Alloy and Carbon Steel Bolting for Use in the Petroleum and Natural Gas Industries

API SPECIFICATION 20E
FIRST EDITION, XXX 201X

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1 Scope

1.1 Purpose

This API standard specifies requirements for the qualification, production and documentation of alloy and carbon steel bolting used in the petroleum and natural gas industries when referenced by an applicable API equipment standard or otherwise specified as a requirement for compliance.

An annex for supplemental requirements that may be invoked by the purchaser is included.

1.2 Applicability

This standard applies to bolting used in pressure containing and primary load bearing oil and gas equipment.

1.3 Bolting Specification Levels (BSL)

This API Standard establishes requirements for three bolting specification levels (BSL). These three BSL designations define different levels of technical, quality and qualification requirements, BSL-1, BSL-2 and BSL-3. The BSLs are numbered in increasing levels of severity in order to reflect increasing technical, quality and qualification criteria.

1.4 Bolting Types

This standard covers the following product forms, processes and sizes:

a) machined studs;
b) machined bolts, screws and nuts;
c) cold formed bolts, screws and nuts (BSL-1 only);
d) hot formed bolts and screws < 1.5 in. nominal diameter;
e) hot formed bolts and screws ≥ 1.5 in. nominal diameter;
f) roll threaded studs, bolts, and screws < 1.5 in. diameter;
g) roll threaded studs, bolts, and screws ≥ 1.5 in. diameter;
h) hot formed nuts < 1.5 in. nominal diameter;
i) hot formed nuts ≥ 1.5 in. nominal diameter.

2 Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the reference document (including amendments) applies. When the latest edition is specified it may be used on issue and shall become mandatory 6 months from the date of the revision.
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ASTM A29/A29M, Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure on High Temperature Service, or Both

ASTM A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low Temperature Service

ASTM A370, Standard Test Method and Definitions for Mechanical Testing of Steel Products

ASTM A540, Standard Specification for Alloy Steel Bolting for Special Applications

ASTM A751, Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

ASTM A941, Standard Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys

ASTM A962, Standard Specification for Common Requirements for Steel Fasteners or Fastener Materials, or Both, Intended for Use at Any Temperature from Cryogenic to the Creep Range

ASTM B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

ASTM B850, Standard Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement

ASTM E10, Standard Test Method for Brinell Hardness of Metallic Materials

ASTM E18, Standard Test Method for Rockwell Hardness of Metallic Materials

ASTM E45, Standard Test Method for Determining the Inclusion Content of Steel

ASTM E112, Standard Test Method for Determining Average Grain Size

ASTM E381, Standard Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

ASTM E384, Standard Method for Knoop and Vickers Hardness of Materials

ASTM E1268, Standard Practice for Assessing Degree of Banding or Orientation of Microstructure

ASTM F606, Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

ASTM F1470, Standard Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

ANSI/NCSL Z540.3, Requirements for the Calibration of Measuring and Test Equipment

SAE-AMS 2750, Pyrometry

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3 Terms, Definitions and Abbreviations

3.1 Terms and Definitions

3.1.1 bolting
All-thread studs, tap-end studs, double-ended studs, headed bolts, cap screws, screws, and nuts.

3.1.2 cold formed bolts, screws, and nuts
Parts formed through the mechanical cold (at a temperature below the recrystallization temperature) upsetting of wire, rod or bar in order to generate the bolt or screw head (cold heading) or the configuration of the nut.

3.1.3 heat
Material originating from a final melt, or for remelted alloys, the raw material originating from a single remelted ingot.

3.1.4 heat lot
Bolting or raw material of a single heat and diameter processed together as a single austenitizing, quenching, tempering, and stress relieving charge. For material processed in continuous furnaces, a heat lot shall consist of a maximum weight as specified for bolts in ASTM A193.

3.1.5 hot formed bolts, screws, and nuts
Parts formed through the mechanical hot (at a temperature above the recrystallization temperature) upsetting of wire, rod or bar in order to generate the bolt or screw head (hot heading) or the configuration of the nut.

3.1.6 machined bolts, screws and nuts
Parts manufactured by machining from raw material to generate the bolt, screw head or the configuration of the nut.

