
Standard Specification for Turnbuckles and Shackles

AASHTO Designation: M 269-96 (2022)

Technically Revised: 1996

Reviewed but Not Updated: 2022

Technical Subcommittee: 4d, Safety Devices



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
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1. SCOPE

- 1.1. *Scope*—This specification covers forged turnbuckles, with and without jam nuts, and shackles for guardrail, sign supports, and similar uses. These items are considered to be available commercially. Not all classes, styles, and types of turnbuckles and shackles that are available commercially are covered by this specification.
- 1.2. *Classification:*
- 1.2.1. *Turnbuckles:*
- 1.2.1.1. *Type*—Turnbuckles covered by this specification shall be forged and of the design specified by the purchaser.
- 1.2.1.2. *Sizes*—Turnbuckles covered by this specification shall be of the sizes listed in Table 2, as specified.
- 1.2.2. *Shackles:*
- 1.2.2.1. Shackles shall be one of the classes in Table 1, as specified by the purchaser.

Table 1—Classes of Shackles

Class 1—Screw-pin anchor shackles
Class 2—Screw-pin chain shackles
Class 3—Oval-pin chain shackles
Class 4—Round-pin anchor shackles
Class 5—Round-pin chain shackles
Class 6—Bolt-type anchor shackles

- 1.3. The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- [M 102M/M 102](#), Steel Forgings, Carbon and Alloy, for General Industrial Use
 - [M 169](#), Steel Bars, Carbon and Alloy, Cold-Finished
 - [M 232M/M 232](#), Zinc Coating (Hot-Dip) on Iron and Steel Hardware

- **T 65M/T 65**, Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

2.2. *National Institute of Standards and Technology (NIST) Standard:*

- Handbook H28, Screw Thread Standards for Federal Services

2.3. *ANSI/ASME Standard:*

- B18.2.2, Heavy Hex Jam Nuts

2.4. *Military Standard:*

- MIL-P-21035, Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

3. MATERIALS AND MANUFACTURE

3.1. *Materials:*

3.1.1. *Turnbuckles*—Unless otherwise specified, material for turnbuckles and end pulls shall comply with **M 102M/M 102** and be of a grade that will meet the requirements of Table 2.

Table 2—Breaking Strength of Forged Turnbuckles (Complete with End Pulls)

Size, Nominal Outside Diameter of Thread, mm (in.)	Breaking Strength, kN (lb) Min	Recommended Working Loads, kN (lb)
	Eye or Stub End Pulls, kN (lb)	Eye or Stub End Pulls, kN (lb)
19.0 (³ / ₄)	89.0 (20,000)	17.8 (4,000)
22.2 (⁷ / ₈)	129.0 (29,000)	25.8 (5,800)
25.4 (1)	169.0 (38,000)	33.8 (7,600)
31.8 (1 ¹ / ₄)	266.9 (60,000)	53.4 (12,000)
34.9 (1 ³ / ₈)	320.3 (72,000)	64.0 (14,400)
38.1 (1 ¹ / ₂)	378.1 (85,000)	75.6 (17,000)
44.4 (1 ³ / ₄)	511.5 (115,000)	102.3 (23,000)
50.8 (2)	667.2 (150,000)	133.4 (30,000)
57.2 (2 ¹ / ₄)	876.3 (197,000)	175.2 (39,400)

3.1.2. *Shackles*—Each shackle, together with its pin or bolt, shall be forged at elevated temperature for final shape and size, in conformance with **M 102M/M 102**, Class AH.

3.2. *Construction:*

3.2.1. *Turnbuckles:*

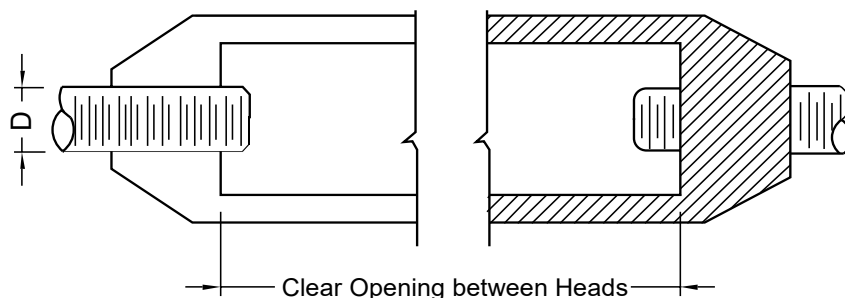
3.2.1.1. *Method*—Each turnbuckle body and each end pull shall be forged at elevated temperature to final shape and size.

