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Standard Specification for Structural Steel for Ships[1]

This standard is issued under the fixed designation A 131/A 131M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers structural steel plates, shapes, bars, and rivets intended primarily for use in ship construction.

1.2 Material under this specification is available in the following categories:

1.2.1 *Ordinary Strength*—Grades A, B, D, and E with a specified minimum yield point of 34 ksi [235 MPa], and

1.2.2 *Higher Strength*—Grades AH, DH, EH, and FH with a specified minimum yield point of 46 ksi [315 MPa], 51 ksi [350 MPa], or 57 ksi [390 MPa].

1.3 Shapes and bars are normally available as Grades A, AH32, and AH36. Other grades may be furnished by agreement between the purchaser and the manufacturer.

1.4 The maximum thickness of products furnished under this specification is 4 in. [100 mm] for plates and 2 in. [50 mm] for shapes and bars.

1.5 When the steel is to be welded, it is presupposed that a welding procedure suitable for the grade of steel and intended use or service will be utilized. See Appendix X3 of Specification A 6/A 6M for information on weldability.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 6/A 6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

E 112 Test Methods for Determining Average Grain Size

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *control rolling*, *n*—a steel treatment that consists of final rolling within the range used for normalizing heat treatments so that the austenite completely recrystallizes.

3.1.2 *thermo-mechanical controlled processing*, *n*—a steel treatment that consists of strict control of the steel temperature and the rolling reduction. A high proportion of the rolling reduction is to be carried out close to or below the Ar_3 transformation temperature and may involve rolling towards the lower end of the temperature range of the intercritical dual-phase region, thus permitting little if any recrystallization of the austenite. The process may involve accelerated cooling on completion of rolling.

4. Ordering Information

4.1 Specification A 6/A 6M establishes the rules for the ordering information that should be complied with when purchasing material to this specification.

4.2 Additional ordering considerations specific to this specification are:

4.2.1 Condition (control rolled or thermo-mechanical control processed, if applicable).

5. Materials and Manufacture

5.1 Rimmed steels shall not be applied.

5.2 Except for Grades A and B steel, semi-killed steels shall not be applied.

5.3 Grades D, E, AH32, AH36, AH40, DH32, DH36, DH40, EH32, EH36, EH40, FH32, FH36, and FH40 shall be made using a fine grain practice. For ordinary-strength grades, aluminum shall be used to obtain grain refinement. For

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

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higher-strength grades, aluminum, vanadium, or columbium (niobium) may be used for grain refinement.

5.4 Plates in all thicknesses ordered to Grade E shall be normalized, or thermo-mechanical control processed. Plates over 1⅜ in. [35 mm] in thickness ordered to Grade D shall be normalized, control rolled, or thermo-mechanical control processed. See Table 1.

5.5 Plates in all thicknesses ordered to Grades EH32 and EH36 shall be normalized, or thermo-mechanical control processed. Plates in all thicknesses ordered to Grade EH40, FH32, FH36, and FH40 shall be normalized, thermo-mechanical control processed, or quenched and tempered. Plates ordered to Grades AH32, AH36, AH40, DH32, DH36, and DH40 shall be normalized, control rolled, thermo-mechanical control processed, or quenched and tempered when so specified. See Table 2.

5.6 In the case of shapes, the thicknesses referred to are those of the flange. Heat treatment and rolling requirements for shapes and bars are given in Table 1 and Table 2.

6. Chemical Requirements

6.1 The heat analysis shall conform to the requirements for chemical composition given in Table 3 and Table 4.

6.1.1 When specified, the steel shall conform on product analysis to the requirements given in Table 3 and Table 4, subject to the product analysis tolerances in Specification A 6/A 6M.

6.2 For thermo-mechanical control process steel, the carbon equivalent shall be determined from the heat analysis and shall conform to the requirements given in Table 5.

7. Metallurgical Structure

7.1 The steel grades indicated in 5.3 shall be made to fine grain practice, and the requirements for fine austenitic grain size in Specification A 6/A 6M shall be met.

7.2 Where the use of fine grain practice using columbium, vanadium, or combinations is permitted in 5.3, one or more of the following shall be met:

7.2.1 Minimum columbium (niobium) content of 0.020 % or minimum vanadium content of 0.050 % for each heat, or

7.2.2 When vanadium and aluminum are used in combination, minimum vanadium content of 0.030 % and minimum acid-soluble aluminum content of 0.010 %, or minimum total aluminum content of 0.015 %.

