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ASME B94.51M-1999
(Revision of ASME B94.51M-1994)

SPECIFICATIONS FOR BAND SAW BLADES (METAL CUTTING)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Date of Issuance: December 31, 1999

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FOREWORD

The first band saw standard was issued by the United States Department of Commerce in 1945. The standard was a joint industry effort geared at reducing the number of band saw sizes and thereby simplifying the manufacturing of band saws during World War II.

Three years later, in cooperation with the Department of Commerce, the Band Saw Manufacturers Association (a predecessor organization of the Hack and Band Saw Manufacturers Association of America) issued a Simplified Practice Recommendation. At that time, seven new sizes were added to the existing wartime sizes in order to meet consumer needs.

In 1954, the Band Saw Manufacturers Association requested that hook tooth band saws be added. At that time an additional 15 sizes were added. In 1961, 3 new wavy sizes, 8 raker sizes, and 1 skip size were added.

Recognizing the interest in international standards evidenced by both American producers and consumers, the Hack and Band Saw Manufacturers Association of America submitted in 1967 a general set of standard band saw sizes to the American National Standards Institute for adoption under the existing standards method of procedure. This action resulted in the issuance of the first American National Standard Specifications for Band Saw Blades (ANSI B122.1-1970).

As a result of work in the 1970s in the area of international standards, the Hack and Band Saw Manufacturers Association, who were the Secretariat for the promulgation of the standard (ISO/TC29-WG25), felt that additional information should be available to manufacturers, distributors, and users that would enable them to produce, sell, and utilize better band saw blades.

Added sections included:

(a) suggested composition guidelines for intermediate, composite, and high speed steel band saws;

(b) hardness limits;

(c) tooth form suggestions;

(d) tooth set tolerances;

(e) flatness tolerances.

In order to promulgate the standard as an update of ANSI B122.1-1970, the industry submitted the document to the American National Standards Committee B94. This Committee formed a Subcommittee to consider standards for hack and band saws.

The resulting standard was submitted to the full ANSI B94 Committee, who achieved consensus by means of procedures accepted by the American National Standards Institute. The American Society of Mechanical Engineers was the Secretariat for B94 and supervised the promulgation of the standard with expertise furnished by individual members.

The original revision of B122.1-1970 was redesignated as B94.51-1976 and approved as an American National Standard on September 13, 1976.

The present revision, formulated by the ASME B94 Committee under procedures accepted by the American National Standards Institute, was approved as an American National Standard on April 14, 1999.

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Cutting Tools, Holders, Drivers, and Bushings

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The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

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SPECIFICATIONS FOR BAND SAW BLADES (METAL CUTTING)

1 SCOPE

This Standard provides a useful criterion of practice in production, distribution, and use of metal cutting band saw blades. It was developed to provide blades that will meet all normal requirements of consumers. Section 3, Definitions, indicates the specific types in common usage and also defines the various elements.

This Standard covers tooth shape, sizes, and tolerances for regular, skip tooth, and hook tooth band saw blades; and it also sets out the determination of:

(a) band saw blade dimensions;

(b) tooth form and set;

(c) blade flatness and minimum hardness characteristics.

This is a Standard for use in the United States of America, its territories and protectorates. Therefore English units are considered standard dimensions. Metric dimensions shown are based on the Renard R-40 system for conversion and are for the guidance of those countries using metric units as their standard.

2 FIELD OF APPLICATION

This Standard applies to carbon hard edge flexible and tempered back band saw blades and composite steel band saw blades; information on friction cutting band saw blades is set forth in Appendix I.

3 DEFINITIONS

For the purpose of this Standard, the following definitions are set forth.

band saw blade: an endless blade manufactured of a continuous strip of steel having one toothed edge as defined in Fig. 1. The body of the blade may be hardened and tempered to impart strength to the blade in certain types. This strip may be available as coil stock or cut and welded to length.

carbon hard edge flexible back band saw blades: made from steel strip with one toothed edge. The toothed edge is harder than the body of the saw below the gullets of the teeth, having a minimum hardness at the point of the tooth not less than 62 Rockwell C. The body of the blade after heat treating shall not be less than 25 Rockwell C nor more than 38 Rockwell C.

