INTERNATIONAL STANDARD ISO 3820

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Cinematography — Sprockets for 8 mm Type S motion-picture film — Dimensions and design

Cinématographie — Tambours dentés pour film cinématographique 8 mm *type S — Dimensions et construction*

First edition — 1978-02-01

UDC 778.533.1 : 778.553.1 **Ref. No. ISO 3820-1978 (E)**

Descriptors : cinamatography, motion-picture film, motion-picture film 8 mm, pinions, dimensions, specifications.

Price based on 8 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3820 was developed by Technical Committee ISO/TC 36, *Cinematography*, and was circulated to the member bodies in June 1976.

It has been approved by the member bodies of the following countries :

Australia	Germany	Spain
Austria	India	Sweden
Belgium	Italy	Switzerland
Canada	Japan	Turkey
Czechoslovakia	Mexico	U.S.A.
Denmark	Romania	U.S.S.R.
France	South Africa, Rep. of	Yugoslavia

The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

would. If the wrap length is defined as one-half of the sum of the number of pitch lengths in the arc of engagement, E, and the number of pitch lengths in the arc of contact, C (figure 1), then the wrap length may be as high as 9 1/4 pitch lengths without producing interference at the entering teeth of a drive sprocket if the film shrinkage does not exceed 0,8 %.

3.7 The lateral profile of the sprocket has been derived on the assumption that the film is channel-guided at or near the sprocket. This guiding may be provided by fixed guides, by the flanges of an adjacent roller at the entering position, or preferably by flanges on the sprocket itself. When a fixed guide is needed at the perforated edge and the film is urged against the guide by a spring or other means, the lateral dimensions L of the tooth can be increased. If the sprocket teeth are to perform the function of side guiding, then their lateral dimension L may be increased to

$$0{,}902\,^{0}_{-0{,}013}\ \text{mm}\ (0.035\,5\,^{0}_{-0.000\,5}\ \text{in})$$

with special consideration given to tooth alignment, smoothness of the sides, and rounding or tapering at the tips. When the sprocket teeth have been increased in width to perform the function of lateral guiding, the R_3 value, for the radius of the corners of the sprocket tooth, should be increased to comply with the radius of the perforation fillet, nominally 0,13 mm (0.005 in).

3.8 In order for the film guides to function properly, the sprocket eccentricity as mounted in operation should not exceed 0,025 mm (0.001 0 in) and the lateral weave or wobble measured at the root circle should not exceed 0,025 mm (0.001 0 in). Less eccentricity may be required for a special application such as a sound printer sprocket.

3.9 In some cases of large-scale layouts or critical comparisons, it may be more convenient to work with values of X_T than values of B.

NOTE — The inch dimensions in this International Standard have been converted from the specified metric dimensions, but have not been carried out to two more places as specified in ISO 370. They do, however, reflect the engineering practice in the countries using the Imperial system of units.

