For Best Nonstructural Steel Stud Specifications, Stay Apprised of Industry Standard Requirements

By ClarkDietrich®

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ClarkDietrich

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WITH A HISTORY SPANNING MORE THAN HALF A CENTURY in noncombustible commercial construction, cold-formed steel is a popular material choice for framing non-structural interior walls, load-bearing interior and exterior walls, floor joists, and curtain walls. The many performance-based characteristics and green attributes of cold-formed steel framing have enabled architects to design structures that are safer and more durable, dynamic as well as sustainable.

Cold-formed steel offers the strength, durability and stability needed for framing applications. From a sustainable construction standpoint, the material is ideal for new construction and commercial renovation projects. Unlike wood, it's noncombustible, corrosion- and mold-resistant, termite-proof, made with high recycled content, reduces on-site construction waste, and can be recycled at the end of the structure's life cycle. Cold-formed steel framing products are 100% recyclable and can be locally or regionally sourced for most projects. In fact, new construction projects that feature cold-formed steel components are eligible for up to 7 LEED®v4 points, collectively, from five different LEED v4 credit categories.

The two primary framing applications for cold-formed steel are structural and nonstructural. This paper will focus on nonstructural framing members and their installation. Nonstructural steel studs are not designed for bearing any axial loads and are ideal for supporting the dead load of many typical wall finishes, such as gypsum board, tile, etc., and providing resistance to limited interior transverse loads.

Accounting for the use of nearly 60 percent of all metal studs in the United States, interior, nonstructural wall partitions are one of the most common applications for steel framing— specifically cold-formed steel studs. Therefore, it's important to understand the material and manufacturing requirements for cold-formed nonstructural steel studs set by AISI S220, the installation requirements set by ASTM C754, and the specification of fire-rated partitions.

Regarding nonstructural steel framing, the latest standard is AISI S220: North American Standard for Cold-Formed Steel Framing— Nonstructural Members. This standard has been adopted by the 2015 International Building Code (IBC) and has replaced ASTM C645 as the universal industry standard for the specification of nonstructural steel framing.

AISI S220

AISI S220: North American Standard for Cold-Formed Steel Framing – Nonstructural Members. It is referenced in IBC 2015 and 2018 to determine code compliance for nonstructural studs.

The four key attributes to examine when evaluating nonstructural steel stud products are thickness, shape or configuration, coating, and marking or identification. AISI S220 addresses these attributes, and more, in a series of sections, including Material, Corrosion Protection, Base Steel Thickness, Manufacturing Tolerances and Product Identification.

MATERIALS AND MANUFACTURE

Steel Requirements—General

The first requirement for compliance with AISI S220 in the manufacture of cold-formed, nonstructural steel studs is for the sheet steel to comply with ASTM A1003 Type NS, which specifies the mandatory physical properties of the steel sheet used to manufacture the studs. It specifies that the yield strength of the material must be at least 33ksi. For nonstructural steel studs, there is no requirement for elongation (ductility).

Minimum Steel Thickness Requirements

Traditionally, for conventional steel studs, the minimum base steel thickness prior to the application of any protective coating is 0.0179 inches, and the minimum thickness of the delivered product to the field, including the thickness of the protective coating, is 0.019 inches. Typically, the base metal thickness of nonstructural members will range between 0.0179 inches (18mil) to 0.0296 inches (30mil). There is no top-end thickness for studs meeting AISI S220. However, thicknesses greater than 30mil are typically considered to be structural members and must meet the minimum requirements of ASTM C955: Standard Specification for Cold-Formed Steel Structural Framing Members for IBC 2012 and prior or AISI S200 “North American Standard for Cold-Formed Steel Framing – General Provisions” for IBC 2015 and AISI S240 “North American Standard for Cold-Formed Steel Structural Framing for IBC 2018. For example, 20 gauge is a range of thicknesses, 20 gauge interior wall partition studs have a minimum thickness of 30mil, while 20 gauge structural studs have a minimum thickness of 33mil.

Per AISI S220, the minimum thickness shall not be less than 95% of the design thickness.