7.2.3 When columbium (niobium) and aluminum are used in combination, minimum columbium (niobium) content of 0.010 % and minimum acid-soluble aluminum content of 0.010 %, or minimum total aluminum content of 0.015 %.

7.2.4 A McQuaid-Ehn austenitic grain size of 5 or finer in accordance with Test Methods E 112 for each ladle of each heat.

8. Mechanical Requirements

8.1 *Tension Test*:

8.1.1 Except as specified in the following paragraphs, the material as represented by the test specimens shall conform to the tensile requirements prescribed in Table 6.

8.1.1.1 Shapes less than 1 in.^{2} [645 mm^2] in cross section, and bars, other than flats, less than ½ in. [12.5 mm] in thickness or diameter need not be subjected to tension tests by the manufacturer, but chemistry consistent with the required tensile properties must be applied.

8.1.1.2 The elongation requirement of Table 6 does not apply to floor plates with a raised pattern. However, for floor plates over ½ in. [12.5 mm] in thickness, test specimens shall be bent cold with the raised pattern on the inside of the specimen through an angle of 180° without cracking when subjected to a bend test in which the inside diameter is three times plate thickness. Sampling for bend testing shall be as specified for the tension tests in 8.1.2.

8.1.2 One tension test shall be made from each of two different plates, shapes, or bars from each heat of structural steel unless the finished product from a heat is less than 50 tons [45 Mg], in which case one tension test is sufficient. If, however, product from one heat differs ⅜ in. [10 mm] or more in thickness or diameter, one tension test shall be made from both the thickest and the thinnest structural product rolled, regardless of the weight [mass] represented.

TABLE 1 Condition of Supply and Frequency of Impact Tests for Ordinary-Strength Structural Steel

Grade	Deoxidation	Product[A]	Condition of Supply[B] (Frequency of Impact Test[C]) Thickness (t), in. [mm]			
			t >0.25 [6.4] t ≤1.0 [25]	t >1.0 [25] t ≤1.375 [35]	t >1.375 [35] t ≤2.0 [50]	t >2.0 [50] t ≤4.0 [100]
A	Semi-Killed	All	A (–)			NA[D]
	Killed	P				N (–)[E], TM (–), CR (50 [45]), AR (50 [45])
		S				NA[D]
B	Semi-Killed	All	A (–)	A (50 [45])		NA[D]
	Killed	P				N (50 [45]), TM (50 [45]), CR (25 [23]), AR (25 [23])
		S				NA[D]
D	Killed, Fine Grain Practice	P	A (50 [45]), N (50 [45])		N (50 [45]), TM (50 [45]), CR (50 [45])	N (50 [45]), TM (50 [45]), CR (25 [23])
		S				NA[D]
E	Killed, Fine Grain Practice	P	N (P), TM (P)			N (P), TM (P)
		S	N (25 [23]), TM (25 [23]), CR (15 [14])			NA[D]

[A] Product: P = plate; S = shapes and bars
[B] Condition of Supply: A = any condition; AR = as-rolled; N = normalized; CR = control rolled; TM = thermo-mechanical controlled processing
[C] Frequency of Impact Test: (impact test lot size in tons [Mg] from each heat); (–) = no impact test required; (P) = each plate-as-rolled
[D] Condition of supply is not applicable
[E] Impact tests for Grade A are not required if material is produced using a fine grain practice and normalized

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TABLE 2 Condition of Supply and Frequency of Impact Tests for Higher-Strength Structural Steel

