



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

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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.

1.5 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

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

2.2 *ANSI Standard:*³

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

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.

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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 (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

2.3 *Military Document:*⁴

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

2.4 *Other Documents:*

[Title 46 Code of Federal Regulations \(CFR\), Subchapter F, Marine Engineering](#)⁴

[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.

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 Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

⁵ Available from Department of the Navy, Commander Naval Sea Systems Command, 1333 Isaac Hull Avenue, SE, Washington Navy Yard, DC 20376, <http://www.navsea.navy.mil>.

⁶ Available from American Bureau of Shipping (ABS), ABS Plaza, 16855 Northchase Dr., Houston, TX 77060, <http://www.eagle.org>.

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

Penetration Pipe Size, NPS	Shell Plating Thickness (T), in.								
	1/4 -1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
1	80	80	160	160	160	160	XXS	XXS	XXS
1 1/4	80	160	160	160	XXS	XXS	XXS	XXS	XXS
1 1/2	80	160	160	160	160	XXS	XXS	XXS	XXS
2	80	160	160	160	160	160	160	XXS	XXS
2 1/2	80	80	160	160	160	160	160	XXS	XXS
3	80	80	160	160	160	160	160	160	XXS
4	80	80	120	120	120	120	160	160	160
5	80	80	80	120	120	120	120	160	160
6	80	80	80	120	120	120	120	120	160
8	80	80	80	80	100	100	100	120	120
10	60	60	60	80	80	100	100	100	120
12	60	60	60	80	80	80	100	100	100
14	60	60	60	80	80	80	80	100	100
16	40	60	60	60	80	80	80	80	100
18	40	40	60	60	60	80	80	80	80
20	40	40	60	60	60	60	80	80	80
22	40	40	60	60	60	60	80	80	80
24	40	40	60	60	60	60	60	60	80

^A See Fig. 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.

5. General Requirements

5.1 Overboard discharges shall be combined to the maximum extent practicable to minimize the number of shell penetrations.

5.2 A minimum of 3 in. shall be maintained between the edge of penetrations and shell plate welding seams. Penetrations shall be located so as to provide sufficient space for welding between the penetration and shell longitudinals, stiffeners, or other structural members.

5.3 Shell penetrations located above the light load line shall be clear of side ports, accommodation ladders, lifeboat-handling areas, or other areas where discharge overboard is detrimental to normal operation of the vessel or would create a nuisance for personnel or other vessels in the area.

5.4 Overboard discharges shall be located to minimize recirculation into suction seachests.

5.5 Shell penetrations shall be located outside of cathodic protection areas.

5.6 Unfavorable flow characteristics may result when small diameter, extreme schedule penetration pipe is used in accordance with Table 1. In this case, minimum allowable schedule penetration pipe, with necessary reinforcement as specified in Tables 2-6, is suggested.

5.7 Penetration pipe extension past the shell plate shall be equal to the pipe wall thickness but not more than 3/8 in.

6. Welding

6.1 Welding shall be in accordance with Figs. 1-6 (see also ANSI B36.10).

6.2 Weld quality shall be in accordance with American Bureau of Shipping standards.

6.3 Fillet welds shall be equal to the penetration pipe wall thickness but not more than 3/8 in.

6.4 Weld quality for military vessels shall be in accordance with MIL-STD-1689.

7. Workmanship, Finish, and Appearance

7.1 Surface areas, corners, and discharge pipe ends shall be free of burrs and sharp edges.

8. Keywords

8.1 discharge hull penetration; hull penetration; marine technology; penetration connection; ships; system piping



