

11.6 Elongation Requirement Adjustments:

11.6.1 Due to the specimen geometry effect encountered when using the rectangular tension test specimen for testing thin plate, adjustments in elongation requirements must be provided for thicknesses under 0.312 in. [8 mm]. Accordingly, the following deductions shall be made from the base elongation requirements in the applicable product specification:

Plate Nominal Thickness Range, in. [mm]	Elongation Deduction, %
0.299–0.311 [7.60–7.89]	0.5
0.286–0.298 [7.30–7.59]	1.0
0.273–0.285 [7.00–7.29]	1.5
0.259–0.272 [6.60–6.99]	2.0
0.246–0.258 [6.20–6.59]	2.5
0.233–0.245 [5.90–6.19]	3.0
0.219–0.232 [5.50–5.89]	3.5
0.206–0.218 [5.20–5.49]	4.0
0.193–0.205 [4.90–5.19]	4.5
less than 0.193 [4.90]	5.0

11.6.2 Due to the inherently lower elongation that is obtainable in thicker plate, adjustments in elongation requirements in 2-in. [50-mm] gage length shall be provided for thicknesses over 3.5 in. [90 mm]. Accordingly, the following deductions shall be made from the base elongation requirements in 2 in. [50 mm] prescribed in the applicable product specification:

Plate Nominal Thickness Range, in. [mm]	Elongation Deduction, %
3.501–3.999 [90.00–102.49]	0.5
4.000–4.499 [102.50–114.99]	1.0
4.500–4.999 [115.00–127.49]	1.5
5.000–5.499 [127.50–139.99]	2.0
5.500–5.999 [140.0–152.49]	2.5
6.000 and thicker [152.50 and thicker]	3.0

11.6.3 A characteristic of certain types of alloy steels is a local disproportionate increase in the degree of necking down or contraction of the test specimens during the tension test, resulting in a decrease in the percentage of elongation as the gage length is increased. The effect is not so pronounced in thicker plates. For such material, if so stated in the applicable product specification for plates up to ¾ in. [20 mm], inclusive, in thickness, if the percentage of elongation of an 8-in. [200-mm] gage length test specimen falls not more than 3 percentage points below the amount prescribed, the elongation shall be considered satisfactory if the percentage of elongation in 2 in. [50 mm] across the break is not less than 25 %.

11.6.4 The tensile requirements tables in many of the product specifications covered by this general requirements specification specify elongation requirements in both 8-in. [200-mm] and 2-in. [50-mm] gage lengths. Unless otherwise provided in the applicable product specification, both requirements are not required to be applied simultaneously, and the elongation need only be determined in the gage length appropriate for the test specimen used. After selection of the appropriate gage length, the elongation requirement for the alternative gage length shall be deemed not applicable.

11.7 This specification does not provide requirements for product tension testing subsequent to shipment (see 15.1). Therefore, the requirements of 11.1 through 11.6 and Section 16 apply only for tests conducted at the place of manufacture prior to shipment. Compliance to Specification A20/20M and the applicable product specification does not preclude the possibility that product tension test results may vary outside

specified ranges. The tensile properties will vary within the same plate-as-rolled or piece, be it as-rolled, control-rolled, or heat-treated. The purchaser should, therefore, be aware that tension testing in accordance with the requirements of Specification A20/A20M does not provide assurance that all products of a plate-as-rolled will be identical in tensile properties with the products tested. If the purchaser wishes to have more confidence than that provided by Specification A20/A20M testing procedures, additional testing or requirements, such as Supplementary Requirement S4, should be imposed.

11.8 Appendix X2 provides additional information on the variability of tensile properties in plates for pressure vessels.

12. Notch-Toughness Tests

12.1 Charpy V-Notch Tests:

12.1.1 *Number of Tests*—Except for quenched and tempered plates, and except as allowed by 12.1.1.1 and 12.1.1.2, one impact test (3 specimens) for each specified orientation (see 12.1.2) shall be made from each plate-as-rolled. For quenched and tempered plates, one impact test shall be made from each plate, as heat treated.

