NONMANDATORY APPENDIX HH
RULES FOR VALVE INTERNAL AND EXTERNAL ITEMS

ARTICLE HH-1000
REQUIREMENTS

HH-1100 INTRODUCTION

HH-1110 SCOPE
When selected for use, all the rules shall be applied to materials, design, fabrication, and examination of internal and external valve items for valves manufactured to Subsections NB, NC, and ND. Valve internal and external items are those items of a valve other than valve bodies, valve bonnets, valve items welded to valve bodies and bonnets (but not including internal permanent attachments), and bolting that join valve bodies and bonnets. As an alternative to the requirements of Section III, internal permanent attachments, disks, and those valve items covered by NB-3546.3(a) may be constructed in accordance with the requirements of this Appendix.

HH-1120 CATEGORIES
As set forth in Table HH-1120-1, Category is the grouping of various valve internal and external items for the purpose of applying the rules of this Appendix. Categories for typical valve types are shown in Figures HH-1120-1 through HH-1120-11. The figures are not to scale and not intended to convey any preference for valve type or design but are provided as a guide to the Manufacturer to identify the various valve internal and external items of a valve for categorization. In determining Categories for valve items of valve types not specifically illustrated, a valve or valve detail that is most nearly representative shall apply. Categories 1 and 2 are those valve items presently covered by Subsections NB, NC, and ND. Categories 3 through 8 are internal and external valve items that may be constructed in accordance with this Appendix.

HH-1200 GENERAL REQUIREMENTS

HH-1210 RESPONSIBILITIES AND DUTIES
It is the responsibility of the Certificate Holder to assign each valve item of a valve to the proper Category and to indicate the Categories in the Design Report and/or on a general assembly drawing. The Certificate Holder shall have an Article NCA-4000 Quality Assurance Program. Category 3 through 8 items for valves shall be manufactured under the Certificate Holder Quality Assurance Program or Quality Control System, as applicable, except that Material Organizations supplying Category 4 through 8 valve items are not required to comply with NCA-3800. The Design Report for valves manufactured to Subsection NB shall include an analysis of the primary stresses for Category 3 through 6 valve items, as required by HH-1400.

HH-1220 CERTIFICATION MARK
Stamping with the Certification Mark is not required for the valve internal and external items described in HH-1110.

HH-1300 MATERIALS

HH-1310 GENERAL REQUIREMENTS FOR MATERIAL

HH-1311 Scope of Principal Terms Employed
The term material as used in this Appendix applies both to those valve items produced to material specifications permitted by Section III and to the material permitted by this Appendix.

HH-1312 Permited Material Specifications
(a) Materials used for Category 3 and 4 valve items shall conform to the requirements of the specifications for materials given in Table HH-1312-1 of this Appendix or materials listed in Section II, Part D, Subpart 1, Tables 1A, 1B, and 3, and to the special requirements of this Appendix that apply to the valve item for which the material is used. All of the requirements of the material specification and of this Appendix shall be satisfied.

(b) Material used for Category 6 valve items shall conform to the requirements of one of the ASTM materials suitable for the application or an equivalent specification for materials listed in Section II, Part D, Subpart 1, Tables 1A, 1B, and 3.
(c) Category 5, 7, and 8 valve items may be made from any material suitable for the intended service. Consideration shall be given to stress relaxation when selecting materials for Category 5 items.

(d) The Certificate Holder shall provide a list that identifies the material used for each Category 3, 4, 5, 6, 7, or 8 valve item. This list may be included as a parts list on a general arrangement assembly drawing or as a separate list.

(e) Where the tensile strength, yield strength, hardness, tempering temperature, or aging temperature listed in Table HH-1312-1 differs from the requirements of the material specification, the requirements listed in Table HH-1312-1 shall apply.

HH-1313 Special Requirements Conflicting With Permitted Material Specifications

(a) Special requirements stipulated in this Appendix shall apply in lieu of the requirements of the materials specifications wherever the special requirements conflict with the material specification requirements. Where the special requirements include an examination, test, or treatment that is also required by the materials specification, the examination, test, or treatment need be performed only once. Any required nondestructive examinations shall be performed as specified in HH-1330. Any examination, repair, test, or treatment required by the material specification or this Appendix may be performed by the Material Organization or the Certificate Holder. The Material Organization shall obtain approval from the Certificate Holder for the weld repair of materials (see HH-1340).

