ASME B5.60-2014
(Revision of ASME B5.60-2002)

Workholding Chucks: Jaw-Type Chucks

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

During the review, revision, and update of the existing inch-based American National Standard B5.8 on Chucks and Chuck Jaws, Technical Committee 11 of the ASME B5 Committee on Machine Tools recognized the need for an industry standard on metric-dimensioned chucks.

This Standard was developed after reviewing currently available national and international standards, which were used as its foundation.

ASME B5.60-2002 was approved by the American National Standards Institute on June 26, 2002. Addenda were approved on February 24, 2005 and February 2, 2009.

ASME B5.60-2014 was approved by the American National Standards Institute on September 15, 2014.

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Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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WORKHOLDING CHUCKS: JAW-TYPE CHUCKS

Chapter 1
General Description and Definitions of Terms

1-1 INTRODUCTION

This Standard establishes technical requirements for workholding chucks used primarily in turning operations. It covers jaw-type chucks, whether manual or power-operated.

1-2 SCOPE

This Chapter covers the general description and definitions of terms related to jaw-type workholding chucks.

1-3 TYPES OF JAW CHUCKS BY DESIGN

compensating chuck: a chuck in which the jaw(s) moves to or away from the workpiece without altering the position of the workpiece.

independent chuck: a chuck in which each individual workholding jaw is moved to or from the workpiece without disturbing the position of any other jaw.

self-centering chuck: a chuck in which all jaws move to or away from the workpiece and maintain one common center.

An example of a power chuck assembly is presented in Fig. 1-1.

1-4 METHODS OF ACTUATION

manual: a chuck that is actuated by hand with the aid of human energy (e.g., by means of a chuck wrench). Refer to Fig. 1-2.

power: a chuck that is actuated by means of, e.g., pneumatic, hydraulic, or electrical energy. Refer to Fig. 1-3.

1-5 DEFINITIONS

actuator: a component within a chuck's body, used to operate the chuck's mechanism, e.g., a wedge, lever, or scroll.

base jaw: see *master jaw.*

centrifugal force: force generated by rotation that tends to move all parts radially away from the axis of rotation of the chuck.

chuck adapter: interface between the machine and the chuck. It can be a separate component or integral to the chuck body.

chuck body: that part of the chuck that contains the actuator and master jaws.

clamping cylinder: device that actuates the chuck through a drawbar or drawtube with the aid of pneumatic or hydraulic energy.

clamping force: algebraic sum of the individual radial forces applied by the top jaws on the workpiece.

clamping torque: product of the clamping force, clamping radius, and the coefficient of friction between the top jaw(s) and the workpiece.

countercentrifugal chuck: a chuck in which there is a system that permits compensation for the loss of clamping force due to centrifugal force.

drawbar: a bar or tube that connects the clamping cylinder to the chuck's actuator to transmit the input force to the chuck.

dynamic clamping force: actual clamping force when the chuck is rotating.

hysteresis: change in static clamping force after the chuck has been rotated at working rotational speed with a constant input force.

indicating band: a diameter on the chuck body designated for measuring runout of a chuck.

input force: force acting on the chuck's actuator, applied from an external energy source.

input torque: torque acting on the chuck's actuator, applied from an external energy source.

master jaw: radial moving part within the chuck body to which the top jaw is mounted.

maximum rotational speed: maximum rotational speed in rpm specified by the manufacturer for a chuck with

standard jaws in compliance with the manufacturer's instructions.

maximum static clamping force: maximum clamping force obtained when the maximum permissible input force (or maximum input torque) is applied to a particular chuck.

moment of inertia: moment of inertia with respect to a given axis is the limit of the sum of the products of the mass of each of the elemental particles in which the body may be conceived to be divided and the square of their distance from the given axis.

rotational balance: equilibrium of all masses around the axis of rotation [any difference(s) between the axis of rotation and the center of gravity will cause imbalance].

static clamping force: clamping force of the chuck when the chuck is not rotating.

top jaw: component that clamps the workpiece and is mounted on a master jaw.

workholding chuck: a clamping device with movable jaw(s) to hold a workpiece, designated hereinafter as a "chuck."

working rotational speed: rotational speed in rpm under machining conditions.

Fig. 1-1 Example of a Power Chuck Assembly

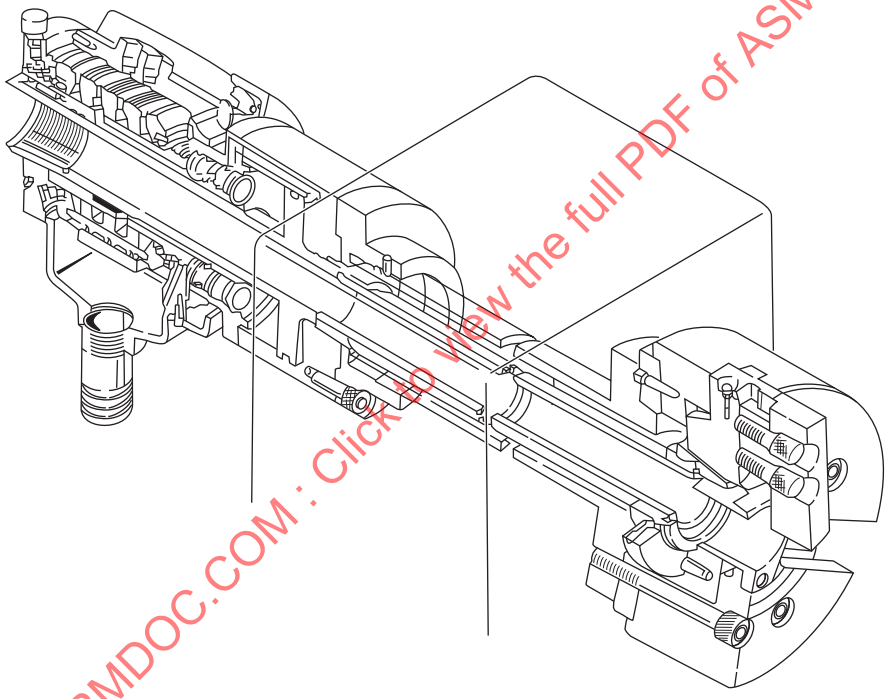


Fig. 1-2 Exploded View of a Typical Manual Chuck

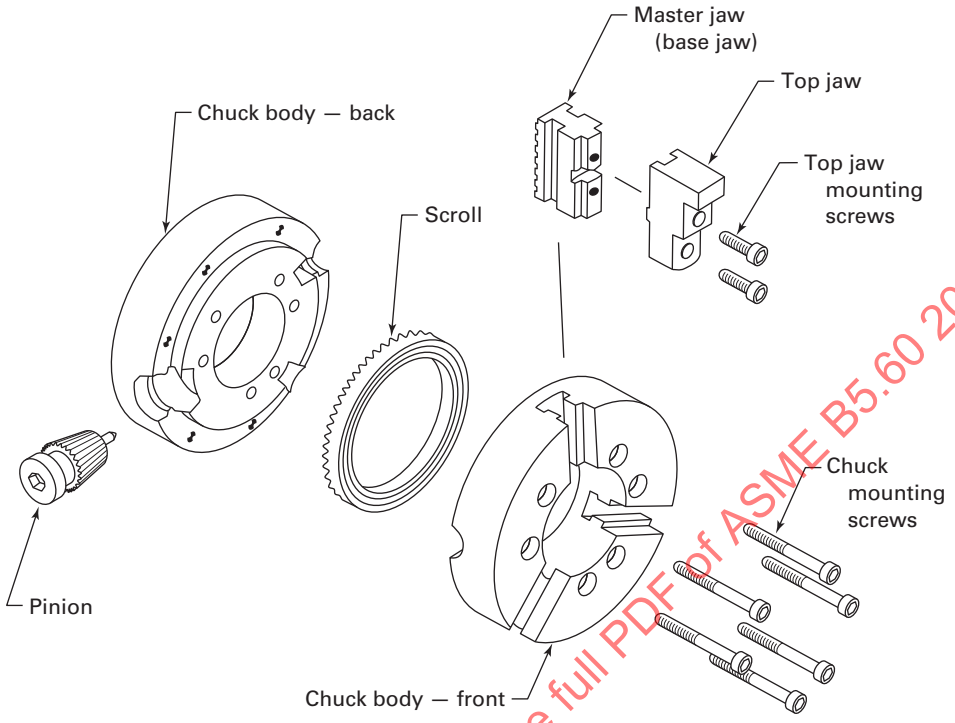
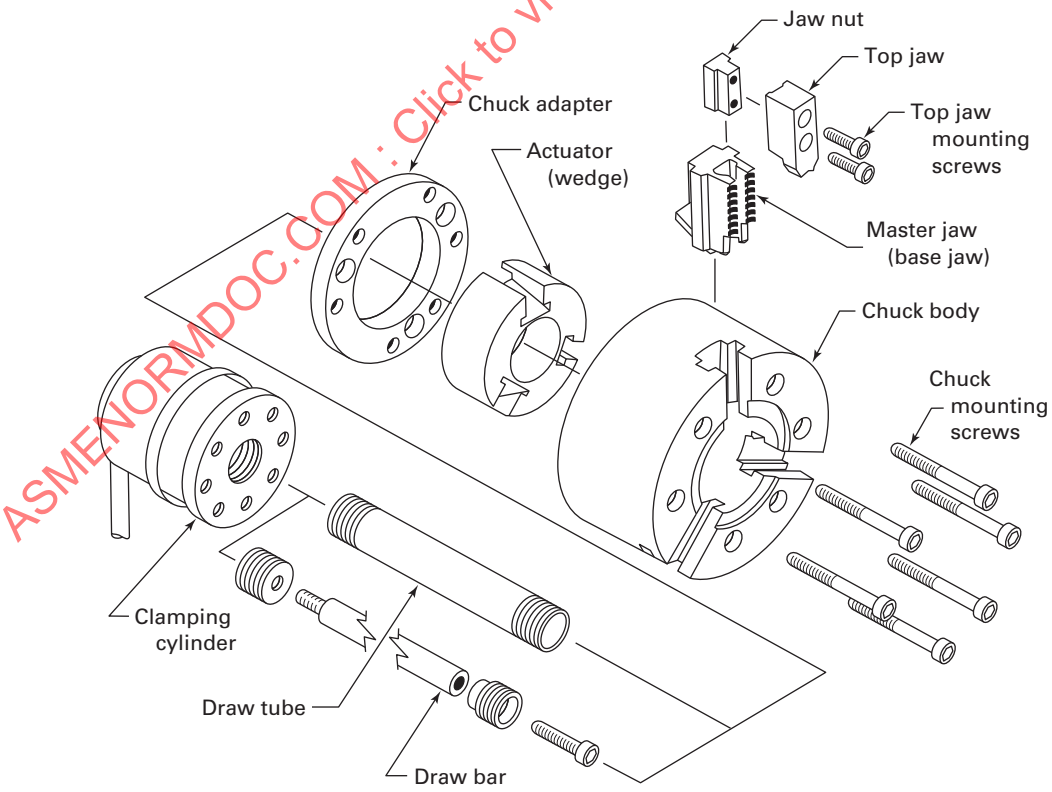


Fig. 1-3 Exploded View of a Power Chuck



Chapter 2
Chuck-to-Spindle Interface

2-1 SCOPE AND PURPOSE

This Chapter covers spindle noses for use on turning machines. Dimensions for each size and type of spindle nose, as well as the corresponding backs of chucks, faceplates, or fixtures, have been updated using metric dimensioning. Tolerances have been revised in order to minimize chuck distortion.

This Section replaces American National Standard B5.9-1967, reaffirmed 2014. For informational purposes, legacy data from this now-obsolete standard is provided in Nonmandatory Appendix A.

2-2 NOMENCLATURE

2-2.1 Spindle Sizes

The accompanying tables list the dimensions of Types A, C, and D spindle noses. Nine sizes from 3 through 28 are provided in Type A, tapered nose, and are shown in Table 2-1. Type A is divided into two categories, A1 and A2. Type A1 is provided with holes in both the inner and outer bolt circles in sizes 5 through 28 (Figs. 2-1 and 2-2). Type A2 has holes in the outer bolt circle only, in sizes 3 through 28. The smaller sizes 3 and 4 are available in Type A2 only (Fig. 2-3). Cylindrical nose, Type C, is available in sizes 3 through 28, shown in Figs. 2-4 and 2-5. Type D, cam lock spindle, which comes in nine sizes from 3 through 20, is shown in Fig. 2-6.

2-2.2 Chucks, Faceplates, and Fixtures

In specifying chucks, faceplates, or fixtures, the size and the type of spindle shall be designated.

2-2.3 Spindle Nose Identification

To clearly identify a spindle nose, the terminology used should include the type, the category in the case of Type A, and the size. For example, a Type A1 nose of size 6 would be designated as an A1-6 spindle. Likewise, a cylindrical or cam lock spindle of size 6 would be designated as C-6 or D-6, respectively.

2-2.4 Types of Spindle Noses

A detailed description of each spindle nose is given below.

(a) The Type A1 spindle nose is provided with two rows of tapped holes and a drive button as shown in Figs. 2-1 and 2-2. The inner row of tapped holes provides means for attaching certain sizes of scroll chucks by the use of socket-head cap screws that pass inside the scroll plate between the chuck jaws. The outer row of tapped holes provides a means for attaching faceplates, fixtures, and other chucks with the use of socket-head cap screws.

(b) The Type A2 spindle nose is shown in Fig. 2-7 and is the same as Type A1 except the holes on the inner bolt circle are omitted. Type A2 may be used when the spindle hole is so large that there is no space left for the inner bolt circle and where the type of workholding device does not require the inner bolt circle.

(c) The Type C cylindrical spindle is shown in Fig. 2-4. The Type C cylindrical nose has a mounting diameter with a bolt circle of tapped holes as shown in Fig. 2-5 and Table 2-2.

(d) The Type D spindle nose, shown in Fig. 2-6, is equipped with three equally spaced clearance holes in the outer bolt circle in sizes 3 and 4, and six equally spaced clearance holes in sizes 5 through 20. Each hole is provided with a cam, cam spring, and other details as shown in Figs. 2-8 through 2-16 and Tables 2-3 through 2-7. This type of nose is intended for use on machines where the saving of time in changing manual workholding devices is of considerable importance. A slight turn of each cam releases the cam lock studs and allows the instant removal of the workholding device. Similarly, when mounting a workholder on the spindle, the device can be locked in place very quickly and easily by turning each cam.

WARNING: Type D nose is not recommended for high-speed applications. When in doubt, contact the machine builder and chuck manufacturer.

2-3 CHUCKS

Chucks for Type A spindle (Fig. 2-17) noses have the backs of chucks made to the dimensions of Table 2-8 and Fig. 2-18, and are held on the spindle nose with socket-head cap screws. Type C chucks (Fig. 2-19) are made to the dimensions listed in Table 2-9 and Fig. 2-20, and are held on the spindle with socket-head cap screws. Chucks for Type D spindles (Fig. 2-21) have the backs of chucks made to the dimensions of Tables 2-10 through 2-12 and Figs. 2-22 through 2-24, and are held on the spindle through the means of cam studs and cams.

2-4 INSTALLATION

2-4.1 General

Always follow the chuck manufacturer's written instructions for installation of the chuck on a turning machine.

2-4.2 Safety

Chapters 4 and 5 of this Standard should be reviewed and understood before chuck installation.

2-5 BALANCE

Spindles should be balanced in accordance with ISO 1940-1 G2.5.

Chucks and/or spindle-mounted tooling should be balanced to 3 g at the outside diameter or in accordance with ISO 1940-1 G2.5, whichever is more precise.

Type A spindles should be balanced with a full-sized drive button in place, but without a chuck or spindle-mounted tooling.

A Type A chuck or spindle-mounted tooling is balanced without a drive button.

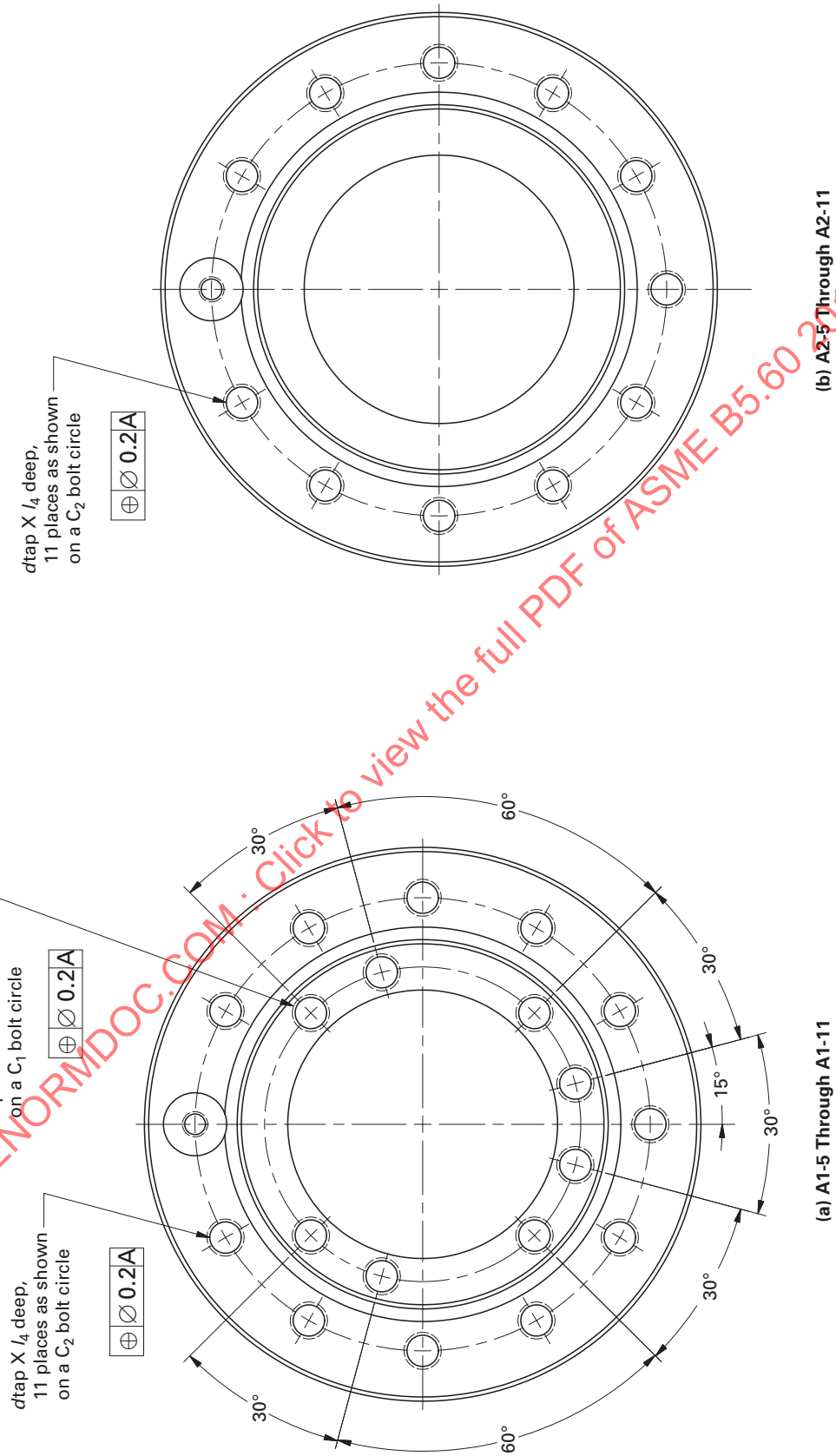
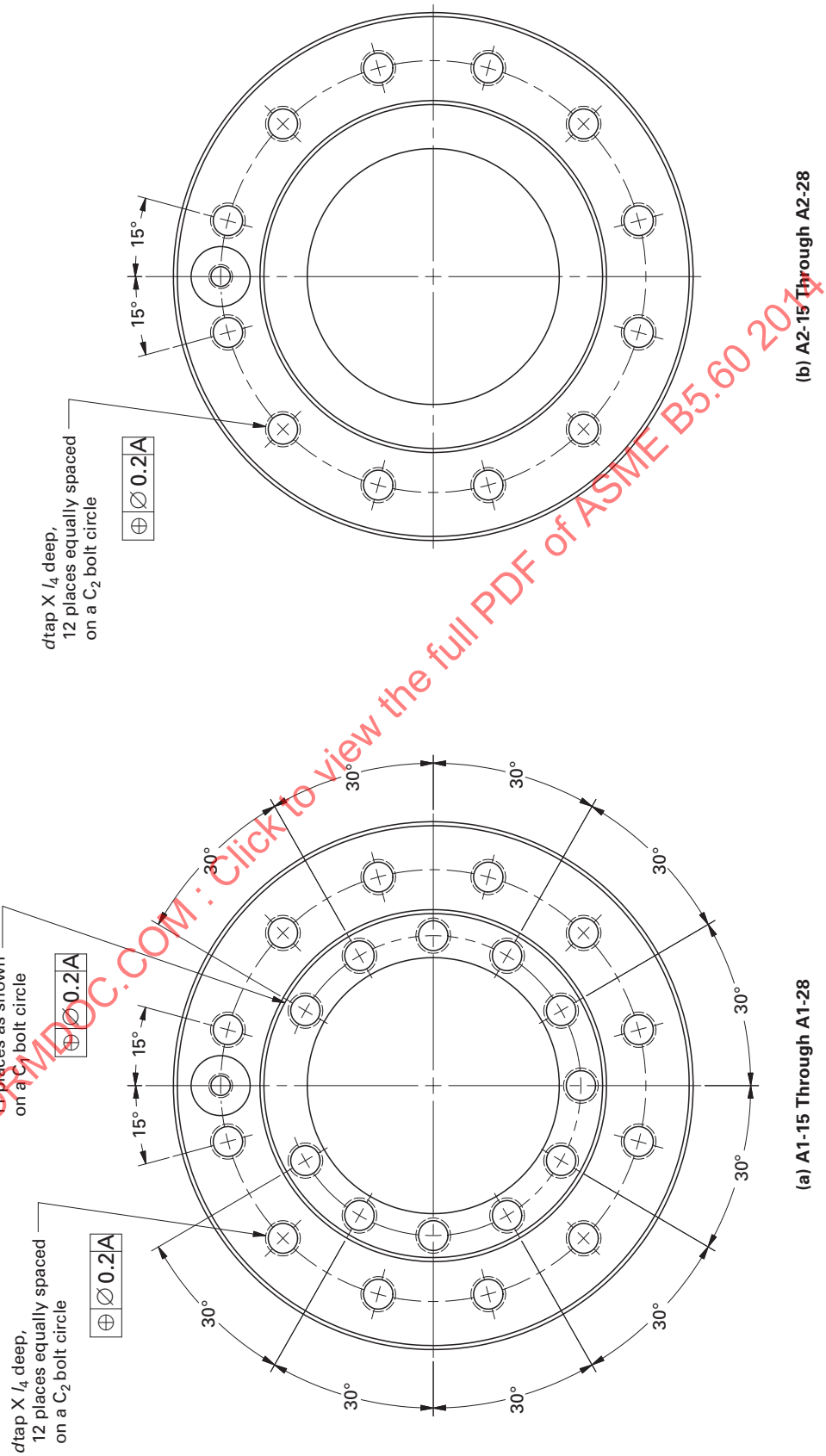


