



World Oil[®] HPHT
DRILLING, COMPLETIONS & PRODUCTION CONFERENCE

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API Specifications 20E and 20F

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Risk Mitigation

Through API 20 E/F - Risk is mitigated by insuring that the supplied product meets, or exceeds the highest levels of quality for safety-related applications. Through rigidly controlled processes for raw material production and procurement, heat treatment requirements, mechanical testing, metallurgical evaluation and physical dimension inspection and verification, assures proper performance in critical-service applications, such as Drilling & Production Equipment. Added inspection and testing of commercially made, commodity Bolting can never insure conformance at the levels required for these applications. The product integrity must be built in, through process control.



AMERICAN PETROLEUM INSTITUTE

API Specification 20E

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

- Second Edition, February 2017
- Effective Date: August 13, 2017

API Specification 20F

Corrosion Resistant Bolting for Use in the Petroleum and Natural Gas Industries

ASTM & API Specifications

- ❑ API product specifications traditionally referenced ASTM specifications for bolting
- ❑ ASTM bolting specifications are material specifications
- ❑ ASTM A01 bolting specifications were developed for pressure vessel and piping applications
- ❑ ASTM has no enforcement power
- ❑ ***API has enforcement power through the monogram program***

History of the Specification

- ❑ Subsea bolting failures lead to loss of production with huge financial, environmental and safety impact
- ❑ Reaction was the introduction of multiple OEM and User specifications adding testing and procurement requirements to ASTM specifications
- ❑ AWHEM standard developed to combine requirements – published as technical guide (TR1001)
- ❑ API SC20 on Supply Chain requested development of true API specifications for bolting

API Specification 20E

Purpose: API standard specifies requirements for the qualification, production and documentation of alloy and carbon steel bolting used in the petroleum and natural gas industries

- ❑ ASTM A193 Grades 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
- ❑ Manufacturer's proprietary grade

API Specification 20F

Purpose: This API standard specifies requirements for the qualification, production and documentation of bolting used in the petroleum and natural gas industries

- ❑ ASTM A453 Grade 660D
- ❑ API 6ACRA (Multiple grades of Ni based, corrosion resistant materials)
- ❑ Cobalt based superalloy (MP35N)

Service Levels

API Standard establishes requirements for three bolting specification levels (BSL) for 20E and two for 20F

- Define different levels of technical, quality and qualification requirements:
 - BSL-1 (Not included in 20F)
 - BSL-2
 - BSL-3
- BSL's are numbered to reflect increasing technical, quality and qualification criteria
 - BSL-3 is for critical application bolting: defined as one who's failure would result in a loss of wellbore fluids to the environment
 - Primarily has been adopted for critical-service, highly stressed structural or pressure-boundary applications

Design: 20E & 20F

20E and 20F have no design authority

- Implementation by designer, purchaser, governing specification
- Applicable to Christmas trees, blow-out preventers, sub-sea pumps, wellhead connectors, hydraulic tensioning systems, drilling risers, sub-sea manifolds, etc.
- **All of the following Specifications either have or are expected to have a normative reference to API 20E/F**

Publications:

- API 6A 21st Edition (*Wellhead & Christmas Tree Equipment*)– publication eminent
- API 6D 24th Edition (*Control Systems for Drilling Well Control & Diverter Equipment*) – published August 2014
- API 6DSS 3rd Edition (*Subsea Pipeline Valves*)– awaiting publication
- API 16A 4th Edition (*Drill-Through Equipment*) – published April 2017, effective April 2018
- API 16AR 1st Edition (*Drill-Through Equipment – Repair & Mfg.*) – published April 2017, effective September 2017
- API 16C 3rd Edition (*Choke & Kill Equipment*) – in process
- API 16F 2nd Edition (*Marine Drilling Riser Equipment*)– published November 2017, effective May 2018
- API 16FR (*Marine Drilling Riser Equipment – Repair & Mfg.*)– in development
- API 17D - (*Design & Operation of Subsea Production Systems – Subsea Wellhead & Tree Equipment*) 3rd edition in development
- API 17TR8 (*HPHT Design Guideline for Subsea Equipment*)- 2nd edition published March 2018