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

Penetrating Pipe Size, NPS, SCH	Shell Plating Thickness (T), in.								
	1/4 to 1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
1, 80	1/4 x 5	3/8 x 5	1/2 x 5	5/8 x 5	3/4 x 5	3/4 x 5	1 x 5	1 x 5	1 1/4 x 5
1 1/4, 80	1/4 x 6	3/8 x 6	1/2 x 6	5/8 x 6	3/4 x 6	3/4 x 6	1 x 6	1 x 6	1 1/4 x 6
1 1/2, 80	1/4 x 6	3/8 x 6	1/2 x 6	5/8 x 6	3/4 x 6	3/4 x 6	1 x 6	1 x 6	1 1/4 x 6
2, 80	1/4 x 7	3/8 x 7	1/2 x 7	5/8 x 7	3/4 x 7	3/4 x 7	1 x 7	1 x 7	1 1/4 x 7
2 1/2, 80	1/4 x 7	3/8 x 7	1/2 x 7	5/8 x 7	3/4 x 7	3/4 x 7	1 x 7	1 x 7	1 1/4 x 7
3, 80	1/4 x 8	3/8 x 8	1/2 x 8	5/8 x 8	3/4 x 8	3/4 x 8	1 x 8	1 x 8	1 1/4 x 8
4, 80	1/4 x 9	3/8 x 9	1/2 x 9	5/8 x 9	3/4 x 9	3/4 x 9	1 x 9	1 x 9	1 1/4 x 9
5, 80	1/4 x 10	3/8 x 10	1/2 x 10	5/8 x 10	3/4 x 10	3/4 x 10	1 x 10	1 x 10	1 1/4 x 10
6, 80	1/4 x 12	3/8 x 12	1/2 x 12	5/8 x 12	3/4 x 12	3/4 x 12	1 x 12	1 x 12	1 1/4 x 12
8, 80	1/4 x 14	3/8 x 14	1/2 x 14	5/8 x 14	3/4 x 14	3/4 x 14	1 x 14	1 x 14	1 1/4 x 14
10, 60	1/4 x 16	3/8 x 16	1/2 x 16	5/8 x 16	3/4 x 16	3/4 x 16	1 x 16	1 x 16	1 1/4 x 16
12, 60	1/4 x 18	3/8 x 18	1/2 x 18	5/8 x 18	3/4 x 18	3/4 x 18	1 x 18	1 x 18	1 1/4 x 18
14, 60	1/4 x 20	3/8 x 20	1/2 x 20	5/8 x 20	3/4 x 20	3/4 x 20	1 x 20	1 x 20	1 1/4 x 20
16, 40	1/4 x 22	3/8 x 22	1/2 x 22	5/8 x 22	3/4 x 22	3/4 x 23	1 x 22	1 x 23	1 1/4 x 24
18, 40	1/4 x 24	3/8 x 24	1/2 x 24	5/8 x 24	3/4 x 24	3/4 x 25	1 x 24	1 x 25	1 1/4 x 28
20, 40	1/4 x 26	3/8 x 26	1/2 x 26	5/8 x 26	3/4 x 26	3/4 x 27	1 x 26	1 x 27	1 1/4 x 30
22, 60	1/4 x 28	3/8 x 28	1/2 x 28	5/8 x 28	3/4 x 28	3/4 x 29	1 x 28	1 x 29	1 1/4 x 32
24, 40	1/4 x 30	3/8 x 30	1/2 x 30	5/8 x 30	3/4 x 30	3/4 x 31	1 x 30	1 x 31	1 1/4 x 33

^A See Fig. 2 and Fig. 3.

TABLE 3 Insert Plate Dimensions ($T_i \times D_i$), NPS 1 Through NPS 24 (in. x in.)^A

