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Steel framing members for gypsum board systems — Specification

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0 Foreword

Steel framing components for gypsum board systems are common products used in building and construction industry. Currently, these products are available and applied at different levels of quality and performance. Therefore, in order to meet quality and performance requirements for ensuring the public safety, health, environmental protection and social-economic welfare of the general public this standard has been prepared.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a measurement or test shall be rounded off in accordance with TZS 4, *Rounding off numerical values*.

During the preparation of this Tanzania Standard, assistance was derived from the following publications:

ASTM C645 − 18, *Standard Specification for Nonstructural Steel Framing Members* published by the ASTM International.

1 Scope

This standard covers non-structural steel framing members used in interior construction assemblies for gypsum panel products.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below:

ISO 10684, Fasteners — Hot dip galvanized coatings

ISO 3575, Continuous hot-dip zinc-coated and zinc-iron alloy-coated carbon steel sheet of commercial and drawing qualities

ISO 6892-1, Metallic materials — Tensile testing — Part 1: Method of test at room temperature

ISO 9227, Corrosion tests in artificial atmospheres — Salt spray tests

ISO 9223, Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation

3 Definitions

3.1 members

in screw application of gypsum board, studs, runners (track), hat furring channels, main beams, and cross furring members of grid suspension systems or other items manufactured in accordance with this specification.

3.2 non-structural wall stud

a member in a steel framed wall system which is limited to a lateral (transverse) load of not more than 480 Pa, a superimposed vertical load, exclusive of sheathing materials, of not more than 1460 N/m, or a superimposed vertical load of not more than 890 N.

4 Materials and Manufacture

4.1 Members shall be manufactured from steel meeting the requirements of Table 1. The determination of chemical composition shall be made in accordance with acceptable chemical, spectrochemical, or other test methods.

Table 1: Chemical Composition Heat and Product Analysis, Max %

Element	Class 1		Class 2	
	Heat Analysis	Product Analysis	Heat Analysis	Product Analysis
Carbon	0.25	*A*	0.25	*A*
Manganese	1.15	*A*	1.65	*A*
Phosphorus	0.20	*A*	0.20	*A*
Sulfur	0.04	*A*	0.04	*A*
Copper	0.20[B]	0.23	0.50[C]	0.58
Nickel	0.20[B]	0.23	0.30[C]	0.35
Chromium	0.15[B,D]	0.19	0.30[C]	0.35
Molybdenum	0.06[B]	0.07	0.16[C]	0.17
Vanadium	0.008[E]	0.018[E]	0.20	0.23
Columbium	0.008[E]	0.018[E]	0.15	0.17
Titanium	0.008[E]	0.018[E]	0.20	0.23

[A] Product analysis tolerances for these elements are found in Table 2.

[B] The sum of copper, chromium, nickel, and molybdenum shall not exceed 0.50 %. When one or more of these elements are specified, the sum does not apply. If this occurs, only the individual limits on the remaining elements shall apply.

[C] The sum of copper, chromium, nickel, and molybdenum shall not exceed 1.00 %. When one or more of these elements are specified, the sum does not apply. If this occurs, only the individual limits on the remaining elements shall apply.

[D] Chromium is permitted, at producer's option, to 0.25 % maximum when the carbon content is less than or equal to 0.05 %. In this case, the limit on the sum of the four elements in footnote *B* does not apply.