12.1.1.1 *Plates Ordered Without the Heat Treatment Specified by the Applicable Product Specification*—Coupons for Charpy V-notch tests shall be taken in accordance with the same requirements as given for tensile test coupons in 11.4.2 and 11.4.3.

12.1.1.2 *Plates Produced from Coil*—If Charpy V-notch tests are specified, the number of impact tests required shall be the same as the number specified for tension tests in 11.1.2 or 11.1.3, whichever is applicable. The test coupons shall be taken from the material after decoiling and leveling.

12.1.2 *Orientation of Test Specimens*—The long axis of the test specimens shall be oriented either longitudinal (parallel to the final direction of rolling) or transverse (transverse to the final direction of rolling), as specified in the applicable product specification or the purchase order.

12.1.3 *Location of Test Coupons*—The impact test coupons shall be taken adjacent to the tension test coupons. The impact test coupons shall be subject to the same requirements as those specified for tension tests in 11.4, except that the provisions of 11.4.4.1 apply to the area under the notch of the impact test specimen instead of to the gage length of the tension test specimen.

12.1.4 *Test Method*—Impact testing shall be performed in accordance with Test Methods and Definitions A370 using Charpy V-notch (Type A) specimens as shown in Test Methods and Definitions A370. Except as allowed by 12.1.4.1, full-size specimens (0.394 by 0.394 in. [10 by 10 mm]) shall be used if the plate thickness permits, and their central axis shall correspond as near as practical to the ¼ *t* plane in the plate thickness *t*. If the plate thickness is insufficient to obtain full-size specimens, the largest possible subsize specimens shall be used.

12.1.4.1 For plates that normally have absorbed energy values in excess of 180 ft-lbf [245 J] if tested using full-size specimens at the specified testing temperature, subsize 0.394 by 0.264 in. [10 by 6.7 mm] specimens may be used in lieu of full-size specimens; however, if this option is used, the

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shall be taken from each plate-as-rolled. Two tension test coupons shall be taken from each quenched and tempered plate, as heat treated. If plates are furnished by the manufacturer or processor in accordance with 11.4.2 and qualified by using test specimens taken from heat-treated test coupons (including normalized, normalized and tempered, and quenched and tempered), one tension test coupon shall be taken from each plate-as-rolled (see Terminology A941 for the definition of plate-as-rolled).

11.1.2 Plates Produced from Coil and Furnished without Heat Treatment or with Stress Relieving Only—Except as allowed by 11.1.2.1 and 11.1.4, a minimum of three tension coupons shall be taken from each coil as follows:

11.1.2.1 The first test coupon shall be taken immediately prior to the first plate to be qualified to the applicable product specification, the second test coupon shall be taken from the approximate center lap, and the third test coupon shall be taken immediately after the last plate to be qualified to the applicable product specification. If, during decoiling, the amount of material decoiled is less than that required to reach the next standard test location, a test for qualification of that particular portion of the coil shall be made from a test coupon taken from a location adjacent to the innermost portion decoiled.

11.1.2.2 All plates between any two test locations that meet the requirements of the applicable product specification are acceptable.

11.1.2.3 All plates between a test location that fails to meet the requirements of the applicable product specification and an adjacent test location that meets the requirements of the applicable product specification are rejectable, except that the processor has the option to make other tests after cutting back the coil in either direction.

11.1.3 Plates Produced from Coil and Furnished Heat Treated by Other than Stress Relieving—For other than quenched and tempered plates, one tension test coupon shall be taken from each coil. Two tension test coupons shall be taken from each quenched and tempered plate, as heat treated.

11.1.4 Plates Produced from Coil and Qualified Using Test Specimens Taken from Test Coupons Heat Treated by Other than Stress Relieving—One tension test coupon shall be taken from each coil.