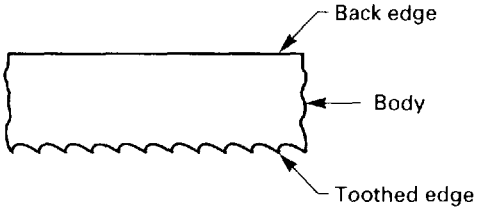

FIG. 1 BAND SAW BLADE

carbon hard edge tempered back band saw blades: made from steel strip with one toothed edge. The toothed edge is harder than the body of the saw below the gullets of the teeth, having a minimum hardness at the point of the tooth not less than 62 Rockwell C. The body of the blade after heat treating shall not be less than 38 Rockwell C nor more than 48 Rockwell C.

NOTE: Carbon hard edge flexible back and tempered back band saw blades are generally classified as metal cutting, but as defined here the term includes all such band saw blades irrespective of actual or intended use.

composite steel band saw blades: made with a cutting edge of high speed steel, as defined below, welded to a backing of low alloy spring steel (similar to 6150), and the gullets of the teeth shall extend below the weld. The cutting edge is harder than the body of the saw and has a minimum hardness at the point of the teeth not less than 62 Rockwell C. The body of the blade after heat treating shall not be less than 37 Rockwell C nor more than 52 Rockwell C.

In manufacturing this blade, alternative alloying steels of equivalent or superior properties may be used.

hardness: hardness testing of band saws is a specialized art and can be accomplished by the following methods: Superficial Rockwell 15N, Vickers, or micro hardness. Any of the readings taken from the above methods can then be converted to Rockwell C equivalents by using an approximate conversion table.

NOTE: See conversion table in Appendix I.

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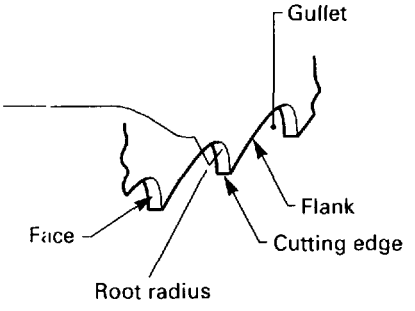

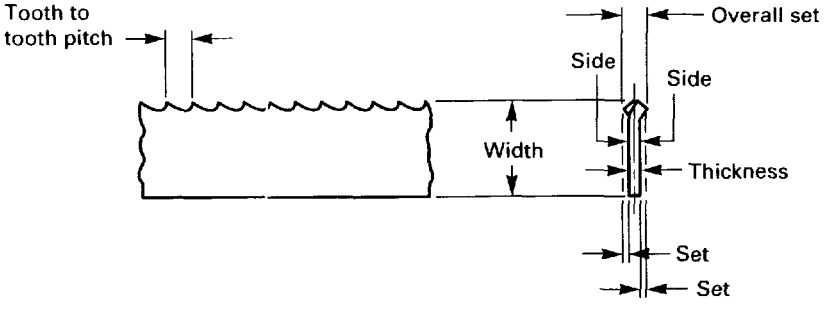

FIG. 2 TOOTH FEATURES

overall set: the total width of the extreme distance of opposite teeth, taking into account the set on either side of the blade that determines the overall width of cut (see Fig. 2).

pitch: the distance between apices of adjacent teeth measured in millimeters. Teeth per unit length is the number of complete teeth per 25.4 mm (1 in.) length.

NOTE: Pitch and teeth per in. (mm) are reciprocals of each other.

tooth set: the projection of the teeth from the side of the blade to provide cutting clearance (see Fig. 2).