Fig. 2-1 Type A Spindle Location of Holes and Drive Button for Sizes A-5 Through A-11

Fig. 2-2 Type A Spindle Location of Holes and Drive Button for Sizes A-15 Through A-28



(a) A1-15 Through A1-28

(b) A2-15 Through A2-28

Fig. 2-3 Type A Spindle Dimensions for Sizes A-3 Through A-28, and Location of Holes and Drive Button for Sizes A2-3 and A2-4

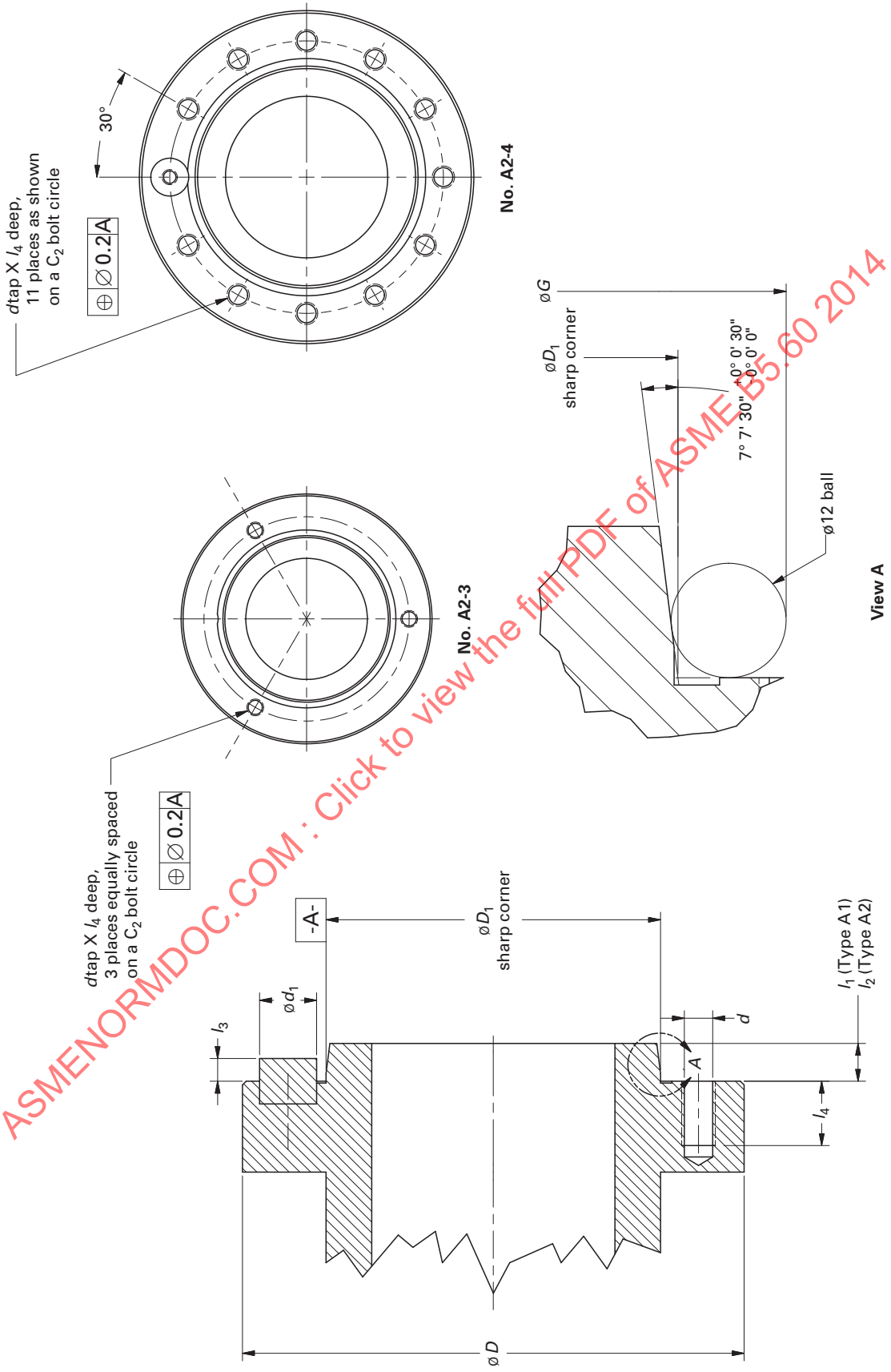


Table 2-1 Type A Spindle Dimensions

Dimension	Spindle								
	A-3	A-4	A-5	A-6	A-8	A-11	A-15	A-20	A-28
D	92	108	133	165	210	280	380	520	725
D_1	53.975 +0.008	63.513 +0.008	82.563 +0.010	106.375 +0.010	139.719 +0.012	196.869 +0.014	285.775 +0.016	412.775 +0.020	584.225 +0.023
C_1	. . .	. . .	61.9	82.6	111.1	165.1	247.6	368.3	530.2
C_2	70.6	82.6	104.8	133.4	171.4	235	330.2	463.6	647.6
d [Note (1)]	M10	M10	M10	M12	M16	M20	M24	M24	M30
d_1	. . .	14.25	15.90	19.05	23.80	28.60	34.90	41.30	50.80
l_1 (Type A1)	. . .	. . .	14.288 −0.025	15.875 −0.025	17.462 −0.025	19.050 −0.025	20.638 −0.025	22.225 −0.025	25.400 −0.025
l_2 (Type A2)	11	11	13	14	16	18	19	21	24
l_3	. . .	5	5	5	6	8	8	8	8
l_4	14	17	19	22	25	32	37	42	50
G	76.568 +0.008	86.106 +0.008	105.156 +0.010	128.968 +0.010	162.312 +0.012	219.462 +0.014	308.368 +0.016	435.368 +0.020	606.818 +0.023

GENERAL NOTES:

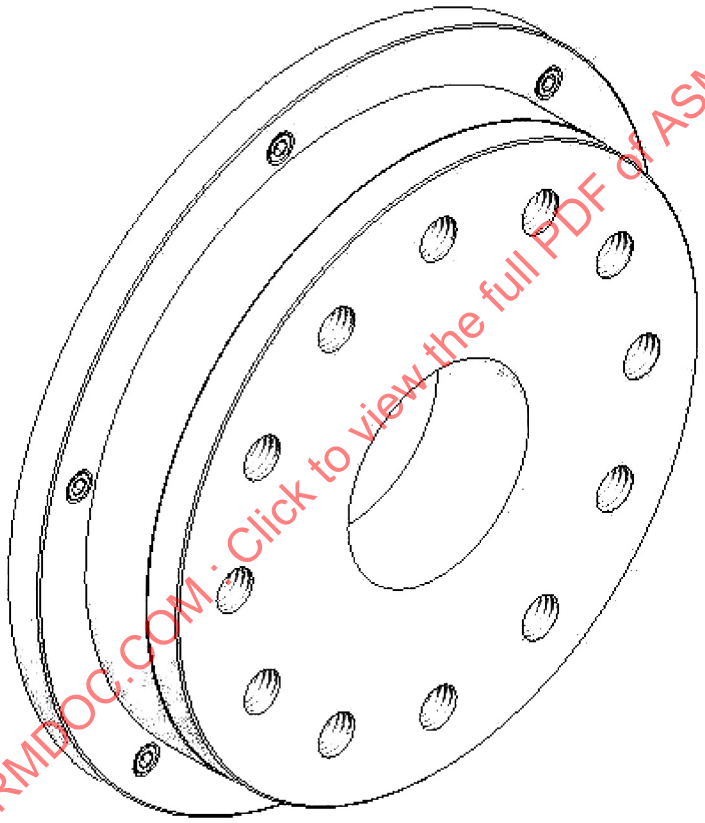
(a) Threads other than those listed may have been used. Contact spindle manufacturer.

(b) All dimensions are in millimeters.

NOTE:

(1) Unspecified tolerances ±0.4.

Fig. 2-4 Type C Spindle



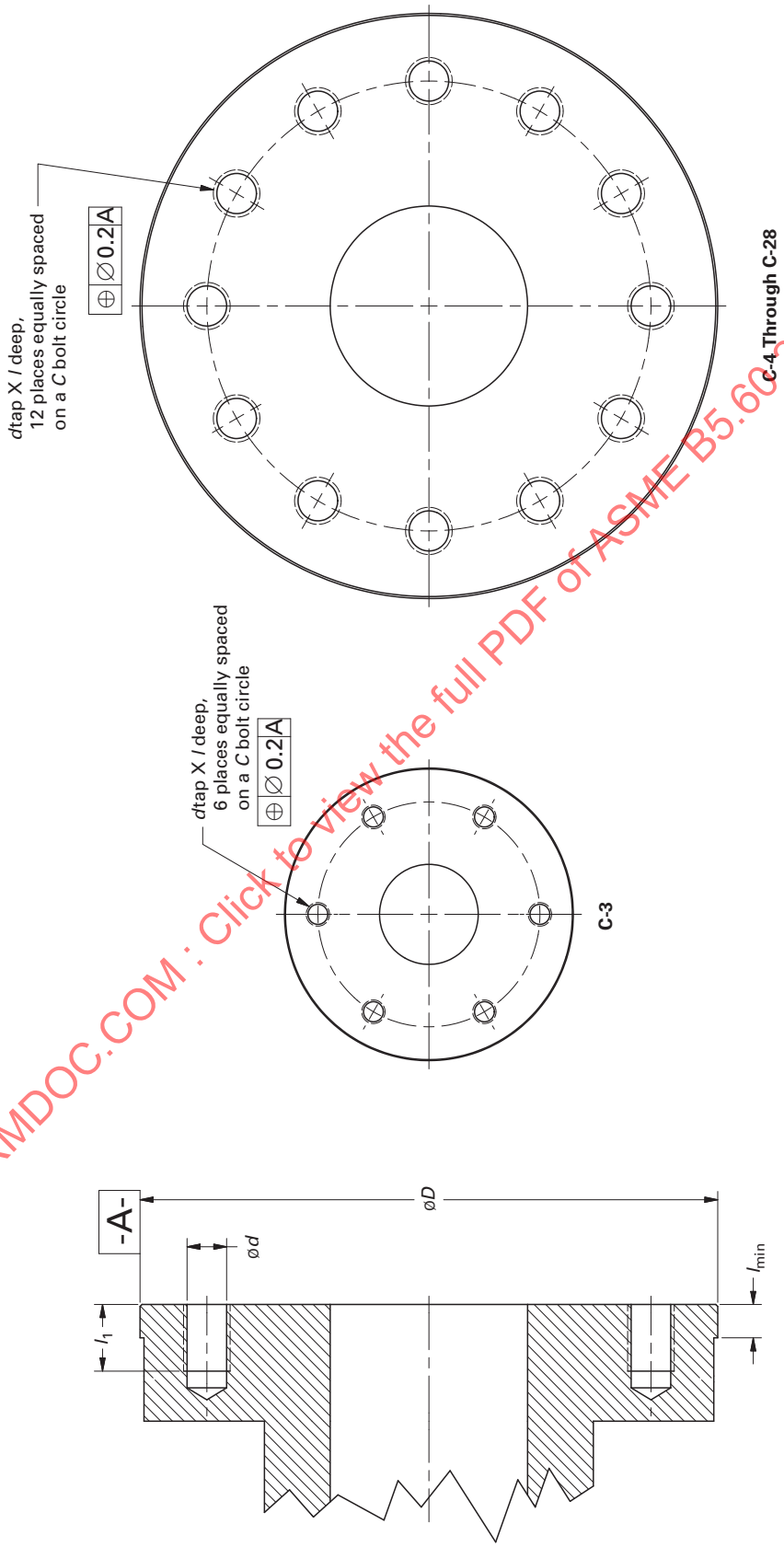


Fig. 2-5 Type C Spindle Location of Holes

Table 2-2 Type C Spindle Dimensions

	Spindle								
Dimension	C-3	C-4	C-5	C-6	C-8	C-11	C-15	C-20	C-28
D	90 −0.010	115 −0.010	140 −0.012	170 −0.012	220 −0.014	300 −0.016	380 −0.018	520 −0.022	720 −0.015
C	70.6	82.6	104.8	133.4	171.4	235.0	330.2	463.6	647.6
d	M10	M10	M10	M12	M16	M20	M24	M24	M30
l_1	20	20	20	24	36	40	48	48	60
l_{min}	6	6	7	7	7	7	7	7	7

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) All dimensions are in millimeters.

Fig. 2-6 Type D Spindle

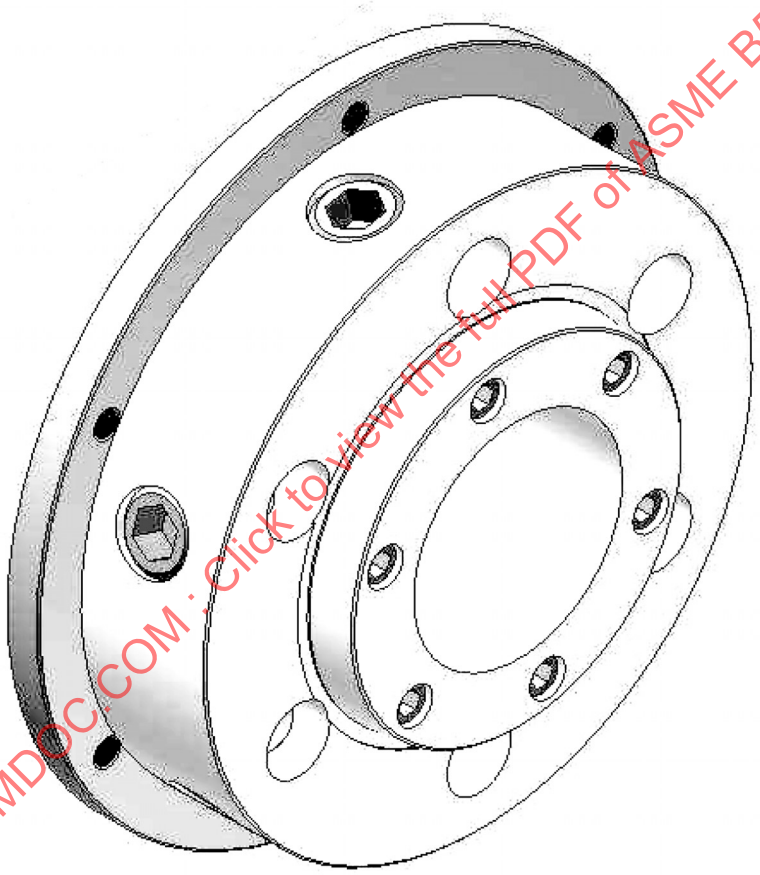
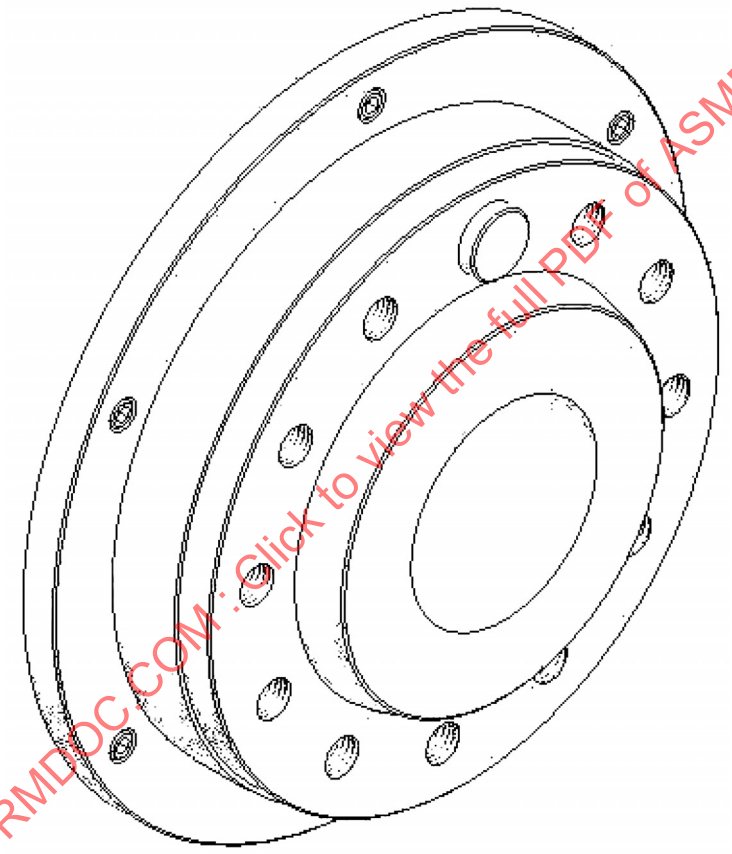


Fig. 2-7 Type A Spindle



GENERAL NOTE: Type A2 is shown.