[E] The limits for steels whose carbon content is 0.02 % or less are as follows:

Element	Heat Analysis	Product Analysis
Vanadium	0.10	0.11
Columbium	0.045	0.055
Titanium	0.30	0.33

Table 2: Product Analysis Tolerances

Element	Limited or Maximum of Specified Element, %	Tolerance	
		Under Minimum Limit	Over Maximum Limit
Carbon	≤ 0.15	0.02	0.03
	0.15 < x ≤ 0.40	0.03	0.04
	0.40 < x ≤ 0.80	0.03	0.05
Manganese	≤ 0.60	0.03	0.03
	0.60 < x ≤ 1.15	0.04	0.04
	1.15 < x ≤ 1.65	0.05	0.05
Phosphorus	. . .	. . .	0.01
Sulfur	. . .	. . .	0.01
Silicon	≤ 0.30	0.02	0.03
	0.30 < x < 0.60	0.05	0.05
Copper	. . .	0.02	. . .
Titanium	≤ 0.10	0.01[A]	0.01
Vanadium	≤ 0.10	0.01[A]	0.01
	0.10 < x ≤ 0.25	0.02	0.02
	Minimum only specified	0.01	. . .
Columbium	≤ 0.10	0.01[A]	0.01

[A]If the minimum of the range is 0.01 %, the under tolerance is 0.005 %.

4.2 Metallic Coating

Nonstructural steel members shall have a protective coating of minimum Z100 in accordance with ISO 3575 or shall have a protective coating with an equivalent corrosion resistance. The minimum metallic coating weight [mass] requirements shall be as shown in Table 3.

Table 3: Coating mass (total both sides)

Coating designation (Z – zinc; ZF – zinc-iron alloy)	**Minimum check limit**	
	Triple-spot test	**Single-spot test**
	g/m^2 (of sheet)	g/m^2 (of sheet)
Z001	No minimum [a]	No minimum [a]
Z100	100	85
Z180	180	150
Z200	200	170
Z275	275	235
Z350	350	300
Z450	450	385
Z600	600	510
Z700	700	595
ZF001	No minimum [a]	No minimum [a]
ZF100	100	85
ZF180	180	150

NOTE 1: Because of the many variables and changing conditions that are characteristic of continuous zinc coating, the coating mass is not always evenly divided between the two surfaces of zinc-coated and zinc-alloy coated sheet; neither is the coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40 % of the single-spot check limit will be found on either surface.

NOTE 2: The coating thickness may be estimated from the coating mass by using the following relationship: 100 g/m^2 total mass both sides = 0.014 mm total thickness both sides.

[a] "No minimum" means that there are no established minimum check limits for triple- and single-spot tests.

4.2.1 Not all coatings will react the same under a given set of environmental conditions. These minimum coating designations assume normal exposure conditions and construction practices. When more severe exposure conditions are probable, for example, in coastal areas, consideration should be given to specifying heavier coating weight [mass].

4.2.2 Other metallic coatings shall be considered for inclusion to Table 3 provided they satisfy the minimum expected corrosion characteristics The minimum expected corrosion characteristics as indicated by laboratory testing for metallic coated sheet steels are as follows:

4.2.2.1 Corrosion Standard — No more than 10 % loss of coating from the surface of the laboratory test sample at the end of the prescribed test duration.
4.2.2.2 Test Duration — Minimum exposure for Type NS steels is 75 h. The laboratory procedure for determining conformance to the minimum expected corrosion characteristics is ISO 9227.

4.3 Painted-Metallic Coatings
Painted-metallic coated steel sheet shall consist of a metallic-coated substrate and a paint film. The metallic-coated substrate shall meet the coating weight [mass] requirements of Table 3. The paint film shall have a minimum thickness of 0.5 mm per side (primer plus topcoat) with a minimum primer thickness of 0.1 mm per side.

4.4 Nonmetallic Coatings
Non-metallic coated (painted) steel sheet is intended to be used in environments where the rate of corrosion is low. Typically, these environments include very dry atmospheres, such as areas of low rainfall and low humidity, and the interior of buildings that are climate-controlled. The application of painted product shall be restricted to applications defined as Category 1 or 2 of the table found in Annex B. These categories are described in ISO 9223.

Nonmetallic-coated steel which is painted after roll forming shall have a minimum paint thickness of 1.0 mm on all surfaces including the edges.

4.5 Members shall be manufactured from steel having a minimum thickness, individual measurement of 0.455 mm, before application of protective coating.