3.1.7 manufacturing procedure specification
A written document describing the complete production sequence and method.

NOTE MPS are usually proprietary by manufacturer and not for general publication but are available for review by customers or authorized third parties.

3.1.8 raw material
Bar, coil, rod or wire used to manufacture bolting.

3.1.9 raw material supplier
The manufacturer of raw material used to produce qualified bolting defined as the steel mill or forging supplier.

NOTE A distributor is not considered a raw material supplier.
3.1.10 **wrought structure**  
Structure that contains no cast dendritic elements.

### 3.2 Abbreviations

- **BSL**: bolting specification level
- **MPS**: manufacturing procedure specification

## 4 Qualification Bolting

### 4.1 General

**4.1.1** This standard states the requirements for three bolting specification levels (BSL) and nine bolting types. The manufacturer may qualify to one or more of the bolting types listed in 1.4 and to one or more BSLs. Each individual bolting type shall be qualified. Qualification to a higher BSL shall qualify to a lower BSL. The following paragraphs describe the conditions which, when met, allow the bolting to meet the appropriate bolting type and BSL classification level.

**4.1.2** Qualification bolts and nuts shall be produced from raw material procured from an approved supplier as defined in 5.1 and manufactured in accordance with an applicable Manufacturing Procedure Specification (MPS) from a bolting grade listed in 4.4.

### 4.2 Qualification Testing

**4.2.1** Qualification bolting shall be tested and evaluated by the bolting manufacturer in order to establish qualification to the bolting types listed in 1.4. Qualification bolting shall meet all of the requirements indicated in Table 1 for the applicable sections of this standard.

<table>
<thead>
<tr>
<th>BSL</th>
<th>Material</th>
<th>Heat Treat</th>
<th>Chemistry</th>
<th>Mechanical</th>
<th>Metallurgical</th>
<th>Hardness</th>
<th>NDE Surface</th>
<th>NDE Volumetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSL-1</td>
<td>5.5.1</td>
<td>5.4.3</td>
<td>5.6</td>
<td>5.7</td>
<td>5.8.1</td>
<td>5.9.1.1</td>
<td>5.10.1</td>
<td>---</td>
</tr>
<tr>
<td>BSL-2</td>
<td>5.5.2</td>
<td>5.4.4</td>
<td>5.6</td>
<td>5.7.1</td>
<td>5.8.2</td>
<td>5.9.1.2</td>
<td>5.10.2</td>
<td>---</td>
</tr>
<tr>
<td>BSL-3</td>
<td>5.5.3</td>
<td>5.4.5</td>
<td>5.6</td>
<td>5.7.1</td>
<td>5.8.3</td>
<td>5.9.1.3</td>
<td>5.10.3</td>
<td>5.10.3</td>
</tr>
</tbody>
</table>

**4.2.2** All required tests, including those certified by the steel producer, shall be performed by a laboratory qualified in accordance with an internationally recognized international standard for the qualification of test laboratories, such as ISO 17025.

**4.2.3** Qualification may be performed on parts specifically manufactured for qualification or random parts selected from a production lot.

**4.2.4** The manufacturer shall retain and have available a MPS and qualification records for each product qualified. The qualification records shall show all of the products, processes and sizes qualified and all of the
Table 1 requirements for each qualification including the results of tests and inspections. The following manufacturing process steps must be documented as a part of the qualification.

— forming;
— heat treatment;
— machining;
— roll threads;
— testing;
— inspection.

4.3 Materials

4.3.1 The following bolting material grades are covered by this standard:

— ASTM A193 B7 and B7M;
— ASTM A194 Grades 2H, 4, 7, 2HM and 7M;
— ASTM A320 Grades L7, L7M, and L43;
— ASTM A540 Grades B22 and B23.

4.3.2 All requirements of the referenced ASTM specifications shall be met except as modified by this standard. In the case of conflict between the requirements of referenced specifications and this standard, the requirements of this standard shall apply.

4.4 Acceptance of Qualification Bolting

4.4.1 General

Results of the tests specified in Table 1 shall comply with the acceptance criteria specified in Section 5 and the bolting manufacturer’s written specification. Results shall be documented.