3.1 Tooth Nomenclature

cutting edge: the transverse edge formed by the intersection of the flank and the face (see Fig. 2).

face: that surface of the tooth adjacent to the cutting edge, on which the chip impinges as it is severed from the work (see Fig. 2).

flank: that surface behind the cutting edge which extends to the root radius (see Fig. 2).

gullet: the space bounded by the face, root radius, and flank of a tooth which permits the removal of the severed chips (see Fig. 2).

rake angle: the incline of the face of the nonset tooth from the perpendicular.

side: the flat surface between the toothed edge and the back edge (see Fig. 2).

4 TOOTH FORM AND SET

4.1 Tooth Form

Tooth form may be varied to suit the individual manufacturer, the user, and the material to be cut. The basic types of tooth form are listed below.

(a) Regular or Standard. Regular or standard tooth form has zero degree rake angle, full round gullets, and is the most widely used design (see Fig. 3). This tooth style is furnished in alternate, raker, and wavy set (see para. 4.2).

(b) Skip. Skip tooth form is basically a regular tooth

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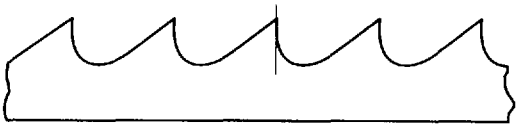

FIG. 3 REGULAR OR STANDARD TOOTH FORM

form with every alternate tooth removed (see Fig. 4). The large pitch increases the chip space within the gullet without making the tooth depth too great at the expense of blade strength.

(c) Hook. Hook tooth form is similar to skip tooth [see para. 4.1(b)], except the rake angle of the tooth is positive (see Fig. 5).

4.2 Tooth Set

The basic types of tooth set are listed below.

(a) Alternate. This is a transverse setting of individual teeth, alternately to the right and the left (see Fig. 6).

(b) Raker. This is a transverse setting of individual teeth, one to the right, one to the left, and one unset (see Fig. 7).

(c) Wavy. This is a transverse setting of groups of teeth to the left and right (see Fig. 8).

(d) Variable Raker. Variable raker set is a special set used on variable pitch teeth. Teeth are alternately set to the right and to the left with one unset tooth in each variable pitch sequence. The number of set teeth between unset teeth varies with tooth specifications (see Fig. 9).

5 DIMENSIONS AND TOLERANCES

5.1 Width

Band saw blades can be of the following nominal widths:

2 mm	(1/16 in.)
3 mm	(1/8 in.)
5 mm	(3/16 in.)
6 mm	(1/4 in.)
10 mm	(3/8 in.)
13 mm	(1/2 in.)
16 mm	(5/8 in.)
19 mm	(3/4 in.)
25 mm	(1 in.)
27 mm	(1 in.)
32 mm	(1 1/4 in.)
41 mm	(1 1/2 in.)
50 mm	(2 in.)
67 mm	(2 5/8 in.)
80 mm	(3 1/8 in.)

NOTE: R-40 system.

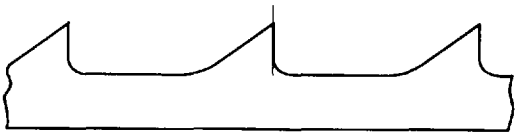

FIG. 4 SKIP TOOTH FORM

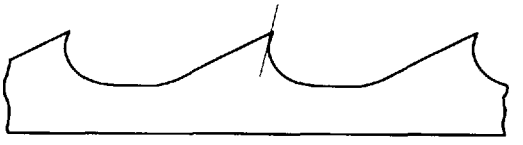

FIG. 5 HOOK TOOTH FORM

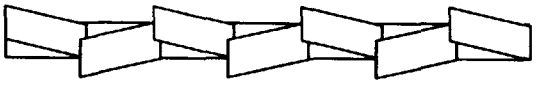

FIG. 6 ALTERNATE TOOTH SET

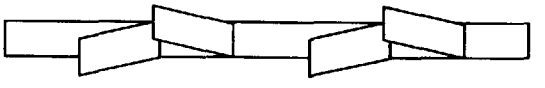

FIG. 7 RAKER TOOTH SET



FIG. 8 WAVY TOOTH SET

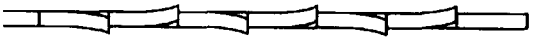

FIG. 9 VARIABLE RAKER TOOTH SET

5.1.1 Width Tolerance. The manufacturing width tolerance shall be:

Width	Tolerance
All widths (mm)	(+0, −0.51 mm)
All widths (in.)	(+0, −0.020 in.)