4.6 Non-structural members utilized in cold formed steel framed construction shall be cold formed to shape from steel sheets of “NS” steel designations and shall have mechanical properties shown in Table 4. Test method for mechanical properties shall be in accordance with ISO 6892-1.

Table 4: Mechanical Properties, Base Metal

Designation	Yield Strength, MPa	Tensile Strength MPa	Elongation[A] in 13 mm	Elongation in 50 mm
NS80	550		. . .*G*	. . .*G*
NS70	480		. . .*G*	. . .*G*
NS65	450		. . .*G*	. . .*G*
NS60	410		. . .*G*	. . .*G*
NS57	395		. . .*G*	. . .*G*
NS50	340		. . .*G*	. . .*G*
NS40	275		. . .*G*	. . .*G*
NS33	230		. . .*G*	. . .*G*

[A]The procedure for determining the local and uniform elongation can be found in the *AISI Cold Formed Design Manual*, “Standard Methods for Determination of Uniform and Local Ductility.”
[E]Local elongation in a 13-mm gage length across the fracture.
[G]Where an ellipsis appears there is no requirement.
NOTE 1: All values are minimum requirements in the longitudinal direction.

5 Dimensions and Permissible Variations

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. Main beams and cross furring of grid suspension systems shall be limited to a deflection of L/240. The manufacturer shall supply sufficient data for calculating design performance.

NOTE: Allowable deflection varies depending on the cladding used and architectural requirements. Detailed requirements shall be specified in application specifications.

Members, except main beams of grid suspension systems, shall be sufficiently rigid to permit penetration of the screw.

Minimum width of face to which gypsum board is screw-attached shall be not less than 32 mm.

Minimum lip dimension shall be 5 mm.

5.2 Members shall comply with the manufacturing tolerances as listed in Table 5 as shown in figure 1.

Table 5: Manufacturing Tolerances for Nonstructural Members

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

[1] All measurements shall be taken not less than 305 mm from the end.

[2] Outside dimension for stud; inside for track.

5.3 Rigid Furring Channels minimum depth shall be 22 mm. Minimum width of furring attachment flanges (see Fig. 2) shall be 12.7 mm.

5.4 Grid suspension systems include main beams and cross furring members which mechanically interlock to form a modular supporting network. Length tolerance for grid suspension members shall be 1.59 mm.

5.5 Runners (track) shall be formed in a U-shaped configuration, having web depth compatible with those of the studs of the same nominal size. The runners (track) shall be designed such that when the studs are placed in both the top and bottom runners (track), they are held by friction. Minimum height of flanges shall be 25 mm.