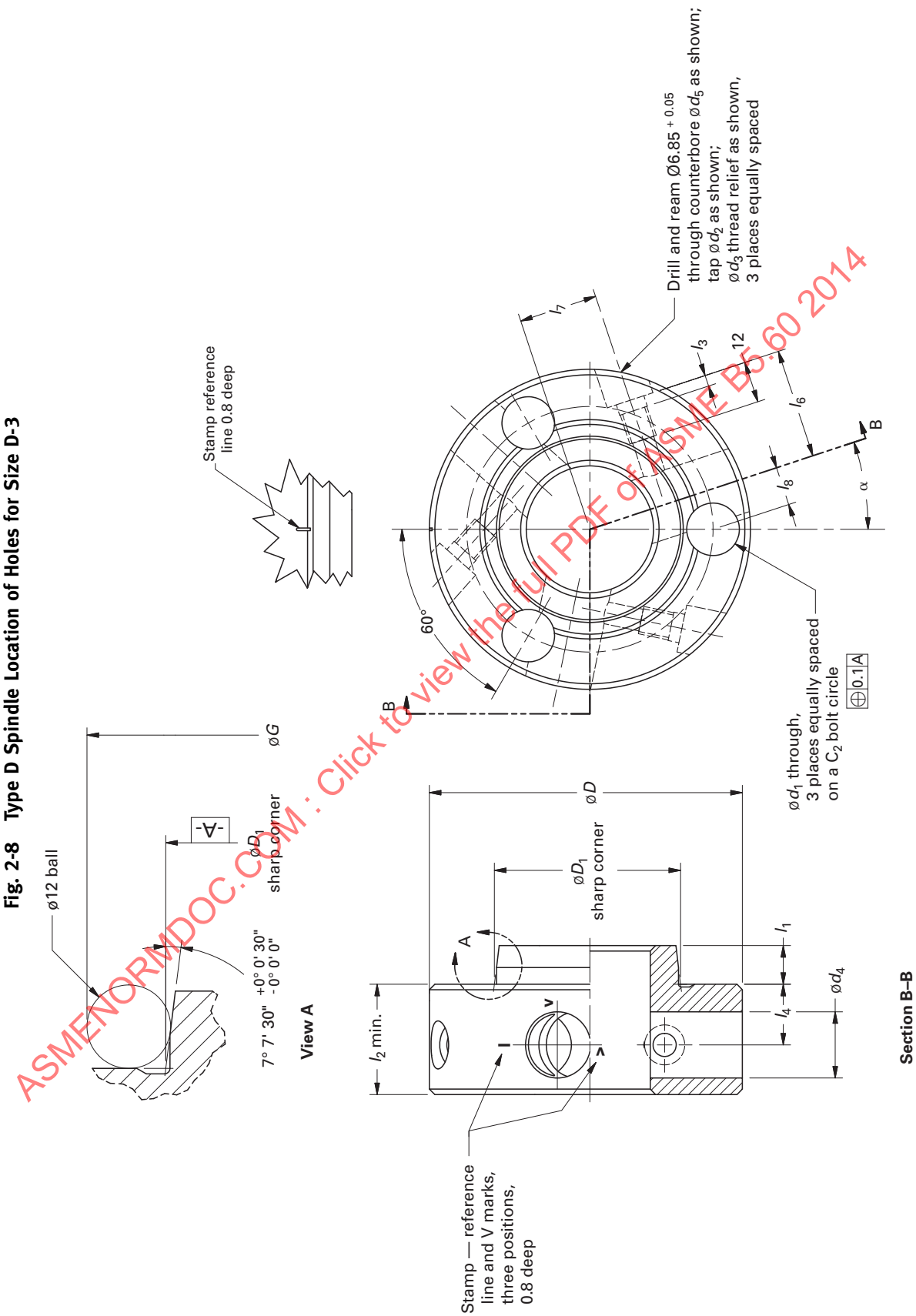


Fig. 2-8 Type D Spindle Location of Holes for Size D-3

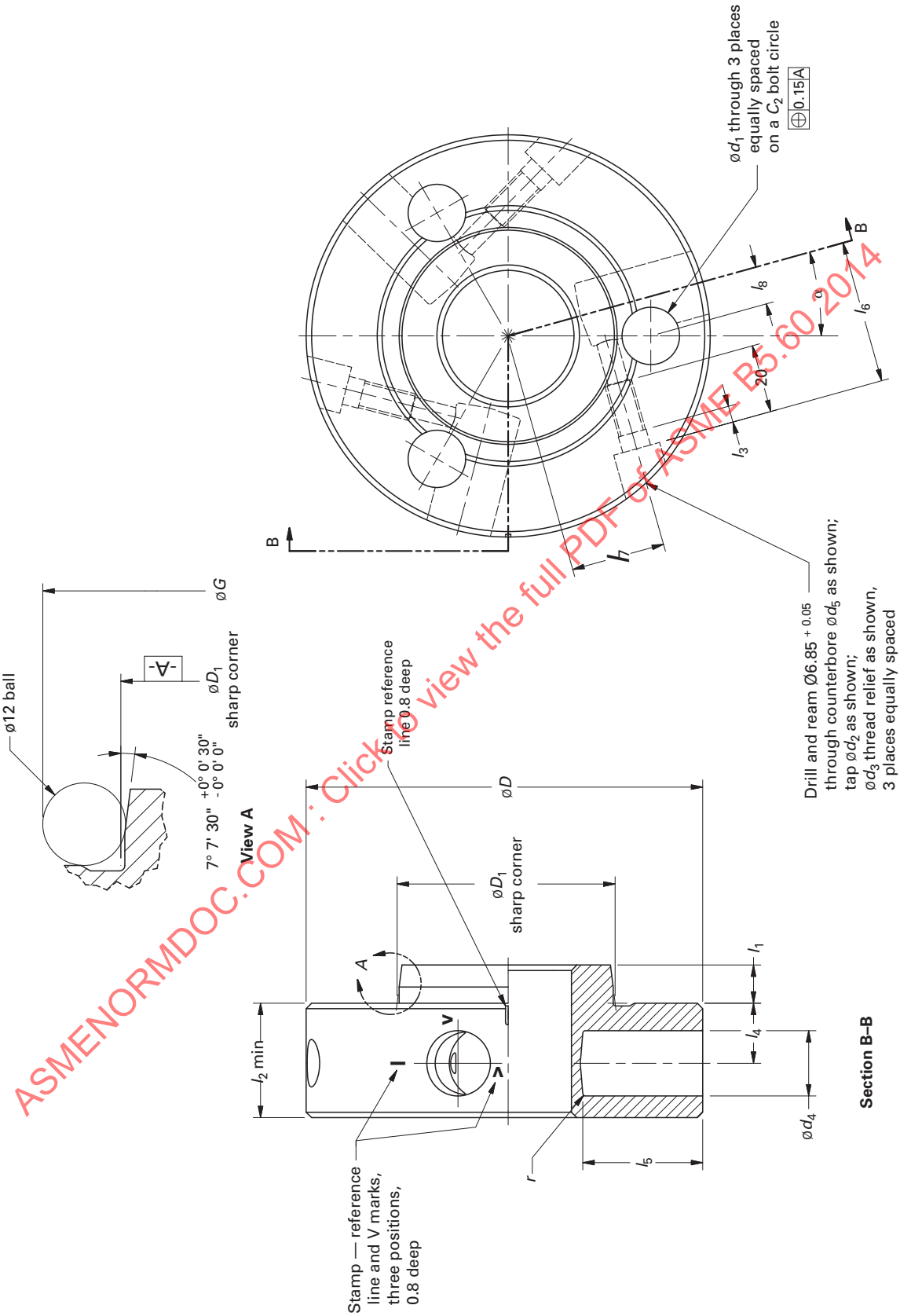


Fig. 2-9 Type D Spindle Location of Holes for Size D-4

Fig. 2-10 Type D Spindle Location of Holes for Sizes D-5 Through D-20

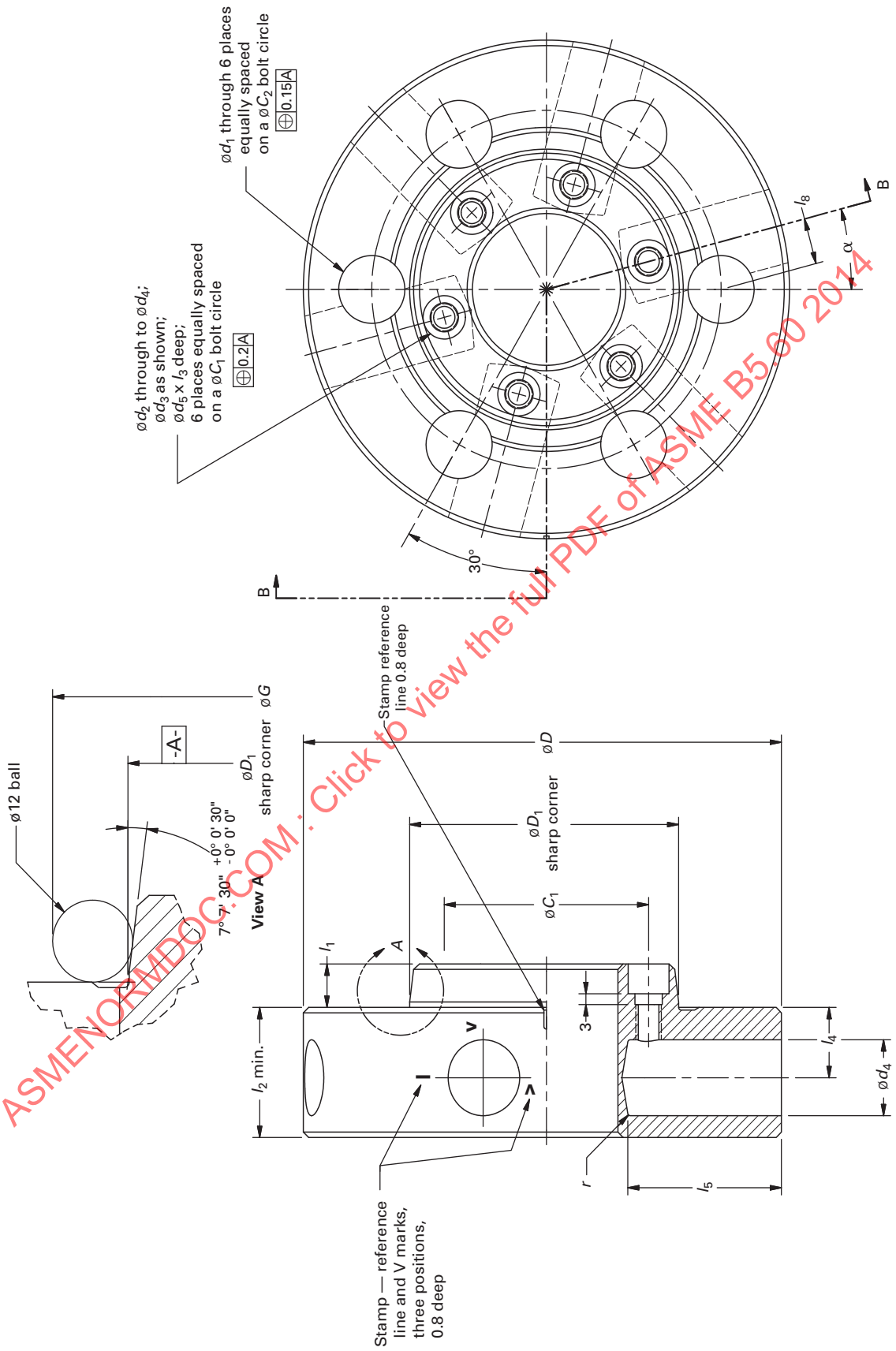
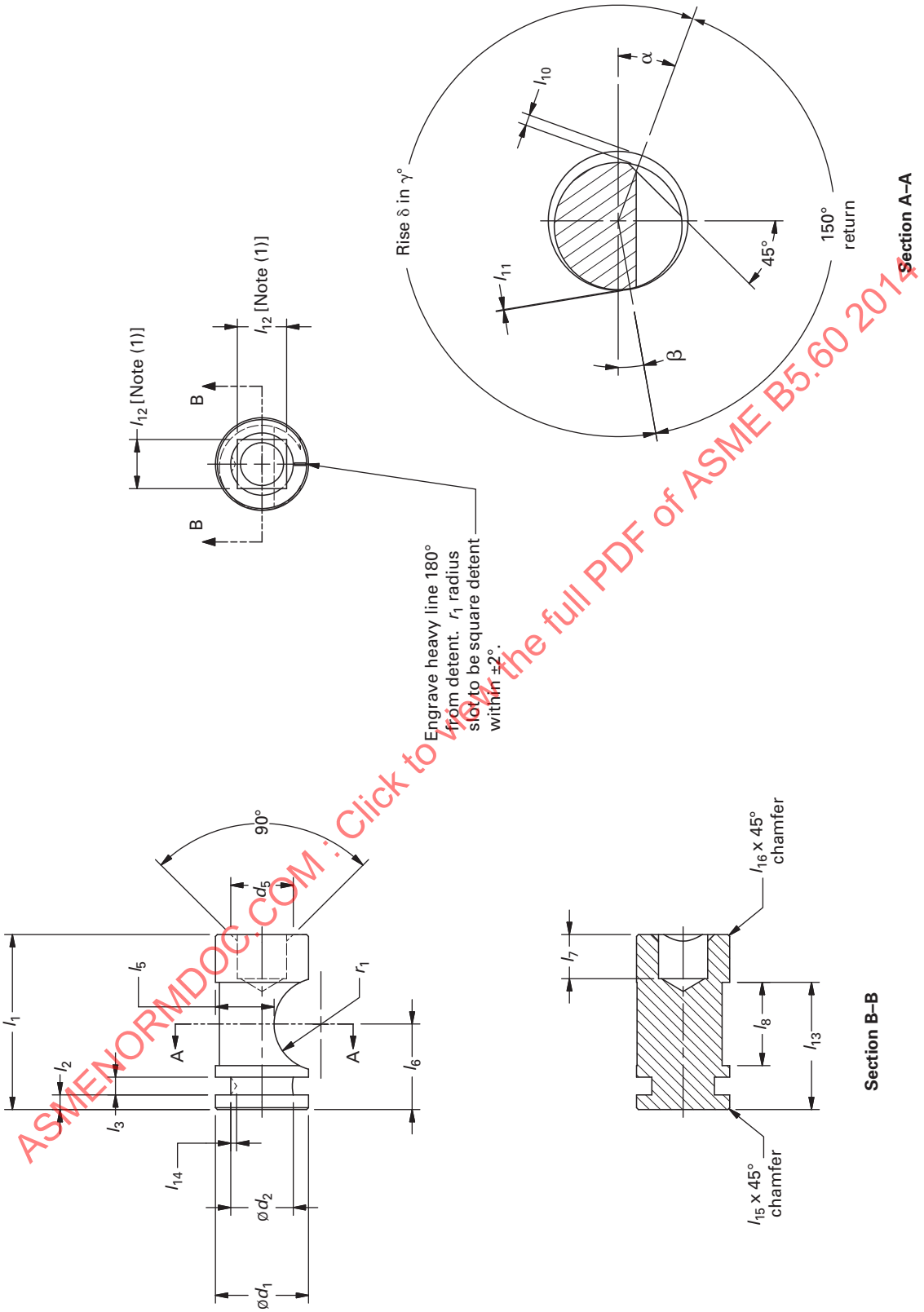


Fig. 2-11 Type D Spindle Cam for Size D-3



NOTE:
(1) l_{12} square hole to be square with radius slot within ±2°.

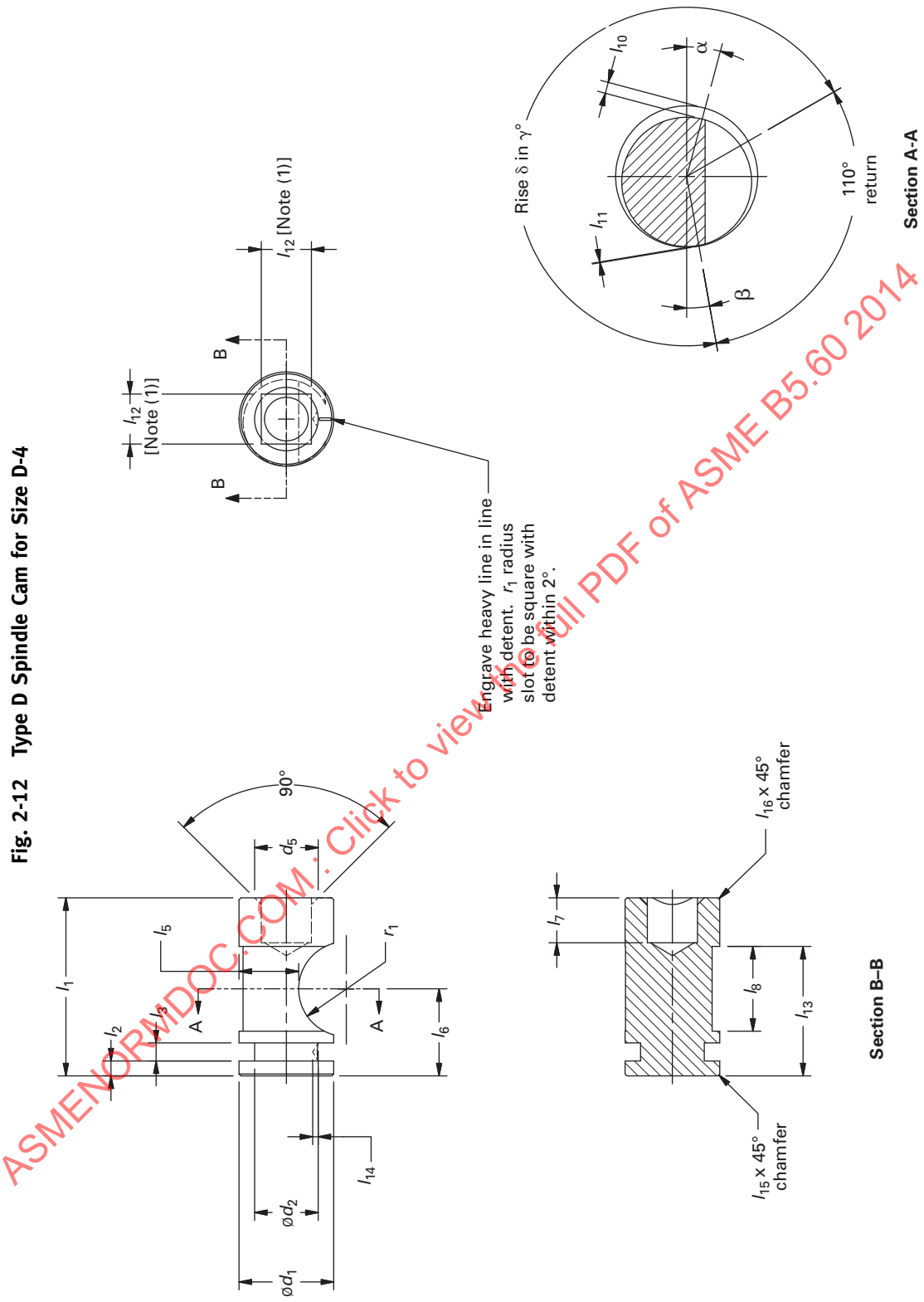


Fig. 2-12 Type D Spindle Cam for Size D-4

NOTE:
(1) l_{12} square hole to be square with radius slot within 2°.