4.4.2 Qualification Samples

4.4.2.1 Samples failing to meet acceptance criteria shall be cause for revaluation of the processes and procedures used and requalification is required.

4.4.2.2 When a qualification sample is selected from a production lot, as defined in 4.2.3 fails to meet acceptance criteria, the entire lot shall be rejected.

4.4.2.3 Should the manufacturer chose to continue the qualification process with the same lot, the entire lot shall be 100% inspected and sorted or reprocessed to correct the deficiencies.

4.4.2.4 For reprocessed lots, the qualification tests that failed and any qualification tests that could be affected by reprocessing shall be repeated. Should the second sample fail to meet the acceptance criteria, the entire lot shall be scrapped.
4.5 Records of Qualification

The following records are required to document the qualification of bolting:

a) ASTM specification number and grade, heat number, and size;
b) process control variables;
c) record of test results as applicable in Sections 4 and 5;
d) manufacturing procedure specification;
e) personnel qualifications;
f) test laboratory qualification;
g) records of qualification test failures and corrective action.

4.6 Limits of Bolting Qualification

4.6.1 BSL-1

A change of heat treat method (type of equipment, furnace control method, cooling methods) requires requalification.

4.6.2 BSL-2 and BSL-3

Limits of bolting qualification for BSL-1 are required for BSL-2 and BSL-3 for the following changes:

a) change of raw material supplier requires requalification;
b) change of machining or threading methods – type of equipment, control;
c) change of hot forming practice – type of equipment, heating method, temperature control method.

5 Production of Qualified Bolting

5.1 Qualification of Procurement Sources for Raw Material

5.1.1 Only sources for raw material that are approved by the bolting manufacturer are to be used to supply raw material. The bolting manufacturer shall have a documented procedure, fully implemented, for qualifying raw material suppliers for each grade and heat treat condition of material. The approval process shall be based on both a quality assurance and a technical evaluation. The approval process shall establish the methodology by which the raw material supplier will be evaluated on an ongoing basis to maintain their status as an approved supplier.

5.1.2 The maintenance of an acceptable quality program, such as an ISO 9001 registration, is not sufficient by itself to satisfy the requirements of 5.1.1. Documented evidence that a raw material supplier has a historical and ongoing technical capability of producing materials meeting this standard and who has proven, implemented procedures and capabilities in place to consistently produce acceptable product is a minimum requirement. Options for the technical approval of a raw material supplier are the following.
a) BSL-1 – use of one or more of the following four methods:

1) material receipt inspection that includes NDE, chemistry check, macroetch, etc. on a routine basis;
2) material first article evaluation;
3) supplier experience over an extended period of time; demonstration of acceptable experience shall include tests/inspections, quantity of material received, nonconformance analysis etc.;
4) physical technical audits at scheduled 3 year intervals.

b) BSL-2 – three of the four methods listed in 5.1.2.a) shall be used.

c) BSL-3 – all of the methods listed in 5.1.2.1 shall be used.

5.1.3 The bolting manufacturer is responsible for ensuring that a raw material supplier has implemented controls addressing the following for each grade of raw material ordered:

a) chemistry controls;

b) melting practice controls;

c) pouring practice;

d) hot work practice controls;

e) heat treatment controls, as applicable;

f) raw material inspection and acceptance criteria (cleanliness requirements, limitations on porosity or inclusions, grain size, secondary phases, microstructure, macrostructure, etc. as applicable);

g) no welding.

5.2 Material Specifications

5.2.1 The bolting manufacturer shall document raw material requirements in the form of a material specification. For BSL-1 this may be the applicable ASTM specification. For BSL-2 and BSL-3, material specifications shall include as a minimum:

a) material grade, including element chemistry and allowable ranges;

b) acceptable melt practices and ladle refinements, as applicable per BSL;

c) acceptable hot work reduction range, as applicable per BSL;

d) acceptable cleanliness level range, as applicable per BSL;

e) heat treatment requirements, as applicable per BSL;

f) acceptable inspection practices and criteria.

5.2.2 The bolting manufacturer shall document acceptance of incoming raw material to the requirements of the material specification prior to use in the production of bolting.
5.3 Manufacturing Procedure Specification

5.3.1 General

The bolting manufacturer shall prepare a manufacturing procedure specification (MPS) to include, as minimum allowable levels for all bolting manufacturing parameters including the process control variables listed in 5.3.2 and the heat treatment parameters listed in 5.3.3.