(b) For materials listed in Table HH-1312-1 for Category 3 and 4 valve items, the tensile test requirements of the material specification may be performed on representative samples of each heat of material used, for each specified heat treatment. The tensile strength, yield strength, and hardness results shall meet or exceed the minimum specified values listed in the table. Where the material will be used to fabricate various valve item sizes in different heat-treated thicknesses, the Certificate Holder shall ensure that the heat treatment specified will be effective for the entire size range.

HH-1314 Allowable Stress Values

Allowable stress values, \( S \), are listed in Table HH-1312-1 of this Appendix or Section II, Part D, Subpart 1, Tables IA, IB, and 1A. For Table HH-1312-1, the allowable stress values are based on trend curves adjusted to the minimum specified room temperature tensile and yield strengths shown in the table. The listed values are allowable stress values and are not design stress intensity values.

HH-1315 Certification of Materials

(a) Material for Category 3 and 4 valve items, including all welding and brazing material, shall be certified in accordance with NCA-3862.1. Copies of all Certified Material Test Reports shall be available to the Inspector.

(b) For Category 5 and 6 valve items, a Material Organization Certificate of Compliance with the Material Specification, Grade, Class, and heat-treated condition, as applicable, shall be provided.

(c) Certified Material Test Reports or Material Organization Certificates of Compliance are not required for Category 7 and 8 valve items.

HH-1316 Welding, Brazing, and Hardsurfacing Material

All welding and brazing material used on Category 3 and 4 valve items shall meet the requirements of NY-2400 as applicable. Hardsurfacing material shall meet the requirements of AWS-A5.13, AWS-A5.21, or as otherwise specified by the Certificate Holder (see HH-1542).

HH-1317 Material Identification

HH-1317.1 Subsections NB and NC Valve Items.

(a) The identification of materials for Category 3 and 4 valve items used for valves manufactured to Subsections NB and NC shall consist of marking or tagging the material with the applicable specification number, grade, heat number, or heat code and any additional marking required to facilitate traceability of the reports of the results of all tests and examinations performed on the material, except that heat number identification is not required for valves with all piping connections NPS 2 (DN 50) and smaller. Alternatively, a marking symbol and/or code may be used that identifies the material with the material certification, and such symbol or code shall be explained in the certificate (see HH-1315). For identification and marking during fabrication by the Certificate Holder, see HH-1520.

(b) The identification of material for Category 5 through 8 valve items used for valves manufactured to Subsections NB and NC shall consist of marking or tagging the material or its container in accordance with the marking requirements of the applicable material specification.

(c) Material may be marked by any method that will not result in any harmful contamination or sharp discontinuities. Stamping, when used, shall be done with blunt-nosed continuous or blunt-nosed interrupted dot die stamps.

HH-1317.2 Subsection ND Valve Items. The identification of materials for Category 3 through 8 valve items used for valves manufactured to Subsection ND shall consist of marking the material or its container in accordance with the requirements of the applicable material specification.
HH-1317.3 Welding, Brazing, and Hardsurfacing

Material Identification. Welding, brazing, and hardsurfacing materials shall be clearly identified by legible marking on the package or container to ensure positive identification as acceptable material until actually consumed in the process.