3.2.1.2. *Size*—Turnbuckles covered by this specification shall be furnished in the sizes shown in Table 3, clear opening between heads, as specified. The size of turnbuckle bodies shall be the nominal major diameter of the threads in the heads and the clear opening between heads (which is approximately equal to the take-up); thus, for a 19-by-152-mm (³/₄-by-6-in.) turnbuckle body, the heads shall be threaded for a 19-mm (³/₄-in.) nominal major-diameter end pull, and the clear opening between heads shall be 152 mm (6 in.). The difference between the actual clear opening in the turnbuckle body and the nominal value given in Table 4 for the size specified shall not exceed 5 percent of the nominal value.

Table 3—Turnbuckles

Thread, Nominal Outside Diameter, mm (in.)	Size						
	Clear Opening between Head, mm (in.)						
	152.4 (6)	228.6 (9)	304.8 (12)	457.2 (18)	609.6 (24)	914.4 (36)	1219.2 (48)
19.0 (³ / ₄)	X	X	X	X	X	—	—
22.2 (⁷ / ₈)	—	—	X	X	X	—	—
25.4 (1)	—	—	X	X	X	X	—
31.8 (1 ¹ / ₄)	—	—	X	X	X	X	—
38.1 (1 ¹ / ₂)	—	—	X	X	X	X	X
44.4 (1 ³ / ₄)	—	—	—	X	X	X	X
50.8 (2)	—	—	—	—	X	X	X
57.2 (2 ¹ / ₄)	—	—	—	—	X	X	X

- 3.2.1.3. *Length of Head*—The length of the heads of the turnbuckle bodies shall be not less than 1.5 times the nominal outside diameter of the end pull for sizes up to 31.8 mm (1¹/₄ in.), and 1.25 times for sizes 31.8 mm (1¹/₄ in.) and above.
- 3.2.1.4. *Thread*—Turnbuckle bodies and end pulls shall be threaded after fabrication to final size and shape. The threads in the heads of the turnbuckle bodies and on the end pulls shall comply with NIST H28 (National Institute of Standards and Technology Specification H28, Screw-Thread Standards for Federal Services). Unified threads in the coarse (UNC) standard series (Table 5) should be used. If the standard diameter–pitch combinations are not suitable, the UNS threads with dimensions in accordance with NBS H28 should be used. Threads on the finished turnbuckle shall not be looser than Class 1A/1B fit. The female threads on the turnbuckle body may be oversized as necessary, so that after coating they will properly mate (not looser than Class 1A/1B fit) with the standard-size male threads of the end pulls. The thread in one head of each turnbuckle body shall be right-hand and in the other head left-hand. The threads on the end pulls shall be great enough so that the ends of the end pulls can be brought into contact with each other at the middle of the body length when jam nuts are not used.
- 3.2.1.5. *Breaking Strength*—The breaking strength of turnbuckles, equipped with end pulls, shall be not less than the value given in Table 2 for the required size, type, and form of end pull specified.
- 3.2.1.6. *Turnbuckle Bodies, Types*—Open turnbuckles shall be forged as specified. Forged turnbuckle bodies shall be similar to Figure 1. They shall be forged as specified. The shape of the head of the turnbuckle body shall be either round or hexagonal.

**Figure 1**—Open Turnbuckle Body, Forged

- 3.2.1.7. *Jam Nuts*—Jam nuts shall be right-hand or left-hand threaded, as required, made of carbon steel of a type selected from group 1016 to 1020 inclusive for M 169, and shall conform to the dimensional requirements of ANSI/ASME B18.2.2, Heavy Hex Jam Nuts.

- 3.2.1.8. *End Pulls*—Eye end pulls shall be forged, similar to Figure 2. The shape of the eye may be either oval or round. Minimum dimensions are as shown in Table 4.