Penetrating Pipe Size, NPS, SCH	Shell Plating Thickness (T), in.								
	1/4 to 1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
1, 80	1 x 8	1 1/8 x 8 1/4	1 1/4 x 8 1/2	1 3/8 x 8 3/4	1 1/2 x 9	1 5/8 x 9 1/4	1 3/4 x 9 1/2	1 7/8 x 9 3/4	2 x 10
1 1/4, 80	1 x 8 1/4	1 1/8 x 8 1/2	1 1/4 x 8 3/4	1 3/8 x 9	1 1/2 x 9 1/4	1 5/8 x 9 1/2	1 3/4 x 10	1 7/8 x 10 1/4	2 x 10 1/2
1 1/2, 80	1 x 8 3/4	1 1/8 x 8 3/4	1 1/4 x 9	1 3/8 x 9 1/4	1 1/2 x 9 1/2	1 5/8 x 10	1 3/4 x 10	1 7/8 x 10 1/2	2 x 10 3/4
2, 80	1 x 9	1 1/8 x 9 1/4	1 1/4 x 9 1/2	1 3/8 x 9 3/4	1 1/2 x 10	1 5/8 x 10 1/4	1 3/4 x 10 1/2	1 7/8 x 11	2 x 11
2 1/2, 80	1 x 10	1 1/8 x 10	1 1/4 x 10	1 3/8 x 10 1/4	1 1/2 x 10 1/2	1 5/8 x 10 3/4	1 3/4 x 11	1 7/8 x 11 1/4	2 x 11 1/2
3, 80	1 x 10 1/2	1 1/8 x 10 3/4	1 1/4 x 10 3/4	1 3/8 x 11	1 1/2 x 11 1/4	1 5/8 x 11 1/2	1 3/4 x 11 3/4	1 7/8 x 12	2 x 12 1/4
4, 80	1 x 11	1 1/8 x 11 1/2	1 1/4 x 11 3/4	1 3/8 x 12	1 1/2 x 12 1/4	1 5/8 x 12 1/2	1 3/4 x 12 3/4	1 7/8 x 13	2 x 13 1/4
5, 80	1 x 12	1 1/8 x 12 1/2	1 1/4 x 13	1 3/8 x 13	1 1/2 x 13 1/4	1 5/8 x 13 1/2	1 3/4 x 13 3/4	1 7/8 x 14	2 1/8 x 15
6, 80	1 x 13	1 1/8 x 13 1/2	1 1/4 x 14	1 3/8 x 14	1 1/2 x 14 1/4	1 5/8 x 14 1/2	1 3/4 x 14 3/4	1 7/8 x 15	2 1/8 x 16 1/4
8, 80	1 x 14	1 1/8 x 14 1/2	1 1/4 x 15	1 3/8 x 16	1 1/2 x 16 1/4	1 5/8 x 16 1/2	1 3/4 x 17	2 x 18	2 1/2 x 19 1/4
10, 60	1 x 16	1 1/8 x 17	1 1/4 x 18	1 3/8 x 18 1/4	1 1/2 x 18 1/2	1 5/8 x 18 3/4	2 x 20 3/4	2 3/8 x 22 3/4	2 1/4 x 23
12, 60	1 x 18	1 1/8 x 18 1/2	1 1/4 x 19	1 3/8 x 20	1 1/2 x 20 1/2	1 5/8 x 20 3/4	2 x 22 3/4	2 3/8 x 24 3/4	2 1/2 x 25
14, 60	1 x 21	1 1/8 x 21	1 1/4 x 21	1 3/8 x 21 1/2	1 1/2 x 21 3/4	1 5/8 x 22	2 x 24	2 3/8 x 26	2 5/8 x 25 3/4
16, 40	1 x 23	1 1/8 x 23	1 1/4 x 23 1/4	1 3/8 x 24 1/4	1 3/4 x 26 1/2	2 1/8 x 27 1/2	2 3/8 x 28 1/2	2 5/8 x 29 3/4	2 7/8 x 31
18, 40	1 x 25	1 1/8 x 25	1 1/4 x 25 1/4	1 3/8 x 25 1/2	1 3/4 x 27 1/2	2 1/8 x 29 1/2	2 3/8 x 30 1/2	2 5/8 x 31 3/4	2 7/8 x 33
20, 40	1 x 27	1 1/8 x 27 1/4	1 1/4 x 27 1/4	1 3/8 x 28 1/4	1 7/8 x 30 1/2	2 1/8 x 31 1/2	2 3/8 x 32 1/2	2 5/8 x 33 3/4	2 7/8 x 35
22, 60	1 x 29	1 1/8 x 29	1 1/4 x 29	1 3/8 x 30	1 7/8 x 30	2 1/8 x 30	2 3/8 x 33 1/2	2 5/8 x 34 1/2	2 7/8 x 36
24, 40	1 x 31	1 1/8 x 31	1 1/4 x 31 1/4	1 3/8 x 31 1/2	1 7/8 x 34 1/2	2 1/8 x 35 1/2	2 3/8 x 36 1/2	2 5/8 x 38	2 7/8 x 39

^A See Fig. 4 and Fig. 5.