HH-1320 FRACTURE TOUGHNESS

REQUIREMENTS FOR MATERIALS

HH-1321 Materials to Be Impact Tested

Materials for Category 3 valve items for valves manufactured to Subsection NB and, when required by the Design Specification, for valves manufactured to Subsections NC and ND shall be impact tested in accordance with the requirements of HH-1320, except that materials meeting any of the following conditions do not require impact testing:

(a) materials with a nominal section thickness of 5/8 in. (16 mm) or less, where the thickness is based on the largest nominal pipe wall thickness of the connecting pipe
(b) bolting with a nominal size of 1 in. (25 mm) and less
(c) bars with a nominal cross-sectional area of 1 in.² (650 mm²) and less
(d) all thicknesses of materials for valves with a NPS 6 (DN 150) and smaller
(e) materials for valves with all pipe connections of 5/8-in. (16-mm) nominal wall and less
(f) austenitic stainless steels, including precipitation hardening grade 660 (UNS S66286)
(g) nonferrous materials

HH-1322 Impact Test Procedure

HH-1322.1 Charpy V-Notch Tests. The Charpy V-notch test shall be performed in accordance with SA-370. Specimens shall be in accordance with SA-370, Figure 11, Type A. A test shall consist of a set of three full-size 10 mm × 10 mm specimens. The test temperature and lateral expansion shall be reported in the Certified Material Test Report.

HH-1322.2 Location and Orientation of Test Specimens. Impact test specimens shall be removed from the locations and orientations specified by the materials specification for tensile test specimens in each product form.

HH-1322.3 Material Conditions for Impact Testing. Impact testing shall be performed on specimens representing the condition of the item after final heat treatment and material forming operations.

HH-1322.4 Test Requirements and Acceptance Standards. Three Charpy V-notch specimens shall be tested at a temperature equal to or lower than the lowest service temperature. All three specimens shall meet or exceed 0.015-in. (0.38-mm) lateral expansion. Lowest service temperature is the minimum temperature of the fluid retained by the valve or, alternatively, the calculated volumetric average metal temperature expected during normal operation, whenever the pressure within the valve exceeds 20% of the preoperational system hydrostatic test pressure. The lowest service temperature shall be specified in the Design Specification.

HH-1322.5 Retests.

(a) One retest at the same temperature may be conducted provided
(1) the average of the test results meets the minimum requirements
(2) not more than one specimen per test is below the minimum requirements
(3) the specimen not meeting the minimum requirements is not lower than 0.005 in. (0.13 mm) below the specified requirements
(b) A retest consists of two additional specimens removed from coupon as near as practicable to the failed specimens. For acceptance of the retest, both specimens shall meet the minimum requirements.

HH-1330 EXAMINATION OF MATERIALS

Category 3 through 5 valve items for valves manufactured to Subsection NB over NPS 2 (DN 50) and cast materials for Category 3 valve items for valves manufactured to Subsection NC over NPS 2 (DN 50) shall be examined by the magnetic particle or liquid penetrant method in accordance with NB-2545 or NB-2546, respectively. In addition, for valves manufactured to Subsection NB with piping connections over NPS 2 (DN 50), all discs and cast materials for Category 3 valve items shall be examined by the applicable radiographic or ultrasonic methods and acceptance standards in accordance with NB-2500. The examination may be performed by the Material Organization or the Certificate Holder. Acceptance standards for magnetic particle and liquid penetrant examination shall be as follows:

Materials for Category 6 through 8 valve items for valves manufactured to Subsection NB and for Category 3 through 8 valve items for valves manufactured to Subsections NC and ND shall be examined in accordance with the material specification.

HH-1331 Time of Examination

Magnetic particle or liquid penetrant examination shall be performed on the final surfaces of the items, except that threaded items may be examined prior to threading. Examinations shall be performed prior to any coating or plating. Lapping of seating surfaces to reduce leakage or lapping of bearing surfaces shall not require reexamination. Ultrasonic or radiographic examinations of cast valve item material manufactured to Subsection NB, when required, shall be performed in accordance with NB-2574 or NB-2575, respectively.

HH-1332 Elimination of Surface Defects

(a) Unacceptable surface defects shall be removed by grinding or machining, provided
the remaining thickness of the section is not reduced below the minimum required by the design.

(2) the depression, after grinding or machining, is blended uniformly into the surrounding surface and the depression does not affect the function of the item.

(3) after grinding or machining, the area is examined by the method that originally disclosed the defect to ensure that the defect has been removed or the indication reduced to an acceptable size.

(b) If grinding or machining reduces the thickness of the section below the minimum required by the design, the item may be repaired in accordance with HH-1340.