5.3.2 General Variables

a) heading equipment;
b) hot forming heating method;
c) hot forming temperature control method;
d) machining and threading equipment: single point (lathe), multiple chaser, roll, tap;
e) machining and threading control methods.

5.3.3 Heat Treatment Parameters

The following are heat treat parameters, as applicable:
a) equipment (batch, continuous, induction, direct resistance);
b) times and temperatures;
c) cooling media (e.g. type, polymer concentration, quench temperature, agitation);
d) control and calibration methods;
e) maximum transfer time;
f) quench media start and finish temperature;
g) furnace load diagrams.

5.3.4 BSL-1 Requirements

5.4.3.1 Heat treatment shall be in accordance with the applicable standard listed in 4.3.1.

5.4.3.2 Manufacturing processes shall be performed so as to avoid the introduction of stress risers that can occur from sharp angles and tool marks. Threads may be cut or rolled. Unified National Threads shall be “R” (UNR controlled radius root) series.

5.4.3.3 Furnace calibration shall be in accordance with API 6A, Annex M, SAE AMS 2750 or SAE AMS-H-6875. For induction or direct resistance heat treatment, calibration shall be in accordance with the manufacturer’s written procedure.

5.3.5 BSL-2 Requirements

5.3.5.1 Requirements specified for BSL-1 are required for BSL-2.
5.3.5.2  ASTM A320 Grade L43 and ASTM A540, Grade B23 shall be double tempered.

5.3.5.3  When threads are rolled, parts shall subsequently be stress relieved at a temperature within 50°F (28°C) of, but not exceeding the final tempering temperature.

5.3.6  BSL-3 Requirements

5.3.6.1  Variables specified for BSL-2 are required for BSL-3.

5.3.6.2  Austenitizing temperatures shall not exceed 1700°F (925°C). Tempering temperatures for ASTM A193, Grade B7, ASTM A320, Grade L7, and Grade L43, and ASTM A540 Grade B23 shall not exceed 1300°F (700°C).

5.3.7  Coating and Plating

Plating and coating shall be provided only when the supplementary requirement in Annex A (SR1) is specified in the purchase agreement.

5.4  Raw Material

5.4.1  BSL-1

5.4.1.1  The steel shall be fully wrought.

5.4.1.2  The reduction ratio based on starting material diameter shall be a minimum of 4:1.

5.4.1.3  The steel shall conform to the requirements of the standards listed in 4.5.1, as applicable.

5.4.1.4  Intentional additions of boron are not allowed.

5.4.1.5  All elements intentionally added to the heat shall be reported.

5.4.2  BSL-2

5.4.2.1  The requirements specified for BSL-1 are required for BSL-2.

5.4.2.2  Melting method of the raw material shall be fine grain practice as defined by ASTM A941. Steel shall be produced by electric furnace or vacuum induction melting followed by secondary refining practices or ladle refining.

5.4.2.3  The allowable sulfur content shall be .025% maximum and the allowable phosphorus content shall be .025% maximum.

5.4.2.4  Residual boron content shall not exceed .0005%.

5.4.3  BSL-3

5.4.3.1  The requirements specified for BSL-2 are required for BSL-3 except as specified below.

5.4.3.2  The reduction ratio based on starting material diameter shall be 10:1 minimum.

5.4.3.3  Allowable sulfur content shall be .015% maximum and the allowable phosphorus content shall be .015% maximum.
5.4.3.4 The continuous cast steel making process is prohibited.

5.4.3.5 In addition to the heat analysis performed by the mill, the bolting manufacturer shall perform a product analysis in accordance with ASTM A29.

5.5 Chemical Analysis

Methods and practices relating to chemical analysis shall be in accordance with ASTM A751. The frequency for chemical analysis shall be one per heat. Results shall be documented on the test report.

5.6 Mechanical Properties

5.6.1 General

Mechanical properties testing shall be performed by the raw material supplier or bolting manufacturer after all thermal treatments including stress relief. Results shall be documented on the test report.