TABLE 1B – **Sprocket dimensions, in inches**

N	D_d	D_c	D_h	K	B	R_2	X_T
12	0.630 7	0.628 8	0.625 8	0.059 8	0.001 9	0.495 4	0.009 69
13	0.683 8	0.681 7	0.678 4	0.062 0	0.002 2	0.526 8	0.009 48
14	0.736 9	0.734 6	0.731 1	0.064 0	0.002 6	0.558 4	0.009 30
15	0.789 9	0.787 5	0.783 7	0.065 9	0.003 1	0.590 1	0.009 15
16	0.843 0	0.840 4	0.836 4	0.067 8	0.003 4	0.622 2	0.009 01
17	0.896 0	0.893 3	0.889 0	0.069 6	0.003 8	0.654 3	0.008 89
18	0.949 1	0.946 2	0.941 7	0.071 4	0.004 2	0.686 3	0.008 78
19	1.002 2	0.999 1	0.994 3	0.073 1	0.004 6	0.718 6	0.008 69
20	1.055 2	1.052 0	1.046 9	0.074 8	0.004 9	0.751 3	0.008 59
21	1.108 3	1.104 8	1.099 6	0.076 4	0.005 2	0.783 6	0.008 52
22	1.161 3	1.157 8	1.152 2	0.078 0	0.005 6	0.816 3	0.008 44
23	1.214 4	1.210 6	1.204 9	0.079 5	0.005 9	0.849 0	0.008 37
24	1.267 4	1.263 5	1.257 5	0.081 1	0.006 3	0.881 9	0.008 31
26	1.373 6	1.369 3	1.362 8	0.084 1	0.006 9	0.947 7	0.008 20
28	1.479 7	1.475 1	1.468 1	0.086 9	0.007 6	1.014 3	0.008 10
30	1.585 8	1.580 9	1.573 4	0.089 8	0.008 2	1.080 8	0.008 02
32	1.691 9	1.686 7	1.678 7	0.092 5	0.008 8	1.148 0	0.007 94
34	1.798 1	1.792 5	1.784 0	0.095 2	0.009 4	1.215 0	0.007 88
36	1.904 2	1.898 3	1.889 3	0.097 8	0.010 0	1.282 9	0.007 82
38	2.010 3	2.004 1	1.994 6	0.100 4	0.010 6	1.351 4	0.007 77
40	2.116 4	2.109 9	2.099 9	0.102 9	0.011 1	1.419 9	0.007 72
42	2.222 5	2.215 7	2.205 2	0.105 3	0.011 7	1.488 1	0.007 68
44	2.328 7	2.321 5	2.310 5	0.107 8	0.012 3	1.557 4	0.007 64
46	2.434 8	2.427 3	2.415 7	0.110 2	0.012 8	1.627 6	0.007 60
48	2.540 9	2.533 1	2.521 1	0.112 5	0.013 4	1.697 3	0.007 57
50	2.647 0	2.638 9	2.626 3	0.114 9	0.013 9	1.767 9	0.007 54
52	2.753 1	2.744 6	2.731 6	0.117 2	0.014 4	1.838 6	0.007 51
54	2.859 3	2.850 5	2.836 9	0.119 4	0.015 0	1.909 2	0.007 49
56	2.965 4	2.956 3	2.942 2	0.121 7	0.015 5	1.981 5	0.007 46
60	3.177 6	3.167 8	3.152 8	0.126 1	0.016 5	2.125 7	0.007 42
64	3.389 8	3.379 4	3.363 4	0.130 5	0.017 6	2.271 9	0.007 38
68	3.602 1	3.591 0	3.574 0	0.134 7	0.018 5	2.418 9	0.007 35
72	3.814 3	3.802 6	3.784 6	0.138 9	0.019 5	2.568 5	0.007 31
76	4.026 6	4.014 2	3.995 2	0.143 0	0.020 5	2.719 7	0.007 29
80	4.238 8	4.225 8	4.205 7	0.147 0	0.021 5	2.872 2	0.007 26
84	4.451 1	4.437 4	4.416 3	0.151 1	0.022 4	3.027 4	0.007 24

N = Number of teeth

D_d = Root diameter, $D^{+0.001}_{0}$ of drive sprocket of 0.166 7 pitch

D_c = Root diameter, $D^{+0.001}_{0}$ of combination sprocket of 0.166 2 pitch

D_h = Root diameter, $D^{0}_{-0.001}$ of hold-back sprocket of 0.165 4 pitch

Film thickness = 0.006 0. For other thicknesses :

$$\text{Root diameter} = N \times \frac{\text{pitch}}{\pi} - \text{thickness}$$

K = circular arc radius for tooth shape, $^{0}_{-0.002}$

B = Radial distance of centre arc of inside root circle, $^{+0.000\,5}_{0}$

R_2 = Minimum radius of film path concave to sprocket

X_T = Offset of tooth at working height

Tooth working height, H = 0.026 0
Maximum pitch difference = 0.001 8
Minimum film path radius convex to sprocket, R_1 = 0.156 0

Numerical values in inches.

Dimensions in millimetres
(Inch values in parentheses)