HH-1340 REPAIR BY WELDING OF VALVE ITEMS

Category 5 and 8 valve items shall not be repair welded. Category 3, 4, 6, and 7 valve items may be repaired by welding, provided the requirements of the following are met.

HH-1341 Defect Removal

The defect shall be removed or reduced to an acceptable size by suitable mechanical or thermal cutting or gouging methods and the cavity prepared for weld repair.

HH-1342 Qualification of Welding Procedure and Welders

(a) Except as permitted in (b), the welding procedure and welders or welding operators shall be qualified in accordance with Section IX.

(b) Heat-treated material listed in Table HH-1312-1 that is not capable of passing bend tests required by Section IX for procedure or performance qualification may be qualified as required for fillet welding in accordance with QW-180. In addition, a minimum of two cross sections of the qualification test plate (assembly) shall be ground and etched with a suitable etchant and visually examined at 10x magnification. The weld metal and adjacent base material of the ground and etched cross sections shall be free of cracks.

HH-1343 Blending of Repaired Areas

After weld repair, the weld surface shall be blended into the surrounding surface.

HH-1344 Examination of Repair Welds

Each repair weld of material listed in Table HH-1312-1, Category 3 and 4 valve items for valves manufactured to Subsection NB and cast Category 3 valve items for valves manufactured to Subsection NC shall be examined by the method that originally exposed the defect. The finished surface shall be examined by either the magnetic particle or liquid penetrant method in accordance with NB-2545 or NB-2546, respectively.

HH-1345 Heat Treatment After Repair

(a) Materials listed in Table HH-1312-1, which are repaired by welding, shall be heat treated after repair. Such heat treatment shall be the heat treatment specified for the finished item or in accordance with a qualified welding procedure.

(b) Material listed in Section II, Part D, Subpart 1, Tables IA, 1B, and 3, which are repaired by welding, shall be heat treated after repair in accordance with the heat treatment requirements of NX-2500, as applicable.

HH-1346 Repair Weld Report

A record shall be made of each defect repair of Category 5 and 8 valve items in which the depth of the repair cavity exceeds the lesser of 1/8 in. (10 mm) or 10% of the section thickness. The record shall include the location and size of the repaired cavity, the welding materials, the welding procedure, the heat treatment, and the examination results.

HH-1400 DESIGN REQUIREMENTS

HH-1410 GENERAL DESIGN REQUIREMENTS

The requirements of HH-1400 apply to Category 3 through 6 valve items used for valves manufactured to Subsection NB, Category 3 and 4 valve items used for valves manufactured to Subsection NC, and Category 3 and 4 valve items used for valves manufactured to Subsection ND. Only valve items for valves manufactured to Subsection NB, larger than NPS 4 (DN 100), are required to be included in a Design Report.

HH-1420 DESIGN CONDITIONS

The Design Pressure and Design Temperature for the valve items covered by this Appendix shall be determined by HH-1421.

HH-1421 Design Pressure and Temperature

The Design Pressure and Design Temperature shall be specified in the Design Specification.

HH-1430 DESIGN COMPUTATIONS

The specific combinations and values of loadings, including mechanical loadings, that are considered in evaluating the primary stresses (see HH-1420) are those anticipated during Service Levels A and B Loadings. The actual mechanical loads resulting from these conditions shall be used in the computations made to show compliance with the stress limits of HH-1431 through HH-1433.
HH-1431 Design of Category 3, 4, and 6 Valve Items

The stress limits for materials for Category 3, 4, and 6 valve items for Service Levels A and B Loadings shall be as follows:

(a) The primary membrane stress shall not exceed the design allowable stress, $S$ (see HH-1314).

(b) The primary membrane plus primary bending stress shall not exceed 1.5$S$.

(c) Localized stresses associated with contact loading of seating surfaces do not require substantiation by analysis.

HH-1432 Design of Category 5 Valve Items

The Certificate Holder shall perform an analysis that shall include stress and fatigue considerations.

HH-1433 Design of Category 7 and 8 Valve Items

This Appendix does not specify design rules, stress limits, or analytical requirements for Category 7 and 8 valve items.

