NONMANDATORY APPENDIX BB
METALLIC BRAIDED FLEXIBLE HOSE

ARTICLE BB-1000
SCOPE

BB-1100 RULES

This Appendix provides the rules for the construction of metallic braided flexible hose. This Appendix is limited to use in Division 1, Subsection NC and ND, and Division 5, Subsection HC, Subpart A applications.

The braided hose consists of a convoluted inner sheath pressure boundary, with outer reinforcing braided wire welded to end pieces.
BB-2000 MATERIAL

The inner sheath and end pieces shall be fabricated from materials conforming to NC/ND-2000. Whenever NC/ND is used for reference, the reference is NC for Class 2 and ND for Class 3.

The braid shall be made from stainless steel heat-resisting wire conforming to ASTM A580-98. Only wire of material types listed under SA-479 in Section II, Part D, Subpart 1, Tables 1A, 1B, and 3 may be used for the braided sheath.

replace "NC/ND" by "NCD"
ARTICLE BB-3000
DESIGN

BB-3100  DESIGN FACTORS

(a) The design shall consider operating and design loads and movements including differential movement, vibration, and inertia effects when applicable.

(b) The Certificate Holder that manufactures the hose shall establish the pressure and temperature rating of the hose assembly by calculations and tests in accordance with the Expansion Joint Manufacturers Association Standard (EJMA). The minimum and maximum temperatures shall be within the limits listed in Section II, Part D. The hose rating shall be equal to or exceed the piping system design pressure and temperature.

(c) The rating of the hose assembly shall have a minimum design margin of 3.5 against burst and leakage.

BB-3200  GENERAL DESIGN REQUIREMENTS

(a) Braided flexible hoses with the convoluted hose element having a length to outside diameter ratio \((L/D_o)\) of 3 or less shall comply with all the requirements of NC/ND-3649 for bellows expansion joints.

(b) Braided flexible hoses with the convoluted hose element having a length to outside diameter ratio \((L/D_o)\) greater than 3 shall comply with the requirements of NC/ND-3649 with the following exceptions:

1. The flexible wire braid shall act as an axial restraint for the hose and vibration dampener, and provide columnar stability against squirm.

2. Subsections NC/ND-3649.1(a), NC/ND-3649.2(d), and NC/ND-3649.4(c) are not applicable.

(c) The Certificate Holder that manufactures the hose shall supply to the N-type Certificate Holder the maximum allowable end loads, inertia loads, displacements, minimum curvature between the hose ends, and the spring rates for the flexible hose. The calculated loads and displacements for the piping system shall be less than those supplied by the Certificate Holder that manufactures the hose.

BB-3300  SPECIAL DESIGN REQUIREMENTS

(a) Flow-induced vibration at design flow shall be evaluated and a sleeve specified when required per NC/ND-3649.2(f).

(b) The piping system layout, anchorage, guiding, and support shall avoid the imposition of end displacement, vibratory motions, or forces for the hose length, other than those for which the hose is designed.

(c) The hose end on one side of the installation shall not be oriented longitudinally concentric with the other hose end unless the minimum design curvature between the hose ends recommended by the Certificate Holder that manufactures the hose is maintained.

(d) Either annealed or cold-finished wire may be used for the wire braid, but the allowable stresses shall be those listed in Section II, Part D, Subpart 1, Tables 1A, 1B, and 3 for the annealed or solution-treated condition for SA-479 of the same material type as the wire being specified.

As a minimum, the required number of strands shall be established from the equation

\[
N = \frac{F}{SA \cos \alpha}
\]

where

- \(A\) = cross-sectional area of one wire, \(\text{in.}^2\)
- \(F\) = end load due to pressure, \(\text{lb, acting on the effective area of the connector}\)
- \(N\) = minimum number of wires
- \(S\) = allowable stress at the rated temperature, \(\text{psi}\)
- \(\alpha\) = wrap angle (the acute angle supported by the strand and the axis of the connector), as shown in Figure BB-3300-1

\[
F = \frac{\pi}{4} \left( \frac{D_o + D_i}{2} \right)^2 P
\]

where

- \(D_i\) = ID of convolution, Figure BB-3300-1
- \(D_o\) = OD of convolution, Figure BB-3300-1
- \(P\) = rated pressure, \(\text{psi}\)
Figure BB-3300-1
Bellows Configuration and Wrap Angle, $\alpha$

- $d$: Dia.
- $D_i$: Inner Diameter
- $D_o$: Outer Diameter
- $t$: Thickness
- $\alpha$: Wrap Angle
ARTICLE BB-4000
FABRICATION

BB-4100 REQUIREMENTS

(a) All wire braid strands shall be welded to the welding collars of the convoluted hose connector per NC/ND-4800.

(b) All welds shall conform to NC/ND-4800.

(c) The end pieces, whether welded, flanged, or threaded, shall conform to NC/ND-3132 and NC/ND-3612.

(d) The inner sheath shall be attached to the end pieces utilizing circumferential welds of a butt type having full penetration through the thickness of the inner sheath.

replace "NC/ND" by "NCD"
BB-5000 PROCEDURES

(a) Examination requirements for expansion joints in accordance with NC/ND-5700 shall be satisfied.

(b) All butt welds greater than or equal to NPS 4 shall be examined by RT or UT, in accordance with NC/ND-5000.

(c) All butt welds less than NPS 4 shall be examined by PT or MT, as applicable, in accordance with NC/ND-5000.

(d) The wire-strand-to-collar welds shall be visually examined to detect unconnected wires.

replace "NC/ND" by "NCD"
ARTICLE BB-6000
TESTING

BB-6100 HYDROSTATIC AND PNEUMATIC TESTING

All braided flexible hoses shall be hydrostatically tested in accordance with NC/ND-6000, except that test pressure shall be not less than 1.5 times the design pressure at room temperature, and shall be so noted on Data Report Form NPP-1. Alternatively, the hose may be pneumatically tested when submerged in water. The test of hoses with inlet piping connections of NPS 4 and smaller need not be witnessed by the Inspector. The Inspector’s review of the Certificate Holder’s test records will be his authority to sign the Data Report. Installed hose assemblies are subject to the piping system hydrostatic test.

replace "NC/ND" by "NCD"