

Dimensions of 35-, 70- and Combination 70/35-mm Motion-Picture Projection Reels

1. Scope

- 1.1 This standard specifies the dimensions of 35-mm projection reels for motion-picture and television applications and 35- and 70-mm projection reels intended for use on combination 70/35-mm projectors and rewinds.
- 1.2 This standard does not apply to shipping reels as specified in American National Standard Dimensions of Shipping Reels for 35-mm Motion-Picture Prints, ANSI PH22.192-1976.

2. Applications

- 2.1 For conventional application, the 2000-ft (610-m) capacity reel shall be preferred, except in applications where the practice is to combine reels.
- 2.2 For television application, the 3000-ft (914-m) capacity reel shall be preferred.
- 2.3 The 1000-ft (305-m) capacity reel is in general use for laboratory and television applications. It should not be used in theatrical projection because the tension on the 2-in (50.8-mm) core may be excessive.

3. Dimensions

- 3.1 The dimensions of the reels shall be as given in the figures and table.
- 3.2 Dimension F defines the area over which the reel thickness, specified by Dimension C₂, applies.
- 3.3 Dimension M in Fig. 2 indicates a clearance for the driving pin in the reel hub.

3.4 Fig. 4 illustrates an optional spindle hole for reel capacities of 3000 ft and less, but mandatory for large-capacity, 70-mm, and 35-mm combination reels. The four driving holes are intended for use on spindles whose diameter is 0.500 + 0.000 - 0.005 in (12.70 + 0.00 - 0.13 mm) and driven by a pin of 0.250-in (6.35-mm) nominal diameter, engaging in one of the driving holes.

3.5 Fig. 5 illustrates the standard spindle hole for use with 3/16-in spindles. This hole is preferred for reel capacities of 3000 ft and less.

3.6 The centerlines indicated for all figures are coincident.

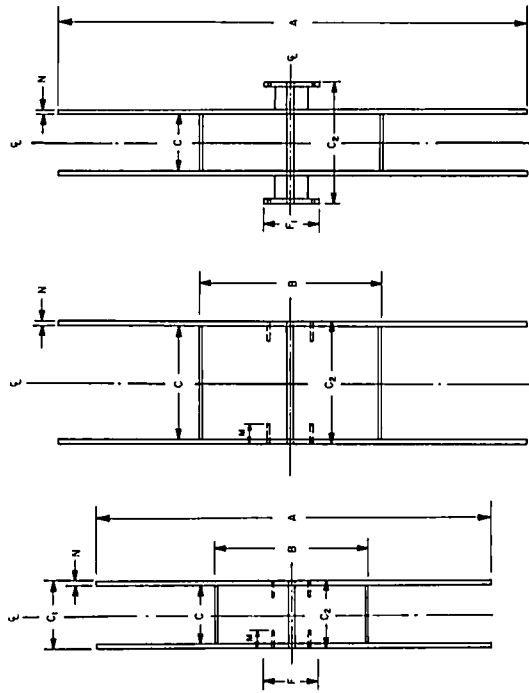


FIG. 1
35-MM REEL

FIG. 2
70-MM REEL

FIG. 3
35-MM REEL FOR
COMBINATION PROJECTORS

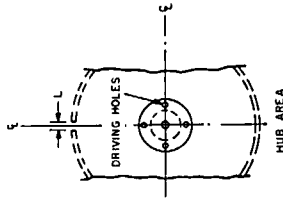


FIG. 4
ENLARGED VIEW OF SPINDLE
AND DRIVING HOLE

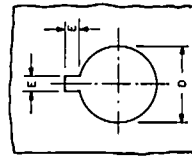


FIG. 5
ENLARGED VIEW
OF HOLE IN BOTH FLANGES

Optional System
(See 3.4)

Preferred System
(See 3.5)