HH-1500 FABRICATION REQUIREMENTS

Category 3 through 8 valve items shall be fabricated in accordance with the requirements of HH-1500 and shall be manufactured from materials that meet the requirements of HH-1300.

HH-1510 CERTIFICATION OF MATERIAL BY CERTIFICATE HOLDER

The Certificate Holder shall provide certification that all treatments, tests, repairs, or examinations performed on valve items are in compliance with the requirements of this Appendix. Reports of all required treatments and the results of all required tests, repairs, and examinations performed shall be maintained in accordance with NCA-4134.17.

HH-1520 MATERIAL IDENTIFICATION

Category 3 and 4 valve material and items for valves manufactured to Subsections NB and NC shall carry identification markings, either directly on the item or on a separate tag that accompanies the item, that will remain distinguishable until the item is assembled in the valve. All other material and items shall be identified by a control procedure, as specified by a Quality Assurance Program, that ensures the specified materials are used.

HH-1530 PERMANENT ATTACHMENT WELDS

Items that are attached by welding to the surface of the valve body or bonnet may be attached by full penetration, partial penetration, or fillet welds. The attachment and weld joint shall meet the design requirements of HH-1400.

HH-1540 WELDING REQUIREMENTS

Except as permitted in HH-1541, all welds shall be made using qualified welding procedures and welders or welding operators in accordance with Section IX.

HH-1541 Special Welds

Fillet welds and partial penetration welds $\frac{1}{4}$ in. (6 mm) and less in size may be made in the fabrication of valve items or between valve items where either of the items is a material listed in Table HH-1312-1, provided the procedures and welders are qualified as follows:

(a) A test assembly shall be made for each combination of materials to be welded.

(b) The test assembly shall be a duplicate of the production weld joint or a groove butt weld $\frac{1}{4}$-in. (6-mm) minimum thickness.

(c) The test assembly shall be sectioned (a minimum of four cross sections), ground, etched with a suitable etchant, and visually examined at 10× magnification. All surfaces of the weld and adjacent base material(s) shall be free of cracks.

HH-1542 Hardsurfacing

Hardsurfacing shall be performed using qualified procedures and personnel in accordance with Section IX.

HH-1543 Examination of Welds

All welds including hardsurfacing shall be examined by the magnetic particle or liquid penetrant method in accordance with NB-5340 or NB-5350, respectively, except for seating surfaces for which all indications shall be removed.

HH-1544 Heat Treatment of Welds

(a) Postweld heat treatment of welds that join material listed in Section II, Part D, Subpart 1, Tables IA and 1B, shall be in accordance with the postweld heat treatment requirements of NX-4620, as applicable.

(b) Postweld heat treatment of welds that join material listed in Table HH-1312-1 to material listed in Section II, Part D, Subpart 1, Tables IA and 1B, shall be in accordance with the postweld heat treatment requirements of NX-4620, as applicable. Special techniques, such as local postweld heat treatment, may be necessary to avoid changing the base material properties of the item in locations not adjacent to the weld.

(c) Postweld heat treatment of welds for joining materials listed in Table HH-1312-1 shall be in accordance with the heat treatment specified for the material of the finished item, i.e., the heat treatment required to obtain the tensile strength, yield strength, and hardness listed in Table HH-1312-1.

(d) For fillet welds and partial penetration welds $\frac{1}{4}$ in. (6 mm) and less in size, postweld heat treatment is neither required nor prohibited.
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**NOTES:**
1. An analysis in the Design Report is required for valves manufactured to Subsection NB larger than NPS 4 (DN 100) (NB-3560).
2. Radiography or ultrasonic examination of cast materials and valve disks for valves over NPS 2 (DN 50) is required.
3. Applies to valves manufactured to Subsection NB larger than NPS 2 (DN 50).
4. Cast materials for valve items over NPS 2 (DN 50) only.
5. When required for the valve per Design Specification.
6. The quality control system shall cover identification in accordance with HH-1317.1 and HH-1317.2.
7. Material Manufacturer’s Certificate of Compliance.