Control of Raw Material

- ❑ This additional control was imposed because poor quality raw material was found to be the cause of failures

- ❑ Raw material suppliers (mills) must be qualified
 - Through on-site quality and process evaluation
 - For BSL-3, mills must be physically audited

- ❑ Manufacturer must have raw material specifications for each material

Hot Formed (Forging)

- ❑ Advantage: radial grain flow
- ❑ Improper processing can lead to service failure
- ❑ Need for control
 - Heating
 - Dimensional control
 - Die wear



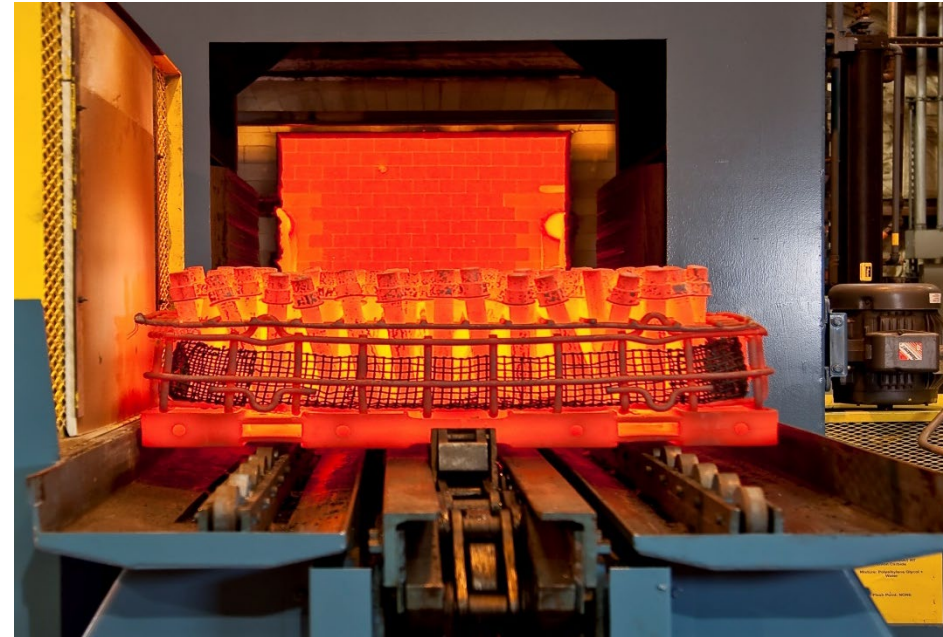
Heat Treatment

BSL-2 Requirements

- ❑ ASTM A320 Grade L43 and ASTM A540, Grade B23 material shall be double tempered
- ❑ When threads are rolled, parts shall subsequently be stress relieved at a temperature within 50°F (10°C) of, but not exceeding the final tempering temperature
 - Done to control the increase of thread hardness / stress increase caused by the rolling process

BSL-3 Requirements

- ❑ Contact thermocouple required
- ❑ Continuous, induction and direct resistance heat treating prohibited
- ❑ Furnace diagram (or photo) required



NDE Requirements

BSL-2

- ❑ Surface NDE is required for 5% of each production lot
- ❑ Volumetric NDE required for 20E bolting greater than 2.5 inches nominal diameter
- ❑ 20F: PMI required for 10 percent of each lot