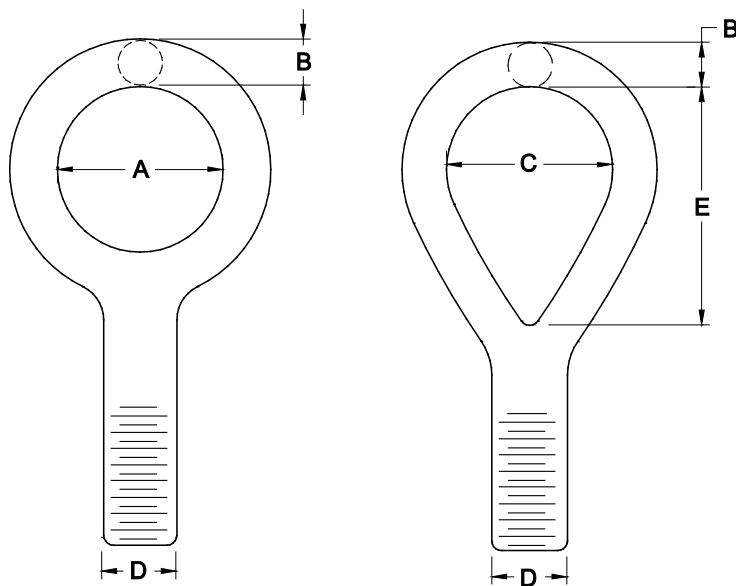


Figure 2—Forged-Eye End Pull

Table 4—Dimensions of Eye End Pulls, mm (in.)

D Nominal	A Minimum	B Minimum	C Minimum	E Minimum
19.0 ($\frac{3}{4}$)	38.1 ($1\frac{1}{2}$)	15.9 ($\frac{5}{8}$)	25.4 (1)	41.3 ($1\frac{5}{8}$)
22.2 ($\frac{7}{8}$)	44.4 ($1\frac{3}{4}$)	19.0 ($\frac{3}{4}$)	31.8 ($1\frac{1}{4}$)	47.6 ($1\frac{7}{8}$)
25.4 (1)	50.8 (2)	22.2 ($\frac{7}{8}$)	36.5 ($1\frac{7}{16}$)	57.2 ($2\frac{1}{4}$)
31.8 ($1\frac{1}{4}$)	54.0 ($2\frac{1}{8}$)	27.0 ($1\frac{1}{16}$)	42.9 ($1\frac{11}{16}$)	65.1 ($2\frac{9}{16}$)
38.1 ($1\frac{1}{2}$)	57.2 ($2\frac{1}{4}$)	31.8 ($1\frac{1}{4}$)	54.0 ($2\frac{1}{8}$)	82.6 ($3\frac{1}{4}$)
44.4 ($1\frac{3}{4}$)	63.5 ($2\frac{1}{2}$)	36.5 ($1\frac{7}{16}$)	60.3 ($2\frac{3}{8}$)	95.2 ($3\frac{3}{4}$)
50.8 (2)	76.2 (3)	41.2 ($1\frac{5}{8}$)	68.3 ($2\frac{11}{16}$)	111.1 ($4\frac{3}{8}$)
57.2 ($2\frac{1}{4}$)	82.5 ($3\frac{1}{4}$)	46.0 ($1\frac{13}{16}$)	74.6 ($2\frac{15}{16}$)	131.8 ($5\frac{3}{16}$)

- 3.2.2. *Shackles:*
- 3.2.2.1. *Threads*—Screw-pin shackles shall be threaded after fabrication to final size and shape. Threads shall conform to National Coarse Series as shown in Table 5. Appropriate portions of Section 3.2.1.4 shall apply to shackles.
- 3.2.2.2. *Size*—Shackles shall have the dimensions shown in Tables 6 through 17 for the appropriate class of shackle.