TABLE 4 Reinforcing Sleeve Dimensions, NPS 1 Through NPS 5 (Seamless Steel Tubing)^A

Penetration Pipe Size, NPS, SCH	Sleeve Size, in.	Shell Plating Thickness (T), in.								
		1/4 – 1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
1, 80	outer diameter	1 7/8	1 7/8	1 7/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8
	wall thickness	1/4	1/4	1/4	3/8	3/8	3/8	3/8	3/8	3/8
	length	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	3
1 1/4, 80	outer diameter	2 1/4	2 1/4	2 1/4	2 1/4	3	3	3	3	3
	wall thickness	9/32	9/32	9/32	9/32	5/8	5/8	5/8	5/8	5/8
	length	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4
1 1/2, 80	outer diameter	2 1/2	2 1/2	2 1/2	3	3	3	3	3	3
	wall thickness	9/32	9/32	9/32	1/2	1/2	1/2	1/2	1/2	1/2
	length	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3
2, 80	outer diameter	3 1/8	3 1/8	3 1/8	3 1/8	4	4	4	4	4
	wall thickness	5/16	5/16	5/16	5/16	3/4	3/4	3/4	3/4	3/4
	length	1 3/4	1 7/8	2 1/4	2 1/2	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4
2 1/2, 80	outer diameter	4	4	4	4	4	4	4	4	4
	wall thickness	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
	length	1 3/4	1 7/8	2	2 1/8	2 1/2	2 3/4	3	3 1/2	3 5/8
3, 80	outer diameter	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 5/8	4 5/8	4 5/8
	wall thickness	7/16	7/16	7/16	7/16	7/16	7/16	1/2	1/2	1/2
	length	1 3/4	1 7/8	2 1/4	2 3/4	3	3 3/8	3 1/2	3 3/4	4 1/8
4, 80	outer diameter	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4
	wall thickness	13/16	13/16	13/16	13/16	13/16	13/16	13/16	13/16	13/16
	length	1 3/4	1 7/8	2	2 1/8	2 1/2	2 3/4	3	3 1/4	3 1/2
5, 80	outer diameter	6 5/8	7 5/8	7 5/8	7 5/8	7 5/8	8	8 5/8	8 5/8	8 5/8
	wall thickness	1/2	1	1	1	1	1 3/16	1 1/2	1 1/2	1 1/2
	length	2	2	2	2 1/8	2 1/2	2 1/2	2 1/2	2 3/4	3

^A See Fig. 6.

TABLE 5 Reinforcing Sleeve Dimensions, NPS 6 Through NPS 12 (Machined Seamless Steel Tube)^A

Penetration Pipe Size, NPS, SCH	Sleeve Size, in.	Shell Plating Thickness (T), in.								
		1/4 – 1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
6, 80	tube outer diameter	8 1/2	8 1/2	8 1/2	8 1/2	9	9	9 1/2	9 1/2	10
	machined inner diameter	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4
	length	1 3/4	2	2 1/4	2 1/2	2 1/2	2 3/4	2 3/4	3	3
8, 80	tube outer diameter	10	10	10 1/2	10 1/2	11	11	11 1/2	11 1/2	12
	machined inner diameter	8 3/4	8 3/4	8 3/4	8 3/4	8 3/4	8 3/4	8 3/4	8 3/4	8 3/4
	length	2 1/4	2 3/4	2 3/4	3	3	3 1/4	3 1/4	3 1/2	3 1/2
10, 60	tube outer diameter	12	12	12 1/2	12 3/4	13 3/8	13 3/8	13 3/8	14	14
	machined inner diameter	10 7/8	10 7/8	10 7/8	10 7/8	10 7/8	10 7/8	10 7/8	10 7/8	10 7/8
	length	2 3/4	3 1/4	3 1/4	3 1/4	3 1/4	3 1/4	3 3/4	3 3/4	4
12, 60	tube outer diameter	14	14 3/8	14 3/8	15	15	16	16	16	16
	machined inner diameter	12 7/8	12 7/8	12 7/8	12 7/8	12 7/8	12 7/8	12 7/8	12 7/8	12 7/8
	length	3	3	3 1/2	3 1/2	3 3/4	3 3/4	3 1/2	3 3/4	4 1/4

^A See Fig. 6.