return, formed of 25 MSG (min) galv steel max stud spacing 24 in. OC. Studs to be cut 3/4 in. less than assembly height.
Fire-Rated Partitions

UL U 412:

• Stud and track are described as “25 MSG”: This means:
  • 0.0180” uncoated base metal thickness for the steel
  • Delivered steel thickness 0.019” with coating
    – Many nonstructural studs do not meet this thickness

• Stud has 1/4” return lip

• See UL listing for additional details pertaining to the board orientation and attachment, the size and spacing of screws, etc.

• Traditional flat steel 25 gauge ASTM C645 studs will not meet the requirements of this fire-rated assembly!
Fire-Rated Partitions

“Generic” assemblies such as those found in compilations do not list all of the information required to determine the stud requirements. To determine the actual thickness and physical configuration of the tested studs you need to examine the tested assembly. Only then you can check what is actually being installed at the jobsite.

Example:

- **GA FILE NO. WP 1616**
- **GENERIC**

<table>
<thead>
<tr>
<th>Gypsum Wallboard, Steel Studs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base</strong> layer 5/8&quot; type X gypsum wallboard or gypsum veneer base applied parallel to each side of 3 5/8&quot; steel studs 24&quot; o.c. with 1&quot; Type S drywall screws 8&quot; o.c. at vertical joints and 12&quot; o.c. at intermediate studs. <strong>Face</strong> layer 5/8&quot; plain or predecorated type X gypsum wallboard or gypsum veneer base applied parallel to each side laminating compound combed over entire surface. Metal base and top retainer channels.</td>
</tr>
<tr>
<td>Joints staggered 24&quot; each layer and side. (NLB)</td>
</tr>
</tbody>
</table>

**2 Hour Fire**
- Thickness: 6 1/8"
- Approx. Weight: 10 psf
- Fire Test: UL R1319-31, 6-2-60, UL Design U411
- Sound Test: NGC 2005905, 6-15-05, RAL TL06-115, 4-12-06

Note: This assembly was tested in 1960. This also tells the reader that the assembly is UL 411 and this is where they can find the material description.

Here the studs are only described as “steel studs”. In General Note No.14 (defined elsewhere in the manual), metal studs and runners are defined as “nominal 25 gage unless otherwise specified”.

**Single Stud Wall Assemblies**

<table>
<thead>
<tr>
<th>Design No.</th>
<th>Hourly Rating</th>
<th>Bare Steel Thickness</th>
<th>Coated Steel Tkn. (in.)</th>
<th>Flange Width (in.)</th>
<th>Return Lip (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U403</td>
<td>2hr</td>
<td>25 gauge (0.020&quot;)</td>
<td>0.021</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U404</td>
<td>1 hr or 2 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.500</td>
<td>0.250</td>
</tr>
<tr>
<td>U405</td>
<td>1 hr</td>
<td>25 gauge</td>
<td>0.019</td>
<td>1.375</td>
<td>0.250</td>
</tr>
<tr>
<td>U406</td>
<td>1 hr</td>
<td>25 gauge</td>
<td>0.019</td>
<td>1.375</td>
<td>0.250</td>
</tr>
<tr>
<td>U407</td>
<td>3 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>not specified</td>
<td>not specified</td>
</tr>
<tr>
<td>U408</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.188</td>
</tr>
<tr>
<td>U410</td>
<td>1 hr.</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.375</td>
<td>0.250</td>
</tr>
<tr>
<td>U411</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U412</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U419</td>
<td>1 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U419</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U419</td>
<td>3 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U419</td>
<td>4 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U419</td>
<td>1, 2, 3 or 4 hr</td>
<td>0.0149&quot;</td>
<td>n/a</td>
<td>1.250</td>
<td>0.219</td>
</tr>
<tr>
<td>U421</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U422</td>
<td>1 hr.</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U430</td>
<td>1 hr or 2 hr</td>
<td>20 MSG (0.0327&quot;)</td>
<td>0.033</td>
<td>1.500</td>
<td>0.250</td>
</tr>
<tr>
<td>U432</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>not specified</td>
<td>not specified</td>
</tr>
<tr>
<td>U435</td>
<td>3 or 4 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U439</td>
<td>2hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U441</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.188</td>
</tr>
<tr>
<td>U442</td>
<td>3 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U443</td>
<td>2 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U448</td>
<td>1 hr</td>
<td>25 MSG</td>
<td>0.021</td>
<td>1.375</td>
<td>not specified</td>
</tr>
<tr>
<td>U450</td>
<td>3 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U451</td>
<td>1 hr</td>
<td>18 MSG</td>
<td>0.045</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U452</td>
<td>1 1/2 hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U453</td>
<td>2 hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U454</td>
<td>2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U455</td>
<td>3 hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U457</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U463</td>
<td>3 hr or 4 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U465</td>
<td>1 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U470</td>
<td>1 1/2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>2.000</td>
<td>0.250</td>
</tr>
<tr>
<td>U471</td>
<td>1 1/2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.375</td>
</tr>
<tr>
<td>U474</td>
<td>2 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U475</td>
<td>1, 2, or 3 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U475</td>
<td>4 hr</td>
<td>18 MSG</td>
<td>0.045</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U478</td>
<td>3 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U484</td>
<td>2 hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U488</td>
<td>1 hr</td>
<td>20 MSG</td>
<td>0.034</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U490</td>
<td>4 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
</tbody>
</table>