11.2 Orientation of Test Specimens—The longitudinal axis of the tension test specimens shall be transverse to the final rolling direction of the plate.

11.3 Location of Test Coupons—Tension test coupons shall be taken from a corner of the plate. For quenched and tempered plates, the two tension test coupons shall be taken from opposite ends of the plate.

11.4 Tests from Heat-Treated Plates:

11.4.1 If heat treatment is performed by the manufacturer or processor, the test specimens shall be taken from the plate in the heat-treated condition or from full-thickness coupons simultaneously heat treated with the plate.

11.4.2 If heat treatment is to be performed by the fabricator, the plates shall be accepted on the basis of tests made on test specimens taken from full-thickness coupons heat treated in accordance with the requirements specified in the applicable

product specification or the purchase order. If the heat-treatment temperatures are not specified, the manufacturer or processor shall heat treat the coupons under conditions it considers appropriate. The purchaser shall be informed of the procedure followed in heat treating the specimens.

11.4.3 If approved by the purchaser, the procedures of 11.4.2 may be implemented on plates heat treated by the manufacturer or processor, except that for plates that are quenched and tempered, all testing required the specification or the purchase order must be performed after plate heat treatment, in accordance with 11.1.1 and 11.4.4, and the results reported.

11.4.4 For plates that are heat treated with a cooling rate faster than still-air cooling from the austenitizing temperature, one of the following shall apply in addition to other requirements specified herein:

11.4.4.1 The gage length of the tension test specimen shall be taken at least $1T$ from any as-heat treated edge, where T is the thickness of the plate, and shall be at least $\frac{1}{2}$ in. [12.5 mm] from flame-cut or heat-affected-zone surfaces.

11.4.4.2 A steel thermal buffer pad, $1T$ by $1T$ by at least $3T$, shall be joined to the plate edge by a partial penetration weld completely sealing the buffered edge prior to heat treatment.

11.4.4.3 Thermal insulation or other thermal barriers shall be used during the heat treatment adjacent to the plate edge where the test specimens are to be removed. It shall be demonstrated that the cooling rate of the tension test specimen is no faster than, and not substantially slower than, that attained by the method described in 11.4.4.2.

11.4.4.4 When test coupons cut from the plate but heat treated separately are used, the coupon dimensions shall be not less than $3T$ by $3T$ by T and each tension test specimen cut from it shall meet the requirements of 11.4.4.1.

11.4.4.5 If cooling rate data for the plate and cooling rate control devices for the test coupons are available, the test coupons may be heat treated separately in the device, provided that this method is approved by the purchaser.

11.5 Test Specimen Preparation:

11.5.1 Tension test specimens for plates $\frac{3}{4}$ in. [20 mm] and under in thickness shall be the full thickness of the plates. The test specimens shall conform to the requirements for either the $1\frac{1}{2}$ -in. [40-mm] wide or the $\frac{1}{2}$ -in. [12.5-mm] wide rectangular tension test specimen of Test Methods and Definitions A370. The $1\frac{1}{2}$ -in. [40-mm] wide test specimen may have both edges parallel. The $\frac{1}{2}$ -in. [12.5-mm] wide specimen may have a maximum nominal thickness of $\frac{3}{4}$ in. [20 mm].

11.5.2 For plates up to 4 in. [100 mm], inclusive, in thickness, tension test specimens may be the full thickness of the plate and conform to the requirements for the $1\frac{1}{2}$ -in. [40-mm] wide rectangular tension test specimen of Test Methods and Definitions A370 if adequate testing machine capacity is available.

11.5.3 For plates over $\frac{3}{4}$ in. [20 mm] in thickness, except as permitted in 11.5.2, tension test specimens shall conform to the requirements for the 0.500-in. [12.5-mm] diameter test specimen of Test Methods and Definitions A370. The axis of the test specimen shall be located midway between the center of thickness and the top or bottom surface of the plate.