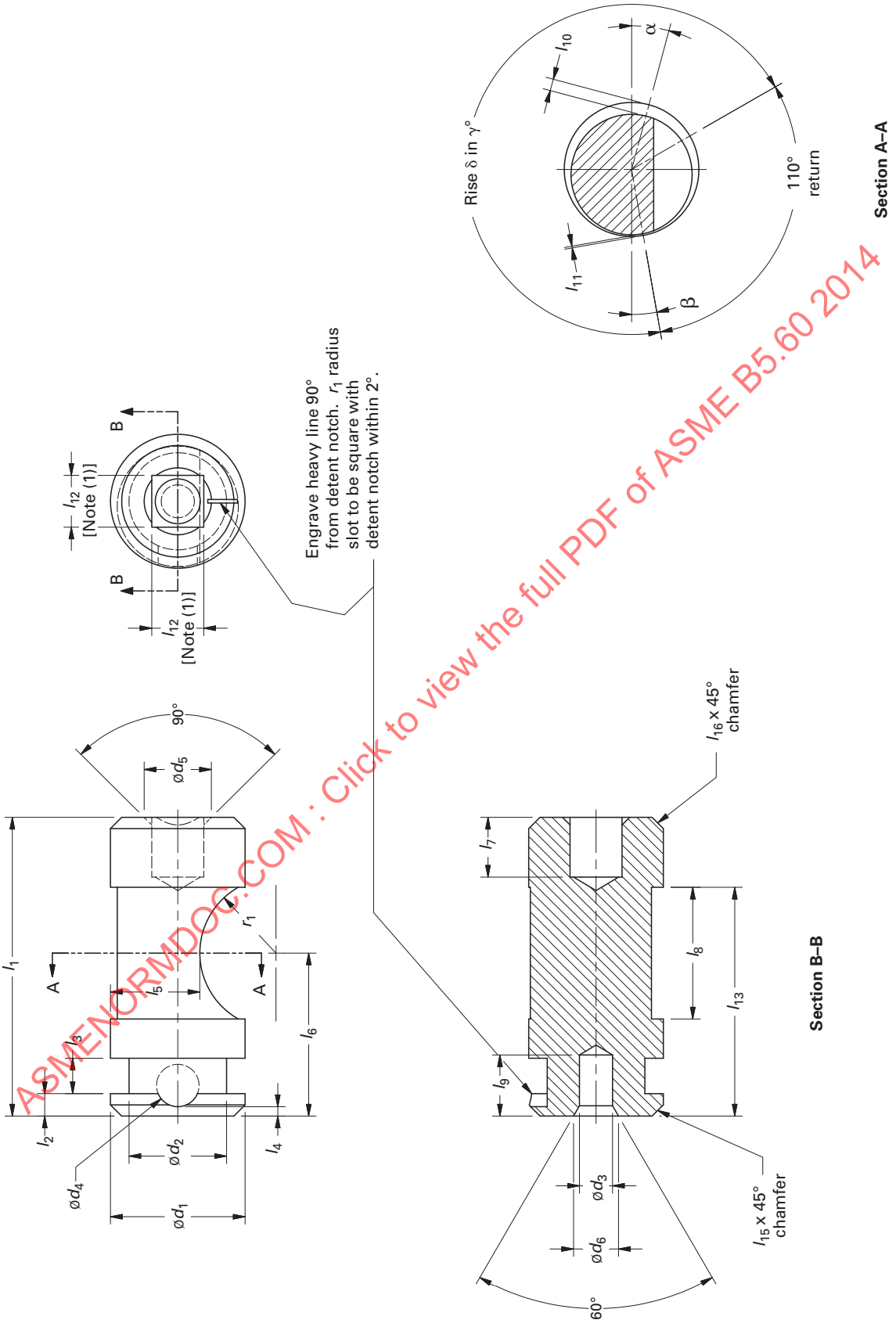
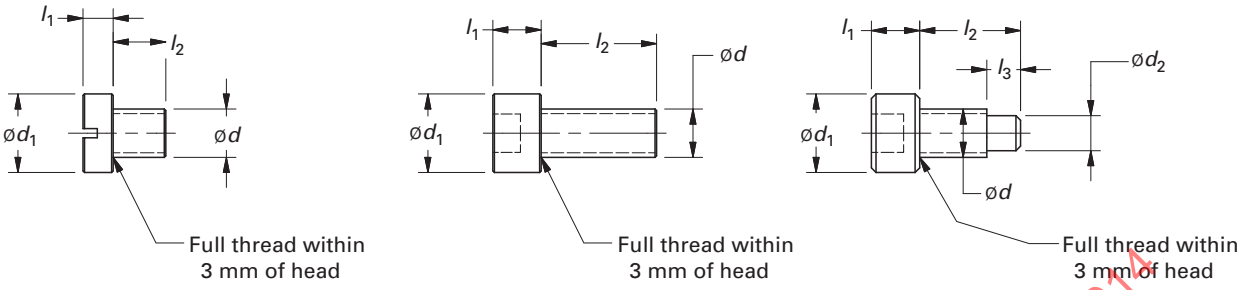


Fig. 2-13 Type D Spindle Cams for Sizes D-5 Through D-20

NOTE:
(1) l_{12} square hole to be square with radius slot within 2°.

Fig. 2-14 Type D Spindle Detent and Cam Screws



(a) D-3 Detent Screw

(b) D-4 Detent Screw

(c) D-5 Through D-20 Cam Screws

Fig. 2-15 Type D Spindle Detent and Cam Springs

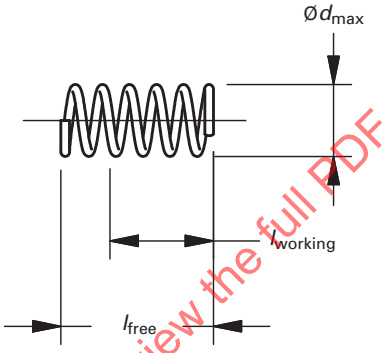
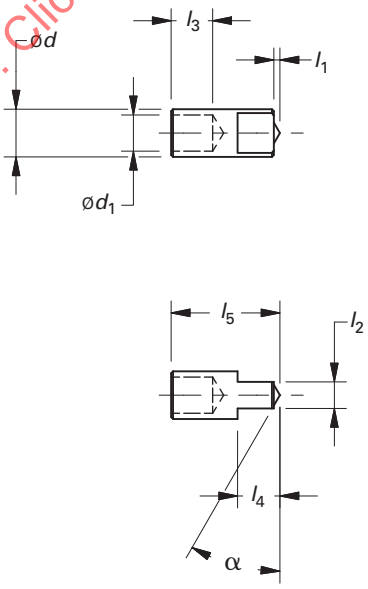


Fig. 2-16 Type D Spindle Detent Plunger



D-3 and D-4 Detent Plunger

Table 2-3 Type D Spindle Dimensions

Dimension	Tolerance	Spindle							
		D-3	D-4	D-5	D-6	D-8	D-11	D-15	D-20
D	...	92	117	146	181	225	298	403	546
D_1	...	53.975 +0.008	63.513 +0.008	82.563 +0.010	106.375 +0.010	139.719 +0.012	196.869 +0.014	285.775 +0.016	412.775 +0.020
C_1	±0.2	...	...	63.5	82.6	114.3	171.5	257.2	381.0
C_2	...	70.6	82.6	104.8	133.4	171.5	235.0	330.2	463.6
d_1	+0.05	15.1	16.7	19.8	23.0	26.2	31.0	35.7	42.1
d_2	...	M8 × 1.25	M8 × 1.25	M8 × 1.25	M10 × 1.5	M10 × 1.5	M10 × 1.5	M10 × 1.5	M10 × 1.5
d_3	±0.1	8.4	8.4	8.4	10.4	10.4	10.4	10.4	10.4
d_4	+0.05	19.05	19.05	22.22	25.40	28.57	31.75	34.92	41.27
d_5	...	13.5	13.5	13.5	16.5	16.5	16.5	16.5	16.5
l_1	...	11	11	13	14	16	18	19	21
l_2 min.	...	32	34	38	45	50	60	70	82
l_3	...	3.1	4.7	8.7	10.3	10.3	10.3	10.3	10.3
l_4	...	17.5	17.5	20.6	23.8	27.0	31.8	36.5	42.9
l_5	+0.4	...	38.06	47.80	57.25	64.20	73.70	83.35	92.95
l_6	...	30.4	40.6	...	...	...	...	...	...
l_7	±0.05	22.6	27.0	...	...	...	...	...	...
l_8	±0.1	11.10	11.10	13.50	15.90	18.25	21.45	24.60	28.60
α	...	18 deg, 18.6 min	15 deg, 36 min	14 deg, 55 min	13 deg, 46 min	12 deg, 18 min	10 deg, 30 min	8 deg, 35 min	7 deg, 5 min
r	...	...	0.8	0.8	0.8	0.8	1.6	1.6	1.6
G	...	76.568 +0.008	86.106 +0.008	105.156 +0.010	128.968 +0.010	162.312 +0.012	219.462 +0.014	308.368 +0.016	435.368 +0.020

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) Unless otherwise specified, all dimensions are in millimeters.

Table 2-4 Type D Spindle Cam Dimensions

Dimension	Tolerance	Cam							
		D-3	D-4	D-5	D-6	D-8	D-11	D-15	D-20
l_1	−0.2	26.6	35.7	46.8	56.4	63.5	73.0	82.6	92.1
l_2	±0.1	2.2	3.0	3.2	4.0	4.8	6.4	6.4	6.4
l_3	±0.05	3.6	3.6	6.2	7.5	7.5	7.5	7.5	7.5
l_4	−0.2	. . .	. . .	2.4	3.2	4.0	5.6	5.6	5.6
l_5	±0.1	13.4	11.9	14.3	16.3	18.6	21.0	23.4	27.4
l_6	±0.2	14.9	17.4	24.2	30.2	34.1	38.9	43.7	48.4
l_7	. . .	8	9	11	13	14	16	19	21
l_8	. . .	13	17	21	25	27	32	37	43
l_9	. . .	. . .	. . .	. . .	14	16	16	16	16
l_{10}	+0.3	1.6	1.6	1.6	2.2	2.2	2.3	2.3	2.7
l_{11}	+0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
l_{12}	+0.1, −0.3	8	10	11	12	14	17	17	22
l_{13}	. . .	21.4	26.2	35.0	42.9	47.6	54.8	61.9	69.9
l_{14}	. . .	1.2	1.2	. . .	. . .	. . .	. . .	. . .	. . .
l_{15}	. . .	0.4	0.8	0.8	1.1	1.1	1.5	1.5	1.5
l_{16}	. . .	0.8	0.8	1.6	1.6	1.6	2.4	2.4	2.4
d_1	−0.05	18.95	18.95	22.12	25.30	28.47	31.65	34.82	41.17
d_2	. . .	12.7 ±0.2	12.7 ±0.2	14.3	17.5	20.6	23.8	27.0	33.3
d_3	±0.1	. . .	. . .	7.9	9.5	9.5	9.5	9.5	9.5
d_4	±0.05	. . .	. . .	5.8	7.2	7.2	7.2	7.2	7.2
d_5	. . .	11.1	13.9	15.3	16.7	19.4	23.6	23.6	30.6
d_6	. . .	. . .	. . .	10	11	11	11	11	11
r_1	. . .	7.5	9.5	11.1	12.7	14.3	16.7	19.0	22.2
α, deg	. . .	15	15	15	20	20	20	20	20
β, deg	. . .	15	10	10	10	10	15	15	15
γ, deg	. . .	210	250	250	250	250	250	250	250
δ	. . .	1.60	1.91	1.91	2.64	2.64	2.64	2.64	3.18

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) Unless otherwise specified, all dimensions are in millimeters.

Table 2-5 Type D Spindle Detent and Cam Screws Dimensions

Dimension	Detent Screws		Cam Screws					
	D-3	D-4	D-5	D-6	D-8	D-11	D-15	D-20
Type	Pan head	SHCS	SHCS	SHCS	SHCS	SHCS	SHCS	SHCS
d	M8 × 1.25	M8 × 1.25	M8 × 1.25	M10 × 1.5	M10 × 1.5	M10 × 1.5	M10 × 1.5	M10 × 1.5
d_1	13	13	13	16	16	16	16	16
d_2, −0.05	. . .	. . .	5.8	7.2	7.2	7.2	7.2	7.2
l_1	5	8	8	10	10	10	10	10
l_2	9.1 ±0.2	19.3 ±0.2	16.9	17.9	21.6	26.8	30.9	36.1
l_3	. . .	. . .	5.6	5.6	5.6	5.6	5.6	5.6

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) SHCS = socket head cap screw.
(c) All dimensions are in millimeters.

Table 2-6 Type D Spindle Detent and Cam Spring Dimensions

Dimension	Detent Springs, Sizes D-3 and D-4	Cam Springs	
		D-5	D-6, D-8, D-11, D-15, and D-20
d_{max}	4.6	7.7	9.3
d_{wire}	0.66	1.14	1.24
$l_{working}$	6.0	15.1	16.9
l_{free}	9.5	20.7	25.4
Spring rate, N/mm	6.5	8.9	7.2
Load, N	18–27	35–50	50–70

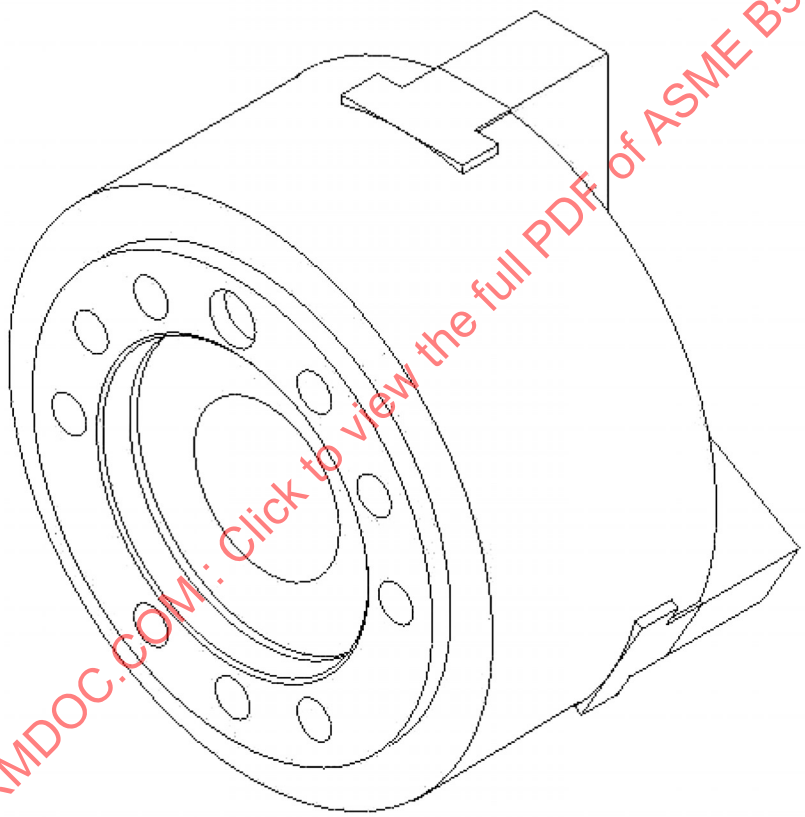
GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) Unless otherwise specified, all dimensions are in millimeters.

Table 2-7 Type D Spindle Detent Plunger Dimensions

Dimension	Detent, Sizes D-3 and D-4
d, −0.02	6.32
d_1, ±0.1	4.8
l_1	0.8
l_2, −0.05	3.5
l_3	5.5
l_4	4.8
l_5, −0.2	14.4
α, deg	30

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) Unless otherwise specified, all dimensions are in millimeters.

Fig. 2-17 Type A Chucks and Faceplates



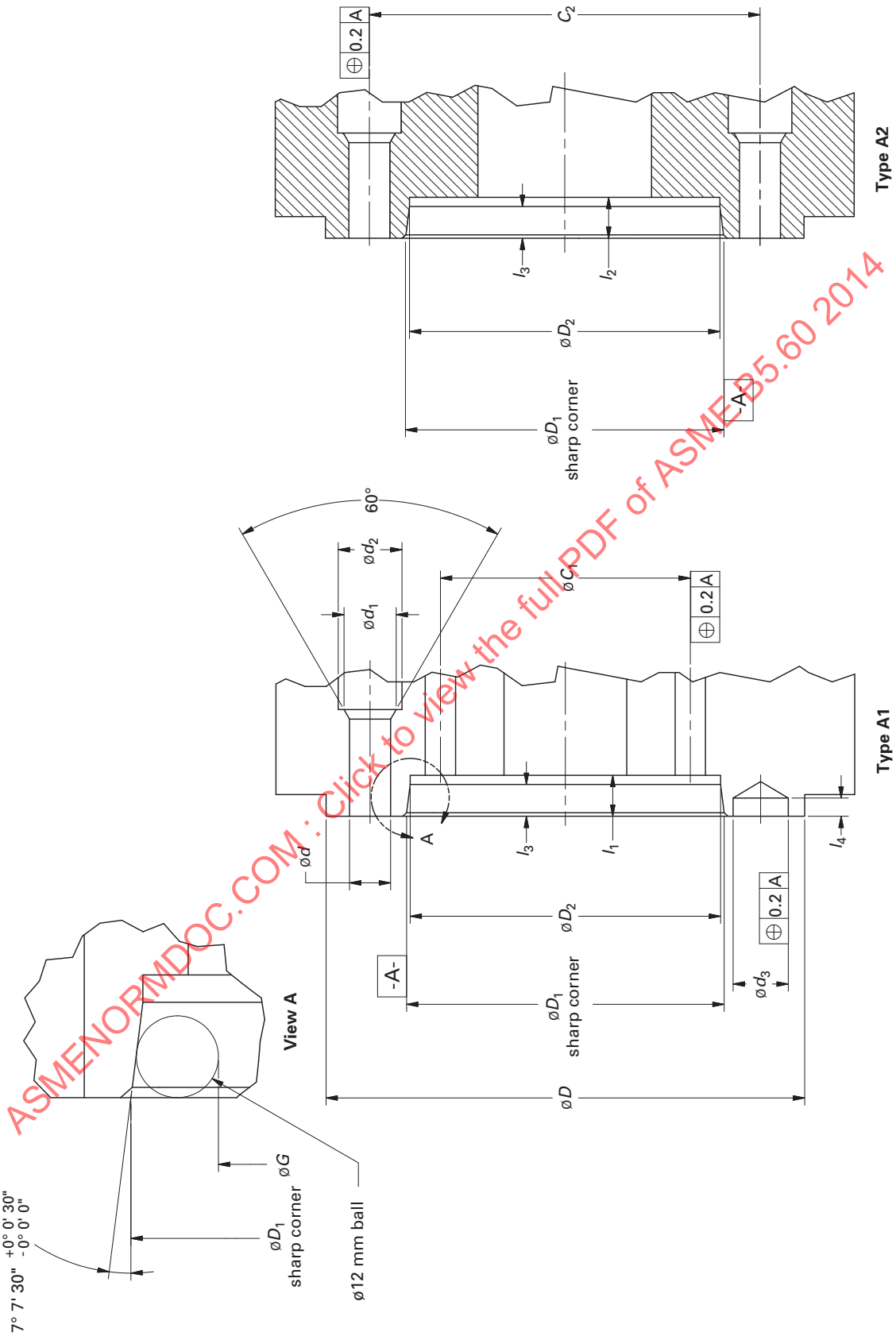


Fig. 2-18 Type A Chuck and Faceplate Dimensions

Table 2-8 Type A Chuck and Faceplate Dimensions

Dimension	Chuck or Faceplate								
	A-3	A-4	A-5	A-6	A-8	A-11	A-15	A-20	A-28
D	92	108	133	165	210	280	380	520	725
D_1	53.986 +0.010	63.524 +0.010	82.576 +0.012	106.388 +0.012	139.735 +0.014	196.888 +0.017	285.797 +0.019	412.802 +0.024	584.256 +0.028
D_2	51.59 +0.10	61.11 +0.10	79.78 +0.10	103.17 +0.10	136.12 +0.15	192.89 +0.15	281.38 +0.15	407.97 +0.15	578.64 +0.15
C_1	. . .	. . .	61.9	82.6	111.1	165.1	247.6	368.3	530.2
C_2	70.6	82.6	104.8	133.4	171.4	235	330.2	463.6	647.6
d [Note (1)]	10.80	10.80	10.80	12.75	16.75	20.75	24.75	24.75	31.75
d_1	11.2	11.2	11.2	14.2	18.2	22.4	26.4	26.4	33.4
d_2	17.25	17.25	17.25	19.25	25.50	31.50	37.50	37.50	47.50
d_3	. . .	14.70	16.30	19.45	24.20	29.40	35.70	42.10	51.60
l_1 (Type A1)	. . .	. . .	14.288 +0.025	15.875 +0.025	17.462 +0.025	19.050 +0.025	20.638 +0.025	22.225 +0.025	25.400 +0.025
l_2 (Type A2)	13	13	15	16	18	20	21	23	26
l_3	10	10	12	13	14	16	17	19	22
l_4	. . .	6.5	6.5	6.5	8	10	10	10	10
G	28.393 +0.010	37.931 +0.010	56.983 +0.012	80.795 +0.012	114.142 +0.014	171.295 +0.017	260.204 +0.019	387.209 +0.024	558.663 +0.028

