Replace Fig. T-1420-2 by the following figure:

![Creep-Fatigue Damage Envelope](image)

- 304 and 316 stainless steels, Intersection (0.3, 0.3)
- 2½ Cr-1Mo steel and Ni-Fe-Cr Alloy 800H, Intersection (0.1, 0.1)
- 9 Cr-1Mo-V steel, Intersection (0.1, 0.01)

FIG. T-1420-2  CREEP-FATIGUE DAMAGE ENVELOPE

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NC-3259 Design Requirements for Nozzle Attachment Welds and Other Connections

The minimum design requirements for nozzle attachment welds and other connections are set forth in (a) through (c) below.

(a) Permitted Types of Nozzles and Other Connections. Nozzles and other connections may be any of the types for which rules are given in this Subarticle, provided the requirements of (1) through (7) below are met.

1. Nozzles shall meet requirements regarding location.

2. The attachment weld shall meet the requirements of NC-3252.4.

3. The requirements of NC-3230 shall be met.

4. Type No. 1 full penetration joints shall be used when the openings are in shells 2\(1/2\) in. (64 mm) or more in thickness.

5. The welded joints shall be examined by the methods stipulated in NC-5250.

6. Studded connections shall meet the requirements of NC-3262.4.

7. Threaded connections shall meet the requirements of NC-3270.

(b) Provision of Telltale Holes for Air Testing. Reinforcing plates and saddles attached to the outside of a vessel shall be provided with at least one telltale hole, of maximum size \(1/4\) in. (6 mm) pipe tap, that may be tapped for a preliminary compressed air and soap solution or equivalent test for tightness of welds that seal off the inside of the vessel. These telltale holes may be left open or may be plugged when the vessel is in service. If the holes are plugged, the plugging material used shall not be capable of sustaining pressure between the reinforcing plate and the vessel wall. Telltale holes shall not be plugged during heat treatment.

(c) Attachments. Typical attachments are shown in Fig. NC-4267-1. The minimum dimensions in this figure are as follows:

\[
a \geq t/4; \ b \geq t/2; \ c \geq t\]

where

\[c = \text{minimum thickness of weld metal from the root to the face of the weld}
\]

\[t = \text{thickness of attached member}\]

NC-3260 SPECIAL VESSEL REQUIREMENTS

NC-3261 Transition Joints Between Sections of Unequal Thickness

Unless the requirements of Appendix XIII, XIV, or II are shown to be satisfied, a tapered transition as shown in
(c) Horizontal vessels supported by saddles shall provide bearing extending over at least one-third of the shell circumference.

(d) Additional requirements for the design of supports are given in NCA-3240 and Subsection NF.

NC-3264.5 Types of Attachment Welds. Welds attaching nonpressure parts or stiffeners to pressure parts shall meet the requirements of NC-4267.

NC-3264.6 Stress Values for Weld Material. Attachment weld strength shall be based on the nominal weld area and the design stress intensity values in Tables 2A, 2B, and 4, Section II, Part D, Subpart 1 and stress criteria in NC-3200 for the weaker of the two materials joined, or, where weaker weld metal is permitted, the design stress intensity values of the weld metal multiplied by the following reduction factors: 0.5 for fillet welds NC-3264.5; 0.75 for partial penetration groove or partial penetration groove plus fillet welds NC-3264.5; 1.0 for complete weld penetration. The nominal weld area for fillet welds is the throat area; for groove welds, the depth of penetration times the length of weld; and for groove welds with fillet welds, the combined throat and depth of penetration, exclusive of reinforcement, times the length of weld.

(a) Attachment Welds — Evaluation of Need for Fatigue Analysis. In applying Condition AP or BP of NC-3219.3, fillet welds and partial penetration welds are considered nonintegral attachments, except that the following welds need not be considered:

1. welds for minor attachments
2. welds for supports which may be considered integral as covered by Conditions A and B of NC-3219.2

NC-3266 Threaded Connections

(a) Threads

1. Pipes, tubes, and other threaded connections that conform to ANSI/ASME B1.20.1, Pipe Threads, General Purpose, may be screwed into a threaded hole in a vessel wall, provided the pipe engages the minimum number of threads specified in Table NC-3266-1 after allowance has been made for curvature of the vessel wall. A built-up pad or a properly attached plate or fitting shall be used to provide the metal thickness and number of threads required in Table NC-3266-1 or to furnish reinforcement when required.