Grade	Deoxidation	Grain Refining Element	Product[A]	Condition of Supply[B] (Frequency of Impact Test[C]) Thickness (*t*), in. [mm]					
				t >0.25 [6.4] *t* ≤0.5 [12.5]	*t* >0.5 [12.5] *t* ≤0.80 [20]	*t* >0.80 [20] *t* ≤1.0 [25]	*t* >1.0 [25] *t* ≤1.375 [35]	*t* >1.375 [35] *t* ≤2.0 [50]	*t* >2.0 [50] *t* ≤4.0 [100]
AH32 AH36	Killed, Fine Grain Practice	Cb V	P	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])				N (50 [45]), TM (50 [45]), CR (25 [23])
			S	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45]), AR (25 [23])				NA[D]
		Al	P	A (50 [45])		AR (25 [23]), N (50 [45]) , TM (50 [45]), CR (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])		N (50 [45],) TM (50 [45]), CR (25 [23])
		Al + Ti	S	A (50 [45])		AR (25 [23]), N (50 [45]), TM (50 [45]), CR (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45]), AR (25 [23])		NA[D]
DH32 DH36		Cb V	P	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])				N (50 [45]), TM (50 [45]), CR (25 [23])
			S	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])				NA[D]
		Al	P	A (50 [45])		AR (25 [23]), N (50 [45]), TM (50 [45]), CR (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])		N (50 [45]), TM (50 [45]), CR (25 [23])
		Al + Ti	S	A (50 [45])		AR (25 [23]), N (50 [45]), TM (50 [45]), CR (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])		NA[D]
EH32 EH36		Any	P	N (P), TM (P)					N (P), TM (P)
			S	N (25 [23]), TM (25 [23]), CR (15 [14])					NA[D]
FH32 FH36		Any	P	N (P), TM (P), QT (P)					N (P), TM (P), QT
			S	N (25 [23]), TM (25 [23]), QT (25 [23])					NA[D]
AH40		Any	P	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])				N (50 [45]), TM (50 [45]), QT (P)
			S	A (50 [45])	N (50 [45]), TM (50 [45]), CR (50 [45])				NA[D]
DH40		Any	P		N (50 [45]), TM (50 [45]), CR (50 [45])				N (50 [45]), TM (50 [45]), QT (P)
			S		N (50 [45]), TM (50 [45]), CR (50 [45])				NA[D]
EH40		Any	P	N (P), TM (P), QT (P)					N (P), TM (P), QT (P)
			S	N (25 [23]), TM (25 [23]), CR (25 [23])					NA[D]
FH40		Any	P	N (P), TM (P), QQT (P)					N (P), TM (P), QT (P)
			S	N (25 [23]), TM (25), CR (25 [23])					NA[D]

[A] Product: P = plate; S = shapes and bars
[B] Condition of Supply: A = any condition; AR = as-rolled; TM = thermo-mechanical controlled processing; CR = control rolled; QT = quenched and tempered; N = normalized
[C] Frequency of Impact Test: (impact test lot size in tons [Mg] from each heat); (P) = each plate-as-rolled
[D] Condition of supply is not applicable

8.1.3 For quenched and tempered steel, including Grades EH40, FH32, FH36, and FH40, one tension test shall be made on each plate as quenched and tempered.

8.2 *Toughness Tests*:

8.2.1 Charpy V-notch tests shall be made on Grade A material over 2 in. [50 mm] in thickness, on Grade B material over 1 in. [25 mm] in thickness and on material over ¼ in. [6.4 mm] in thickness of Grades D, E, AH32, AH36, AH40, DH32, DH36, DH40, EH32, EH36, EH40, FH32, FH36, and FH40, as required by Table 1 and Table 2. The frequency of Charpy V-notch impact tests shall be as given in Table 1 and Table 2. The test results shall conform to the requirements given in Table 7.

8.2.2 For Grades EH32, EH36, EH40, FH32, FH36, and FH40 plate material, one set of three impact specimens shall be made from each plate-as-rolled.

8.2.3 For Grade A, B, D, AH32, AH36, AH40, DH32, DH36, and DH40 plate material, and for all shape material, and all bar material, one set of three impact specimens shall be made from the thickest material in each test lot size of each heat, as required by Table 1 and Table 2. If heat testing is required, a set of three specimens shall be tested for each test lot size indicated in Table 1 and Table 2, of the same type of product produced on the same mill from each heat of steel. The set of impact specimens shall be taken from different as-rolled or heat-treated pieces of the heaviest gage produced. An as-rolled piece refers to the product rolled from a slab, billet, bloom, or directly from an ingot. Where the maximum thickness or diameter of various sections differs by ⅜ in. [10 mm] or more, one set of impacts shall be made from both the thickest and the thinnest material rolled regardless of the weight represented.

8.2.4 The specimens for plates shall be taken from a corner of the material and the specimens from shapes shall be taken from the end of a shape at a point one third the distance from the outer edge of the flange or leg to the web or heel of the shape. Specimens for bars shall be in accordance with Specification A 6/A 6M.