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5.2 Thickness

Band saw blades can be of the following thicknesses:

0.5 mm	(0.020 in.)
0.6 mm	(0.025 in.)
0.8 mm	(0.032 in.)
0.9 mm	(0.035 in.)
1.1 mm	(0.042 in.)
1.3 mm	(0.050 in.)
1.6 mm	(0.063 in.)

NOTE: R-40 system.

5.2.1 Thickness Tolerance. The manufacturing thickness tolerance shall be:

Thickness	Tolerance
0.50 mm (0.020 in.)	±0.025 mm (±0.0010 in.)
0.6 mm (0.025 in.)	±0.025 mm (±0.0010 in.)
0.8 mm (0.032 in.)	±0.027 mm (±0.0011 in.)
0.9 mm (0.035 in.)	±0.027 mm (±0.0011 in.)
1.1 mm (0.042 in.)	±0.034 mm (±0.0013 in.)
1.3 mm (0.050 in.)	±0.038 mm (±0.0015 in.)
1.6 mm (0.063 in.)	±0.051 mm (±0.0020 in.)

5.3 Tooth Set Tolerance

The amount of set shall be the standard adopted at the discretion of each manufacturer to meet the customers' requirements. The set at each side of the blade shall be similar and maintained within the limits of ±0.05 mm (±0.002 in.) or ±0.10 mm (±0.004 in.) overall.

5.4 Flatness (Dish) Tolerances

The band saw material shall be flat across the sectional profile (see Fig. 10), and the tolerance shall be:

Strip Width	Permissible Departure From Flatness (Dish)
Up to and including	
13 mm (1/2 in.)	0.010 mm (0.0004 in.)
16 mm (5/8 in.)	0.015 mm (0.0006 in.)
19 mm (3/4 in.)	0.020 mm (0.0008 in.)
25 mm (1 in.)	0.025 mm (0.0010 in.)
27 mm (1 in.)	0.038 mm (0.0011 in.)
32 mm (1 1/4 in.)	0.046 mm (0.0018 in.)
41 mm (1 1/2 in.)	0.053 mm (0.0021 in.)
50 mm (2 in.)	0.091 mm (0.0036 in.)
67 mm (2 5/8 in.)	0.107 mm (0.0042 in.)
80 mm (3 1/8 in.)	0.152 mm (0.0060 in.)

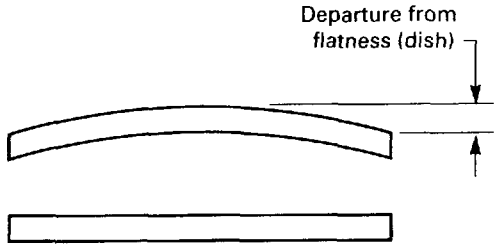

FIG. 10 BAND SAW FLATNESS (DISH) TOLERANCE

5.5 Nominal Dimensions

The dimensions for band saw blade backs are set forth as follows:

Table 1 Carbon Hard Edge Flexible Back
Table 2 Carbon Hard Edge Tempered Back
Table 3 Composite Steel

5.6 Camber

The amount of camber shall be the standard adopted at the discretion of the blade manufacturer to meet the customer's requirements.

6 PITCH SIZES

Fixed pitch sizes allowed by this Standard are given in Table 4. Variable pitch sizes allowed by this Standard are given in Table 5.