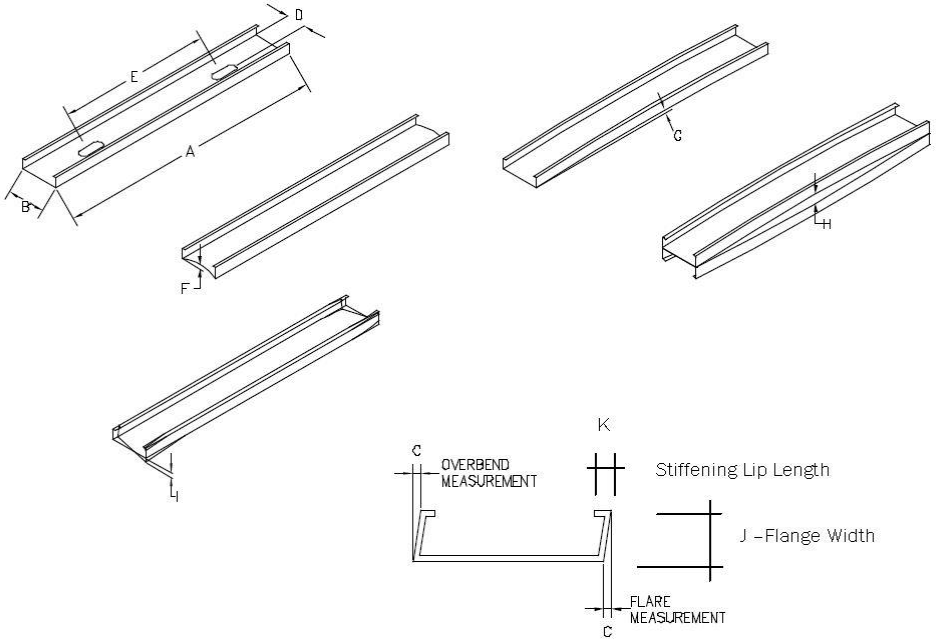

Figure 1: Manufacturing Tolerances for Nonstructural Members

6 Edges

6.1 Members shall be manufactured in such a fashion as to minimize burrs and sharp edges.

7 Cutouts

7.1 Cutouts shall not reduce the performance of the members in the gypsum board construction assembly below the specified performance requirements.