2. Straight threaded connections may be employed as provided for in NC-3266(b)(2).

(b) Restrictions on the Use of Threaded Connections

1. Taper Threaded Connections. Internal taper pipe thread connections larger than NPS 2 (DN 50) shall not be used.
NONMANDATORY APPENDIX NF-D TOLERANCES

ARTICLE NF-D-1000
INTRODUCTION

NF-D-1100 OBJECTIVE

It is recognized that design of supports is based on the use of nominal dimensions. This is not different from the design of piping or equipment which also is based on nominal dimensions. Good design practice dictates that the designer consider the degree of deviation from nominal design which can be tolerated when supports are manufactured as well as when they are installed. It is the intent of this Appendix to provide guidance to the designer as to the need for establishing such tolerances and dimensional inspection requirements.

NF-D-1200 SCOPE

Tolerances referred to in this Appendix apply only to such values that may affect Code compliance of a support and are not already addressed in the body of the Code. Any other dimensions and tolerances associated with a support are not addressed.

NF-D-1300 GENERAL REQUIREMENTS

NF-D-1310 Material — NCA-7100-1

Material supplied to an SA, SB, SFA Specification, or Table NF-D-3120. Dimensional Standards, need not have material dimensional tolerances specified by the support designer. Material provided to those specifications and standards have their own tolerances and the use of nominal dimension design is adequate. However, tolerance(s) on any manufacturing operation(s) affecting the support load capacity needs to be considered.

NF-D-1320 Fabrication Tolerances

The recommended fabrication tolerances are listed in (a) through (h).

(a) Tolerances for raw material such as strip, sheet, bar, plate, pipe, tubing, structural and bar size shapes, bolting, hot wound springs, and cold wound springs shall be in accordance with recognized standards or specifications for this raw material.

(b) Tolerances for castings, forgings, and extrusions shall be in accordance with the individual manufacturer's standard.

(c) Cut to length — linear

(1) Hanger rods ± 1/8 in. (13 mm).

(2) Structural shapes, pipe, and tubing for critical assembly make-up dimensions ± 1/8 in. (3 mm). Squareness of cut 1 deg, not to exceed 1/8 in. (3 mm) offset.

(3) Plates and bars for critical dimensions (as defined by the designer) ± 1/8 in. (3 mm). Squareness of cut 1 deg, not to exceed 1/8 in. (3 mm) offset.

(4) Tolerances for noncritical dimensions shall be to the individual manufacturer’s standard.

(d) Clamps for pipe and tubing, formed and fabricated, are shown in Table NF-D-1320-1.

(e) Angularity — all forming operations ± 4 deg.

(f) Punched holes

(1) Location — center to edge, or center to center ± 1/8 in. (3 mm).

(2) Diameter — plus 0.2 times metal thickness or minus 1/2 in. (0.8 mm).

(g) Drilled holes — as specified on manufacturer's drawings.

(h) Machined parts — as specified on manufacturer’s drawings.

NF-D-1330 Installation Tolerances

(a) Installation tolerances of supports need to be established. There are two categories of installation tolerances associated with a support. The first is a local installation tolerance affecting only the load capacity of the support itself. The second is a global installation tolerance which may affect the conclusions of the component or piping qualification.

(b) Table NF-D-1330-1 provides acceptable local installation tolerances for supports. When support installation meets these tolerances, any change in the established support load capacity is considered minor to the point that existing load capacity calculations are adequate. Global installation tolerances should be addressed in the piping or component Design Specification or Design Report.
(2) 14 times the thickness of the thinner plate, or 7 in. (175 mm) for unpainted members of weathering steel subject to atmospheric corrosion.

In a tension member the longitudinal spacing of fasteners and intermittent welds connecting two or more shapes in contact shall not exceed 24 in. (600 mm). Tension members composed of two or more shapes or plates separated by intermittent fillers shall be connected to one another at these fillers at intervals such that the slenderness ratio of either component between the fasteners does not exceed 300.

(b) Perforated Cover and Tie Plates. Either perforated cover plates or tie plates without lacing may be used on the open sides of built-up tension members. Tie plates shall have a length not less than two-thirds the distance between the lines of bolts or welds connecting them to the elements of the member. The thickness of such tie plates shall not be less than one-fiftieth of the distance between these lines. The longitudinal spacing of bolts or intermittent welds at tie plates shall not exceed 6 in. (150 mm). The spacing of tie plates shall be such that the slenderness ratio of any component in the length between tie plates shall not exceed 300.