7 COMBINATIONS OF NOMINAL DIMENSIONS AND PITCHES

Nominal dimensions and pitches for band saw blades are set forth as follows:

Table 1 Carbon Hard Edge Flexible Back (see Section 3)
Table 2 Carbon Hard Edge Tempered Back (see Section 3)
Table 3 Composite Steel (see Section 3)

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TABLE 1 CARBON HARD EDGE FLEXIBLE BACK

Regular Type (Raker Set)

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)					
mm	in.	6	8	10	14	18	24
2 x 0.6	1/16 x 0.025	...	...	...	...	...	+
3 x 0.6	1/8 x 0.025	...	...	...	+	+	...
5 x 0.6	3/16 x 0.025	...	...	+	...	...	...
6 x 0.6	1/4 x 0.025	...	...	+	+	...	...
10 x 0.6	3/8 x 0.025	...	...	+	+	...	...
13 x 0.5	1/2 x 0.020	...	...	...	+	...	...
13 x 0.6	1/2 x 0.025	+	...	+	+	+	...
16 x 0.8	5/8 x 0.032	...	+	...	...	...	...
19 x 0.8	3/4 x 0.032	+	+	+	+	...	...
25 x 0.9	1 x 0.035	+	...	+	...	...	...

Regular Type (Wavy Set)

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)
mm	in.	14
13 x 0.6	1/2 x 0.025	+

Skip Tooth

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)		
mm	in.	3	4	6
5 x 0.6	3/16 x 0.025	...	+	...
6 x 0.6	1/4 x 0.025	...	+	+
10 x 0.6	3/8 x 0.025	...	+	...
13 x 0.6	1/2 x 0.025	...	+	...
19 x 0.8	3/4 x 0.032	+	...	...

Hook Tooth

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)			
mm	in.	2	3	4	6
6 x 0.6	1/4 x 0.025	...	...	+	+
6 x 0.8	1/4 x 0.032	...	...	+	...
10 x 0.6	3/8 x 0.025	...	+	+	+
10 x 0.8	3/8 x 0.032	...	+	+	...
13 x 0.6	1/2 x 0.025	...	+	+	+
13 x 0.8	1/2 x 0.032	...	+	+	...
19 x 0.8	3/4 x 0.032	+	+	+	...
25 x 0.9	1 x 0.035	+	+	...	...

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TABLE 2 CARBON HARD EDGE TEMPERED BACK

Regular Type (Raker Set)

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)					
mm	in.	6	8	10	14	18	24
3 x 0.6	1/8 x 0.025	...	...	...	...	...	...
6 x 0.6	1/4 x 0.025	...	...	+	+	+	+
10 x 0.6	3/8 x 0.025	...	...	+	+	...	...
13 x 0.5	1/2 x 0.020	...	...	...	+	...	...
13 x 0.6	1/2 x 0.025	+	...	+	+	+	+
16 x 0.8	5/8 x 0.032	...	...	+	+	...	...
19 x 0.8	3/4 x 0.032	+	+	+	+	...	...
25 x 0.9	1 x 0.035	+	+	+	+	...	...

Regular Type (Wavy Set)

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)			
mm	in.	10	14	18	24
13 x 0.6	1/2 x 0.025	...	+	+	+
19 x 0.8	3/4 x 0.032	...	+	...	...

Skip Tooth

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)	
mm	in.	4	6
6 x 0.6	1/4 x 0.025	+	+
10 x 0.6	3/8 x 0.025	+	...
13 x 0.6	1/2 x 0.025	+	...

Hook Tooth

Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)			
mm	in.	2	3	4	6
6 x 0.6	1/4 x 0.025	...	...	+	+
10 x 0.6	3/8 x 0.025	...	+	+	+
13 x 0.6	1/2 x 0.025	...	+	+	+
19 x 0.8	3/4 x 0.032	...	+	...	...
25 x 0.9	1 x 0.035	+	+	...	...

