



Standard Specification for Design and Installation of Overboard Discharge Hull Penetration Connections¹

This standard is issued under the fixed designation F994; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers carbon steel overboard discharge hull penetrations for system piping of NPS 1 through NPS 24 (see [Note 1](#)).

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such TRADITIONAL terms as nominal diameter, size, and nominal size.

1.2 The minimum pipe schedule and reinforcement dimensions presented in [Tables 1-6](#) are based on specifications in 46 CFR, 56.50-95 and Navy Design Data Sheet 100-1.

1.3 This specification does not include sea chest penetrations.

1.4 This specification does not include penetrations in protective plating.

2. Referenced Documents

2.1 *ASTM Standards*:²

[A519](#) Specification for Seamless Carbon and Alloy Steel Mechanical Tubing

2.2 *ANSI Standard*:

[B36.10](#) Welded and Seamless Wrought Steel Pipe³

2.3 *Military Document*:

[MIL-STD-1689](#) Fabrication, Welding, and Inspection of Ships Structure⁴

2.4 *Other Documents*:

[Title 46](#) Code of Federal Regulations (CFR), Subchapter F, Marine Engineering⁴

¹ This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.11 on Machinery and Piping Systems.

Current edition approved Feb. 1, 2006. Published February 2006. Originally approved in 1986. Last previous edition approved in 2001 as F994 – 86 (2001). DOI: 10.1520/F0994-86R06.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

TABLE 1 Pipe Schedule for Type 1 Penetrations, NPS 1 Through NPS 24^A

Penetration Pipe Size, NPS	Shell Plating Thickness (T), in.									
	¼–½	⅝	¾	⅞	1	1⅛	1¼	1⅝	1⅞	2
1	80	80	160	160	160	160	XXS	XXS	XXS	XXS
1¼	80	160	160	160	XXS	XXS	XXS	XXS	XXS	XXS
1½	80	160	160	160	160	XXS	XXS	XXS	XXS	XXS
2	80	160	160	160	160	160	160	XXS	XXS	XXS
2½	80	80	160	160	160	160	160	160	XXS	XXS
3	80	80	160	160	160	160	160	160	160	XXS
4	80	80	120	120	120	120	160	160	160	160
5	80	80	80	120	120	120	120	160	160	160
6	80	80	80	120	120	120	120	120	160	160
8	80	80	80	80	100	100	100	120	120	120
10	60	60	60	80	80	100	100	100	120	120
12	60	60	60	80	80	80	100	100	100	100
14	60	60	60	80	80	80	80	100	100	100
16	40	60	60	60	80	80	80	80	100	100
18	40	40	60	60	60	80	80	80	80	80
20	40	40	60	60	60	60	80	80	80	80
22	40	40	60	60	60	60	80	80	80	80
24	40	40	60	60	60	60	60	60	60	80

^A See [Fig. 1](#).

Department of the Navy, Bureau of Ship Design Data Sheet 100-1 ⁵

[ABS Rules for Building and Classing Steel Vessels](#) ⁶

3. Classification

3.1 *Type I*—Nonreinforced penetrations. [Table 1](#) provides minimum schedules for the penetration pipe. See [Fig. 1](#) for details of the penetration.

3.2 *Type II*—Doubler plate-reinforced penetrations. [Table 2](#) provides minimum dimensions for doubler plates.

3.2.1 *Class 1*—Inboard doubler plates. ([Fig. 2](#))

3.2.2 *Class 2*—Outboard doubler plates. ([Fig. 3](#))

3.3 *Type III*—Insert plate-reinforced penetrations. [Table 3](#) provides minimum dimensions for insert plates.

⁵ Available from Department of the Navy, Naval Sea Systems Command, Washington, DC 20362.

⁶ Available from American Bureau of Shipping (ABS), ABS Plaza, 16855 Northchase Dr., Houston, TX 77060.