NF-3322.6 Webs, Flanges, and Stiffeners

(a) Webs. The ratio of the clear distance between flanges to the web thickness shall not exceed

\[
\frac{14,000}{\sqrt{S_p(S_p + 16.5)}} \quad (36)
\]

\[
\frac{96,500}{\sqrt{S_p(S_p + 114)}} \quad (36)
\]

except that when transverse stiffeners are provided, spaced not more than \(1\frac{1}{2}\) times the girder depth, the limiting ratio may be \(\frac{5,000}{\sqrt{S_p}}\) (For SI units, use \(5,000/\sqrt{S_p}\)), where \(S_p\) is the yield stress of the compression flange.

(1) Combined Shear and Tension Stress. Plate girder webs which depend upon tension field action, as provided in eq. (45), shall be so proportioned that bending tensile stress due to moment in the plane of the girder web shall not exceed \(0.6S_p\), or

\[
\left(0.825 - 0.375 \frac{F_s}{F_v}\right)S_p \quad (37)
\]

where

\[F_v = \text{allowable web shear stress, ksi (MPa), according to eq. (45)}\]

The allowable shear stress in the webs of girders having flanges and webs with yield values greater than 65 ksi (450 MPa) shall not exceed the values given by eq. (44) if the flexural stress in the flange \(f_b\) exceeds \(0.75F_b\).
(2) Web Crippling

(a) Local Web Yielding. Webs of beams and welded plate girders shall be so proportioned that the compressive stress at the web toe of the fillets, resulting from concentrated loads not supported by bearing stiffeners, shall not exceed the value of 0.66S_y; otherwise, bearing stiffeners shall be provided. The governing equations shall be

(1) for interior loads

[U.S. Customary Units]

\[ \frac{R}{t(N + 5k)} \leq 0.66S_y \] (38)

[SI Units]

\[ \frac{R}{t(N + 125k)} \leq 0.66S_y \] (38)

(2) for end reactions

[U.S. Customary Units]

\[ \frac{R}{t(N + 2.5k)} \leq 0.66S_y \] (39)

[SI Units]

\[ \frac{R}{t(N + 65k)} \leq 0.66S_y \] (39)

where \( N \) is greater than or equal to \( k \) for end reactions.

(b) Stress on Compression Edge of Web Plate.

Bearing stiffeners shall be provided in the webs of members under concentrated loads, when the compressive force exceeds the following limits:

when the concentrated load is applied at a distance not less than \( d/2 \) from the end of the member

[U.S. Customary Units]

\[ R = 67.5 t_w^2 \left[ 1 + 3 \left( \frac{N}{d} \right) \left( \frac{t_w}{t_f} \right) \right] \sqrt{S_y t_f t_w} \] (40)

[SI Units]

\[ R = 177 t_w^2 \left[ 1 + 3 \left( \frac{N}{d} \right) \left( \frac{t_w}{t_f} \right) \right] \sqrt{S_y t_f t_w} \] (40)

when the concentrated load is applied less than a distance \( d/2 \) from the end of the member

[U.S. Customary Units]

\[ R = 34 t_w^2 \left[ 1 + 3 \left( \frac{N}{d} \right) \left( \frac{t_w}{t_f} \right) \right] \sqrt{S_y t_f t_w} \] (41)

[SI Units]

\[ R = 89 t_w^2 \left[ 1 + 3 \left( \frac{N}{d} \right) \left( \frac{t_w}{t_f} \right) \right] \sqrt{S_y t_f t_w} \] (41)
(c) Flange Development

(1) High-strength bolts or welds connecting flange to web or cover plate to flange shall be proportioned to resist the total horizontal shear resulting from the bending forces on the girder. The longitudinal distribution of these bolts or intermittent welds shall be in proportion to the intensity of the shear, but the longitudinal spacing shall not exceed the maximum permitted, respectively, for compression or tension members in NF-3322.4(a)(3) or NF-3322.5(a). Additionally, bolts or welds connecting flange to web shall be proportioned so as to transmit to the web any loads applied directly to the flange unless provision is made to transmit such loads by direct bearing.