PH22.4

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Dimensions	Inches	Millimeters
A (1000 ft, 305 m)	9.90 ± 0.00 — 0.20	251.5 ± 0.0 — 5.1
A (2000 ft, 610 m)	15.00 ± 0.00 — 0.05	381.0 ± 0.0 — 1.3
A (3000 ft, 914 m)	16.90 ± 0.00 — 0.05	429.3 ± 0.0 — 1.3
A (4000 ft, 1219 m)	21.75 ± 0.03	552.4 ± 0.8
A (4300 ft, 1300 m)	21.00 ± 0.06	533.4 ± 1.5
A (5600 ft, 1700 m)	23.70 ± 0.06	602.0 ± 1.5
A (5800 ft, 1775 m)	24.50 ± 0.06	622.3 ± 1.5
B (1000 ft)	1.95 ± 0.10	49.5 ± 2.5
B (2000 ft)	5.00 ± 0.10	127.0 ± 2.5
B (3000 ft)	5.00 ± 0.10	127.0 ± 2.5
B (4000 ft)	8.00 ± 0.03	203.2 ± 0.8
B (4300 ft)	7.00 ± 0.03	177.8 ± 0.8
B (5600 ft)	8.00 ± 0.03	203.2 ± 0.8
B (5800 ft)	8.00 ± 0.03	203.2 ± 0.8
C (35-mm)	1.530 ± 0.075 — 0.030	38.86 ± 1.90 — 0.76
C (70-mm)	2.87 ± 0.03	72.9 ± 0.8
C (35-mm combination)	1.530 ± 0.03	38.86 ± 0.8
C ₁ (35-mm)	1.885 ± 0.075 — 0.030	47.88 ± 1.90 — 0.76
C ₂ (35-mm)	1.625 ± 0.175 — 0.030	41.28 ± 4.44 — 0.76
C ₃ (70-mm end 35-mm combination)	3.41 ± 0.03	86.6 ± 0.8
D	0.317 ± 0.002	8.05 ± 0.05
E	0.150 ± 0.010	3.81 ± 0.25
F	2.25 min	57.2 min
F ₁	2.50 min	63.5 min
G	0.265 ± 0.002	6.73 ± 0.05
H	0.782 nom	19.86 nom
J	0.375 nom	9.52 nom
K (diameter)	0.505 ± 0.003 — 0.000	12.83 ± 0.08 — 0.00
L (threading slot, 35-mm)	0.035 nom	0.89 nom
L (threading slot, 70-mm and 35-mm combination)	0.060 nom	1.52 nom
M	0.75 min	19.0 min
N (flange thickness)	0.27 nom	6.9 nom

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

- A1.** Specifications for the reels are based on good engineering design of film winding equipment and on minimum tension variation between hub and rim. Film tension in a projector feed and take-up mechanism should be kept low to avoid perforation damage. In order to maintain low tension where a constant-torque clutch device is used, it is necessary to keep the quotient B/A (hub diameter B divided by flange diameter A) as large as possible. In this standard, the quotient is 0.333, which maintains the initial film tension to final film tension within the 3:1 ratio. Complete interchangeability may require some adjustment in the take-up and hold-back tensions of the projector, maintaining the lowest film tension possible and still wind a full reel.
- A2.** In designing reels of the size and weight described in this standard, it is the practice to chamfer the spindle hole to facilitate placing the reel on the spindle. The degree of chamfer should be in accordance with good engineering practice, and should not reduce the bearing surface of the spindle hole on the spindle to the point of endangering reel stability.
- A3.** Although this standard does not preclude reels of other diameters or design, the rim-to-hub ratio referred to in A1 remains a factor of consideration for any projector with an uncompensated constant-torque clutch in the feed or take-up mechanism.
- A4.** To minimize perforation damage, projector operators using large-capacity reels are cautioned against allowing film slack to accumulate. Film wound too loosely may slip on itself causing scratches and cinch marks.

Proposed American National Standard

Dimensions of Projection Reels for 8-mm Type S Motion-Picture Film (100- to 312-mm Diameter)

PH22.160M
Revision of
ANSI PH22.160-1977

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1. Scope

This standard specifies the dimensions of 8-mm Type S motion-picture projection reels of 100- to 312-mm (3.94- to 12.28-in) diameter with nominal film capacities up to 360 m (1200 ft).