TABLE 2 Doubler Plate Dimensions ($T_D \times D$) Type II Penetration, NPS 1 Through NPS 24 (in. $\times$ in.)^A

Penetrating Pipe Size, NPS, SCH	Shell Plating Thickness (T), in.								
	¼ to ½	⅝	¾	⅞	1	1⅛	1¼	1⅝	1½
1, 80	¼ $\times$ 5	⅝ $\times$ 5	½ $\times$ 5	⅝ $\times$ 5	¾ $\times$ 5	¾ $\times$ 5	1 $\times$ 5	1 $\times$ 5	1¼ $\times$ 5
1¼, 80	¼ $\times$ 6	⅝ $\times$ 6	½ $\times$ 6	⅝ $\times$ 6	¾ $\times$ 6	¾ $\times$ 6	1 $\times$ 6	1 $\times$ 6	1¼ $\times$ 6
1½, 80	¼ $\times$ 6	⅝ $\times$ 6	½ $\times$ 6	⅝ $\times$ 6	¾ $\times$ 6	¾ $\times$ 6	1 $\times$ 6	1 $\times$ 6	1¼ $\times$ 6
2, 80	¼ $\times$ 7	⅝ $\times$ 7	½ $\times$ 7	⅝ $\times$ 7	¾ $\times$ 7	¾ $\times$ 7	1 $\times$ 7	1 $\times$ 7	1¼ $\times$ 7
2½, 80	¼ $\times$ 7	⅝ $\times$ 7	½ $\times$ 7	⅝ $\times$ 7	¾ $\times$ 7	¾ $\times$ 7	1 $\times$ 7	1 $\times$ 7	1¼ $\times$ 7
3, 80	¼ $\times$ 8	⅝ $\times$ 8	½ $\times$ 8	⅝ $\times$ 8	¾ $\times$ 8	¾ $\times$ 8	1 $\times$ 8	1 $\times$ 8	1¼ $\times$ 8
4, 80	¼ $\times$ 9	⅝ $\times$ 9	½ $\times$ 9	⅝ $\times$ 9	¾ $\times$ 9	¾ $\times$ 9	1 $\times$ 9	1 $\times$ 9	1¼ $\times$ 9
5, 80	¼ $\times$ 10	⅝ $\times$ 10	½ $\times$ 10	⅝ $\times$ 10	¾ $\times$ 10	¾ $\times$ 10	1 $\times$ 10	1 $\times$ 10	1¼ $\times$ 10
6, 80	¼ $\times$ 12	⅝ $\times$ 12	½ $\times$ 12	⅝ $\times$ 12	¾ $\times$ 12	¾ $\times$ 12	1 $\times$ 12	1 $\times$ 12	1¼ $\times$ 12
8, 80	¼ $\times$ 14	⅝ $\times$ 14	½ $\times$ 14	⅝ $\times$ 14	¾ $\times$ 14	¾ $\times$ 14	1 $\times$ 14	1 $\times$ 14	1¼ $\times$ 14
10, 60	¼ $\times$ 16	⅝ $\times$ 16	½ $\times$ 16	⅝ $\times$ 16	¾ $\times$ 16	¾ $\times$ 16	1 $\times$ 16	1 $\times$ 16	1¼ $\times$ 16
12, 60	¼ $\times$ 18	⅝ $\times$ 18	½ $\times$ 18	⅝ $\times$ 18	¾ $\times$ 18	¾ $\times$ 18	1 $\times$ 18	1 $\times$ 18	1¼ $\times$ 18
14, 60	¼ $\times$ 20	⅝ $\times$ 20	½ $\times$ 20	⅝ $\times$ 20	¾ $\times$ 20	¾ $\times$ 20	1 $\times$ 20	1 $\times$ 20	1¼ $\times$ 20
16, 40	¼ $\times$ 22	⅝ $\times$ 22	½ $\times$ 22	⅝ $\times$ 22	¾ $\times$ 22	¾ $\times$ 23	1 $\times$ 22	1 $\times$ 23	1¼ $\times$ 24
18, 40	¼ $\times$ 24	⅝ $\times$ 24	½ $\times$ 24	⅝ $\times$ 24	¾ $\times$ 24	¾ $\times$ 25	1 $\times$ 24	1 $\times$ 25	1¼ $\times$ 28
20, 40	¼ $\times$ 26	⅝ $\times$ 26	½ $\times$ 26	⅝ $\times$ 26	¾ $\times$ 26	¾ $\times$ 27	1 $\times$ 26	1 $\times$ 27	1¼ $\times$ 30
22, 60	¼ $\times$ 28	⅝ $\times$ 28	½ $\times$ 28	⅝ $\times$ 28	¾ $\times$ 28	¾ $\times$ 29	1 $\times$ 28	1 $\times$ 29	1¼ $\times$ 32
24, 40	¼ $\times$ 30	⅝ $\times$ 30	½ $\times$ 30	⅝ $\times$ 30	¾ $\times$ 30	¾ $\times$ 31	1 $\times$ 30	1 $\times$ 31	1¼ $\times$ 33