5.6.2 BSL-2 and BSL-3

When any of the testing has been performed by the raw material supplier, the bolting manufacturer shall perform a retest.

5.7 Metallurgical Requirements

5.7.1 General

Any of the following tests not performed by the raw material supplier shall be performed by the bolting manufacturer. Results shall be documented on the test report.

5.7.2 BSL-1

The microstructure and macrostructure shall conform to the requirements of the standards listed in 4.5.1, as applicable.

5.7.3 BSL-2

5.7.3.1 Microstructure Testing

5.7.3.1.1 General

Microstructure specimens shall be tested in accordance with ASTM E45, Method A, for inclusion content. For other microstructure evaluations, the specimens shall be taken in the longitudinal direction at 1/4T.

5.7.3.1.2 Inclusion Content

The microstructure shall conform to the requirements of Table 2. One test shall be conducted per heat.

5.7.3.1.3 Grain Size

Grain size shall be determined for each heat in accordance with ASTM E112 following etching with a suitable reagent. Grain size shall conform to Table 2.
5.7.3.1.4 Microstructure

The microstructure shall be predominately tempered martensite. One test shall be performed per each heat.

5.7.3.1.5 Banding

Heavily banded microstructures, as shown in ASTM E1268, Figure A1.19, are not permitted. When a banded structure is observed, a minimum of 3 Knoop micro-hardness readings per test, in accordance with ASTM E384, shall be taken on the most predominate bands. The test load shall be 500 g, unless extremely thin bands are observed that will not permit an accurate 500 g test, in which case it is permissible to reduce the test load to as low as 50 g to obtain an accurate reading. Individual readings shall not exceed 470 HK. One test shall be conducted per heat.

NOTE A banded microstructure in this specification refers to the presence of a featureless phase that etches white in etchants such as Nital. When present, this phase appears as white featureless bands. These bands may have extremely high hardness levels and should be confirmed by micro-hardness testing across the width of the bands.

5.7.3.2 Macrostructure Testing

Macrostructure specimens shall be prepared and evaluated in accordance with ASTM E381 and A962. The results shall meet the requirements of Table 2. One test shall be conducted per heat.

5.7.4 BSL-3

5.7.4.1 Requirements specified for BSL-2 are required for BSL-3.

5.7.4.2 When any banding is observed, the hardness test evaluation required under BSL-2 shall be required for a minimum 2 bands.

<table>
<thead>
<tr>
<th>Test</th>
<th>BSL-2</th>
<th>BSL-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion content, Method A</td>
<td>2 for thin, 1.5 for thick, all categories</td>
<td>2 for thin, 1.5 for thick, all categories</td>
</tr>
<tr>
<td>Inclusion test frequency</td>
<td>One per heat</td>
<td>One per heat</td>
</tr>
<tr>
<td>Grain size</td>
<td>Size 5 or finer</td>
<td>Size 5 or finer</td>
</tr>
<tr>
<td>Grain size test frequency</td>
<td>One per each heat</td>
<td>One per each heat lot</td>
</tr>
<tr>
<td>Microstructure</td>
<td>Predominately tempered martensite</td>
<td>Predominately tempered martensite</td>
</tr>
<tr>
<td>Microstructure test frequency</td>
<td>One per each heat (after heat treat)</td>
<td>One per each heat lot</td>
</tr>
<tr>
<td>Macrostructure testing</td>
<td>S1, R1, C2</td>
<td>S1, R1, C2</td>
</tr>
<tr>
<td>Macrostructure test frequency</td>
<td>One per heat</td>
<td>One per heat</td>
</tr>
<tr>
<td>Banding</td>
<td>ASTM E1268 Fig. A1.20 is not permitted</td>
<td>ASTM E1268 Fig. A1.20 is not permitted.</td>
</tr>
<tr>
<td>Banding test frequency</td>
<td>One per each heat</td>
<td>One per each heat lot</td>
</tr>
</tbody>
</table>
5.8 Examination and Test Requirements

5.8.1 General

When inspecting or testing production lots, a sample that fails to meet the applicable requirements shall result in rejection of the entire lot. The rejected lot shall be scrapped, reworked, or where practical, inspected 100% and the defective parts removed. In the case of rework or 100% inspection, the lot shall be re-inspected or tested for the failed characteristic and any characteristic affected by rework.