2. Dimensions

- 2.1** The dimensions shall be as given in the figures and tables.
- 2.2** The dimensions apply regardless of the material used for construction. (See Note 5.)
- 2.3** Dimension H applies from the surface of the hub to the periphery of the flanges.
- 2.4** The minimum Dimension K represents the diameter of the central portion of the reel centered on the spindle hole axis, over which the effective central thickness, J, of the reel is intended to apply. (See 2.5.)
- 2.5** Dimension J applies only within the maximum K diameter area and represents the distance or effective distance between the respective reference planes of rotation for each flange.
- 2.6** Selection of a value for Dimension P is dependent upon the thickness of the material used for the flanges. According to the flange material thickness: (1) the K diameter area may be depressed (with P greater than zero); or (2) the outside surfaces of the flanges may be flat from the spindle hole area to the periphery (with P equal to zero); or (3) in the case of flanges made of very thin material, the K diameter area may be raised rather than recessed (effectively, P less than zero).
- 2.6.1** The P value for one flange should not differ from the corresponding P value for the other flange by more than 0.5 mm (0.02 in).

2.6.2 Any chosen flange thickness shall be maintained within ± 0.13 mm (0.005 in) from 5.0 mm (0.20 in) of the hub to within 5.0 mm of the periphery of the reel flange for reel size 10, and 10.0 mm (0.39 in) from the hub to within 10.0 mm of the periphery for reel size 13 and larger. Intentional special configurations, art work, depressions, or cutouts are excluded from this tolerance limitation.

2.7 If film attachment is provided by a slot in the reel hub, a minimum cutout in the hub is required for easy access to the film end, and to provide for insertion of a film-retention plug or clip for automatic rewind equipment. The stippled area shown in Fig. 1 represents one type of cutout which might be used. The cutout area should be in both flanges so that a retaining clip of width J could be accommodated. The minimum cutout area is outlined within the stippled area and defined by Dimensions R, S, and T (Dimension S is perpendicular to Dimension T). However, the manufacturer may provide an incorporated means of film retention in the design of the reel by use of a special retention plug or clip or other suitable means of film attachment. If a plug or clip is used, it shall not protrude beyond Dimension J for reel-to-reel operation. The cutout area is not required when this is done; however, its supplemental inclusion is recommended when feasible. (See Note 4 for film attachment details.)

2.8 Dimension P_m for each flange is measured at the periphery of the flange and is the greatest distance measured outwardly from the flange reference plane of rotation when the reel is rotated on a test spindle and held against the reference K minimum zone surface. (See Fig. 2.)

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2.9 Dimension P_c for each flange applies anywhere on the outside flange surface opposite the junction of the hub periphery and the flange, and is measured to the same reference plane of rotation used in measuring P_m . An angular envelope is defined by the conical surfaces joining the P_m (max) loci with the particular P_c (max) loci on the outside surfaces of the flanges directly opposite the junction of the hub periphery and the flanges. All other points on the flanges (including rivets or other fastening devices, variations in flange

thickness, flatness, and lateral runout) shall fall within the angular volume-of-rotation envelope.

2.10 The runout of the hub, Dimension E, is specified by Dimension U referenced from the axis through the center of the spindle hole. Dimension C. A similar allowance is provided for the concentricity of the spindle hole and the flanges in the maximum volume-of-rotation diagram by having Dimension V exceed Dimension M maximum by 0.5 mm (0.02 in) for reel sizes up to and including No. 16, and by 0.8 mm (0.03 in) for larger reel sizes.