Table 5—Coarse Thread Series, Basic Dimensions, UNC

Nominal Size and Basic Major Diameter, D in.	Threads per Inch, n	Basic Pitch Diameter E , in.	Minor Diameter, External Threads, K_s , in.	Minor Diameter, Internal Threads, K_n , in.	Lead Angle at Basic Pitch Diameter λ , Deg.		Sectional Area at Minor Diameter at $D-2h_o$, Min., in. ²	Tensile Stress Area $\pi \left(\frac{E}{2} - \frac{3H}{16} \right)^2$, in. ²
0.500	13	0.4500	0.4056	0.4167	3	7	0.1257	0.1419
0.5625	12	0.5084	0.4603	0.4723	2	59	0.162	0.182
0.625	11	0.5660	0.5135	0.5268	2	56	0.202	0.226
0.750	10	0.6850	0.6273	0.6417	2	40	0.302	0.334
0.875	9	0.8028	0.7387	0.7547	2	31	0.419	0.462
1.000	8	0.9188	0.8466	0.8647	2	29	0.551	0.606
1.125	7	1.0322	0.9497	0.9704	2	31	0.693	0.763
1.250	7	1.1572	1.0747	1.0954	2	15	0.890	0.969
1.375	6	1.2667	1.1705	1.1946	2	24	1.054	1.155
1.500	6	1.3917	1.2955	1.3196	2	11	1.294	1.405
1.750	5	1.6201	1.5046	1.5335	2	15	1.74	1.90
2.000	4.5	1.8557	1.7274	1.7594	2	11	2.30	2.50
2.250	4.5	2.1057	1.9774	2.0094	1	55	3.02	3.25
2.500	4	2.3376	2.1933	2.2294	1	57	3.72	4.00
2.750	4	2.5876	2.4433	2.4794	1	46	4.62	4.93

3.3. *Finish:*

3.3.1. *Surface Condition*—Turnbuckle bodies and end pulls shackles shall be finished by grinding the flash smooth, where required, and removing the loose scale. They shall be free of cracks, flaws, seams, and other injurious imperfections.

3.3.2. *Zinc Coating*—Turnbuckles and shackles and accessories shall be galvanized (zinc coated) by the hot-dip process. The hot-dip process shall be applied in conformance with [M 232M/M 232](#), and shall be adherent, smooth, and free from injurious lumps, blisters, dross, or flux. Coating shall be done on the end pulls and threaded pins after threading; coating for turnbuckle bodies, shackles and jam nuts may be done before or after tapping at the option of the purchaser.

3.3.3. *Galvanizing Repair*—Where the galvanizing on turnbuckles, shackles, end pulls, or pins has been damaged, the coating shall be repaired by regalvanizing, or the surface repaired by painting with two coats of zinc dust–zinc oxide paint conforming to MIL-P-21035.

3.4. *Physical Properties of Shackles:*

3.4.1. *Proof Loads*—Shackles shall be capable of withstanding the proof loads shown in the respective class tables when tested as specified in Section 5.1.1 without developing surface rupture or defects that interfere with serviceability or prevent disassembly of the pin. After proof loading, screw-pin shackles shall be capable of disassembly by hand after the first half turn.

3.4.2. *Breaking Loads*—Shackles shall be able to withstand, without breaking, the breaking loads shown in the respective class tables when tested as specified in Section 5.2.

3.4.3. *Ductility*—Shackles shall be sufficiently ductile that, when fractured, the fractured member shall show a permanent distortion before breaking. If the pin fractures, it shall show a permanent bend of not less than 20 degrees. If the body fractures, it shall show a permanent midshackle set of not less than 15 percent of the original spread between bows.

- 3.4.4. *Class 1, Screw-Pin Anchor Shackles*—The screw-pin anchor shackles shall be similar to Figure 3 and shall conform to the dimensions and physical requirements shown in Tables 6 and 7.