8. Sectional Properties

8.1 The sectional properties of members shall be computed in accordance with Tables 6 and 7 and Figs. 2 and 3.

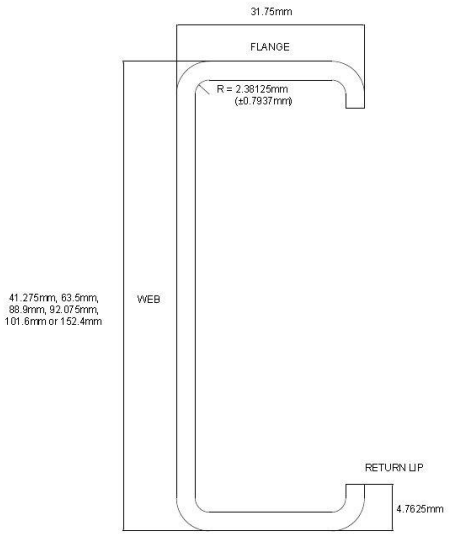

Figure 2: Minimum Drywall Stud Cross Section

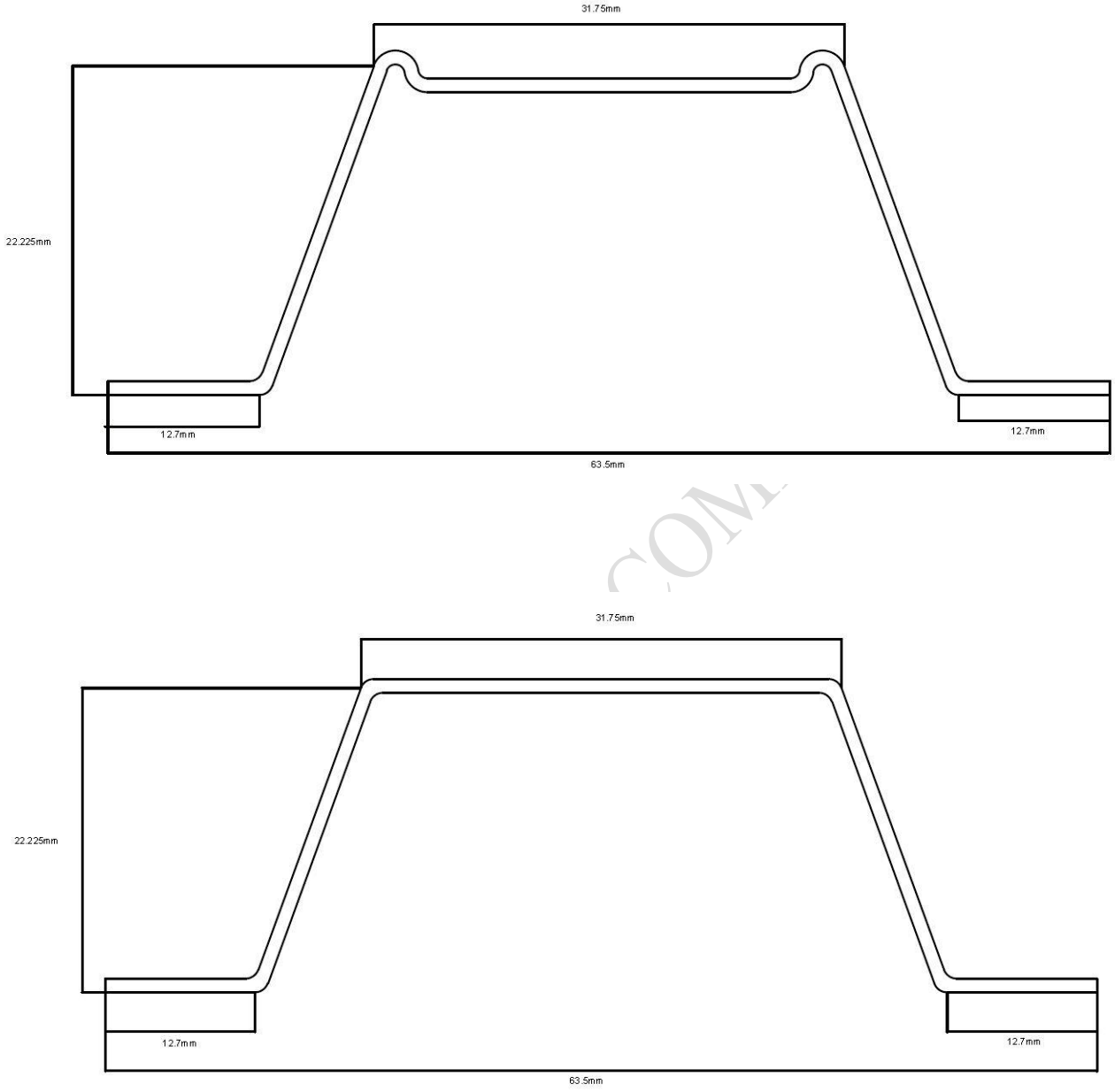

Figure 3: Hat Furring Channel Cross Section

Table 6: Minimum Section Properties for Various Studs

Section Designator[A]	Stud Depth (mm)	Design Thickness (mm)	Minimum Base Steel Thickness[B] (mm)	Gross Area[C] (mm^2)	Effective Properties [C,D]	
					Ix[E] (1000 mm^4)	Mn/Ω[F] (N-m)
162S125-18	41	0.478	0.454	52	14	69
162S125-30	41	0.792	0.752	85	25	134
162S125-33	41	0.879	0.835	94	27	155
250S125-18	64	0.478	0.454	63	38	116
250S125-30	64	0.792	0.752	102	66	236
250S125-33	64	0.879	0.835	114	73	272
350S125-18	89	0.478	0.454	74	84	161
350S125-30	89	0.792	0.752	123	144	335
350S125-33	89	0.879	0.835	135	159	390
362S125-18	92	0.478	0.454	76	92	167
362S125-30	92	0.792	0.752	125	157	348
362S125-33	92	0.879	0.835	138	173	406
400S125-18[G]	102	0.478	0.454	81	117	185
400S125-30	102	0.792	0.752	133	197	388
400S125-33	102	0.879	0.835	147	218	453
600S125-30	152	0.792	0.752	173	513	609
600S125-33	152	0.879	0.835	192	574	714

[A] The section designator defines the cold-formed steel framing member dimensions.
Example: 350S125-18
350 designates the member web depth in 100ths of an inch, 350 = 88.9 mm
S designates the type of member, S = Stud
125 designates the member flange width in 100ths of an inch, 125 = 31.8 mm
-18 designates the minimum base metal thickness in mm, 18 = 0.454 mm
-30 designates the minimum base metal thickness in mm, 30 = 0.752 mm
-33 designates the minimum base metal thickness in mm, 33 = 0.836 mm

[B] Minimum base steel thickness is 95 % of Design Thickness.