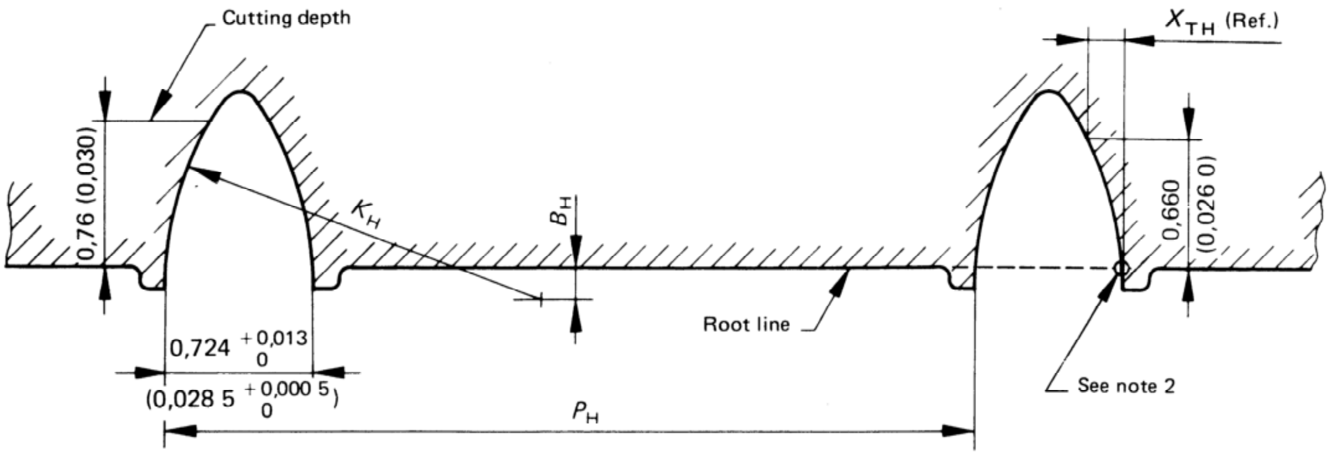

FIGURE 4 — **Basic rack**

TABLE 3 — **Basic racks for hobs to make sprockets**

Range of teeth	**Pitch of rack, P_H** ± 0,002 5 mm (± 0.000 1 in)		**Tooth shape radius, K_H** $^{0}_{-0,025}$ mm ($^{0}_{-0.001}$ in)		**Distance of centre below root, B_H** $^{+0,005}_{0}$ mm ($^{+0.000\ 2}_{0}$ in)		**Reference dimension — Offset at 0,66 mm (0.026 in) height, X_{TH}**	
	mm	in	mm	in	mm	in	mm	in
12 to 24	4,194	0.165 1	2,028	0.079 9	0,169	0.006 7	0,170 3	0.006 71
25 to 84	4,221	0.166 2	3,371	0.132 7	0,507	0.020 0	0,170 3	0.006 71

NOTES

1 For some purposes the stated ranges of hobs may be extended in the numbers of teeth specified. However, for more critical uses such as for low flutter or good picture steadiness, the stated ranges should be observed together with suggested film paths.

2 Dimension X_{TH} applies only to the root line of the rack and not to the base.

film gouging. The last tooth fully engaged with the film essentially carries the film load. When the film strips off this last tooth, the film slips back relative to the sprocket base until the next perforation, which is now the last perforation, carries the film load. The maximum slipback of the film (see 3.3) as well as the relative paths taken by the base and tip of the sprocket tooth and by the film were used in the computations of X_T. When X_T is established for each N, the position of one point along the shape of each sprocket tooth relative to the root position has been determined.

It is necessary that the face of each sprocket tooth be as erect as possible to give good load-carrying capacity, and a minimum tendency for the film to ride up on the tooth. Also, of course, the tooth must not force the film to slip along the base of the sprocket in the forward direction at any point as this would increase the load because of friction and would require more total backslip and tooth slant. Yet the tooth shape must provide smooth transfer of the film load from one tooth to the next, at disengagement, for long life of the film. This leads to another requirement that cannot be overlooked in sprocket specifications, the condition for maximum steadiness of film motion or minimum flutter within the design range of pitch differentials. If the film on exiting from the sprocket is made to ride up the sprocket teeth smoothly, a condition of minimum flutter can be achieved where a smooth transfer of film load from one tooth to the next can be obtained (several teeth are usually engaged simultaneously). The minimum value of the radius (concave toward the sprocket) defining the exiting film path for minimum flutter or maximum smoothness has been designated as R_2 and is listed in tables 1A and 1B for each value of N (see reference 2). Computing the values of R_2 would hardly be possible without the electronic computer since a method of successive approximations must be used. The exiting radius R_2 defines the curve of the tooth face. A carefully modified epicycloid best fits this ideal curve. It is far simpler to specify and to use the specifications if the curve of the tooth face is a circular arc with radius and centre given.

On investigation, it was found that errors would be sufficiently small to make the circular arc specification practical. From the data for the tooth face as derived in computing R_2, a point on the face was selected at one-third the working tooth height. Using the position of this point with the established root and tip positions, the radius and its centre were computed for each sprocket. Comparing the positions of points along the sprocket face as defined by the circular arc to those as defined by the ideal curve derived in computing R_2, the maximum deviations at other than the three fixed points were of the order of 0,005 mm (0.000 2 in).

The arc specification is convenient and lends itself to small quantity production of sprockets with a single formed cutter and indexing means. For larger quantity productions the use of hobs is more economical. Many sprockets have been produced using involute shapes of some specified pressure angle. The slope of the resultant tooth at the root is undesirably reduced and the tooth shape is poorer for steadiness and flutter. The use of the circular arc denotes an important improvement over the use of the involute. Therefore, further computer studies investigated the use of hobs with circular arc cutting faces to generate the sprocket teeth. The computer program was made to minimize fit errors for offset values at maximum working heights and at one-third heights. As a result, two hobs are specified; the first covers the range of 12 to 24 teeth, and the second, 25 to 84 teeth. It was found that the maximum errors along the entire tooth height compared with a theoretically correct shape are even less (about two-thirds) than those for the circular arc specifications.

It is anticipated that sprockets not specified by the tables will be specified by interpolation.