5.8.2 Hardness Test Requirements

5.8.2.1 General

Hardness testing, including specimen preparation, shall be performed in accordance with ASTM A370 including Annex A3, except that testing must also be in conformance with ASTM E10 or ASTM E18. Test frequency shall conform to ASTM F1470, Table 3, sample size A except when 100% hardness testing is required by the ASTM specification for the grade. Results shall be documented on the test report.

5.8.2.2 BSL-1

5.8.2.2.1 The hardness test shall conform to the requirements of ASTM A193, A194, A320 or A540 as applicable except that maximum hardness for Grades B7, L7, 2H, 4, 7, L43, B22 and B23 shall be 34 HRC (321 HBW).

5.8.2.2.2 For bars heated by induction or electric resistance methods, a cross section of the bar shall be taken at the same test frequency as the required for lot testing of the heat-treated bar per ASTM A193. The cross-section shall be ground and a Rockwell hardness traverse performed with tests as close to the edge as permitted by ASTM E18, approximately mid radius, and approximately center. All hardness measurements in the traverse shall meet the acceptance criteria of 5.8.2.2.1.

5.8.2.2.3 Electromagnetic sorting in accordance with ASTM A193 is permitted.

5.8.2.3 BSL-2

5.8.2.3.1 General

5.8.2.3.1.1 Hardness testing requirements specified for BSL-1 are required for BSL-2 except that when a hardness traverse for bars heat treated by induction or electric resistance methods is required, all readings must be within 3 HRC.

5.8.2.3.2 Each piece shall be inspected.

5.8.2.3.2 Nuts Not Subject to Mandatory Proof Load

For nuts not listed in ASTM A194 Tables 3 and 4, a sample nut from each heat lot shall be sectioned and the cross-section hardness tested in accordance with ASTM F606. Hardness shall meet the acceptance criteria of 5.9.1.1.

5.8.2.4 BSL-3

5.8.2.4.1 Hardness testing requirements specified for BSL-2 are required for BSL-3.

5.8.2.4.2 Electromagnetic sorting as permitted in ASTM A193 is not permitted.
5.9 Nondestructive Examination Requirements

5.9.1 BSL-1

No requirements except as required by the referenced ASTM specification.

5.9.2 BSL-2

Surface NDE is required. Either magnetic particle examination or liquid penetrant examination is permitted. Magnetic particle examination shall be in accordance with ASTM A962 S55. Liquid penetrant examination shall be in accordance with ASTM A962 S56. Acceptance criteria shall be per ASTM A962 S57. Five (5) % of the pieces shall be examined. Results shall be documented on an examination report.

5.9.3 BSL-3

5.9.3.1 Surface NDE requirements specified for BSL-2 are required for BSL-3 except each piece shall be inspected.

5.9.3.2 Volumetric NDE is required on bar, rod, wire or on bolting after heat treatment and prior to threading. Ultrasonic examination shall be performed in accordance with API 6A, volumetric NDE examination of stems (PSL-3 and PSL-4). Each piece shall be examined. Results shall be documented on the test report.

5.10 Dimensional Inspection

5.10.1 General

All dimensions shall meet the requirements of the applicable ASTM specification. Results shall be documented on an inspection report.

5.10.2 BSL-1 Sample Size

Sample size shall be as required by the applicable ASTM specification.

5.10.3 BSL-2 Sample Size

Sample size shall be in accordance Table 3

5.10.4 BSL-3 Sample Size

Each piece shall be dimensionally inspected.
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<table>
<thead>
<tr>
<th>Lot Size</th>
<th>Sample Size %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 8</td>
<td>100%</td>
</tr>
<tr>
<td>9 to 50</td>
<td>8</td>
</tr>
<tr>
<td>51 to 90</td>
<td>13</td>
</tr>
<tr>
<td>91 to 150</td>
<td>20</td>
</tr>
<tr>
<td>151 to 280</td>
<td>32</td>
</tr>
<tr>
<td>281 to 500</td>
<td>50</td>
</tr>
<tr>
<td>501 to 1200</td>
<td>80</td>
</tr>
</tbody>
</table>

Based on ANSI/ASQ Z1.4 Table I, General inspection level II).