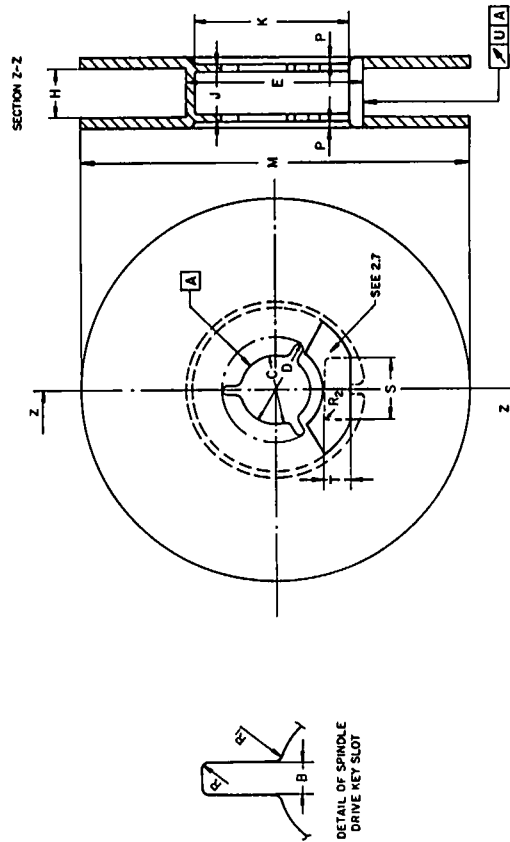


Fig. 1
Reel Dimensions

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PH22.160M

Table 1

Reel Size Number*	Nominal Reel Capacity m ft	Dimensions	Millimeters	Inches
10	30 100	M	100.0 ± 1.0	3.94 ± 0.04
		E	46.0 max	1.81 max
		V	32.0 min	1.26 min
13	60 200	P _{mt} †	100.5	3.96
		M	1.9 max	0.07 max
		M	128.0 ± 1.0	5.04 ± 0.04
16	90 300	E	50.8 max	2.00 max
		V	45.0 min	1.77 min
		P _m	128.5	5.06
18	120 400	M	2.0 max	0.08 max
		M	159.0 ± 1.0	6.26 ± 0.04
		E	62.0 ± 1.5	2.44 ± 0.06
21	180 600	V	159.5	6.28
		P _m	2.3 max	0.09 max
		M	180.0 ± 2.0	7.09 ± 0.08
24	240 800	E	62.0 ± 1.5	2.44 ± 0.06
		V	180.8	7.12
		P _m	2.3 max	0.09 max
27	300 1000	M	209.0 ± 2.0	8.23 ± 0.08
		E	62.0 ± 1.5	2.44 ± 0.06
		V	209.8	8.26
29	360 1200	P _m	2.6 max	0.10 max
		M	237.0 ± 2.0	9.33 ± 0.08
		E	124.0 ± 2.0	4.88 ± 0.08
31	480 1600	V	237.8	9.36
		P _m	2.6 max	0.10 max
		M	252.0 ± 2.0	9.92 ± 0.08
33	600 2000	E	80.0 ± 1.5	3.15 ± 0.06
		V	252.8	9.95
		P _m	2.6 max	0.10 max
35	800 2800	M	268.0 ± 2.0	10.55 ± 0.08
		E	124.0 ± 2.0	4.88 ± 0.08
		V	268.8	10.58
37	1000 3600	P _m	2.8 max	0.11 max
		M	292.0 ± 2.0	11.50 ± 0.08
		E	124.0 ± 2.0	4.88 ± 0.08
39	1200 4800	V	292.8	11.53
		P _m	3.0 max	0.12 max
		M	312.0 ± 2.0	12.28 ± 0.08
41	1500 6000	E	124.0 ± 2.0	4.88 ± 0.08
		V	312.8	12.31
		P _m	3.0 max	0.12 max

*The nominal reel capacities in Table 1 are based on a film thickness of 0.16 mm (0.006 in.). For an evaluation of capacities for various film thicknesses, see A6. The reel size is the nominal flange diameter in centimeters. Only the centimeter size is shown and is preferred. Corresponding inch sizes are recognized and are Max. 4, 5, 6, 7, 8, 9, 9.5, 10, 11, and 12, respectively.
 †See 2.8.
 ‡The No. 27 reel with the higher hub-to-flange ratio is preferred because film damage is minimized.

Table 2

Dimensions	Millimeters	Inches
B	1.5 + 0.3 0	0.06 + 0.01 0
C	12.75 + 0.15 0	0.502 + 0.006 0
D	20.50 + 0.50 0	0.807 + 0.020 0
H	8.4 + 1.5 0	0.33 + 0.06 0
J	11.4 0	0.45 0
K	25.5 min	1.00 min
P	See 2.6 and 2.6.1	
P _m *	1.5 max	0.06 max
R	½ Dimension B	
R ₁	½ Dimension B	
R ₂	1.5 max	0.06 max
S	12.0 min	0.47 min
T	6.0 min	0.24 min
U	0.8 max	0.03 max

*See 2.8.

