Designation: ~~B945 – 06 (Reapproved 2014)~~ B945 – 21

Standard Practice for Aluminum Alloy Extrusions Press Cooled from an Elevated Temperature Shaping Process for Production of T1, T2, T5 and ~~T10–Type~~T10-Type Tempers[1]

This standard is issued under the fixed designation B945; 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.

1. ~~Scope~~ Scope*

1.1 This practice establishes the controls necessary for production of extrusions cooled from an elevated temperature shaping (extrusion) process for the production of T1, T2, T5 and ~~T10–type~~T10-type tempers (see ANSI ~~H35.1).~~H35.1/H35.1M).

1.2 This practice is for production of extruded product supplied in the 6xxx and 7xxx alloys shown in Table 1 in the T1, T2, T5 or ~~T10–type tempers.~~ T10-type tempers (see ANSI H35.1/H35.1M). It contains pertinent information to be used in establishing production practices and is descriptive rather than prescriptive. For the attainment of T3, T4, T6, T7, T8 and T9-type tempers by extrusion press solution heat treatment, refer to Practice B807/B807M.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents of the issue in effect on the date of material purchase form a part of this standard to the extent referenced herein:

2.2 *ASTM Standards:*[2]

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
B647 Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gage
~~E648~~B648 Test Method for ~~Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source~~Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor
B807/B807M Practice for Extrusion Press Solution Heat Treatment for Aluminum Alloys
B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products
B918 Practice for Heat Treatment of Wrought Aluminum Alloys
E10 Test Method for Brinell Hardness of Metallic Materials

[1] This practice is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

Current edition approved ~~Nov. 1, 2014~~Dec. 1, 2021. Published ~~November 2014~~December 2021. Originally approved in 1925. Last previous edition approved in ~~2006~~2014 as ~~B945 – 06.~~B945 – 06 (2014). DOI: ~~10.1520/B0945-06R14.~~10.1520/B0945-21.

[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**

TABLE 1 Extrusion Billet or Log Temperature High Limit[A]

Alloy	Billet or Log Temperature Upper °F
~~6005, 6005A, 6105, 6061, 6162, 6351~~	~~1050~~
~~6060, 6063, 6101, 6463, 6560~~	~~1060~~
~~7005, 7116, 7129~~	~~1000~~

TABLE 1 Extrusion Billet or Log Temperature High Limit[A]

Alloy	Billet or Log Temperature Upper °F
6060, 6360, 6560, 6063, 6463	1060
6005, 6005A, 6105, 6205, 6042, 6151, 6351, 6061, 6162, 6082	1050
7004, 7005	1060
7003, 7116, 7029, 7129	980

[A] These upper limit temperatures avoid the possibility of eutectic melting due to overheating, and include a safety factor of approximately 25°F.

E18 Test Methods for Rockwell Hardness of Metallic Materials
E2281 Practice for Process Capability and Performance Measurement

2.3 *ANSI Standard:*

~~H35.1~~H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum[3]

3. Terminology

3.1 *Definitions*—Refer to Terminology B881 for Definitions of Product terms used in this specification.

4. Equipment

NOTE 1—Equipment includes billet preheating, extruding and quenching.

4.1 Prior to being extruded, aluminum alloys are heated to a temperature not to exceed the temperatures shown in Table 1. Usual heating methods include, but are not limited to, induction, flame impingement, or forced air. Controls shall be adequate to ensure that the equipment can be operated in a manner which precludes metal overheating or deleterious contamination of the metal by the furnace environment.

4.1.1 Temperature control and recording devices used to measure temperature shall be calibrated as specified in 5.2.

4.2 *Quenching*—Quenching methods may consist of, but are not limited to, air, water or water/glycol mixture in forced air, water spray, fog or mist, standing wave, a quench tank or another pressurized water device, or a combination thereof. The quench equipment shall be used in a manner such that the quench parameters can be controlled and recorded.

5. Quality Assurance, Calibration and Testing

5.1 *Process Documentation:*

5.1.1 Extrusion thermal practices shall be established, documented, controlled and monitored so that shipped product meets order requirements.