GENERAL NOTES:

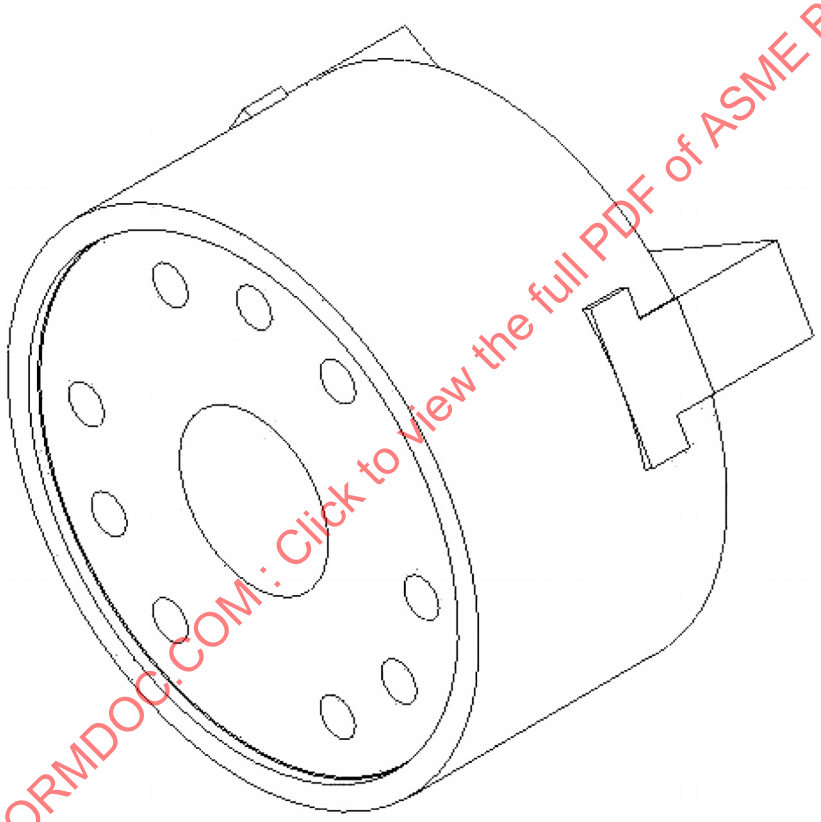
(a) Threads other than those listed may have been used. Contact spindle manufacturer.

(b) All dimensions are in millimeters.

NOTE:

(1) Unspecified tolerances ±0.4.

Fig. 2-19 Type C Chucks and Faceplates



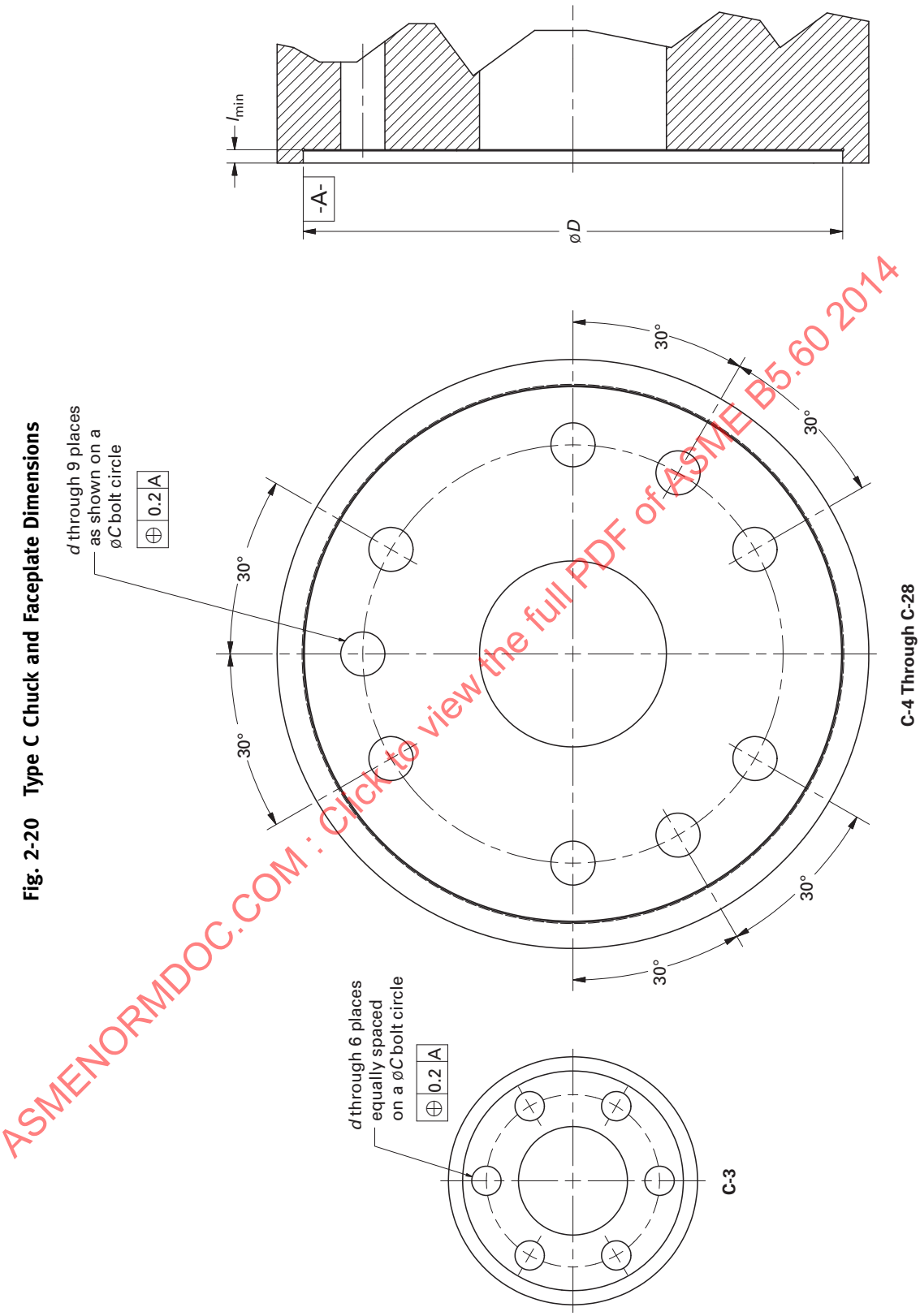


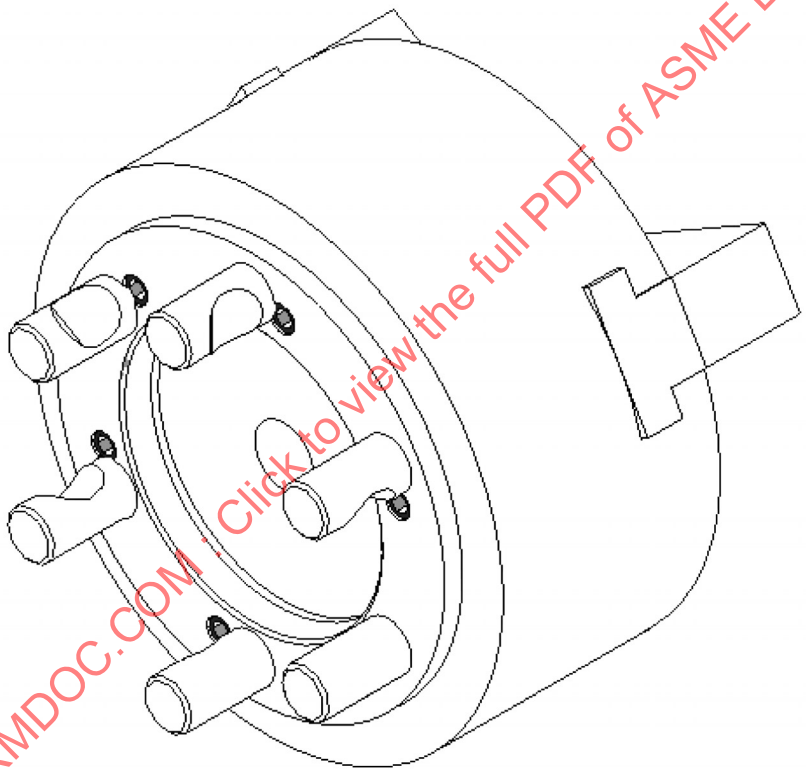
Fig. 2-20 Type C Chuck and Faceplate Dimensions

Table 2-9 Type C Chuck and Faceplate Dimensions

Dimension	Chuck								
	C-3	C-4	C-5	C-6	C-8	C-11	C-15	C-20	C-28
D	90 +0.009	115 +0.009	140 +0.010	170 +0.010	220 +0.012	300 +0.013	380 +0.014	520 +0.018	720 +0.020
C	70.6	82.6	104.8	133.4	171.4	235.0	330.2	463.6	647.6
d	12	12	12	14	18	22	26	26	33
l_{min}	4	4	5	5	5	5	5	5	5

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) All dimensions are in millimeters.