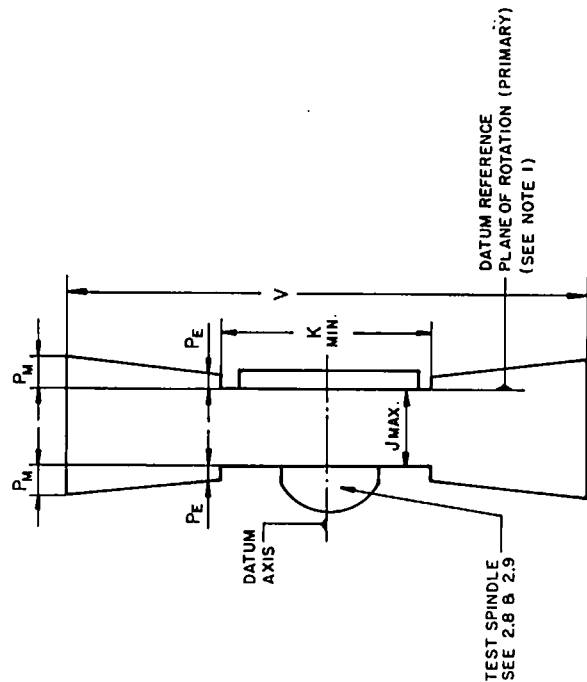


Fig. 2
Maximum Volume of Rotation

Notes

1. A datum reference plane of rotation is defined for each flange of a reel by a plane coincident with the surface of a flat 25.00-mm (0.984-in) diameter support which is centered on the spindle hole datum axis of the flanges. The reference surface makes contact with the reel in the minimum K diameter area. The datum axis, which is perpendicular to the datum reference plane of rotation, does not necessarily coincide with the axis from the center of the spindle holes. (See Fig. 2.)
2. The flanges of the reel should have three radial driving slots placed at $120^\circ \pm 2^\circ$ and conforming to Dimensions B and D. The drive slots of both flanges are aligned. If properly aligned, the reel will fit on a test spindle (gauge) of 12.7-mm (0.50-in) diameter with a radial shoulder drive key having an axial length from the spindle shoulder greater than width J of the reel, a thickness of 1.47 mm (0.058 in); and a height, measured as a radius from the spindle axis, of 9.1 mm (0.36 in).
3. It is recommended that No. 10 reels be designed with one solid flange with the exception of the hub area. The solid flange of the reel shall be opposite the film attachment opening.
4. Means should be provided for securing the end of the film to the reel. Such provision should accept the full width of the film and freely release the film at the end of the run, except when used on automatic rewind equipment. (If film attachment is provided by a slot in the hub, see 2.7.)
5. If the reel hub is made from plastic or other dimensionally unstable material, the spindle hole diameter, C, should be adjusted so that at least the minimum dimension, 12.75 mm (0.502 in), is maintained through the normal use range of temperature and relative humidity.

Appendix

(The Appendix is not a part of this American National Standard, but is included for information purposes only.)