**Chase or Double Stud Wall Assemblies**

<table>
<thead>
<tr>
<th>Design No.</th>
<th>Hourly Rating</th>
<th>Bare Steel Thickness</th>
<th>Coated Steel Tkn. (in.)</th>
<th>Flange Width (in.)</th>
<th>Return Lip (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U420</td>
<td>1 hr or 2 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>not listed</td>
<td>not listed</td>
</tr>
<tr>
<td>U436</td>
<td>1, 2, or 3 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.625</td>
<td>0.250</td>
</tr>
<tr>
<td>U444</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.188</td>
</tr>
<tr>
<td>U445</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.188</td>
</tr>
<tr>
<td>U458</td>
<td>1 hr</td>
<td>20 MSG (0.0329&quot;)</td>
<td>0.034</td>
<td>1.250</td>
<td>0.313</td>
</tr>
<tr>
<td>U466</td>
<td>1 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>U493</td>
<td>1hr or 2 hr</td>
<td>25 MSG</td>
<td>0.034</td>
<td>1.625</td>
<td>0.250</td>
</tr>
<tr>
<td>U493</td>
<td>1hr or 2 hr</td>
<td>20 MSG (0.0327&quot;)</td>
<td>0.034</td>
<td>1.500</td>
<td>0.250</td>
</tr>
<tr>
<td>V437</td>
<td>1 hr</td>
<td>25 MSG</td>
<td>0.019</td>
<td>1.250</td>
<td>0.250</td>
</tr>
<tr>
<td>V442</td>
<td>1hr or 2 hr</td>
<td>22 MSG</td>
<td>0.028</td>
<td>1.375</td>
<td>0.250</td>
</tr>
</tbody>
</table>
Fire-Rated Structural Partitions

What You Need to Know

Pre-test

Post-test

What You Need to Know
Fire-Rated Assemblies

What you need to know:

Some structural stud wall and floor assemblies require a reduction in the load carrying capacity of the stud or joist members.