Fig. 2-21 Type D Chucks and Faceplates



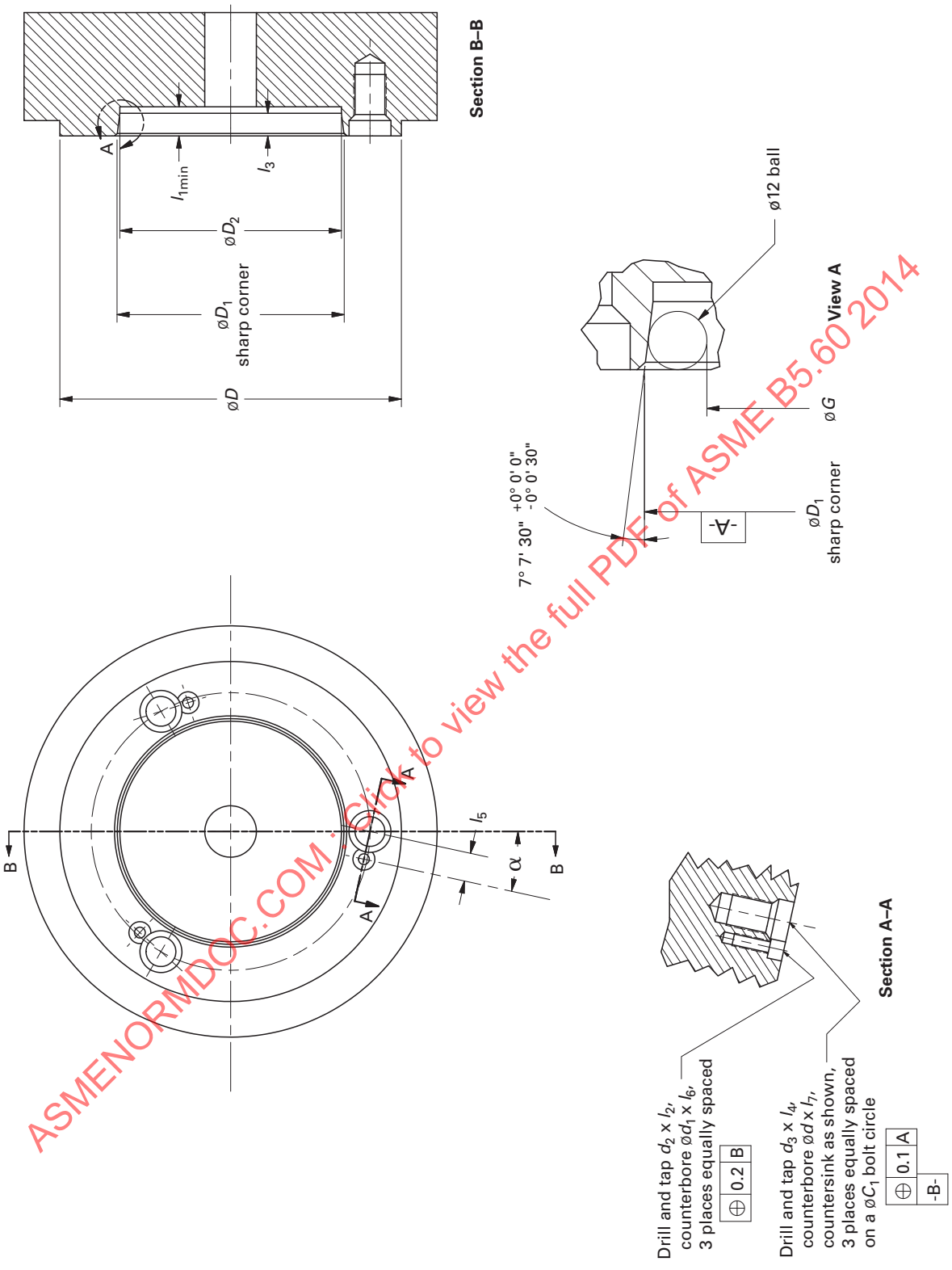


Fig. 2-22 Types D-3 and D-4 Backs of Chucks and Faceplates

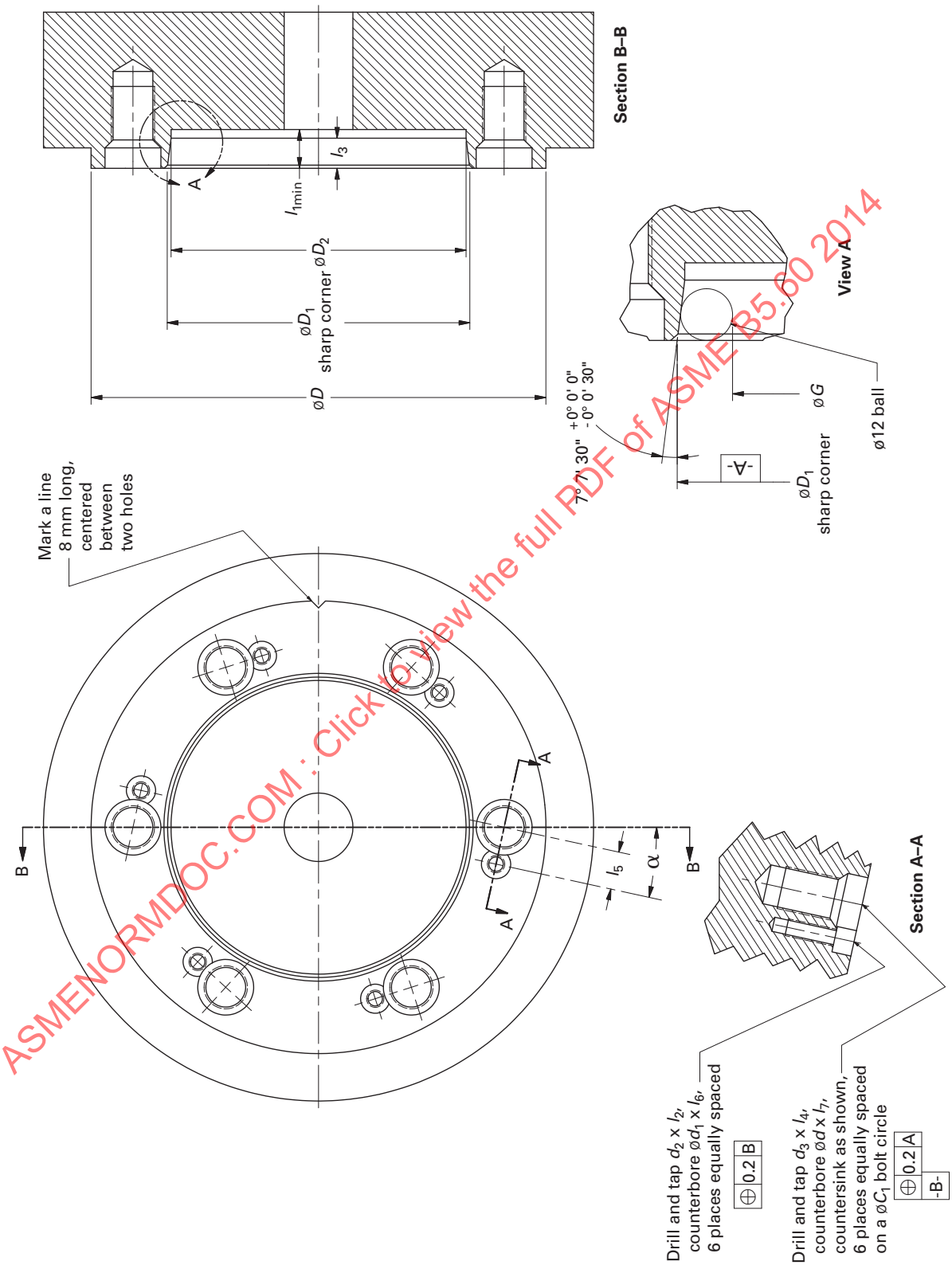


Fig. 2-23 Types D-5 Through D-20 Backs of Chucks and Faceplates

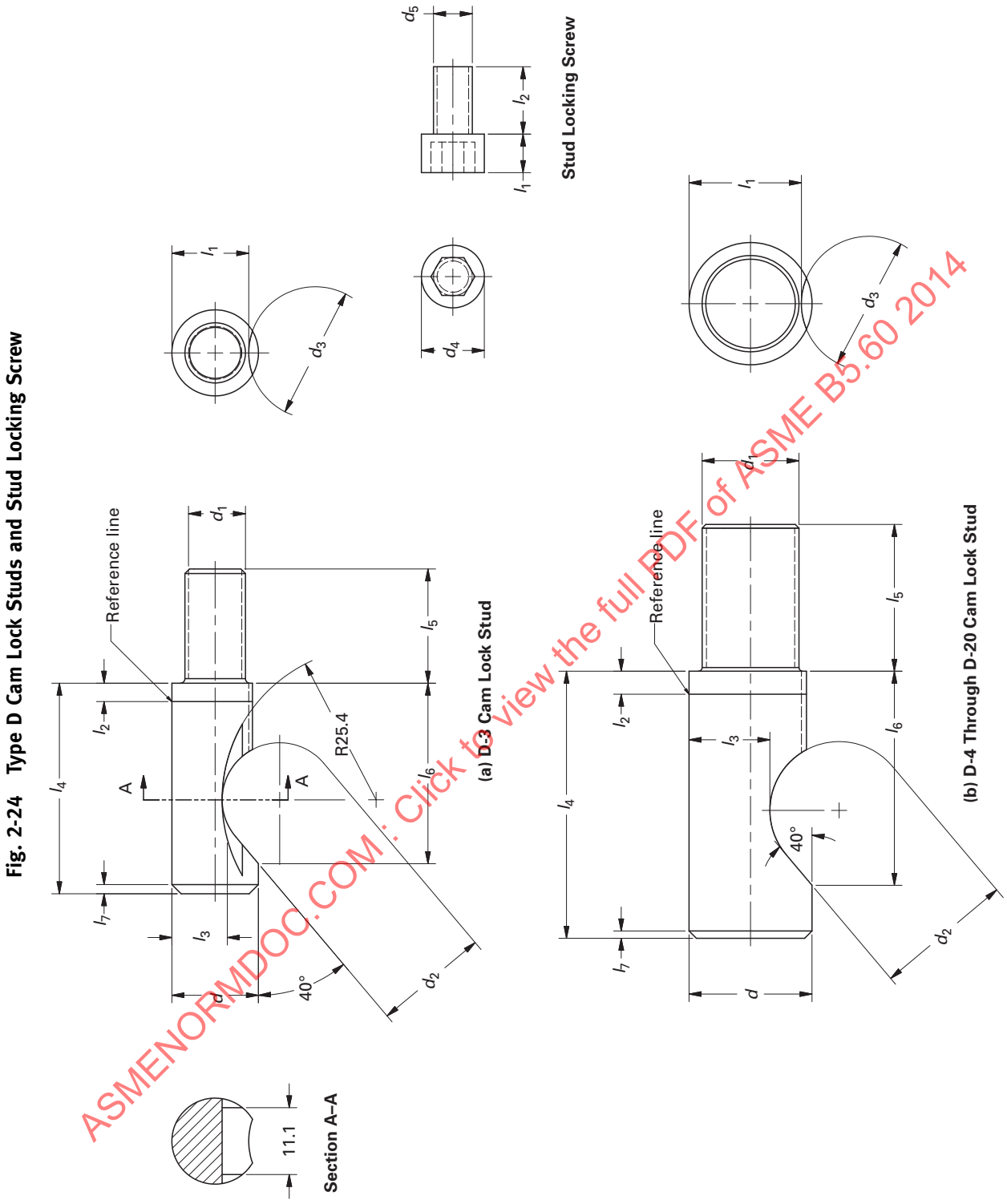


Fig. 2-24 Type D Cam Lock Studs and Stud Locking Screw

Table 2-10 Type D Chuck and Faceplate Dimensions

Dimension	Chuck and Faceplate							
	D-3	D-4	D-5	D-6	D-8	D-11	D-15	D-20
D	92	117	146	181	225	298	403	546
D_1	53.986 +0.010	63.524 +0.010	82.576 +0.012	106.388 +0.014	139.735 +0.017	196.888 +0.019	285.797 +0.024	412.802 +0.028
D_2	51.6 +0.1	61.1 +0.1	79.8 +0.1	103.2 +0.1	136.1 +0.15	192.9 +0.15	281.4 +0.15	408.0 +0.15
C_1	70.6	82.6	104.8	133.4	171.4	235	330.2	463.6
d	14.7	16.3	19.4	22.6	25.8	30.6	35.3	41.7
d_1	10.5	10.5	10.5	13.5	13.5	13.5	13.5	13.5
d_2	M6 × 1	M6 × 1	M6 × 1	M8 × 1.25	M8 × 1.25	M8 × 1.25	M8 × 1.25	M8 × 1.25
d_3	M10 × 1	M10 × 1	M12 × 1	M16 × 1.5	M20 × 1.5	M22 × 1.5	M24 × 1.5	M27 × 2
l_1, min.	12.7	12.7	14.3	15.9	17.5	19.0	20.6	22.2
l_2	20	20	20	26	26	30	30	30
l_3	9.5	9.5	11.1	12.7	14.3	15.9	17.5	19.1
l_4	27	27	30	35	38	45	49	54
l_5, +0.05	11.38	11.42	12.25	15.05	16.63	19.04	21.43	24.64
l_6	7	7	7	9	9	9	9	9
l_7	8.0	8.0	8.0	9.5	9.5	13.0	13.0	13.0
α	18 deg, 18.6 min	15 deg, 36 min	14 deg, 55 min	13 deg, 46 min	12 deg, 18 min	10 deg, 30 min	8 deg, 35 min	7 deg, 5 min
G	28.393 +0.010	37.931 +0.010	56.983 +0.012	80.795 +0.012	114.142 +0.014	171.295 +0.017	260.204 +0.019	387.209 +0.024

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) Unless otherwise specified, all dimensions are in millimeters.

Table 2-11 Type D Chuck and Faceplate Stud Dimensions

Dimension	Tolerance	Stud							
		D-3	D-4	D-5	D-6	D-8	D-11	D-15	D-20
d	−0.1	14.3	15.9	19.0	22.2	25.4	30.2	34.9	41.3
d_1	...	M10 × 1	M10 × 1	M12 × 1	M16 × 1.5	M20 × 1.5	M22 × 1.5	M24 × 1.5	M27 × 2
l_1	±0.1	13.1	13.9	16.5	19.1	23.2	27.0	32.0	38.5
l_2	±0.2	4.2	4.8	4.8	4.8	4.8	6.4	6.4	6.4
l_3	±0.1	8.7	9.5	11.9	14.3	16.7	20.6	24.6	28.6
l_4	...	35	37	43	49	56	67	76	89
l_5	...	19	19	22	27	30	35	40	44
l_6	±0.2	30.0	31.0	35.7	40.5	44.5	53.2	58.7	69.0
l_7	...	2	2	2	3	3	5	5	6
d_2	...	19.0	19.0	22.2	25.4	28.6	31.8	34.9	41.3
d_3	...	9.5	10.3	10.3	12.7	12.7	12.7	12.7	12.7

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) All dimensions are in millimeters.

Table 2-12 Type D Chuck and Faceplate Stud Locking Screw Dimensions

Dimension	Stud-Locking Socket Head Cap Screws		
	D-3, D-4, and D-5	D-6 and D-8	D-11, D-15, and D-20
d	M6 × 1	M8 × 1.25	M8 × 1.25
d_1	10	13	13
l_1	6	8	8
l_2	12	16	20

GENERAL NOTES:
(a) Unspecified tolerances ±0.4.
(b) All dimensions are in millimeters.

Chapter 3
Jaw Mountings

3-1 SCOPE

This Chapter covers the interface of two-piece chuck jaws.

3-2 DEFINITIONS OF TERMS

fasteners: accessory devices (usually threaded) that are used to secure the top jaw onto the master jaw (see Fig. 3-1).

groove (slot): a recessed geometric form that receives a tongue, key, or jaw nut for positioning the top jaw with the master jaw.

hard top jaw: a top jaw that is made to its final size of hardenable steel. It is not intended to be machined in use.

jaw interface: geometric forms with fastening elements that position and secure top jaws to master jaws (see Fig. 3-2).

jaw nut: the fastener used in the master jaw for securing and, in some designs, positioning the top jaw with the master jaw.

jaw-nut slot: a T-slot in the master jaw for receiving a jaw nut.

master jaw (base jaw): radial-moving part within the chuck body to which the top jaw is mounted.

master jaw pins: precision pins that position the top jaw with the master jaw.

master key: a serrated positioning key, secured in the top jaw.

monoblock (solid style jaw): a one-piece combination master and top jaw.

serration: a repetitive geometric form for radially positioning the top jaw with the master jaw.

soft top jaw (blank jaw): a top jaw that is not heat treated and is formed prior to usage.

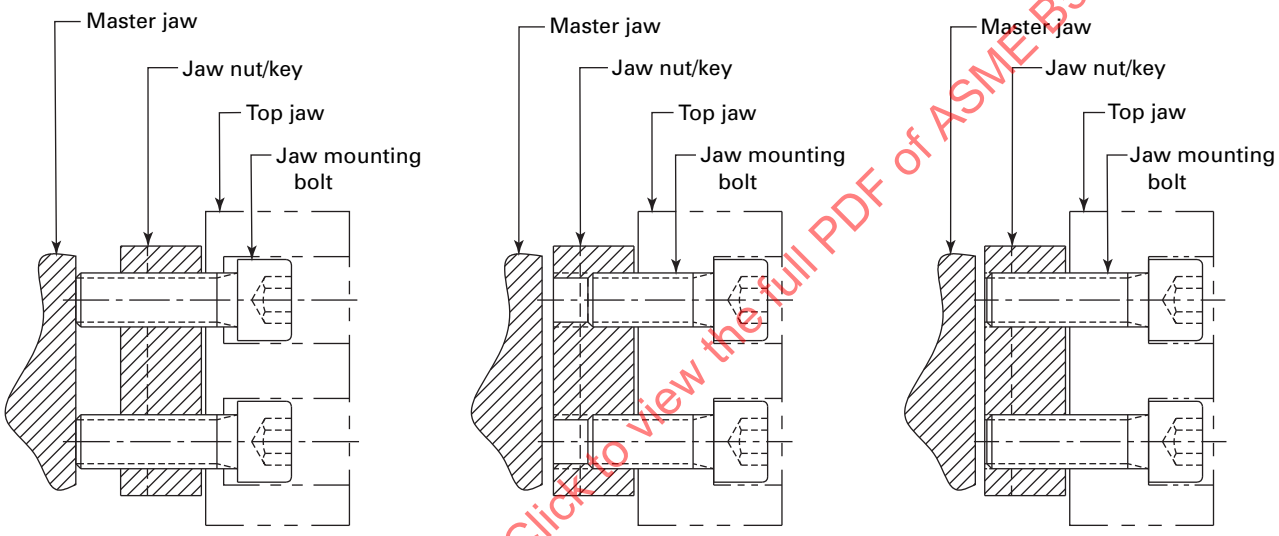
tongue: projected geometric form that aligns the top jaw with the master jaw.

top jaw: component that clamps the workpiece and is mounted on a master jaw.

3-3 CHUCK JAW INTERFACE TYPES

See Table 3-1 for top-jaw features; details are in Tables 3-2 through 3-25.

Fig. 3-1 Fastener Guidelines

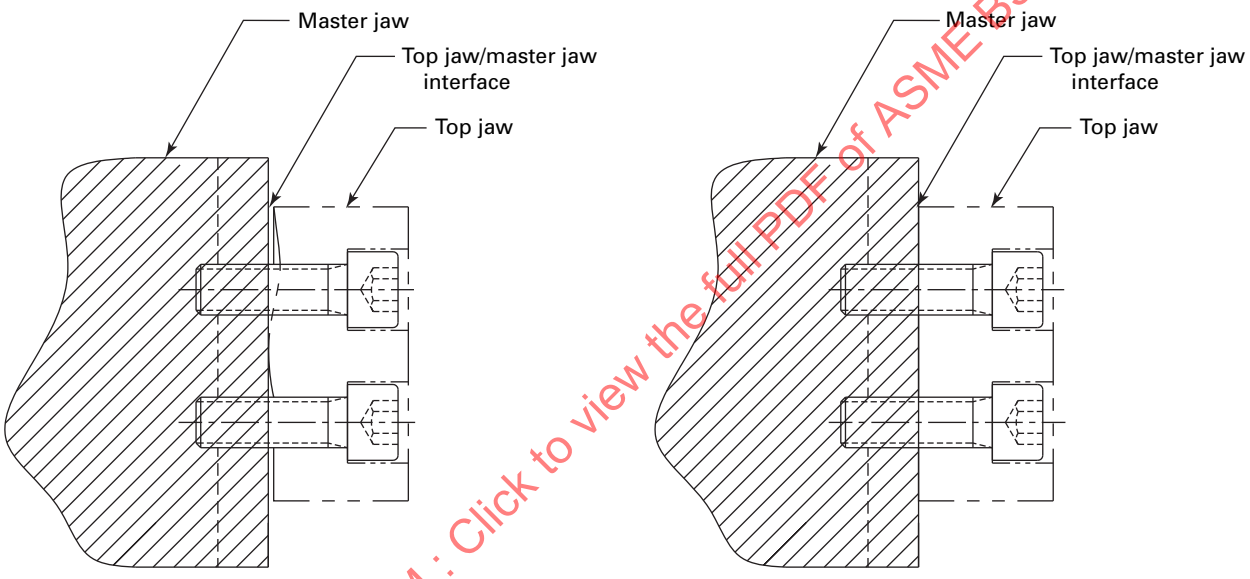


(a) Incorrect: Cap Screws Too Long **(b) Incorrect: Cap Screws Too Short** **(c) Correct: Full Engagement**

GENERAL NOTE: Jaw mounting bolts should be grade 8.8 for U.S. Customary units, 12.9 for metric units. Recommended thread engagement is 1.5 times diameter of thread (with illustration) and chuck manufacturer's recommended torque. Now carefully mate the top jaw to the master jaw, making sure of a proper fit between all components. Insert jaw mounting bolts and tighten them evenly and firmly. Use only high-quality fasteners.

CAUTION: **It is critical that the bolts be of recommended length for the top jaws being used — see illustration. Bolts that are too long will extend through the jaw nut, bottom out, and give the appearance of being properly torqued while not actually securing the top jaw in place, and could cause breakage of the chuck master jaw. Bolts that are too short will have insufficient thread engagement in the jaw nut, and could result in the jaw nut fracturing. Ensure that the master jaw still moves without binding.**

Fig. 3-2 Jaw Interface Flatness Guidelines



(a) Incorrect: Master Jaw/Top Jaw Interface Not Flat/Parallel **(b) Correct: Master Jaw/Top Jaw Interface Is Flat/Parallel**

GENERAL NOTE: Prior to mounting the top jaws, it is critical to confirm that the master jaws, top jaws, and interface between the two are clean, free from nicks/damage, and form a uniform/flat fit. Now carefully mate the top jaw to the master jaw, making sure of a proper fit between all components. Insert jaw mounting bolts and tighten them evenly and firmly.

CAUTION: **It is critical that the interface between the top jaw and master jaw is a flat/parallel fit — see illustration. Improper jaw interface can result in damage to the chuck and/or binding of the master jaw. Binding will result in reduced chuck performance and unsafe operating condition.**

Table 3-1 Top-Jaw Features

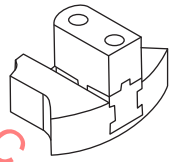
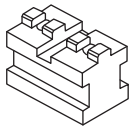
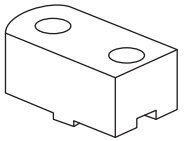
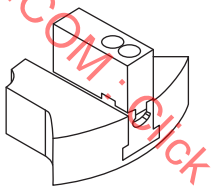
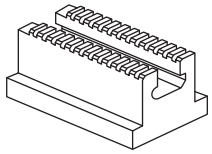
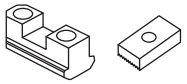
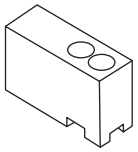
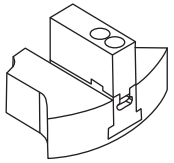
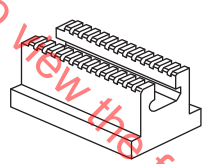
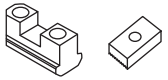
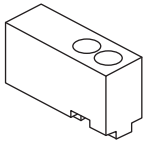
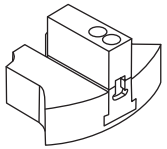
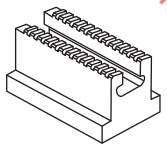
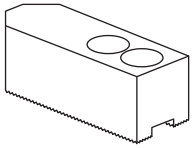
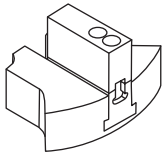
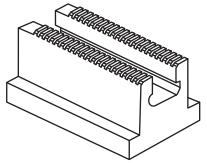
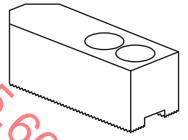
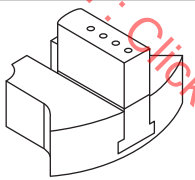
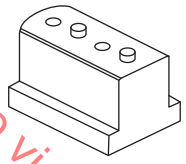
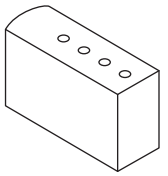
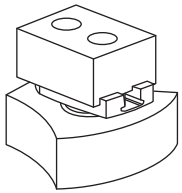
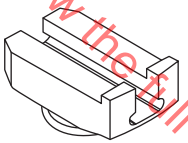
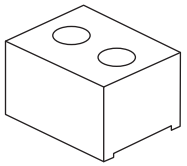
Type	Radial	Tangential	Assembly	Master Jaws	Nut/Key	Top Jaws	Corresponding Tables
Tongue and groove Medium duty Heavy duty Metric/DIN Standard	Groove	Tongue			Not required		Tables 3-2 through 3-7
Square serrated key type	Slot	Master key [Note (1)]					Tables 3-8 through 3-11
Acme serrated key type	Tongue	Master key [Note (1)]					Tables 3-12 through 3-15
90 deg serrated $^{1}/_{16}$ in. × 60 deg $^{3}/_{32}$ in. × 90 deg	Slot	Serration					Tables 3-16, 3-17, and 3-20
60 deg serrated 1.5 mm × 60 deg 3.0 mm × 60 deg	Slot	Serration					Tables 3-18 through 3-21

Table 3-1 Top Jaw Features (Cont'd)

Type	Radial	Tangential	Assembly	Master Jaws	Nut/Key	Top Jaws	Corresponding Tables
Pin locator	Precision pinholes	Precision pinholes			Precision pins		Table 3-22
Ball style platform	Shoulder	Slot					Tables 3-23 through 3-25

NOTE:
(1) Master key is separate from top jaw.