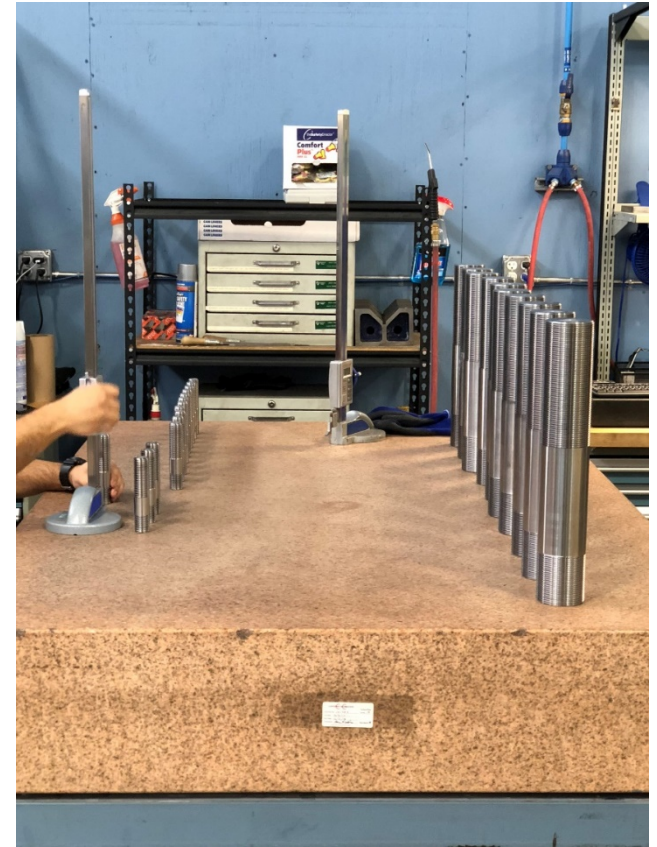
BSL-3

- ❑ Surface NDE required on each piece
- ❑ Volumetric NDE is required
 - 20E all nominal sizes
 - 20F 1 inch and greater
- ❑ 20F: PMI required for each piece

Dimensions / Visual

General

- ❑ BSL-3 requires 100% dimensional inspection
- ❑ Oversizing of nut threads or undersizing of bolt threads is not permissible



Hardness

- ❑ Maximum HRC of 34 for BSL-1, BSL-2 & BSL-3
- ❑ BSL-2 & BSL-3:
 - Each piece must be Hardness tested