[C] Properties are based on a centerline radius of 2.38 mm, see Fig. 2.

[D] Effective properties are calculated in accordance with AISI S100 and are based on a yield strength, F_y = 227 MPa.

[E] Moment of inertia, Ix, given is for deflection calculations.

[F] Allowable moment is taken as the lowest value based on local or distortional buckling. For distortional buckling, $K\Phi = 0$ and $\beta = 1$.

[G] Where noted, member web height-to-thickness ratio exceeds 200, web stiffeners required at supports.

Table 7: Hat Furring Channel Section Properties

Design Thickness (mm)	Minimum Base Steel Thickness[A] (mm)	Gross Area[B] (mm^2)	Effective Properties[B,C,D]	
			Ix^E (mm^4)	Mn/Ω^F (N-m)
0.477	0.453	45.29	3563	36.16
0.719	0.683	67.48	5440	61.02
0.792	0.752	74.32	5953	68.98
0.879	0.835	81.94	6531	74.58

[A] Minimum base steel thickness is 95 % of Design Thickness.
[B] Properties are based on a centerline radius of 2.38 mm.
[C] Effective properties are given as the minimum value for either positive or negative bending.
[D] Effective properties calculated in accordance with AISI S100 and are based on F_y = 227 MPa.
[E] Moment of inertia given is for deflection calculations.
[F] Allowable moment based on local buckling.

9 Performance Requirements

When tested in accordance with clause 10, members shall be capable of pulling the head of the screw below the surface of the gypsum board in less than 2 s without spin out.

10 Penetration Test

This test method provides a procedure for evaluating the member's ability to pull the head of a screw below the surface of gypsum wallboard. It shall be used to determine compliance with this specification. The degree of performance of this test method with service performance has not been determined.

The screw penetration test shall be conducted according to Annex A.

11 Inspection

Inspection of the members shall be agreed upon between the purchaser and the producer or supplier as part of the purchase agreement.

12 Rejection

When specified in the purchase agreement, members that fail to conform to the requirements of the specification shall be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. The notice of rejection shall contain a statement documenting how the member has failed to conform to the requirements of this specification and the purchase agreement.

13 Marking and Identification

Framing members used in cold-formed steel framed construction shall be identified in accordance with the requirements of this section.

13.1 Identification of Groups of Like Members

Groups of like members shall be marked with a label or an attached tag. Marking shall include the roll-former's identification (name, logo, or initials), length, quantity, and roll-former's member designator including member depth, flange size, minimum steel thickness in millimeters exclusive of protective coating, and the designation "NS".

13.2 Identification of Individual Framing Members

In addition to the marking referenced in 13.1, individual framing members shall have a legible label, stencil, or embossment at a maximum distance of 2440 mm on center, on the member, with the following minimum information:

(1) The manufacturer's identification (i.e., name, logo, trademark or initials).
(2) The minimum steel thickness, in mm, exclusive of protective coating.
(3) The minimum yield strength in megapascals (MPa) if other than 230 MPa.
(4) The protective coating type and weight, if other than as specified in clause 4.2
(5) The designation "NS".

14 Protection

14.1 Material shall be protected during shipment as required. When specified in the purchase order, the members shall be packaged in accordance with the purchaser's instructions.

14.2 When materials are stored, they shall be stored off the ground and be properly supported on a flat surface.

Bibliography

[1] AISI S100-16, *North American Specification for the Design of Cold-Formed Steel Structural Members*
[2] AISI S220-15, *North American Standard for Cold-Formed Steel Framing – Nonstructural Members*
[3] ASTM A1003/A1003M – 15, *Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members*
[4] ASTM A 924/A 924M – 09*, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process*

ANNEX A

PENETRATION TEST

A-1 SIGNIFICANCE AND USE

A-1.1 This test method provides a procedure for evaluating the member's ability to pull the head of a screw below the surface of gypsum wallboard. It shall be used to determine compliance with this specification. The degree of performance of this test method with service performance has not been determined.