Table A6-1
Manufacturing Tolerances for Nonstructural Members

Dimension[1]	Item Checked	Studs, in. (mm)	Tracks, in. (mm)
A	Length	+1/8 (3.18)	+ 1(25.40)
		-1/4 (6.35)	-1/4 (6.35)
B[2]	Web Depth	+1/32 (0.79)	+1/8 (3.18)
		-1/32 (0.79)	-0 (0)
C	Flare	+1/16 (1.59)	+0 (0)
	Overbend	-1/16 (1.59)	-3/16 (4.76)
D	Hole Center Width	+1/8 (3.18)	NA
		-1/8 (3.18)	NA
E	Hole Center Length	+1/4 (6.35)	NA
		-1/4 (6.35)	NA
F	Crown	+1/8 (3.18)	+ 1/8 (3.18)
		-1/8 (3.18)	- 1/8 (3.18)
G	Camber	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
H	Bow	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
I	Twist	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
J	Flange Width	+1/8 (3.18)	+1/2 (12.7)
		-1/16 (1.59)	-1/16 (1.59)
K	Stiffening Lip Length	+1/8 (3.18)	NA
		-1/32 (0.79)	

[1] All measurements shall be taken not less than 1 ft (305 mm) from the end.
[2] Outside dimension for *stud*; inside for *track*.

GAUGE SPECIFICATIONS				
Designation Thickness (mil)	**Minimum Thickness* (inch)**	**Design Thickness (inch)**	**Yield Strength**	**Reference Gauge**
15	0.015	0.0158	50 ksi	25 EQ
18	0.0179	0.0188	33 ksi	25
18	0.0181	0.0190	70 ksi	20 EQ
30	0.0296	0.0312	33 ksi	20
33	0.0329	0.0346	33 ksi	20 STR
*Minimum base-thickness represents 95% design thickness				

Coating Requirements

AISI S220 requires steel stud members to have a protective coating conforming to ASTM A653/A653M—G40 minimum or shall have a protective coating with an equivalent corrosion resistance. In addition to the protective coating requirement, ASTM A1003 requires that for the addition of a new nonstructural steel coating, stud products must be capable of surviving a minimum of 75 hours in an ASTM B117 salt-spray test with less than 10% loss of coating— commonly measured by red rust.

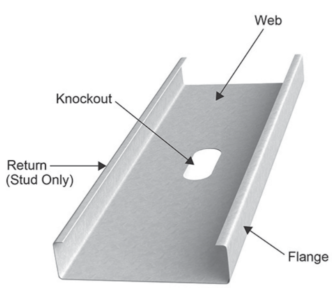
To explain the meaning of G40, the alpha character “G” stands for “hot-dipped galvanized zinc” and the number following it represents the total amount of zinc in ounces per square foot contained on both sides of the sample. For instance, a G40 contains .4 ounces of zinc per square foot total on both sides. When using a coating other than a G40, to ensure “equivalent corrosion resistance”, a G40-coated steel sample should be tested side-by-side with the specimens under consideration to ensure equivalent corrosion resistance.

Unlike AISI S220, ASTM A653 allows one additional coating type to the hot-dipped zinc G40 coating. This other coating is an A40 hot-dipped galvannealed steel, a coating used extensively in the automotive industry. This coating has 8%–12% zinc-iron alloy in addition to the zinc. Since the automotive industry paints over the galvannealed coating, it is almost always less than the 0.4 ounces per square foot minimum required. This coating, since it is not referenced in AISI S220 is not acceptable for use.

The newest development in the industry is the advent of “EQ” or equivalent coatings that have further advanced the performance characteristics of nonstructural framing. These new coatings are applied pre- and post-production and represent a scientific advancement in coating protection. Equivalent coatings or “EQ coatings” as they are now called can offer performance characteristics greater than traditional G40 coatings.

Shape or Configuration

AISI S220 requires that the stud members have a minimum flange of 1-1/4" . Tracks are required to have a minimum leg (flange) of 1". The standard also contains a table of minimum tolerances.



Marking and Identification

AISI S220, Paragraph A6.5 —Product Identification for the marking and identification requirements for the individual members. Members are required to show the manufacturer’s name, logo or initials, the minimum steel thickness (in mils or inches), the minimum yield strength if other than 33ksi, and the minimum coating designation if other than G40. Marking on the members must be at a maximum of 96" on-center.