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TABLE 3 Chemical Requirements for Ordinary-Strength Structural Steel

Element	Chemical Composition (heat analysis), % max unless otherwise specified[A]			
	Grade A	Grade B	Grade D	Grade E
	Deoxidation and Thickness (t), in. [mm]			
	Killed or Semi-Killed $t \leq 2.0$ in. [50 mm] Killed $t > 2.0$ in. [50 mm]	Killed or Semi-Killed $t \leq 2.0$ in. [50 mm] Killed $t > 2.0$ in. [50 mm]	Killed, Fine Grain Practice[B]	Killed, Fine Grain Practice[B]
C	0.21[C]	0.21	0.21	0.18
Mn, min	2.5 × C	0.60	0.60	0.70
Si	0.50	0.35	0.10–0.35[D]	0.10–0.35[D]
P	0.035	0.035	0.035	0.035
S	0.035	0.035	0.035	0.035
Ni	[E]	[E]	[E]	[E]
Cr	[E]	[E]	[E]	[E]
Mo	[E]	[E]	[E]	[E]
Cu	[E]	[E]	[E]	[E]
C + Mn/6	0.40	0.40	0.40	0.40

[A] Intentionally added elements are to be determined and reported.
[B] Grade D steel over 1.0 in. [25 mm] and Grade E steel are to contain at least one of the grain refining elements in sufficient amount to meet the fine grain practice requirements (see Section 7).
[C] A maximum carbon content of 0.23 % is acceptable for Grade A shapes and bars.
[D] Where the content of acid soluble aluminum is not less than 0.015 %, the minimum required silicon content does not apply.
[E] The contents of nickel, chromium, molybdenum, and copper are to be determined and reported. When the amount does not exceed 0.02 %, these elements may be reported as ≤0.02 %.

TABLE 4 Chemical Requirements for Higher-Strength Structural Steel

Element	Chemical Composition[A] (heat analysis), % max unless otherwise specified	
	Grades AH/DH/EH32, AH/DH/EH36, and AH/DH/EH40	Grades FH32/36/40
	Deoxidation	
	Killed, Fine Grain Practice[B]	Killed, Fine Grain Practice[B]
C	0.18	0.16
Mn	0.90–1.60[C]	0.90–1.60
Si	0.10–0.50[D]	0.10–0.50[D]
P	0.035	0.025
S	0.035	0.025
Al (acid soluble), min[E,F]	0.015	0.015
Cb[F]	0.02–0.05	0.02–0.05
V[F]	0.05–0.10	0.05–0.10
Ti	0.02	0.02
Cu	0.35	0.35
Cr	0.20	0.20
Ni	0.40	0.40
Mo	0.08	0.08
N	...	0.009[G]

[A] The contents of any other element intentionally added is to be determined and reported.
[B] The steel is to contain at least one of the grain refining elements in sufficient amount to meet the fine grain practice requirement (see Section 7).
[C] Grade AH 0.5 in. [12.5 mm] and under in thickness may have a minimum manganese content of 0.70 %.
[D] If the content of soluble aluminum is not less than 0.015 %, the minimum required silicon content does not apply.
[E] The total aluminum content may be used instead of acid soluble content, in accordance with 7.1.
[F] The indicated amount of aluminum, columbium, and vanadium applies if any such element is used singly. If used in combination, the minimum content in 7.2.2 and 7.2.3, as appropriate, will apply.
[G] 0.012 if aluminum is present.

8.2.5 The largest size specimens possible for the material thickness are to be machined. The longitudinal axis of each specimen shall be located midway between the surface and the center of the structural product thickness, and the length of the notch shall be perpendicular to the rolled surface of the structural product.

8.2.6 Unless a specific orientation is called for on the purchase order, the longitudinal axis of the specimens may be parallel or transverse to the final direction of rolling of the structural product at the option of the steel manufacturer.

8.2.7 The impact test shall be made in accordance with the Charpy Impact Testing section in Test Methods and Definitions A 370.

8.2.8 Each impact test shall constitute the average value of three specimens taken from a single test location. The average value shall meet the specified minimum average with not more

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TABLE 5 Carbon Equivalent for Higher-Strength Structural Steel Produced by TMCP

Grade	Carbon Equivalent[A], max, %	
	Thickness (*t*), in. [mm]	
	t ≤2.0 in. [50 mm]	*t* >2.0 in. [50 mm] *t* ≤4.0 in. [100 mm]
AH32, DH32, EH32, FH32	0.36	0.38
AH36, DH36, EH36, FH36	0.38	0.40
AH40, DH40, EH40, FH40	0.40	0.42

[A] The following carbon equivalent formula shall be used to calculate the carbon equivalent, C_{eq}:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}\ (\%)$$

than one value below the specified minimum average but in no case below 70 % of the specified minimum average.