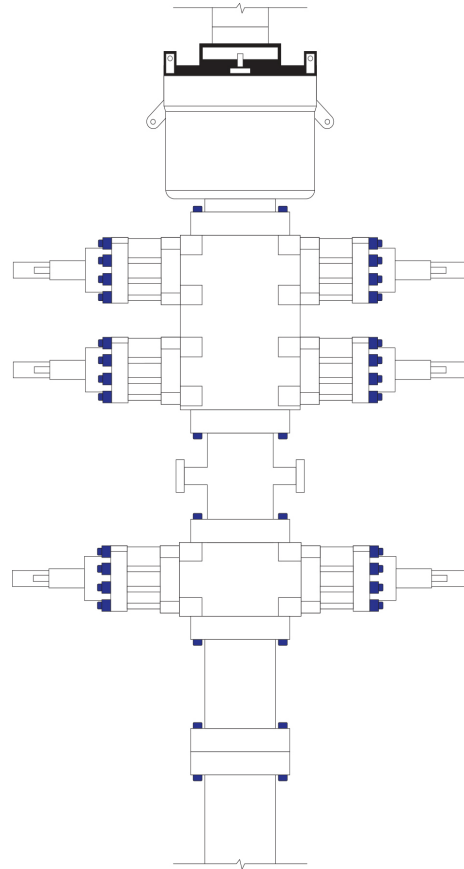


Bolt Marking

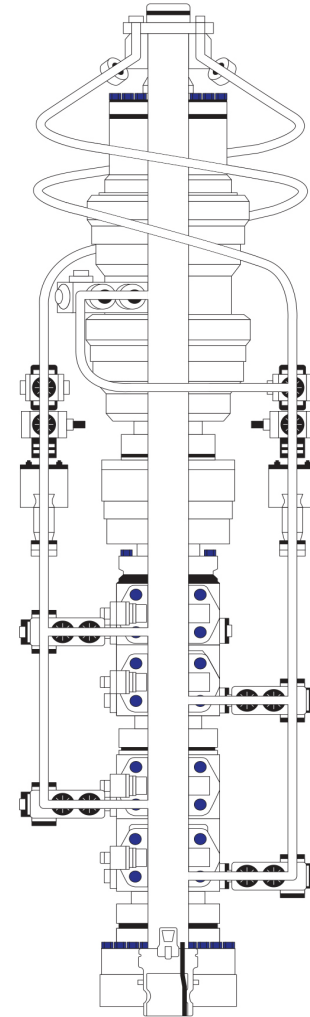
- ❑ Mfg. trademark & material type (US L43)
- ❑ Part Number (if required by client)
- ❑ API 20E BSL Level, (20E2)
- ❑ Month/Year of Manufacture (02/18)
- ❑ API 20E License Number (20E-0001)
- ❑ Manufacturers Heat Treat Lot Number (JB19)
- ❑ Specific Part Serial Number (19)
- ❑ API Monogram



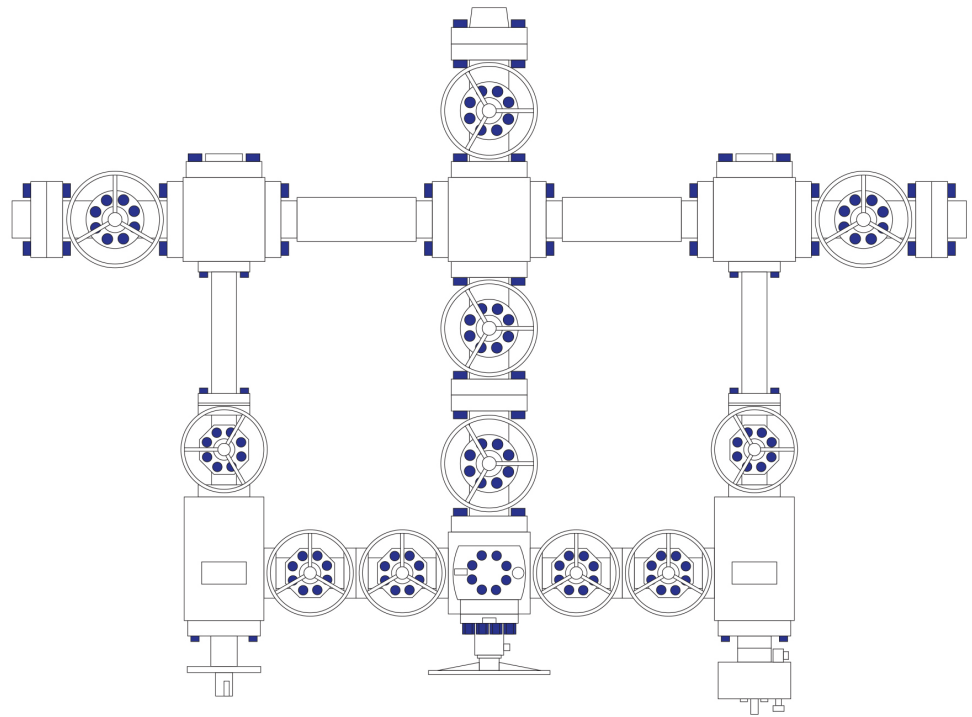
BLOW OUT PREVENTER (BOP)