EQ STUDS

New technology developed within the cold-formed framing industry in recent years has led to new and better framing member products. EQ (Equivalent Gauge) studs have been in the framing industry for over 15 years, and approximately 95% of the market now consists of EQ stud products. Manufacturers now produce EQ studs with higher yield strength than traditional studs using less steel, which helps support the mission of sustainable construction. An EQ stud, as defined by both the Steel Framing Industry Association (SFIA) and Steel Stud Manufacturers Association (SSMA) code compliance certification programs, must:

- Have a bending moment that is at least equal to that of their traditional stud counterpart
- Have developed and published composite limiting height tables in accordance with ICC-ES AC86-(Reapproved August 2015): Acceptance Criteria For Cold-Formed Steel Framing Members—Interior Nonload-Bearing Wall Assemblies
- Have published screw data (shear and pullout) and must pass the screw spin-out performance test in ASTM C645 and/or AISI S220.
- Meet the corrosion protection requirements of AISI S220.

There are two ways for EQ studs to meet the requirements of AISI S220. First, they must have a configuration and steel thickness such that the system in which they are implemented will carry the design transverse loads without exceeding either the allowable stress of the steel or the allowable design deflection. Manufacturers are expected to supply sufficient data for calculating design performance.

Because EQ studs are formed from steel with higher yield strength, they have greater pullout and shear values. Higher pullout values are advantageous when attaching handrails, fixtures, etc. EQ studs meet the same requirements as traditional studs, despite being thinner, due to a variety of factors. To begin with, manufacturers of EQ studs have taken advantage of new, higher-strength steels available today, as well as new steel processing methods. They may have also added more steel into the strip width used to make the studs. Reinforcing ribs and other reinforcing devices have been added to the flanges and/or webs.

In addition, new technology is being used by manufacturers to develop high-performance coatings that protect the base steel so that it can meet the protective coating requirements of AISI S220. These performance coatings use new corrosion-inhibiting and adhesion- enhancing formulas. The coating chemically reacts and bonds with the zinc on the substrate, producing a synergistic effect, which greatly enhances corrosion resistance. The coatings can be applied to any zinc or zinc-alloy coated substrate. As an added advantage, any imperfections—fractures and/or porosity—in the existing zinc or zinc-alloy coating substrate are filled by the performance coating.

EQ studs differ from traditional flat studs in a variety of ways. For example, they generally have a minimum thickness of 0.0150 inches instead of 0.0179 inches. And, because they are thinner than traditional studs, the majority of their physical structural properties are less. However, with regard to performance, they perform as well or better than traditional studs because of the stronger yield strength steel and enhanced section configuration. To summarize, EQ studs are the new-and-improved nonstructural steel stud. They can contribute to more LEED points, they're lighter, they install faster, have better screw values, utilize the latest technology and result in less construction waste.

ASTM C754: STEEL STUD INSTALLATION

The industry standard for the installation of nonstructural steel framing members is ASTM C754: Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products, which covers all members made in conformance with AISI S220. To begin with, steel tracks for nonload-bearing interior partitions are secured to the supporting structure. If the floor is a concrete slab, installers should fasten the tracks with concrete stub nails, expansion anchors, shielded screws or power-driven fasteners. If floors are wooden, tracks should be fastened with screws (1-inch minimum) or nails (1-1/2-inch minimum penetration). Tracks can be secured to suspended ceilings with "Molly"-type expandable fasteners, toggle bolts or screws fastened into channels, splines, T-runners or other framing members.

All fasteners should be located 2 inches from each end and be spaced a maximum of 24 inches on-center. When attaching track-to-stud, which is only required at door jambs, partition intersection and borrowed light frames, a sharp point pan head or low-profile, Number 6 diameter screw with a flat surface on the underside of the head should be used.

Floor-to-ceiling steel studs should be inserted between tracks, positioned vertically, with their open side facing in the same direction, to engage floor and ceiling tracks. They must be spaced 16 inches or 24 inches maximum on-center based on the thickness of the gypsum board, the ability of the board to span the distance between studs, the number of layers of board, as well as the requirements of the fire rating if a rated partition. Stud spacing is not permitted to exceed spacing requirements by more than ±1/8 inch. Aligning the studs properly will permit correct bracing, utility runs and prevent stepped or uneven joint surfaces.

To get current limiting height information, your manufacturer should be consulted for their limiting height tables. Composite limiting height data can only be applied to walls where gypsum board is installed on both flanges of the stud for the full height of the wall. This allows higher limiting heights without needing a heavier stud or lesser spacing.

Non-composite conditions, however, are common in all structures. These occur where the gypsum board stops at the ceiling level, but the stud continues to the deck, or where the gypsum board is only partial height on one or both sides of the stud, or when the stud only has gypsum board on one side. When these conditions occur, composite limiting height tables cannot be used. Consult your manufacturer for their non-composite limiting height tables.