8.2.8.1 If the results fail to meet the preceding requirements but 8.2.8.1 (*2*) and (*3*) are complied with, three additional specimens may be taken from the location as close to the initial specimens as possible and their test results added to those previously obtained to form a new average. The structural product represented may be accepted if for the six specimens 8.2.8.1 (*1*), (*2*), and (*3*) are met.

(*1*) The average is not less than the required minimum average.

(*2*) No more than two individual values are below the required minimum average.

(*3*) No more than one individual value is below 70 % of the required minimum average.

8.2.8.2 If the required energy values are not obtained upon retest, the material may be heat treated at the option of the producer in the case of as-rolled material or reheat treated in the case of heat-treated material.

8.2.8.3 After heat treatment or reheat treatment, a set of three specimens shall be tested and evaluated in the same manner as for the original material.

8.2.8.4 If the impact test result fails to meet the requirement for the thickest product tested when heat testing, that material shall be rejected and the next thickest material may be tested to qualify the balance of the heat in accordance with 8.2.8. At the option of the producer, retests may be made on each piece of the rejected material, in which case each piece shall stand on the results of its own test. It shall also be the option of the producer to heat treat the product prior to retesting if desired.

9. General Requirements for Delivery

9.1 Material furnished under this specification shall conform to the requirements of the current edition of Specification A 6/A 6M, for the specific structural product ordered, unless a conflict exists in which case this specification shall prevail.

10. Plate Conditioning

10.1 After removal of any imperfection preparatory to welding the thickness of the plate at any location must not be reduced by more than 20 % of the nominal thickness of the plate.

11. Test Reports

11.1 When test reports are required by the purchase order, the report shall show the results of each test required by Sections 7 and 8, except that the results of only one set of tests need be reported when the amount of material from a heat in a shipment is less than 10 tons [9 Mg] and when the thickness variations described in Section 8 are not exceeded.

11.2 The thickness of the product tested may not necessarily be the same as an individual ordered thickness since it is the heat that is tested rather than each ordered item.

12. Marking

12.1 Plates produced to a normalized heat treatment condition shall be marked with the suffix **N** to indicate that the plates have been normalized.

12.2 Plates produced to a control rolled condition shall be marked with the suffix **CR** to indicate that the plates have been control rolled.

12.3 Plates produced to a thermo-mechanical control processed condition shall be marked with the suffix **TM** to indicate that the plates have been thermo-mechanical control processed.

12.4 Plates produced to a quenched and tempered heat treatment condition shall be marked with the suffix **QT** to indicate that the plates have been quenched and tempered.

13. Keywords

13.1 bars; higher strength; ordinary strength; plates; rivets; shapes; ship construction; steel; structural steel

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TABLE 6 Tensile Requirements for Ordinary-Strength and Higher-Strength Structural Steel

Grade	Tensile Strength, ksi [MPa]	Yield Point, min, ksi [MPa]	Elongation in 8 in. [200 mm][A,B], min, %	Elongation in 2 in. [50 mm][B,C], min %
Ordinary strength:				
A, B, D, E	58 to 75 [400 to 520][D]	34 [235]	21	24
Higher strength:				
AH32, DH32, EH32, FH32	64 to 85 [440 to 590]	46 [315]	19	22
AH36, DH36, EH36, FH36	71 to 90 [490 to 620]	51 [355]	19	22
AH40, DH40, EH40, FH40	74 to 94 [510 to 650]	57 [390]	19	22

[A] For nominal thickness or diameter under 5/16 in. [8 mm], a deduction from the specified percentage of elongation in 8 in. [200 mm] shall be made. See elongation requirement adjustments under the Tension Tests section of Specification A 6/A 6M for deduction values.
[B] Elongation is not required for floor plate.
[C] For nominal thickness or diameter over 3.5 in. [90 mm], a deduction from the specified percentage of elongation in 2 in. [50 mm] shall be made. See elongation requirement adjustments under the Tension Tests section of Specification A 6/A 6M for deduction values.
[D] For Grade A shapes and bars, the upper limit of tensile strength may be 80 ksi [550 MPa].