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TABLE 3 COMPOSITE STEEL (BI-METAL)

AISI M-2 & Matrix Regular Type (Raker Set)						AISI M-2 & Matrix Variable Pitch Zero Rake						
Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)				Number of Teeth per 25.4 mm (1 in.)						
mm	in.	10	14	18	24	3–4	4–6	5–8	6–10	8–12	10–14	14–18
6 x 0.6	1/4 x 0.025	...	...	...	...	...	...	...	...	+	...	...
6 x 0.9	1/4 x 0.035	...	...	...	...	...	...	...	...	...	+	...
10 x 0.6	3/8 x 0.025	...	...	...	...	...	...	...	...	...	+	...
13 x 0.5	1/2 x 0.020	...	+	+	+	...	...	...	...	...	+	+
13 x 0.6	1/2 x 0.025	...	+	+	...	...	...	...	+	+	+	+
13 x 0.9	1/2 x 0.035	+	+	...	...	...	...	...	...	...	...	...
20 x 0.9	3/4 x 0.035	+	+	...	...	...	+	+	+	+	+	...
27 x 0.9	1 x 0.035	+	...	...	...	+	+	+	+	+	+	...
34 x 1.1	1 1/4 x 0.042	...	...	...	...	+	+	+	+	...	...	...
41 x 1.3	1 1/2 x 0.050	...	...	...	...	+	+	...	...	...	...	...

AISI M-2 & Matrix Hook Tooth				
Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)	AISI M-2 & Matrix Variable Pitch Positive Rake	
			Number of Teeth per 25.4 mm (1 in.)	
mm	in.	4	3–4	4–6	5–8
10 x 0.9	3/8 x 0.035	+	...	...	...
20 x 0.9	3/4 x 0.035	...	...	+	+
27 x 0.9	1 x 0.035	...	+	+	+
34 x 1.1	1 1/4 x 0.042	...	+	+	+
41 x 1.3	1 1/2 x 0.050	...	+	+	...

AISI M42 and AISI M51 Regular Type (Raker Set)				AISI M42 and AISI M51 Variable Pitch Zero Rake			
Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)		Number of Teeth per 25.4 mm (1 in.)			
mm	in.	4	6	3–4	4–6	5–8	6–10
27 x 0.9	1 x 0.035	...	+	+	+	+	+
34 x 1.1	1 1/4 x 0.042	+	+	+	+	+	...

Super High Speed Steel AISI M42 and AISI M51 Hook Tooth				Super High Speed Steel AISI M42 and AISI M51 Variable Pitch Positive Rake				
Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)		Number of Teeth per 25.4 mm (1 in.)				
mm	in.	3	4	1.5–2.5	2–3	3–4	4–6	5–8
20 x 0.9	3/4 x 0.35	...	...	...	...	...	+	...
27 x 0.9	1 x 0.035	+	+	...	+	+	+	+
34 x 1.1	1 1/4 x 0.042	+	...	...	+	+	+	+
41 x 1.3	1 1/2 x 0.050	...	...	+	+	+	+	...
54 x 1.3	2 x 0.050							
54 x 1.6	2 x 0.063	...	...	...	+	+	...	...
67 x 1.6	2 5/8 x 0.063	...	...	...	+	...	...	...

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TABLE 4 FIXED PITCH SIZES

Pitch	Teeth per 25.4 mm (1 in.)
0.031	32
0.042	24
0.055	18
0.071	14
0.100	10
0.125	8
0.167	6
0.250	4
0.333	3
0.500	2

TABLE 5 VARIABLE PITCH SIZES

Pitch		Teeth per 25.4 mm (1 in.) Nominal
Largest (± 10%)	Smallest (± 10%)	
1.333	0.666	0.75–1.5
0.666	0.400	1.5–2.5
0.500	0.333	2–3
0.333	0.250	3–4
0.250	0.167	4–6
0.200	0.125	5–8
0.167	0.100	6–10
0.125	0.083	8–12
0.100	0.071	10–14

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MANDATORY APPENDIX I
DESCRIPTIONS OF BAND SAW BLADES WITH A LIMITED FIELD OF APPLICATION

I1 FRICTION CUTTING BAND SAW BLADES

Friction cutting band saw blades are made from fatigue resistant steel for cutting by heat of friction in which the primary functions of the teeth are to generate the heat and scoop in the air needed to support combustion. Friction saws are usually run at speeds in excess of 8000 ft/min and should be used only on machines with adequate shielding.