A-2 APPARATUS SHALL SATISFY THE FOLLOWING:

10-2.1 Power-Driven Drill Screw Gun,
capable of 4000 rpm (free spindle speed) with a depth-sensitive nose piece, supplied with a screw driving bit to fit the screw used in the test.
A-2.2 Stop Watch,
capable of being read to the nearest 0.1 s.

A-3 MATERIALS SHALL SATISFY THE FOLLOWING:

A-3.1 Gypsum Wallboard Specification ASTM C1396/C1396M, Type X, 16 mm thick.
A-3.2 Screws Specification ASTM C1002, Type S, minimum 25.4 mm long.
A-3.3 Paper Joint Tape Specification ASTM C475/C475M.

A-4 SAMPLING

One member shall be selected from each bundle or package, but not more than ten from any one shipment for testing.

A-5 SPECIMEN PREPARATION:

A-5.1 Each member to be tested shall be cut into test specimens not less than 460 mm long.
A-5.2 For each test, one piece of gypsum wallboard, 150 mm square, shall be cut from not less than 300 mm from the edge or end of the gypsum wallboard.
A-5.3 For each test, four pieces of paper joint tape, 50 mm square shall be cut.

A-6 PROCEDURE:

A-6.1 Assemble the member, gypsum wallboard, and paper joint tape on a rigid, flat surface. (See Fig. 4 for studs, Fig. 5 for furring channels.)