^A See Fig. 2 and Fig. 3.TABLE 3 Insert Plate Dimensions ($T_I \times D$), NPS 1 Through NPS 24 (in. $\times$ in.)^A

Penetrating Pipe Size, NPS, SCH	Shell Plating Thickness (T), in.								
	¼ to ½	⅝	¾	⅞	1	1⅛	1¼	1⅝	1½
1, 80	1 $\times$ 8	1⅝ $\times$ 8¼	1¼ $\times$ 8½	1⅝ $\times$ 8¾	1½ $\times$ 9	1⅝ $\times$ 9¼	1¾ $\times$ 9½	1⅞ $\times$ 9¾	2 $\times$ 10
1¼, 80	1 $\times$ 8¼	1⅝ $\times$ 8½	1¼ $\times$ 8¾	1⅝ $\times$ 9	1½ $\times$ 9¼	1⅝ $\times$ 9½	1¾ $\times$ 10	1⅞ $\times$ 10¼	2 $\times$ 10½
1½, 80	1 $\times$ 8¾	1⅝ $\times$ 8¾	1¼ $\times$ 9	1⅝ $\times$ 9¼	1½ $\times$ 9½	1⅝ $\times$ 10	1¾ $\times$ 10	1⅞ $\times$ 10½	2 $\times$ 10¾
2, 80	1 $\times$ 9	1⅝ $\times$ 9¼	1¼ $\times$ 9½	1⅝ $\times$ 9¾	1½ $\times$ 10	1⅝ $\times$ 10¼	1¾ $\times$ 10½	1⅞ $\times$ 11	2 $\times$ 11
2½, 80	1 $\times$ 10	1⅝ $\times$ 10	1¼ $\times$ 10	1⅝ $\times$ 10¼	1½ $\times$ 10½	1⅝ $\times$ 10¾	1¾ $\times$ 11	1⅞ $\times$ 11¼	2 $\times$ 11½
3, 80	1 $\times$ 10½	1⅝ $\times$ 10¾	1¼ $\times$ 10¾	1⅝ $\times$ 11	1½ $\times$ 11¼	1⅝ $\times$ 11½	1¾ $\times$ 11¾	1⅞ $\times$ 12	2 $\times$ 12¼
4, 80	1 $\times$ 11	1⅝ $\times$ 11½	1¼ $\times$ 11¾	1⅝ $\times$ 12	1½ $\times$ 12¼	1⅝ $\times$ 12½	1¾ $\times$ 12¾	1⅞ $\times$ 13	2 $\times$ 13¼
5, 80	1 $\times$ 12	1⅝ $\times$ 12½	1¼ $\times$ 13	1⅝ $\times$ 13	1½ $\times$ 13¼	1⅝ $\times$ 13½	1¾ $\times$ 13¾	1⅞ $\times$ 14	2⅞ $\times$ 15
6, 80	1 $\times$ 13	1⅝ $\times$ 13½	1¼ $\times$ 14	1⅝ $\times$ 14	1½ $\times$ 14¼	1⅝ $\times$ 14½	1¾ $\times$ 14¾	1⅞ $\times$ 15	2⅞ $\times$ 16¼
8, 80	1 $\times$ 14	1⅝ $\times$ 14½	1¼ $\times$ 15	1⅝ $\times$ 16	1½ $\times$ 16¼	1⅝ $\times$ 16½	1¾ $\times$ 17	2 $\times$ 18	2½ $\times$ 19¼
10, 60	1 $\times$ 16	1⅝ $\times$ 17	1¼ $\times$ 18	1⅝ $\times$ 18¼	1½ $\times$ 18½	1⅝ $\times$ 18¾	2 $\times$ 20¾	2⅝ $\times$ 22¾	2¼ $\times$ 23
12, 60	1 $\times$ 18	1⅝ $\times$ 18½	1¼ $\times$ 19	1⅝ $\times$ 20	1½ $\times$ 20½	1⅝ $\times$ 20¾	2 $\times$ 22¾	2⅝ $\times$ 24¾	2½ $\times$ 25
14, 60	1 $\times$ 21	1⅝ $\times$ 21	1¼ $\times$ 21	1⅝ $\times$ 21½	1½ $\times$ 21¾	1⅝ $\times$ 22	2 $\times$ 24	2⅝ $\times$ 26	2⅝ $\times$ 25¾
16, 40	1 $\times$ 23	1⅝ $\times$ 23	1¼ $\times$ 23¼	1⅝ $\times$ 24¼	1¾ $\times$ 26½	2⅞ $\times$ 27½	2⅝ $\times$ 28½	2⅝ $\times$ 29¾	2⅞ $\times$ 31
18, 40	1 $\times$ 25	1⅝ $\times$ 25	1¼ $\times$ 25¼	1⅝ $\times$ 25½	1¾ $\times$ 27½	2⅞ $\times$ 29½	2⅝ $\times$ 30½	2⅝ $\times$ 31¾	2⅞ $\times$ 33
20, 40	1 $\times$ 27	1⅝ $\times$ 27¼	1¼ $\times$ 27¼	1⅝ $\times$ 28¼	1⅞ $\times$ 30½	2⅞ $\times$ 31½	2⅝ $\times$ 32½	2⅝ $\times$ 33¾	2⅞ $\times$ 35
22, 60	1 $\times$ 29	1⅝ $\times$ 29	1¼ $\times$ 29	1⅝ $\times$ 30	1⅞ $\times$ 30	2⅞ $\times$ 30	2⅝ $\times$ 33½	2⅝ $\times$ 34½	2⅞ $\times$ 36
24, 40	1 $\times$ 31	1⅝ $\times$ 31	1¼ $\times$ 31¼	1⅝ $\times$ 31½	1⅞ $\times$ 34½	2⅞ $\times$ 35½	2⅝ $\times$ 36½	2⅝ $\times$ 38	2⅞ $\times$ 39