TABLE I1 FRICTION CUTTING

Regular Type (Raker Set)			
Size (width x thickness)		Number of Teeth per 25.4 mm (1 in.)	
mm	in.	10	14
13 x 0.8	1/2 x 0.032	+	+
19 x 0.9	3/4 x 0.035	+	+
25 x 0.9	1 x 0.035	+	+

TABLE I2 APPROXIMATE HARDNESS CONVERSION TABLE[1]

RC Scale	R15N Scale	Vickers 10KG
25	72.2	266
37	78.8	363
38	79.4	372
48	84.5	484
52	86.4	544
62	91.1	746

NOTE:
(1) Refer to ASTM E 140-97.

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AMERICAN NATIONAL STANDARDS FOR CUTTING TOOLS

Reamers B94.2-1995
Straight Cut-Off Blades for Lathes and Screw Machines ..... B94.3-1965(R1995)
Knurling ..... B94.6-1984(R1995)
Hobs B94.7-1980 (R1995)
Inserted Blade Milling Cutter Bodies ..... B94.8-1967(R1998)
Taps: Cut and Ground Threads (Inch and Metric Series) B94.9-1999
Twist Drills B94.11M-1993
Punches — Basic Head Type ..... B94.14-1968(R1995)
Punches — Basic Head Type (Metric) ..... B94.14.1-1977(R1995)
Retainers — Basic Ball-Lock, Punch and Die Button, Light and Heavy Duty ..... B94.16-1987(R1995)
Retainers — Basic Ball-Lock, Punch and Die Button, Light and Heavy Duty (Metric) ..... B94.16.1-1978(R1995)
Gages — Functional, Ball-Lock Punches, Die Buttons, and Retainers ..... B94.17-1987(R1995)
Gages — Functional, Ball-Lock Punches, Die Buttons, and Retainers (Metric) ..... B94.17.1-1977(R1995)
Punches — Basic Ball-Lock Light and Heavy Duty ..... B94.18-1987(R1995)
Punches — Basic Ball-Lock Light and Heavy Duty (Metric) ..... B94.18.1-1977(R1995)
Milling Cutters and End Mills B94.19-1985
Gear Shaper Cutters ..... B94.21-1968(R1995)
Punches — Variable, Head Type ..... B94.22-1968(R1995)
Punches — Variable, Head Type (Metric) ..... B94.22.1-1977(R1995)
Punch Guide Bushings — Variable, Press Fit ..... B94.23-1969(R1995)
Die Buttons — Basic Taper Relief, Press Fit ..... B94.27-1970(R1995)
Die Buttons — Basic Taper Relief, Press Fit (Metric) ..... B94.27.1M-1983(R1995)
Die Buttons — Basic Straight Relief, Press Fit ..... B94.28-1970(R1995)
Die Buttons — Basic Straight Relief, Press Fit (Metric) ..... B94.28.1M-1984(R1995)
Die Buttons — Basic Ball-Lock ..... B94.29-1970(R1995)
Die Buttons — Basic Ball-Lock (Metric) ..... B94.29.1-1977(R1995)
Die Buttons — Variable, Press Fit ..... B94.30-1970(R1995)
Steel Rotary Slitting Knives and Steel Spacing Collars ..... B94.31-1981(R1995)
Jig Bushings B94.33-1996
Drill Drivers, Split-Sleeve, Collet Type ..... B94.35-1972(R1995)
Roller Turner Type Cutting Tools, Single-Point ..... B94.37M-1979(R1985)
Punches — Variable, Angle Head Type and Related Quill Bushings ..... B94.38-1972(R1995)
Punches — Basic, Combination Angle Head Type and Related Quill Bushings ..... B94.39-1972(R1995)
Punches — Wire Type ..... B94.40-1972(R1995)
Punches — Basic, Angle Head Type and Related Quill Bushings ..... B94.41-1972(R1995)
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Punches — Basic, Cylindrical Head Type and Related Quill Bushings ..... B94.44-1972(R1995)
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Specifications for Hacksaw Blades B94.52M-1999
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