Studs should be located no more than 2 inches away from the intersection of through and abutting partitions. At partition corners, a stud should be installed so that it forms the outside corner. Following the application of a single layer of board to this stud, a second stud should be installed in the abutting track. The web of the second stud should be screwed through the board into the flange of the first stud.

Headers should be installed over doorways and other openings, securely attached to the adjacent vertical studs. ASTM C754 sets no limit on the height or width of openings. An engineered solution may be needed, which may require more than a single-track header.

FIRE-RATED WALL ASSEMBLY REQUIREMENTS

Ensuring fire safety in building designs is critical. There are numerous laboratories, including Underwriter Laboratories (UL®), Intertek, Southwest Research, etc. that perform fire testing for a variety of building assembly materials, including wall assemblies. This testing is designed to determine how quickly fire can raise the temperature to unacceptable levels and how building materials react. The results are fire resistance ratings, which gauge the ability of a construction assembly to confine and isolate fire within a zone composed of fire resistance-rated walls, ceiling and floor assemblies. Fire-rated assemblies are tested and certified in their entirety.

There are several important things to remember about fire resistance-rated wall assemblies and the role of steel studs in the assemblies. A fire-rated partition must adhere to the way the actual tested assembly was constructed—no variation is permitted. Many of today's commonly used fire-rated assemblies were tested decades ago, and there is no requirement for retesting once an assembly passes the fire test. Fire-rated assemblies using EQ studs, however, are more likely to have current fire-testing reports, since the EQ studs are newer products.

EQ studs have either been fire-tested or have gone through an extensive engineering evaluation in order to be listed in a UL fire-rated assembly. It's important to examine current wall assembly schedules and research the listed assembly's components to determine if the EQ studs meet the project's framing requirements. Specifiers will also need to know if 25 EQ—which is often the minimum thickness listed in the UL assembly—is acceptable. The Specifier will also need to know if the assembly is limited to only 1-hour and/or to only one thickness or manufacturer of gypsum board. Also, is the assembly limited to only certain types of board products (cement, impact, etc.)? If any of these exceptions apply, another fire assembly or manufacturer's product may need to be specified.

For the most appropriate stud specification, it's a good idea to verify that product literature and stud sample submissions submitted for approval on the project comply with the requirements of the fire-rated assemblies shown on the partition schedule. In addition, verify through field testing that the proper thickness and profile of stud is being installed per the fire-rated assembly requirements. All products are required to be labeled, so this should be a relatively easy visual inspection.

Integrated Fire Protection Systems

One recent nonstructural (and structural) framing-related innovation that is helping building and design professionals to achieve better fire resistance ratings for wall assemblies is the integration of additional firestop materials into framing members. For commercial and institutional projects, Architects and Specifiers are now using steel tracks that have been manufactured with a factory measured dose of intumescent tape materials attached to the track flanges. Intumescent materials are firestop products that expand greatly from their installed size when exposed to heat or flames and provide a perimeter joint seal for fire, sound, smoke and air leakage protection. These products are easier for contractors to install than traditional firestop materials. All they have to install is the track member at the top of the wall, when it includes the intumescent tape. It eliminates the need to return and install intumescent caulking at a later time, thus eliminating multiple labor and material operations.

NEW TECHNOLOGY IN WALL DESIGN

One of the biggest recent trends in commercial architecture, design and construction is the digital design and coordination of projects through the use of Building Information Modeling (BIM) software, such as Revit®. BIM is helping Architects and Specifiers streamline their product selection process by providing detailed 3D models of specific products and allowing them to track the product through the construction process. So, it is advantageous to use BIM technology for the proper steel stud specification and in-wall assembly design. ClarkDietrich was the first of a growing number of steel framing manufacturers to provide free BIM software to Architects and Specifiers looking for a streamlined, digital route to optimal, high-performance wall assembly designs for their projects.

CONCLUSION

There are various factors that influence the proper specification and installation of nonstructural wall framing. Architects and Specifiers must select the proper steel framing members for the application and follow the requirements of building codes and industry standards to create a design that will lead to a proper installation. Understanding and staying apprised of codes and standards is the key. Times are changing, and the requirements listed in codes and standards are changing with them.

ABOUT CLARKDIETRICH®

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