NOTE 1 Acceptance number is zero.
NOTE 2 Sample shall be random.

6 Calibration Systems

Inspection, measuring and testing equipment used for acceptance shall be identified, inspected, calibrated and adjusted at specific intervals in accordance with ANSI/NCSL Z540.3 and this standard. Calibration standards shall be traceable to the applicable national or international standards agency and shall be no less stringent than the requirements included herein. Inspection, measuring and testing equipment shall be used only within the calibrated range. Calibration intervals shall be established based on repeatability and degree of usage.

7 Test Report

The test report shall include the following as applicable:

— mill chemistry;
— hot work reduction ratio;
— heat treat procedure including times, temperatures and quench media;
— results of mechanical tests;
— results of macrostructure evaluations;
— results of microstructure evaluations;
— results of dimensional inspection;
— results of NDE inspections;
— qualification level;
8 Marking Requirements

8.1 ASTM Product Marking

Product marking shall be in accordance with ASTM A193, A194, A320, or A540 and A962, as applicable.

NOTE The referenced ASTM specifications require marking of individual parts for headed bolting 1/4” nominal diameter and larger, for studs 3/8” nominal diameter and larger and for nuts of all sizes.

8.2 Marking Required by this Standard

Each piece shall be marked with unique heat lot identification and the following:

a) API 20E-1 for BSL-1;
b) API 20E-2 for BSL-2;
c) API 20E-3 for BSL-3.

Marking shall be applied to individual bolting 1 in. nominal diameter and larger. For bolting less that 1 in. nominal diameter, the bolting shall be securely containerized to maintain heat lot identification and traceability. Multiple heat lots shall not be mixed in a single container. Containers used in the processing, storing, and shipping of bolting not individually marked shall be clearly labeled with all marking information required by the relevant ASTM specifications and this standard.

9 Record Retention

The bolting manufacturer shall establish and maintain documented procedures to control all documents and data required by this standard. Records required by this standard shall be maintained for 10 years. Documents and data may be in any type of media (hard copy or electronic) and shall be:

a) maintained to demonstrate conformance to specified requirements;
b) legible;
c) retained and readily retrievable;
d) stored in an environment to prevent loss;
e) available and auditable by user/purchaser.

10 Storage and Shipping

Bolting shall be packaged for storage and shipping in accordance with the written specifications of the bolting manufacturer.
Annex A
(normative)

Supplementary Requirements

A.1 Introduction

This annex describes supplementary requirements that may be specified by the purchaser or agreed upon between the purchaser and bolting manufacturer. These requirements apply only when stated in the purchasing agreement.

A.2 SR1 – Plating and Coating

Plating and coating shall be applied only when specifically stated in the purchasing documents.

Instructions for plating or coating shall consider the effect of build-up on threads.

For plating and coating, low temperature bake shall be specified for prevention of embrittlement in accordance with ASTM B633 and ASTM B850, as applicable.
Annex B
(informative)

API Monogram Program

B.1 Scope

The API Monogram Program allows an API Licensee to apply the API Monogram to products. The API Monogram Program delivers significant value to the international oil and gas industry by linking the verification of an organization’s quality management system with the demonstrated ability to meet specific product specification requirements. The use of the Monogram on products constitutes a representation and warranty by the Licensee to purchasers of the products that, on the date indicated, the products were produced in accordance with a verified quality management system and in accordance with an API product specification.

When used in conjunction with the requirements of the API License Agreement, API Q1, in its entirety, defines the requirements for those organizations who wish to voluntarily obtain an API monogrammed products in accordance with an API product specification.

API Monogram Program licenses are issued only after an on-site audit has verified that the Licensee conforms to the requirements described in API Q1 in total, and the requirements of an API product specification. Customers/users are requested to report to API all problems with API monogrammed products. The effectiveness of the API Monogram Program can be strengthened by customers/users reporting problems encountered with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at http://compositelist.api.org/nr.asp. API solicits information on new product that is found to be nonconforming with API-specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API-specified requirements.