Table 3-2 Tongue and Groove, Medium Duty Chucks, Wrench Operated

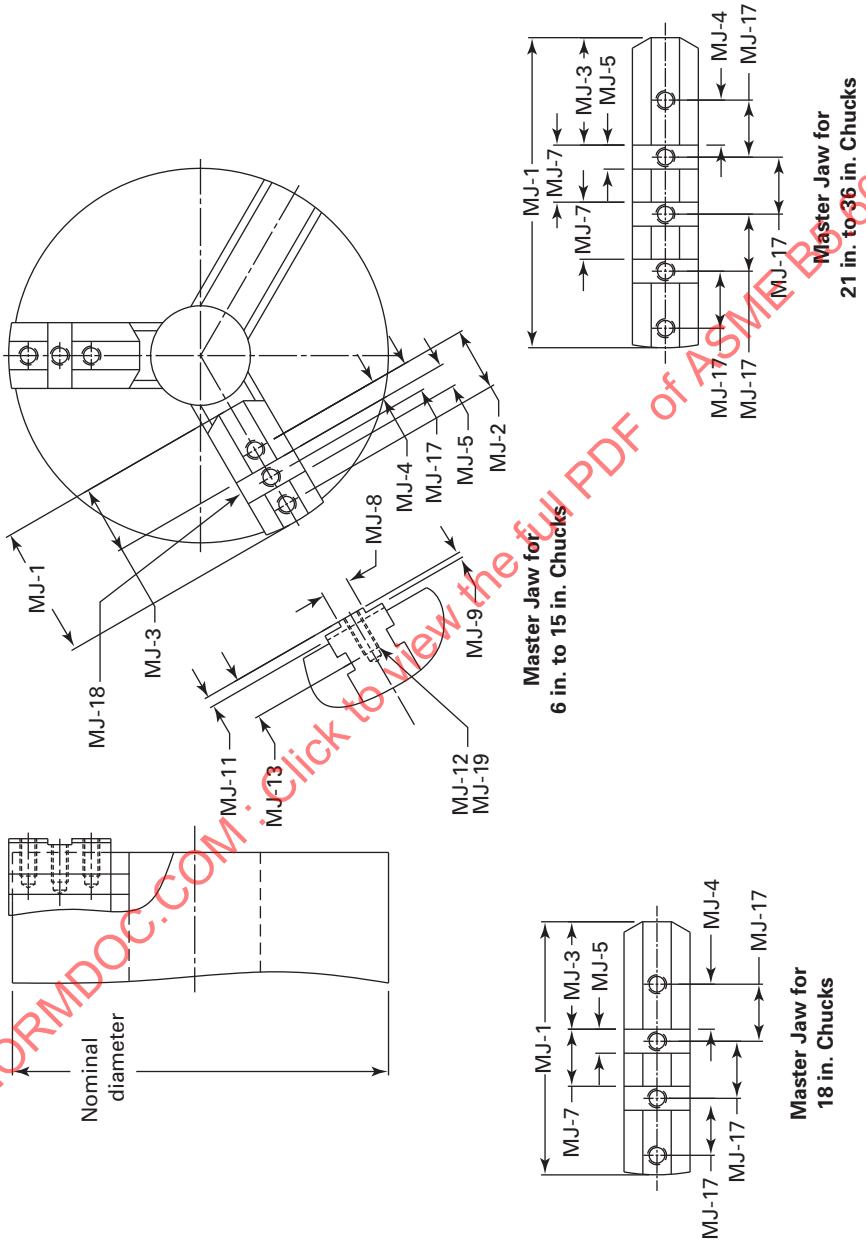


Table 3-2 Tongue and Groove, Medium Duty Chucks, Wrench Operated (Cont'd)

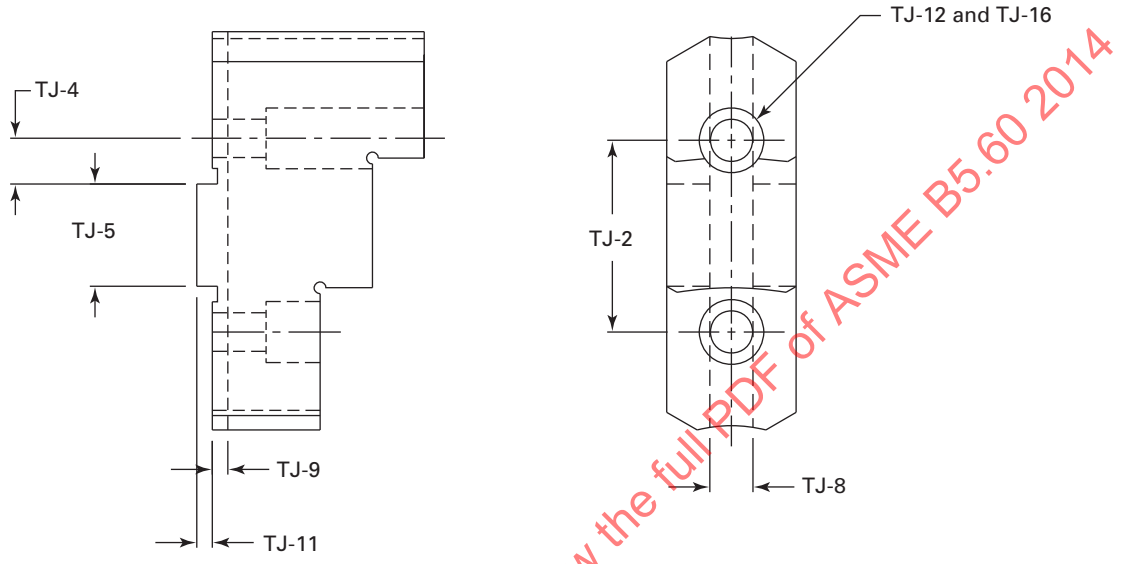
Nominal Size of Chuck	Length of Jaw, MJ-1	Center-to-Center Screw Holes, MJ-2 [Note (1)]	Cross Slot to Centerline of Bite, MJ-3	Screw Center to Cross Slot Edge, MJ-4 [Note (1)]	Width of Cross Slot		Cross Slot to Cross Slot, MJ-5	Width of Tongue, MJ-8		Height of Tongue, MJ-9		Depth of Cross Slot, MJ-11		Tapped Hole (UNC-3B), MJ-12	Full Depth of Thread, MJ-13	Center-to-Center of Holes, MJ-17 [Note (1)]	Number of Cross Slots, MJ-18	Number of Tapped Holes, MJ-19
					Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.					
6	2.56	1.500	1.125	0.500	0.4995	0.500	. . .	0.310	0.312	0.12	0.14	0.16	0.18	3/8-16	0.76	. . .	1	2
8	3.06	1.750	1.375	0.625	0.4995	0.500	. . .	0.310	0.312	0.12	0.14	0.16	0.18	3/8-16	0.76	. . .	1	2
10	3.62	2.125	1.562	0.688	0.7495	0.750	. . .	0.498	0.500	0.12	0.14	0.16	0.18	1/2-13	0.88	. . .	1	2
12	4.26	2.500	1.875	0.875	0.7495	0.750	. . .	0.498	0.500	0.12	0.14	0.16	0.18	1/2-13	1.00	1.250	1	3
15	5.00	3.000	2.250	1.125	0.7495	0.750	. . .	0.498	0.500	0.12	0.14	0.28	0.30	5/8-11	1.12	1.500	1	3
18	6.50	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.12	0.14	0.28	0.30	3/4-10	1.50	1.500	2	4
21 to 36	8.00	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.12	0.14	0.28	0.30	3/4-10	1.50	1.500	3	5

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Table 3-3 Tongue and Groove, Medium Duty Chucks, Three-Step Reversible Top Jaw, Wrench Operated



Nominal Size of Chuck	Center-to-Center Screw Holes, TJ-2 [Note (1)]	Screw Center to Edge of Key, TJ-4 [Note (1)]	Width of Tongue, TJ-5		Width of Tongue Slot, TJ-8		Depth of Tongue Slot, TJ-9		Height of Tongue, TJ-11		Drill Size for Screws, TJ-12	Counter-bore for Screw Head, TJ-16
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
6	1.500	0.500	0.498	0.499	0.313	0.315	0.15	0.17	0.10	0.12	0.406	0.609
8	1.750	0.625	0.498	0.499	0.313	0.315	0.15	0.17	0.10	0.12	0.406	0.609
10	2.125	0.688	0.748	0.749	0.501	0.503	0.15	0.17	0.10	0.12	0.531	0.797
12	2.500	0.875	0.748	0.749	0.501	0.503	0.15	0.17	0.10	0.12	0.531	0.797
15	3.000	1.125	0.748	0.749	0.501	0.503	0.15	0.17	0.23	0.25	0.656	1.000
18 to 36	3.000	1.125	0.748	0.749	0.501	0.503	0.15	0.17	0.23	0.25	0.781	1.188

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Table 3-4 Tongue and Groove, Heavy Duty Chucks, Wrench Operated

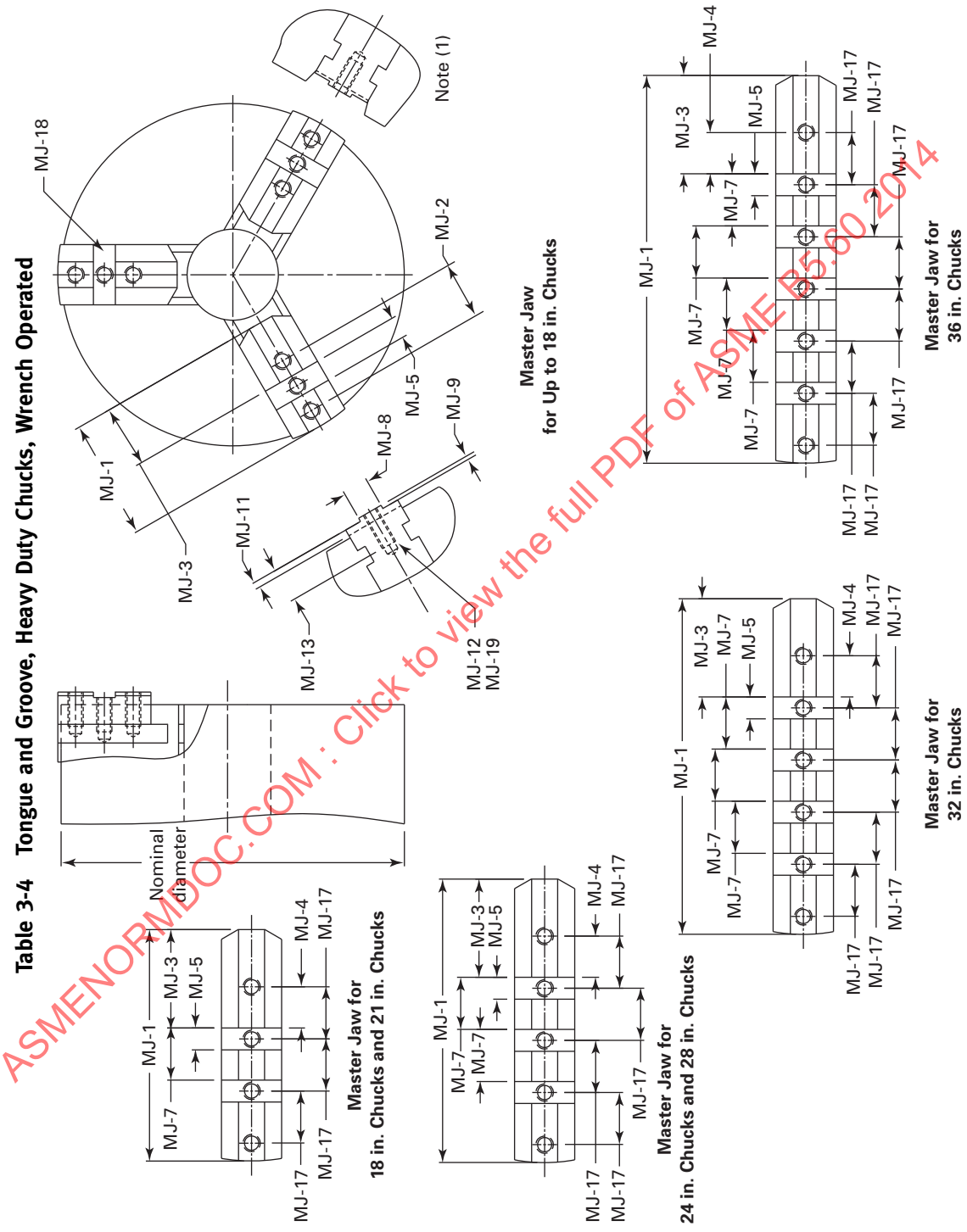


Table 3-4 Tongue and Groove, Heavy Duty Chucks, Wrench Operated (Cont'd)

Nominal Size of Chuck	Length of Jaw, MJ-1	Center-to-Center Bolt Holes, MJ-2 [Note (1)]	Cross Slot to Centerline on Bite, MJ-3	Bolt Center to Cross Slot Edge, MJ-4 [Note (2)]	Width of Cross Slot, MJ-5		Cross Slot to Cross Slot, MJ-7	Width of Tongue, MJ-8		Height of Tongue, MJ-9		Depth of Cross Slot, MJ-11		Tapped Holes (UNC-3B), MJ-12	Full Depth of Thread, MJ-13	Center-to-Center of Holes, MJ-17 [Note (1)]	Number of Cross Slots, MJ-18	Number of Tapped Holes, MJ-19
					Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.					
6	2.56	1.500	1.125	0.500	0.4995	0.500	. . .	0.310	0.312	0.10	0.12	0.15	0.17	7/16-14	0.76	. . .	1	2
8	3.06	1.750	1.375	0.625	0.4995	0.500	. . .	0.310	0.312	0.10	0.12	0.15	0.17	1/2-13	0.85	. . .	1	2
10	3.62	2.125	1.562	0.688	0.7495	0.750	. . .	0.498	0.500	0.10	0.12	0.15	0.17	5/8-11	1.06	. . .	1	2
12	4.26	2.500	1.875	0.875	0.7495	0.750	. . .	0.498	0.500	0.10	0.12	0.15	0.17	5/8-11	1.20	1.250	1	3
15	5.00	3.000	2.250	1.125	0.7495	0.750	. . .	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	1	3
18	6.50	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	2	4
21	6.50	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	2	4
24	8.00	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	3	5
28	8.00	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	3	5
32	9.50	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	4	6
36	11.00	3.000	2.250	1.125	0.7495	0.750	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	5	7

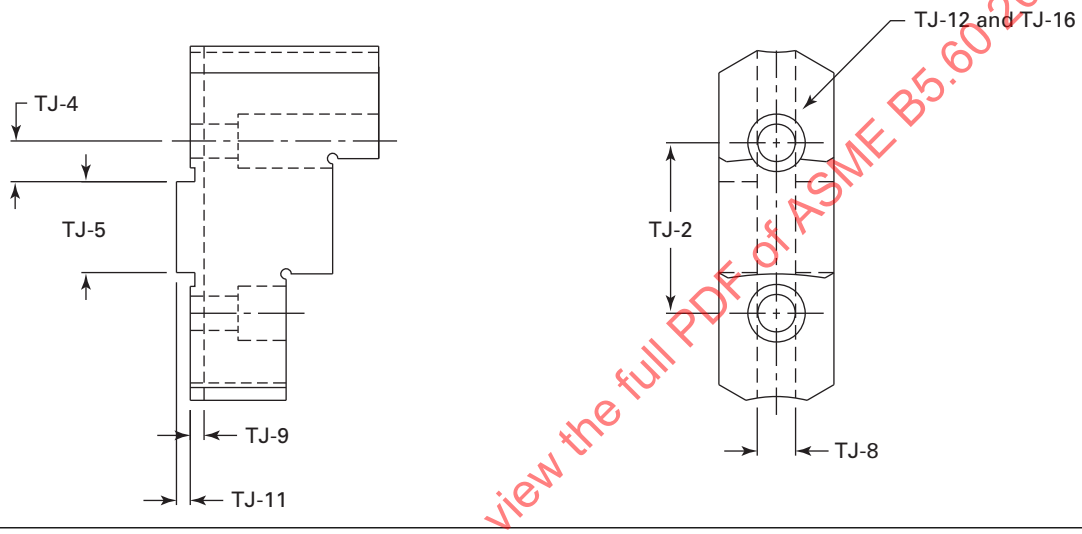
GENERAL NOTE: All dimensions are in inches.

NOTES:

(1) Holes located within Ø 0.012 in. of true position.

(2) Optional: Face of body to project above top of master jaw on 12 in. to 36 in. chucks, inclusive.

Table 3-5 Tongue and Groove, Heavy Duty Chucks, Three-Step Reversible Top Jaw, Wrench Operated



Nominal Size of Chuck	Center-to-Center Screw Holes, TJ-2 [Note (1)]	Screw Center to Edge of Key, TJ-4 [Note (1)]	Width of Tongue, TJ-5		Width of Tongue Slot, TJ-8		Depth of Tongue Slot, TJ-9		Height of Tongue, TJ-11		Drill Size for Screws, TJ-12	Counterbore for Screw Head, TJ-16
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
6	1.500	0.500	0.498	0.499	0.313	0.315	0.15	0.17	0.10	0.12	0.469	0.703
8	1.750	0.625	0.498	0.499	0.313	0.315	0.15	0.17	0.10	0.12	0.531	0.797
10	2.125	0.688	0.748	0.749	0.501	0.503	0.15	0.17	0.10	0.12	0.656	1.000
12	2.200	0.875	0.748	0.749	0.501	0.503	0.15	0.17	0.10	0.12	0.656	1.000
15 to 24	3.000	1.125	0.748	0.749	0.501	0.503	0.15	0.17	0.23	0.25	0.781	1.188
28 to 36	3.000	1.125	0.748	0.749	0.501	0.503	0.15	0.17	0.23	0.25	0.906	1.375

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Table 3-6 Tongue and Groove, Heavy Duty Chucks, Drawbar Operated

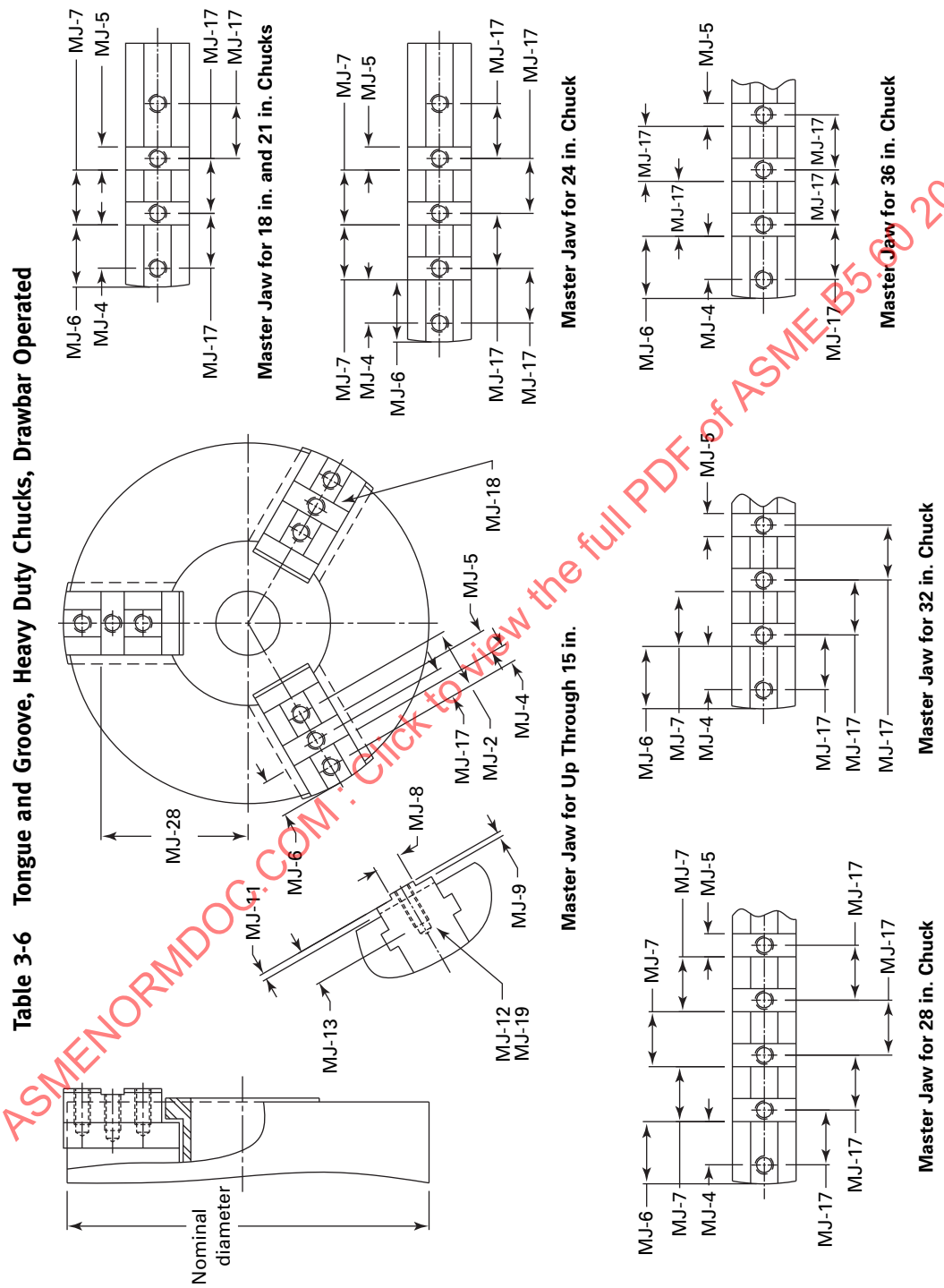


Table 3-6 Tongue and Groove, Heavy Duty Chucks, Drawbar Operated (Cont'd)