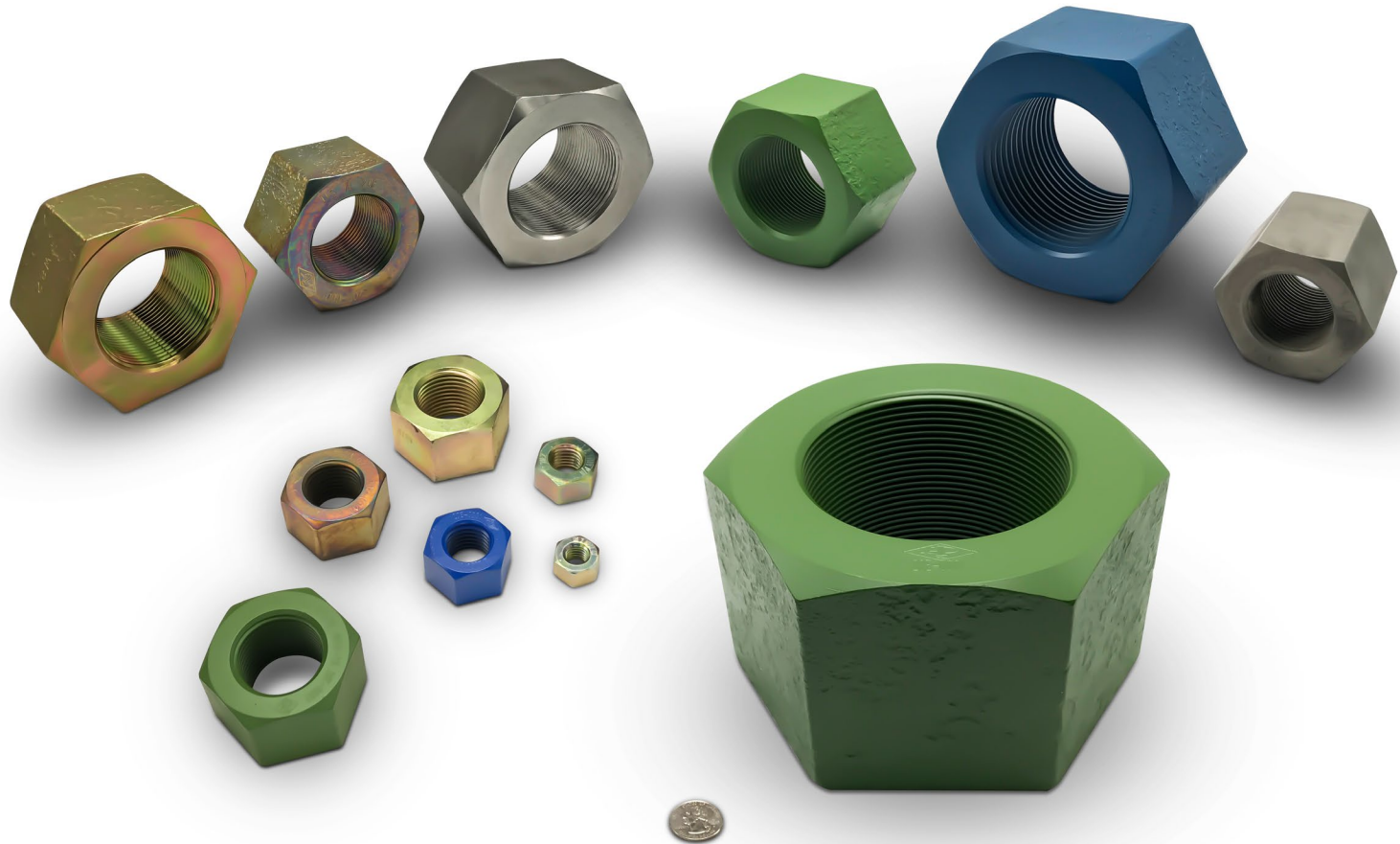
SUB-SEA DRILL THROUGH EQUIPMENT



CHOKE & KILL MANIFOLD



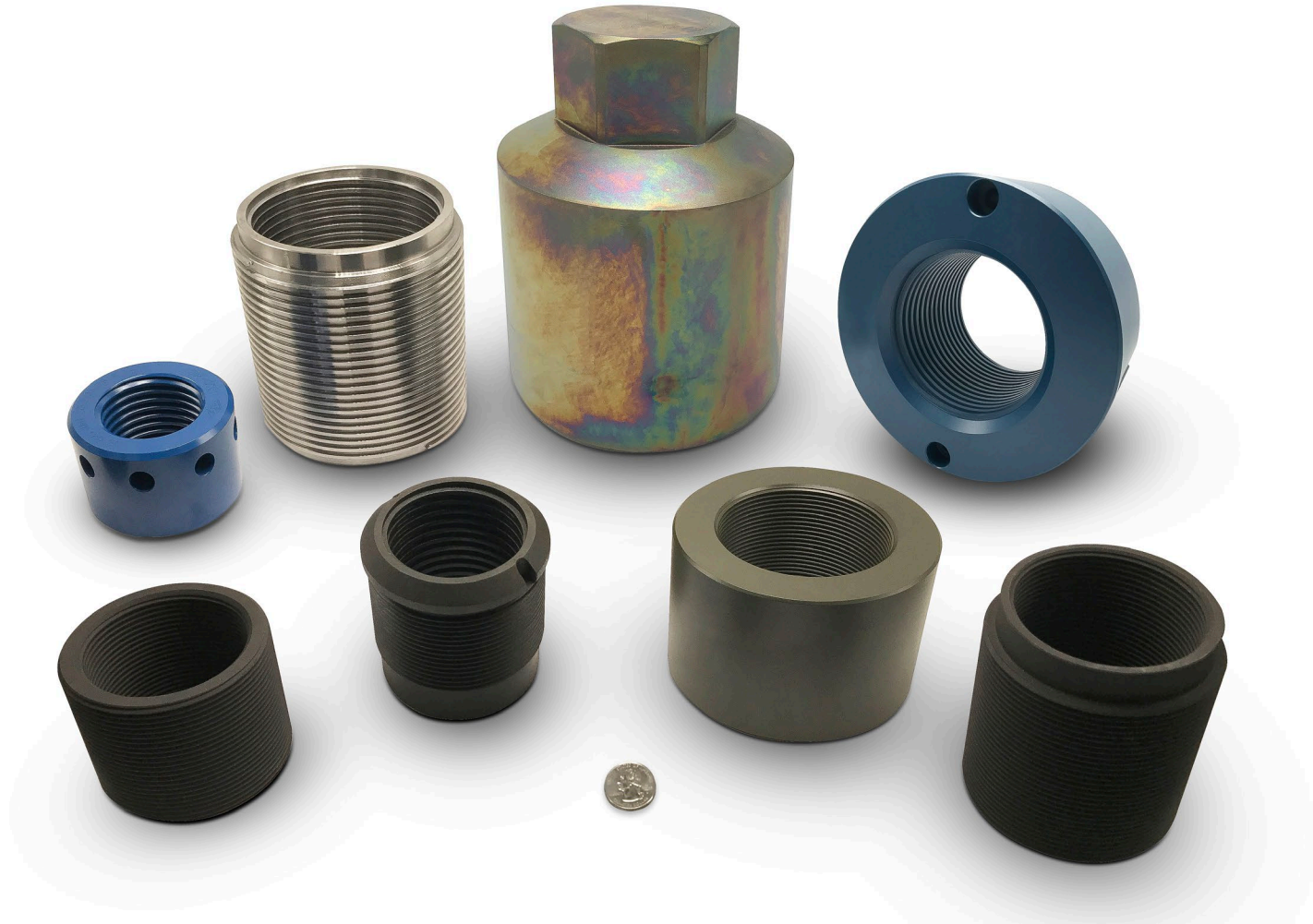
Heavy Hex Nuts (HVHN)



12 PT Flange Screws



Alternate Geometries



Hex Head Bolts



Socket Head Cap Screws