Checking the actual tested assembly is the only way to know. The next series of slides illustrate this point.
# Fire-Rated Assemblies

**Example: Wall Stud Assembly**

**UL Design No. U425 - Interior Bearing Walls**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Wallboard Protection Both Sides of Wall – No. of Layers and Thickness of Board Each Layer</th>
<th>% of Design Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 min</td>
<td>* 1 layer, ½” thick</td>
<td>100</td>
</tr>
<tr>
<td>1 hour</td>
<td>* 1 layer, 5/8” thick</td>
<td>100</td>
</tr>
<tr>
<td>1 ½ hour</td>
<td>* 2 layers, ½” thick</td>
<td>100</td>
</tr>
<tr>
<td>2 hour</td>
<td>* 2 layers, 5/8” thick</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>* 3 layers, ½” thick</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>* 2 layers, 3/4” thick</td>
<td>100</td>
</tr>
</tbody>
</table>

* Ratings applicable to assemblies serving as exterior walls where Classified fire resistive gypsum sheathing type wallboard is substituted on the exterior face

**Note:**
20% reduction of axial load capacity
Fire-Rated Assemblies

Example: Floor/Ceiling Assembly:

UL Design No. L564 v UL Design L567 – Floor/Ceiling Assemblies

<table>
<thead>
<tr>
<th>Flooring</th>
<th>3/4&quot; T&amp;G Viroc</th>
<th>3/4&quot; T&amp;G Plywood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Restriction</td>
<td>None (100%)</td>
<td>Reduce to 77% of allowable load</td>
</tr>
<tr>
<td>Adhesive</td>
<td>Enerbond 45 Spray foam adhesive in T&amp;G</td>
<td>Polyurethane Construction Adhesive to joists</td>
</tr>
<tr>
<td>Deck Fasteners</td>
<td>#8 by 1 5/16&quot; spaced 12&quot; o.c.field and perimeter</td>
<td>#10 x 1-7/16&quot; winged screws 6&quot; o.c. perimeter and 12&quot; field</td>
</tr>
<tr>
<td>Battls and Blankets</td>
<td>Glass Fiber Insulation 3 5/8&quot; or Mineral Wool</td>
<td>Min. 4&quot; of Mineral wool insulation with 4.5 #/ft3 density</td>
</tr>
<tr>
<td>Structural Members</td>
<td>9 1/4&quot; TDW 16ga.</td>
<td>10&quot; 16ga. With 2&quot; flange with Web Stiffeners</td>
</tr>
<tr>
<td>Joist Spacing</td>
<td>24&quot; max</td>
<td>16&quot; max</td>
</tr>
<tr>
<td>Blocking &amp; Lateral Bridging</td>
<td>Solid joist 8&quot; o.c. with &quot;S&quot; clip one end &quot;E&quot; clip the other (2) screws each leg of clip + 2 1/2&quot; TDSB between joists with (1) screw to joists</td>
<td>Solid joist sections every 7&quot; o.c. with 3&quot;x3&quot;x10&quot; clips to each end of block with (4) screws each leg of each clip + U-Channel across joist bottom with (4) screws to each block</td>
</tr>
<tr>
<td>Resilient Channels</td>
<td>25 Ga. RC 12&quot; o.c.</td>
<td>25 Ga. RC 16&quot; o.c.</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>One layer of 5/8&quot; Type C screw 8&quot; o.c. field and perimeter</td>
<td>Two layers of 1/2&quot; Type C screw each layer 6&quot; o.c. perimeter, 16&quot;o.c. field</td>
</tr>
<tr>
<td>Joint System</td>
<td>Paper tape in joint compound</td>
<td>Paper tape in joint compound</td>
</tr>
</tbody>
</table>

There are differences in assemblies. In the example above, one assembly requires a 23% reduction in allowable load capacity. (This is in addition to being framed at a tighter spacing and requiring an additional layer of gypsum board!)
Summary

Components of a code compliant steel stud installation:

1. The proper specification requirements must be met for the stud itself – nonstructural or structural:
   - Proper coating and yield strength
   - Proper thickness
   - Proper configuration
   - Proper labeling

2. Knowledge of the construction of fire-rated assemblies and the limitations associated with their use.
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Email: info@clarkdietrich.com
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