^A See Fig. 4 and Fig. 5.

3.3.1 Class 1—Single-bevel insert plates. (Fig. 4)

3.3.2 Class 2—Double-bevel insert plates. (Fig. 5)

3.4 Type IV—Sleeve-reinforced penetrations. Fig. 6 details sleeve-reinforced penetrations.

3.4.1 Class 1—Sleeves of nonmachined steel tube. Table 4 provides minimum dimensions for nonmachined sleeves.

3.4.2 Class 2—Sleeves of machined steel tube or pipe. Table 5 provides minimum dimensions for machined sleeves.

3.4.3 Class 3—Sleeves of rolled steel flatbar or plate. Table 6 provides minimum dimensions for rolled sleeves.

4. Materials

4.1 Discharge pipe shall be of an acceptable material as specified by Title 46 CFR, 56.60-1.

4.2 Doubler and insert plates shall be of material with physical properties equal to or better than the reinforced shell plate.

4.3 Reinforcing sleeve material shall depend on the penetration pipe size:

Penetration Pipe Size	Sleeve Material
NPS 1 through NPS 10	Seamless Steel Tubing, Specification A519.
NPS 12 through NPS 18	Machined seamless steel pipe of same material as penetration pipe.
NPS 20 through NPS 24	Steel flatbar or plate of same or superior material as hull plate, manufactured with a full penetration, longitudinal butt weld.