TABLE 7 Charpy V-Notch Impact Requirements for Ordinary-Strength and Higher-Strength Structural Steel

Grade[A,B]	Test Temperature, °F [°C]	Average Absorbed Energy[C], min, ft·lbf [J]					
		Thickness (*t*), in. [mm]					
		t ≤2.0 in. [50 mm]		*t* >2.0 in. [50 mm] *t* ≤2.8 in. [70 mm]		*t* >2.8 in. [70 mm] *t* ≤4.0 in. [100 mm]	
		Charpy V-notch Impact Specimen Orientation[D]					
		Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse
A[E]	68 [20]	...	...	25 [34]	17 [24]	30 [41]	20 [27]
B	32 [0]	20 [27]	14 [20]	25 [34]	17 [24]	30 [41]	20 [27]
AH32	32 [0]	23 [31]	16 [22]	28 [38]	19 [26]	34 [46]	23 [31]
AH36	32 [0]	25 [34]	17 [24]	30 [41]	20 [27]	37 [50]	25 [34]
AH40	32 [0]	29 [39]	19 [26]	34 [46]	23 [31]	41 [55]	27 [37]
D	–4 [–20]	20 [27]	14 [20]	25 [34]	17 [24]	30 [41]	20 [27]
DH32	–4 [–20]	23 [31]	16 [22]	28 [38]	19 [26]	34 [46]	23 [31]
DH36	–4 [–20]	25 [34]	17 [24]	30 [41]	20 [27]	37 [50]	25 [34]
DH40	–4 [–20]	29 [39]	19 [26]	34 [46]	23 [31]	41 [55]	27 [37]
E	–40 [–40]	20 [27]	14 [20]	25 [34]	17 [24]	30 [41]	20 [27]
EH32	–40 [–40]	23 [31]	16 [22]	28 [38]	19 [26]	34 [46]	23 [31]
EH36	–40 [–40]	25 [34]	17 [24]	30 [41]	20 [27]	37 [50]	25 [34]
EH40	–40 [–40]	29 [39]	19 [26]	34 [46]	23 [31]	41 [55]	27 [37]
FH32	–76 [–60]	23 [31]	16 [22]	28 [38]	19 [26]	34 [46]	23 [31]
FH36	–76 [–60]	25 [34]	17 [24]	30 [41]	20 [27]	37 [50]	25 [34]
FH40	–76 [–60]	29 [39]	19 [26]	34 [46]	23 [31]	41 [55]	27 [37]

[A] Charpy V-notch impact test requirements for ordinary-strength structural steel grades apply where such test is required by Table 1.
[B] Charpy V-notch impact test requirements for higher-strength structural steel grades apply where such test is required by Table 2.
[C] The energy shown is minimum for full-sized (0.394 by 0.394-in. [10 × 10-mm]) specimen. For sub-sized specimens, the energy shall be as follows:

Specimen Size, in. [mm]	0.394 × 0.295 [10 × 7.5]	0.394 × 0.197 [10 × 5.0]	0.394 × 0.098 [10 × 2.5]
Required Energy	5E/6	2E/3	E/2

E—energy required for full-sized specimen
[D] Either direction is acceptable.
[E] Impact tests for Grade A are not required when the material is produced using fine grain practice and normalized.

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified in the order:

S32. Single Heat Bundles

S32.1 Bundles containing shapes or bars shall be from a single heat of steel.

S85. Product Chemical Analysis

S85.1 The chemical composition shall be determined for plates, shapes, or bars in accordance with 6.1.1. The number of pieces to be tested shall be stated on the order.

S86. Orientation of Impact Specimens

S86.1 The orientation of the impact test specimens shall be as specifically stated on the order. (The purchaser shall state whether the tests are to be longitudinal or transverse.)

S87. Heat-Treatment of Grade DH

S87.1 Grade DH aluminum-treated steel over 3/4 in. [19 mm] in thickness shall be normalized.

S88. Additional Tension Tests

S88.1 At least one tension test shall be made from each 50 tons [45 Mg] or fraction thereof from each heat. If the material differs by 0.375 in. [10 mm] or more in nominal thickness or diameter, one tension test shall be made from both the thickest and thinnest material in each 50 tons.

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 131/A 131M – 07) that may impact the use of this standard. (Approved March 1, 2008.)

(1) Added 1.4 and renumbered 1.5 and 1.6.
(2) Revised 5.5.
(3) Revised Table 1, Table 2, Table 3, Table 6, and Table 7.
(4) Deleted all references to Grade CS throughout.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 131/A 131M – 04$^{\epsilon 1}$) that may impact the use of this standard. (Approved March 1, 2007.)

(1) Revised 5.3.
(2) Deleted paragraph 5.3.1.
(3) Revised Table 1, Table 2, Table 3, Table 5, and Table 7.

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