5.1.1.1 *Capability*—The producer's process shall have been proven capable per Practice E2281, with documented evidence of statistically verified capability, to produce product in various product classes which conforms to required mechanical property minimums. Methods to establish capability are defined in Practice E2281. Appropriate models shall be used for representation of the data as well as the generation of control charts. For further information see ASTM MNL7A[4].

5.1.2 Recommended time measurements:

[3] Available from ~~the~~ Aluminum Association, ~~Inc., 1525 Wilson Blvd.,~~ 1400 Crystal Dr., Suite 430, Arlington, VA ~~22209, www.aluminum.org~~22202, http://www.aluminum.org.

[4] *Manual on Presentation of Data and Control Chart Analysis*, Seventh Edition, ASTM MNL7A, ASTM International, 2002.

5.1.2.1 Time interval between removal of the billet from the billet heating equipment and start of extrusion,

5.1.2.2 Time interval between the metal exiting from press and its entering the quench, and

5.1.2.3 Time interval between metal entry into and exit from the quench below the identified critical maximum temperature.

5.2 *Calibration*—Temperature control and recording devices used to measure temperature shall be calibrated in accordance with documented calibration practices.

5.2.1 *Temperature Measuring System Accuracy*—The accuracy of any temperature sensing system shall be within ±1 %.

5.3 *Records*—Records shall be maintained for each extrusion press/quench facility involved in the production of extrusions cooled from an elevated temperature shaping process to show compliance with this practice. The records shall include identification of the specific press involved (which includes metal heating and quenching equipment), the frequency and results of calibration of measurement equipment used for control, and the dates and description of equipment repairs or alteration and instances of disqualification and corrective action.

5.4 *Process Surveillance Tests:*

5.4.1 *Test Requirements:*

5.4.1.1 Surveillance tests of heating, extrusion, and quench facilities operated in accordance with documented procedures shall have a demonstrated capability for producing material meeting applicable material specification requirements for each type of product (shapes, tube, rod, hollow section, etc.), and alloy and temper produced. Surveillance tests should include tensile properties for all material and metallographic examination to confirm that the elevated temperature shaping process has not resulted in eutectic melting or subsurface porosity from hydrogen diffusion. (Eutectic Melting and Subsurface Porosity tests are applicable to 7xxx alloys only.)

5.4.1.2 *Frequency of Tests*—Material property tests shall be carried out at the frequency required by the applicable material specification. When no material specification is applicable, the number of samples tested shall be not less than one per 1000 lb of product weighing less than 1 lb per ft or not less than one per 1000 ft of product for material weighing 1 lb or more per ft. Product is meant to include the alloy in the form being extruded, such as tube, pipe, or shape. For 7xxx alloys only, examination to confirm the absence of elevated temperature shaping induced eutectic melting or subsurface porosity from hydrogen diffusion shall be performed at a minimum rate of one sample per alloy every three months for each press/quench facility producing that alloy.

5.4.1.3 *Use of Production Test Results*—The results of tests to determine process conformance of material cooled from an elevated temperature shaping process can use the results of tests for requirements of the respective material specification as evidence of process surveillance of the equipment and procedure employed.

5.4.2 *Test Methods:*

5.4.2.1 Mechanical properties shall be determined in accordance with Test ~~Method~~Methods B557.

5.4.2.2 *Eutectic Melting*—Specimens from at least one of the processed samples in 5.4.1.1 shall be sectioned in the plane perpendicular to the direction of the extrusion, polished to an appropriate fineness, mildly etched with an etchant such as Keller's reagent to reveal any evidence of eutectic melting, and examined at a magnification of 500×.

5.4.2.3 *Hardness Testing*—May be used in conjunction with tensile testing for surveillance and process control. The recommended testing procedure should be Brinell Test Method E10, Rockwell Test Method E18, Barcol Test Method ~~E648~~B648, Webster Test Method B647, or any other ASTM approved hardness testing procedure. Each producer using hardness testing shall establish their relationship for hardness values to tensile properties and set limits such that minimum hardness values will correlate to the specified minimum tensile properties required.

5.5 *Interpretation of Results:*