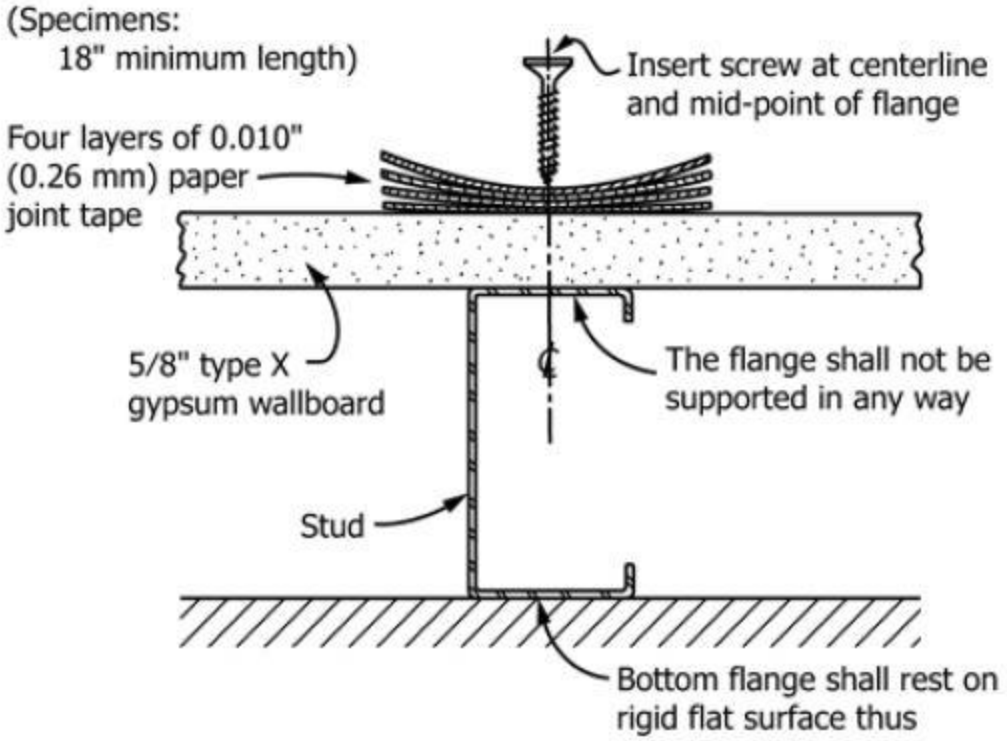

Figure 4: Studs

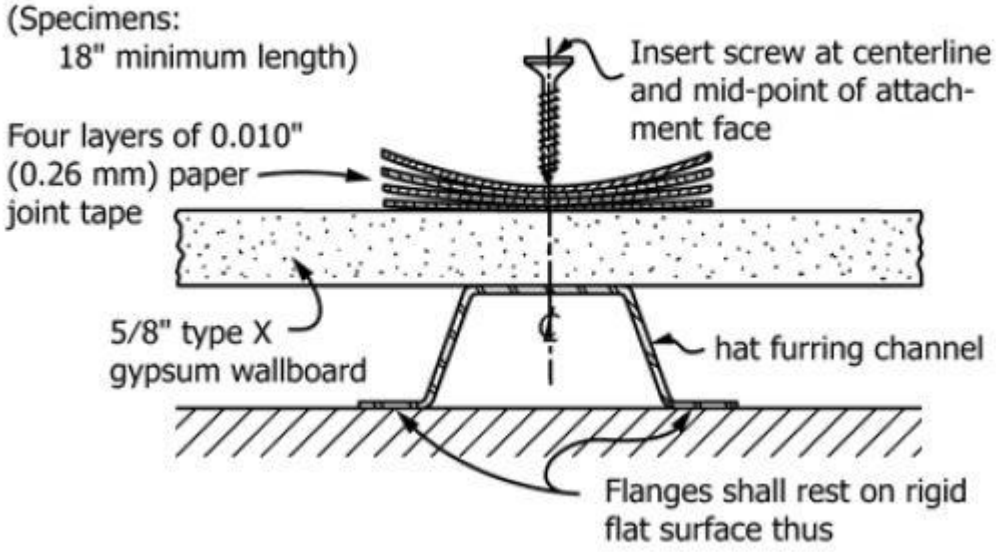

Figure 5: Hat Furring Channels

10.6.2 Prior to performing the test, drive several screws without the paper joint tape to set the depth of the nose piece on the screw gun, allowing the screws to be driven below the surface of the wallboard without breaking the gypsum wallboard
face paper.
10.6.3 Drive the screw through the paper joint tape, using the screw gun, while applying a force (dead weight and applied force) of 30 lbf (112.2 N). Drive the screw until the nosepiece of the screw gun has either stopped and seated the screw or the screw spins out. Record if the screw has spun out and if it exceeds 2 s to seat the screw in the gypsum wallboard.

10.7 NUMBER OF TESTS AND RETESTS:
10.7.1 A sample consisting of five specimens of members shall be tested.
10.7.2 If not more than one of the test specimens fails to meet the requirements, the sample has met the requirements.
10.7.3 If two of the five test specimens fail to meet the requirements, two additional test specimens shall be chosen for retesting. If either of the two additional test specimens fail, the sample has failed to meet the requirements of this test.

10.8 REPORT
Report shall indicate the total number of specimens tested and the number of specimens meeting the requirements of this specification.

ANNEX B

(Mandatory Information)

CATEGORIES OF ATMOSPHERES

Category	Description of Categories[A]
1	Interior climates with climate controlled conditions
2	Properly ventilated interior climates without climate controlled conditions in dry temperature locations [Exceptions — locations (1) with average to high humidity, (2) with substantial air pollution, and/or (3) close to the seacoast.] Exterior climates that are (1) very dry and (2) very warm or dry and very cold.
3	Exterior climates that are dry and warm or cold. Properly ventilated interior climates in (1) dry, warm or cold locations, and (2) temperate locations, both without climate control.
4	All temperate, average humidity exterior climates. Properly ventilated interior climates in humid locations. Unventilated buildings in temperate climates; no climate control.
5	All damp exterior climates. Unventilated buildings in humid climates.
[A]See ISO 9223	