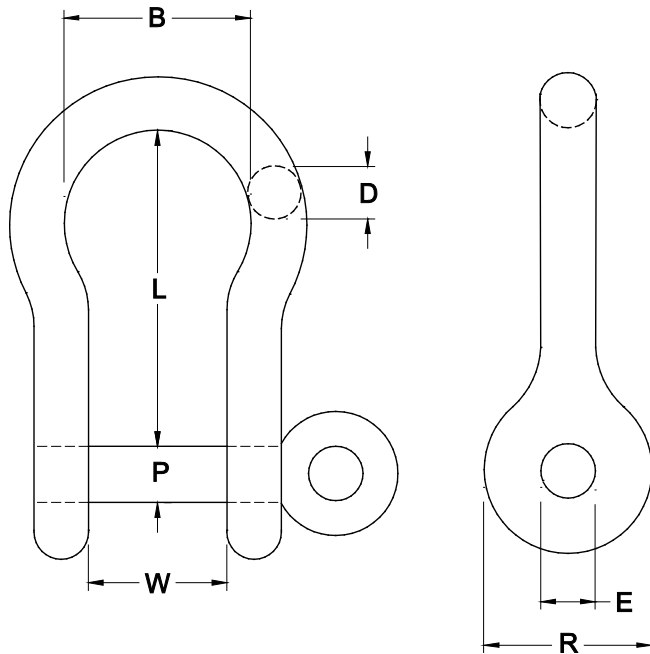


Figure 3—Class 1, Screw-Pin Anchor Shackles

Table 6—Class 1, Screw-Pin Anchor Shackles

Size <i>D</i> , mm	Diameter of Pin (<i>P</i>), mm (Min)	Width between Eyes (<i>W</i>), mm	Tolerance in Width between Eyes (<i>W</i>), mm	Length Inside (<i>L</i>), mm	Tolerance (Plus or Minus) in Inside Length (<i>L</i>), mm	Width Bow (<i>B</i>), mm	Major Diameter Threaded Eye, mm (Max)	Outside Diameter of Eye (<i>R</i>), mm (Max)	Diameter Unthreaded Eye (<i>E</i>), mm (Max)	Mass per 100 Shackles (Approx), kg	Proof Load, kN (Min)	Breaking Loads, kN (Min)
6.35	7.94	11.91	−0.8 + 2.4	28.58	1.59	19.05	8.73	22.22	10.32	5.4	4	16
7.64	9.52	13.49	−0.8 + 2.4	31.75	1.59	20.64	10.32	25.40	11.91	9.5	6	24
9.52	11.11	16.67	−0.8 + 2.4	36.51	1.59	23.18	11.91	28.58	13.49	14.5	9	35
11.11	12.70	18.26	−0.8 + 2.4	42.86	1.59	26.99	13.49	31.75	15.08	22.2	12	48
12.70	15.88	20.64	−1.6 + 2.4	49.21	1.59	30.16	16.67	34.92	18.26	33.1	18	63
14.29	15.88	22.22	−1.6 + 2.4	53.98	1.59	34.92	16.67	41.28	18.26	41.7	24	80
15.88	19.05	26.99	−1.6 + 2.4	63.50	3.18	38.10	19.84	47.62	21.43	68.5	27	98
19.05	22.22	31.75	−1.6 + 2.4	76.20	6.35	44.45	23.02	57.15	24.61	102.5	40	141
22.22	25.40	36.51	−1.6 + 2.4	82.55	6.35	50.80	26.19	60.32	27.78	154.2	53	192
25.40	28.58	42.86	−1.6 + 3.2	95.25	6.35	58.74	29.37	66.68	30.96	224.5	71	260
28.58	31.75	46.04	−1.6 + 3.2	107.95	6.35	66.68	32.94	76.20	34.13	313.4	96	298
31.75	34.92	50.80	−1.6 + 3.2	114.30	6.35	73.02	36.12	82.55	37.31	407.8	122	367
34.92	38.10	57.15	−3.2 + 4.8	133.35	6.35	82.55	39.29	88.90	41.28	552.9	149	444
38.10	41.28	60.32	−3.2 + 4.8	146.05	6.35	85.72	42.46	95.25	44.45	723.5	184	528
41.28	44.45	66.68	−3.2 + 4.8	158.75	6.35	104.78	45.64	104.78	47.62	866.4	222	620
44.45	50.80	73.02	−3.2 + 4.8	177.80	6.35	114.30	51.99	114.30	54.77	1247.4	264	718
50.80	57.15	82.55	−3.2 + 4.8	196.85	6.35	127.00	58.34	130.18	61.12	1769.0	310	939
57.15	63.50	98.42	−3.2 + 4.8	222.25	6.35	139.70	64.69	142.88	67.47	2562.8	359	1201
63.50	69.85	104.78	−3.2 + 4.8	254.00	6.35	152.40	71.04	149.22	73.82	3787.5	469	1503