- A1.** Three drive slots are specified for the spindle hole of each flange to facilitate easy loading of the reel on the drive spindle, even though only one is normally used to drive the reel. However, spindles may have two or three drive keys.
- A2.** A test spindle, shoulder of 25.00-mm (0.984-in) diameter is required for the measurement of Dimension P. Loose fit between a projector spindle and reel spindle hole can contribute to flange excursion not measured when determining Dimension P. This can be minimized if a 25.5-mm (1.00-in) shoulder also is incorporated on the projector spindle and a device for locking the K diameter area of the reel against the support is provided. In any case, it is expected that projector manufacturers will incorporate a spindle shoulder of at least 16.0-mm (0.63-in) diameter on their equipment.
- A3.** Take-up reels, which are uniquely a part of the manufacturer's projection equipment, may deviate from the provisions of this standard. As an example, it may be desirable to taper the flanges from the hub to the periphery or to provide for special film attachment mechanisms.
- A4.** The usual winding of film on a reel with a solid flange is such that the film perforations are closest to the threading slot (i.e., opposite the solid flange).
- A5.** The spindle hole may be formed by a sleeve or there may be an air space between the spindle holes in the flanges, depending upon the type of construction. Because of this, the means of retaining the reel on the projector spindle should be designed to act against the full K dimension of the reel adjacent to the spindle hole.
- A6.** The variety of needs for motion-picture films has resulted in products with a wide range of thicknesses.
- A7.** Some protection from spilling over of the outer laps of film is needed. Therefore, to leave a space between the film and the periphery of the flange, an arbitrary value along the radius was chosen to derive the maximum film diameter: 3.5 mm (0.14 in) for size 10 reels; 5.0 mm (0.20 in) for size 13, 16, and 18 reels; and 6.5 mm (0.26 in) for larger reels.
- A7.** Caution must be exercised when film is stored on reels intended for archival storage. It is strongly recommended that the reels used not be finished with paints or coatings that have a tendency to evaporate over a long period of time inasmuch as this will affect the stored material.

PH22.160M

Table 3
Film Capacities in Meters

Reel Size	Flange Diameter	Hub Diameter E_{max}	Maximum Film Coil D	Length l Calculated for Each Value of Thickness, t, in Millimeters*									
cm	mm	mm	mm	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18
10 min	99.0	46.0	92.0	55.4	49.9	45.3	41.5	38.4	35.6	33.2	31.2	29.3	27.7
10 max	100.0	32.0	93.0	66.5	59.9	54.4	49.9	46.1	42.8	39.9	37.4	35.2	33.3
13 min	127.0	50.8	117.0	96.9	87.2	79.3	72.7	67.1	62.3	58.2	54.5	51.3	48.5
13 max	128.0	45.0	118.0	103.8	93.5	85.0	77.9	71.9	66.8	62.3	58.4	55.0	51.9
16	158.0	63.5	148.0	156.0	140.4	127.6	117.0	108.0	100.3	93.6	87.7	82.6	78.0
18	178.0	63.5	168.0	211.1	190.0	172.7	158.3	146.2	135.7	126.7	118.8	111.8	105.6
21	207.0	63.5	194.0	293.2	263.9	239.9	219.9	203.0	188.5	175.9	165.0	155.2	146.6
24	235.0	126.0	222.0	291.5	262.4	238.5	218.7	201.8	187.4	174.9	164.0	154.3	145.8
25	250.0	81.5	237.0	422.2	389.0	353.6	324.2	299.2	277.8	259.3	243.1	228.8	216.1
27	266.0	126.0	253.0	420.0	378.0	343.7	315.0	290.8	270.0	252.0	233.3	222.4	210.0
29	290.0	126.0	277.0	531.0	477.9	434.5	398.3	367.6	341.4	318.6	298.7	281.1	265.5
31	310.0	126.0	297.0	631.2	568.1	516.5	473.4	437.0	405.8	378.7	355.1	334.2	315.6

*The formula used for the calculation of film capacity is:

$$l = \frac{\pi(D^2 - E_{max}^2)}{4000t}$$

Table 4
Film Capacities in Feet
t in Inches

Reel Size	Length l Calculated for Each Value of Thickness, t, in Millimeters*									
cm	0.0035	0.0040	0.0043	0.0047	0.0051	0.0055	0.0059	0.0063	0.0067	0.0071
10 min	182	164	149	136	126	117	109	102	96	91
10 max	218	197	179	164	152	140	131	123	116	109
13 min	318	286	260	239	220	204	191	179	168	159
13 max	341	307	279	256	236	219	204	192	180	170
16	512	461	419	384	354	329	307	288	271	256
18	693	623	567	519	480	445	416	390	367	347
21	962	866	787	721	666	618	577	541	509	481
24	956	861	783	718	662	615	574	538	506	478
25	1418	1276	1160	1064	982	911	851	798	751	709
27	1378	1240	1128	1034	954	886	827	775	730	689
29	1742	1568	1426	1307	1206	1120	1045	980	922	871
31	2071	1864	1695	1553	1434	1331	1242	1165	1096	1035

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