This annex sets forth the API Monogram Program requirements necessary for a supplier to consistently produce products in accordance with API-specified requirements. For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, NW, Washington, DC 20005 or call 202-962-4791 or by email at certification@api.org.

B.2 References

In addition to the referenced standards listed earlier in this document, this annex references the following standard:

API Specification Q1.

For Licensees under the Monogram Program, the latest version of this document shall be used. The requirements identified therein are mandatory.

B.3 API Monogram Program: Licensee Responsibilities

B.3.1 Maintaining a License to Use the API Monogram

For all organizations desiring to acquire and maintain a license to use the API Monogram, conformance with the following shall be required at all times:
a) the quality management system requirements of API Q1;

b) the API Monogram Program requirements of API Q1, Annex A;

c) the requirements contained in the API product specification(s) for which the organization desires to be licensed;

d) the requirements contained in the API Monogram Program License Agreement.

B.3.2 Monogrammed Product Conformance with API Q1

When an API-licensed organization is providing an API monogrammed product, conformance with API-specified requirements, described in API Q1, including Annex A, is required.

B.3.3 Application of the API Monogram

Each Licensee shall control the application of the API Monogram in accordance with the following.

a) Each Licensee shall develop and maintain an API Monogram marking procedure that documents the marking/monogramming requirements specified by the API product specification to be used for application of the API Monogram by the Licensee. The marking procedure shall define the location(s) where the Licensee shall apply the API Monogram and require that the Licensee's license number and date of manufacture be marked on monogrammed products in conjunction with the API Monogram. At a minimum, the date of manufacture shall be two digits representing the month and two digits representing the year (e.g. 05-07 for May 2007) unless otherwise stipulated in the applicable API product specification. Where there are no API product specification marking requirements, the Licensee shall define the location(s) where this information is applied.

b) The API Monogram may be applied at any time appropriate during the production process but shall be removed in accordance with the Licensee’s API Monogram marking procedure if the product is subsequently found to be nonconforming with API-specified requirements. Products that do not conform to API-specified requirements shall not bear the API Monogram.

c) Only an API Licensee may apply the API Monogram and its license number to API monogrammable products. For certain manufacturing processes or types of products, alternative API Monogram marking procedures may be acceptable. The current API requirements for Monogram marking are detailed in the API Policy Document, Monogram Marking Requirements, available on the API Monogram Program website at http://www.api.org/certifications/monogram/.

d) The API Monogram shall be applied at the licensed facility.

e) The authority responsible for applying and removing the API Monogram shall be defined in the Licensee’s API Monogram marking procedure.

B.3.4 Records

Records required by API product specifications shall be retained for a minimum of five years or for the period of time specified within the product specification if greater than five years. Records specified to demonstrate achievement of the effective operation of the quality system shall be maintained for a minimum of five years.
B.3.5 Quality Program Changes

Any proposed change to the Licensee’s quality program to a degree requiring changes to the quality manual shall be submitted to API for acceptance prior to incorporation into the Licensee’s quality program.

B.3.6 Use of the API Monogram in Advertising

Licensee shall not use the API Monogram on letterheads or in any advertising (including company-sponsored web sites) without an express statement of fact describing the scope of Licensee’s authorization (license number). The Licensee should contact API for guidance on the use of the API Monogram other than on products.

B.4 Marking Requirements for Products

B.4.1 General

These marking requirements apply only to those API Licensees wishing to mark their products with the API Monogram.

B.4.2 Product Specification Identification

Manufacturers shall mark equipment on the nameplate with the information identified in Section 8, as a minimum, including “API Spec 20E.”

B.4.3 Units

As a minimum, equipment should be marked with U.S. customary (USC) units. Use of dual units [metric (SI) units and USC units] is acceptable.

B.4.4 License Number

The API Monogram license number shall not be used unless it is marked in conjunction with the API Monogram.

B.5 API Monogram Program: API Responsibilities

The API shall maintain records of reported problems encountered with API monogrammed products. Documented cases of nonconformity with API-specified requirements may be reason for an audit of the Licensee involved (also known as audit for “cause”).

Documented cases of specification deficiencies shall be reported, without reference to Licensees, customers or users, to API Subcommittee 18 (Quality) and to the applicable API Standards Subcommittee for corrective actions.