(2) Partial length cover plates shall be extended beyond the theoretical cut-off point and the extended portion shall be attached to the beam or girder by high strength bolts for friction-type joints or fillet welds adequate at the applicable stresses allowed in NF-3324.6(a), NF-3324.5(d), or NF-3324.4, to develop the cover plate portion of the flexural stresses in the beam or girder at the theoretical cut-off point. In addition, for welded cover plates, the welds connecting the cover plate termination to the beam or girder in the length \( a' \) defined in NF-3322.6(c)(1)(a) through (c)(1)(c), shall be adequate at the allowed stresses to develop the cover plate portion of the flexural stresses in the beam or girder at the distance \( a' \) from the end of the cover plate. The length \( a' \) measured from the end of the cover plate, shall be

(a) a distance equal to the width of the cover plate when there is a continuous weld equal to or larger than three-fourths of the plate thickness across the end of the plate and continuous welds along both edges of the cover plate in the length \( a' \)

(b) a distance equal to \( 1\frac{1}{2} \) times the width of the cover plate when there is a continuous weld smaller than three-fourths of the plate thickness across the end of the plate and continuous welds along both edges of the cover plate in the length \( a' \)

(c) a distance equal to two times the width of the cover plate when there is no weld across the end of the plate, but continuous welds along both edges of the cover plate in the length \( a' \)

(d) Reduction in Flange Stress. When the web depth-thickness ratio exceeds \( 760 \sqrt{F_b} \), the maximum stress in the compression flange shall not exceed

(U.S. Customary Units)

\[
F'_b \leq F_b \left[ 1.0 - 0.0005 \frac{A_w}{A_f} \left( \frac{h}{t} - \frac{760}{\sqrt{F_b}} \right) \right]
\]  

(SI Units)

\[
F'_b \leq F_b \left[ 1.0 - 0.0005 \frac{A_w}{A_f} \left( \frac{h}{t} - \frac{2000}{\sqrt{F_b}} \right) \right]
\]
Errata for the 2009 Addenda of Section III, Div. 1, Appendix XIII

The following items were not properly implemented...

Appendix XIII, XIII-1123 (d), (f), (g), and (m) changes were not completely implemented. Therefore, please make the intended changes as noted below.

(d) Normal Stress. Normal stress is the component of stress normal to the plane of reference. This is also referred to as direct stress. Usually, the distribution of normal stress is not uniform through the thickness of a part, so this stress is considered to be made up in turn of two components, one of which is uniformly distributed and equal to the average value of stress across the thickness of the section under consideration and the other of which varies with the location across the thickness.

(e) Shear Stress. Shear stress is the component of stress tangent to the plane of reference that varies from this average value.

(f) Membrane Stress. Membrane stress is the component of normal stress which is uniformly distributed and equal to the average value of stress across the thickness of the section under consideration.

(g) Bending Stress. Bending stress is the variable component of normal stress described in (d) above. The variation may or may not be linear across the thickness.

(m) Thermal Stress. Thermal stress is a self-balancing stress produced by a nonuniform distribution of temperature or by differing thermal coefficients of expansion. Thermal stress is developed in a solid body whenever a volume of material is prevented from assuming the size and shape that it normally would under a change in temperature. For the purpose of establishing allowable stresses, two types of thermal stress are recognized, depending on the volume or area in which distortion takes place, as described in (a) and (b) below.

1. General thermal stress is associated with distortion of the structure in which it occurs. If a stress of this type, neglecting stress concentrations, exceeds twice the yield strength of the material, the elastic analysis may be invalid and successive thermal cycles may produce incremental distortion. Therefore, this type is classified as secondary stress in Table XIII-1130-1 and Fig. XIII-1141-1. Examples of general thermal stress are

\[
\begin{align*}
(1) & \quad \text{change (a) and (b) to (1) and (2)} \\
(2) & \quad (a) \text{ and (b) below.}
\end{align*}
\]
Errata for the 2009 Addenda of Section III, Div. 1, Subsection NE

NE-3213.6 and NE-3213.7 changes were not completely implemented. Therefore, please make the intended changes as noted below.

A06  NE-3213.6 Membrane Stress. Membrane stress is the component of normal stress that is uniformly distributed and equal to the average of stress across the thickness of the section under consideration.

A06  NE-3213.7 Bending Stress. Bending stress is the component of normal stress that varies across the thickness. The variation may or may not be linear across the thickness.