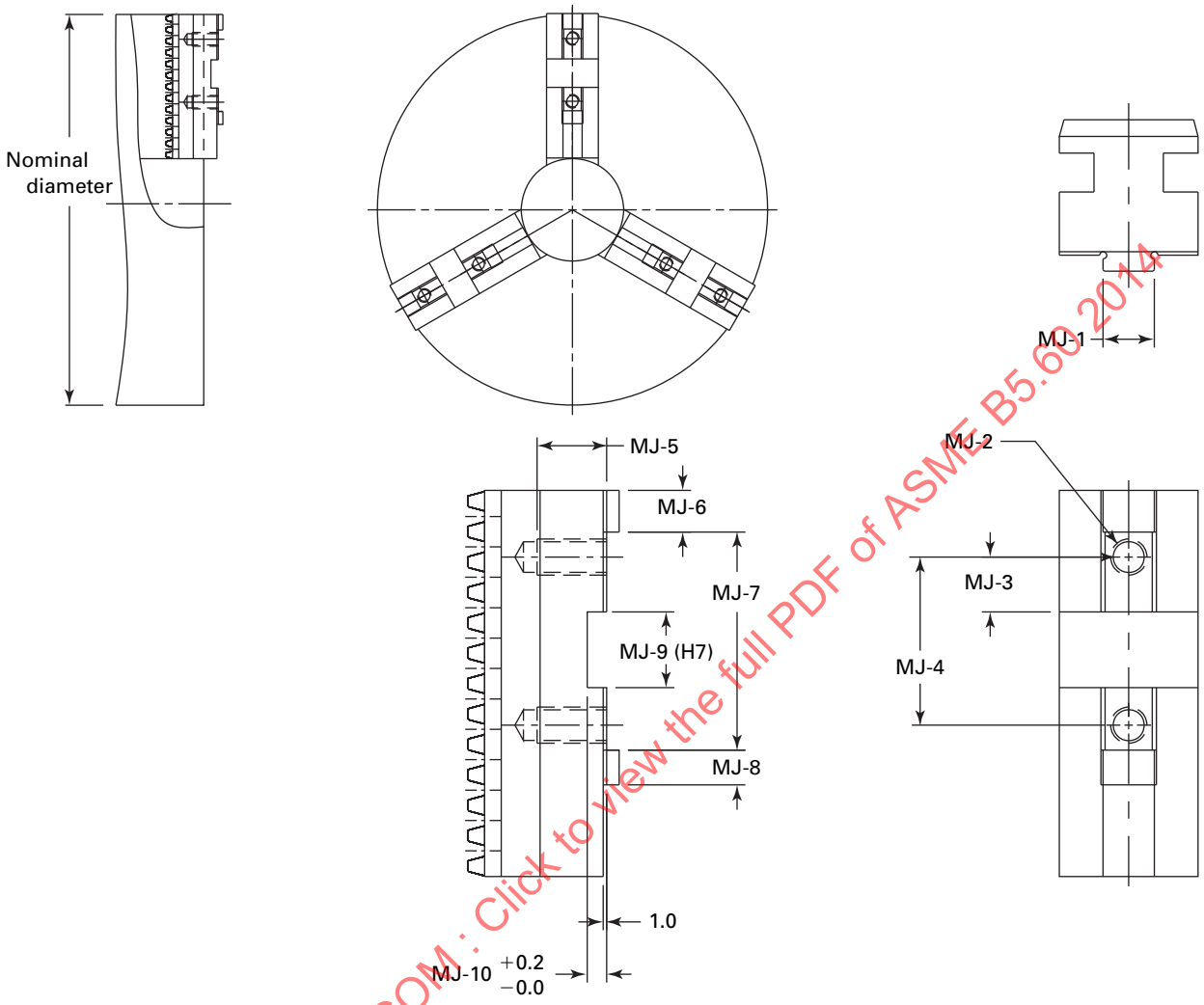
Nominal Size of Chuck	Center-to-Center Screw Holes, MJ-2 [Note (1)]	Bolt Center to Cross Slot Edge, MJ-4 [Note (1)]	Width of Cross Slot, MJ-5		Outside Edge to Cross Slot Edge, MJ-6	Cross Slot to Cross Slot, MJ-7	Width of Tongue, MJ-8		Height of Tongue, MJ-9		Depth of Cross Slot, MJ-11		Tapped Holes (UNC-3B), MJ-12	Full Depth of Thread, MJ-13	Center-to-Center of Holes, MJ-17 [Note (1)]	Number of Cross Slots, MJ-18	Number of Tapped Holes, MJ-19
			Min.	Max.			Min.	Max.	Min.	Max.	Min.	Max.					
6	1.500	0.500	0.4995	0.500	0.938	. . .	0.310	0.312	0.10	0.12	0.15	0.17	7/16-14	0.76	. . .	1	2
8	1.750	0.625	0.4995	0.500	1.188	. . .	0.310	0.312	0.10	0.12	0.15	0.17	1/2-13	0.88	. . .	1	2
10	2.125	0.687	0.7495	0.750	1.312	. . .	0.498	0.500	0.10	0.12	0.15	0.17	5/8-11	1.06	. . .	1	2
12	2.500	0.875	0.7495	0.750	1.625	. . .	0.498	0.500	0.10	0.12	0.15	0.17	5/8-11	1.20	1.250	1	3
15	3.000	1.125	0.7495	0.750	2.000	. . .	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	1	3
18	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	2	4
21	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	2	4
24	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	3/4-10	1.50	1.500	3	5
28	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	4	6
32	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	5	7
36	3.000	1.125	0.7495	0.750	2.000	1.500	0.498	0.500	0.10	0.12	0.28	0.30	7/8-9	1.50	1.500	6	8

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Table 3-7 Metric Tongue and Groove Chucks, Master Jaw



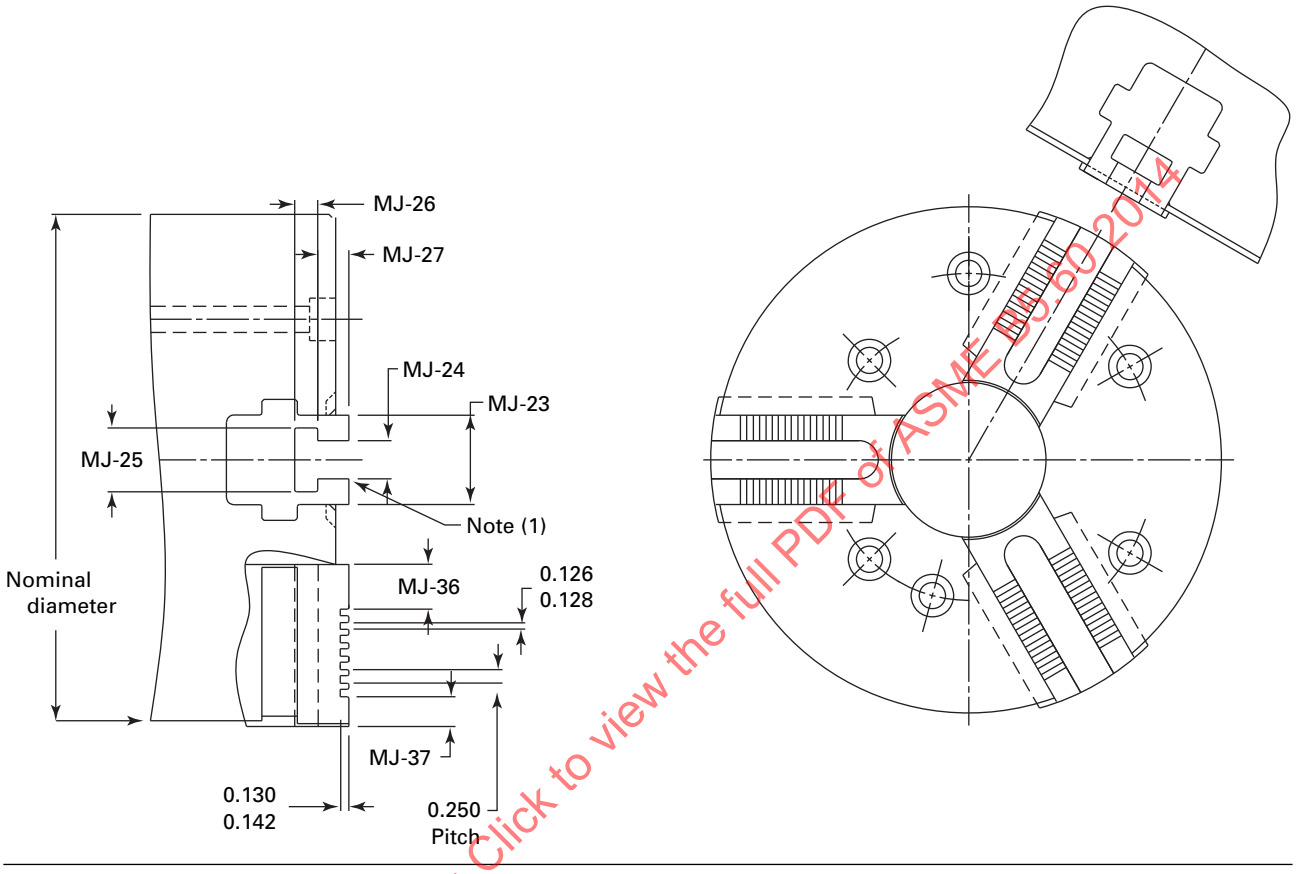
Nominal Size of Chuck	Width of Tongue, MJ-1 +0.01, −0.04	Class G6 Tapped Hole, (2) Holes, MJ-2	Edge of Cross Slot to Tapped Hole, MJ-3 [Note (1)]	Center-to-Center for Holes, MJ-4 [Note (1)]	Depth of Tapped Holes, MJ-5	Length of Tongue, MJ-6	Distance Between Tongues, MJ-7	Length of Tongue, MJ-8	Width of Cross Slot, MJ-9		Depth of Cross Slot, MJ-10
									Min.	Max.	
165	8	M8	7.00	32.00	12.0	7.0	42.0	7.0	18.000	18.018	5.0
210	10	M8	10.00	40.00	13.0	8.0	50.0	8.0	20.000	20.021	4.5
265	12	M12	10.00	40.00	14.0	9.0	54.0	9.0	20.000	20.021	5.5
315	12	M12	10.00	40.00	17.0	9.0	54.0	9.0	20.000	20.021	6.0
400	12	M12	14.00	54.00	17.0	9.0	68.0	9.0	26.000	26.021	6.0
500	18	M16	15.00	60.00	34.0	11.0	78.0	14.0	30.000	30.021	9.0
630	18	M16	15.00	60.00	34.0	11.0	78.0	14.0	30.000	30.021	9.0

GENERAL NOTE: All dimensions are in millimeters.

NOTE:

(1) Tapped holes located within Ø 0.3 mm of true position.

Table 3-8 Square Serrated, Heavy Duty Chucks, Wrench or Drawbar Operated



Nominal Size of Chuck	Jaw Width, MJ-23	Width of Throat, MJ-24		Width of Head Space, MJ-25		Depth of Head Space, MJ-26	Depth of Throat, MJ-27		Start of Serrations, MJ-36, Min.	Outside Edge to First Tooth, MJ-37
		Min.	Max.	Min.	Max.		Min.	Max.		
8	1.76	0.753	0.755	1.10	1.16	0.44	0.44	0.46	0.62	0.38
10	1.76	0.753	0.755	1.10	1.16	0.44	0.44	0.46	0.62	0.50
12	1.76	0.753	0.755	1.10	1.16	0.44	0.44	0.46	0.62	0.75
15	2.12	1.003	1.005	1.34	1.40	0.50	0.62	0.64	0.88	0.75
18	2.12	1.003	1.005	1.34	1.40	0.50	0.62	0.64	0.88	0.75
21	2.94	1.003	1.005	1.34	1.40	0.50	0.62	0.64	1.12	1.00
24	2.94	1.003	1.005	1.34	1.40	0.50	0.62	0.64	1.12	1.00
28	2.94	1.190	1.192	1.62	1.68	0.76	0.88	0.90	1.18	1.00
32	2.94	1.190	1.192	1.62	1.68	0.76	0.88	0.90	1.18	1.00
36	2.94	1.190	1.192	1.62	1.68	0.76	0.88	0.90	1.18	1.00

GENERAL NOTES:

(a) All dimensions are in inches.

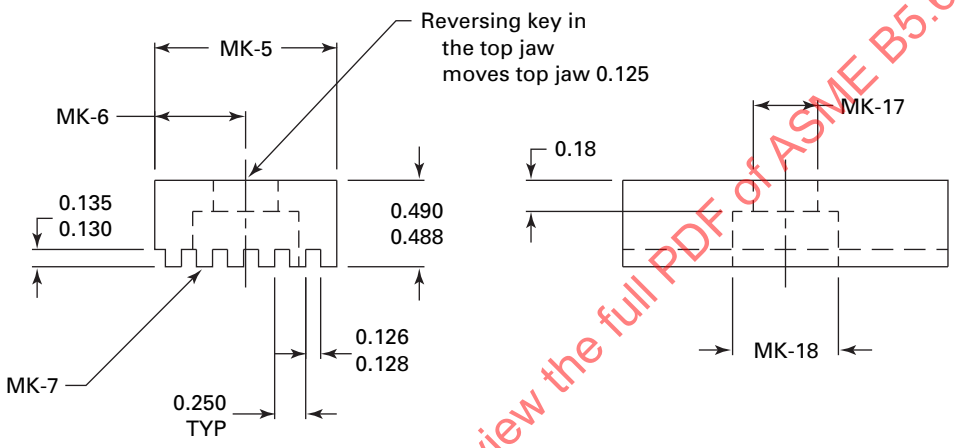
(b) See Tables 3-9, 3-10, and 3-11 for dimensions of master key, jaw nut, and three-step reversible top jaws.

(c) Serration pitch error not to accumulate more than 0.0002 in. per inch.

NOTE:

(1) Jaws optional above or below chuck face.

Table 3-9 Square Serrated, Heavy Duty Chucks, Top-Jaw Master Key

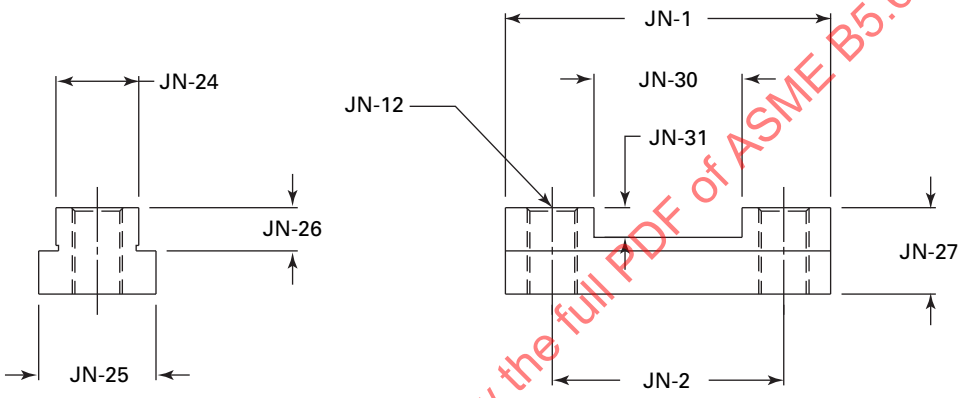


Nominal Size of Chuck	Width of Key, MK-5		Edge to Center of Screw, MK-6 [Note (1)]	Number of Teeth, MK-7	Drill Size for Screw, MK-17	Counterbore for Screw Head, MK-18
	Min.	Max.				
8	0.744	0.745	0.375	3	0.281	0.422
10	0.994	0.995	0.500	4	0.344	0.515
12	0.994	0.995	0.500	4	0.344	0.515
15 and 18	1.486	1.487	0.750	6	0.406	0.609
21 and 24	1.486	1.487	0.750	6	0.406	0.609
28 and 36	1.530	1.531	0.766	6	0.406	0.609

GENERAL NOTES:
(a) All dimensions are in inches.
(b) Serration pitch error not to accumulate more than 0.0002 in. per inch.

NOTE:
(1) Hole located within Ø 0.012 in. of true position.

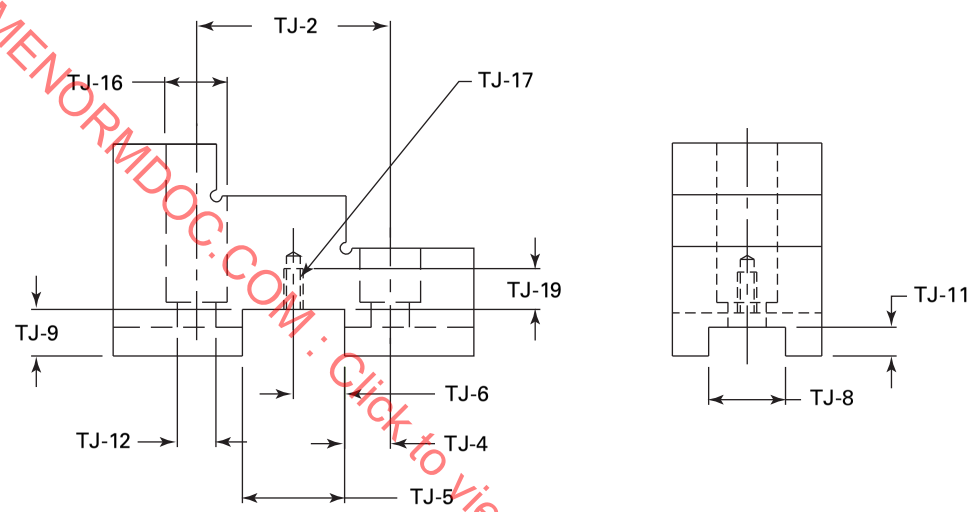
Table 3-10 Square Serrated, Heavy Duty Chucks, Master Jaw Nut



Nominal Size of Chuck	Length of Nut, JN-1	Center-to-Center Tapped Holes, JN-2	Size of Tapped Holes (UNC-2B), JN-12	Width of Tongue, JN-24		Minimum Width of Nut Flange	Height of Tongue, JN-26		Thickness of Nut, JN-27	Length of Slot, JN-30	Depth of Slot, JN-31
				Min.	Max.		Min.	Max.			
8	2.32	1.438	1/2-13	0.749	0.750	1.000	0.62	0.64	1.00	0.88	0.38
10	2.62	1.750	1/2-13	0.749	0.750	1.000	0.62	0.64	1.00	1.12	0.38
12	2.62	1.750	1/2-13	0.749	0.750	1.000	0.62	0.64	1.00	1.12	0.37
15 and 18	3.76	2.500	3/4-10	0.999	1.000	1.250	0.80	0.82	1.26	1.62	0.46
21 and 24	4.26	3.000	3/4-10	0.999	1.000	1.250	1.06	1.08	1.26	1.62	0.46
28 and 36	4.50	3.000	7/8-9	1.186	1.187	1.562	1.06	1.08	1.76	1.62	0.46

GENERAL NOTES:
(a) All dimensions are in inches.
(b) Holes located within Ø 0.012 in. of true position.

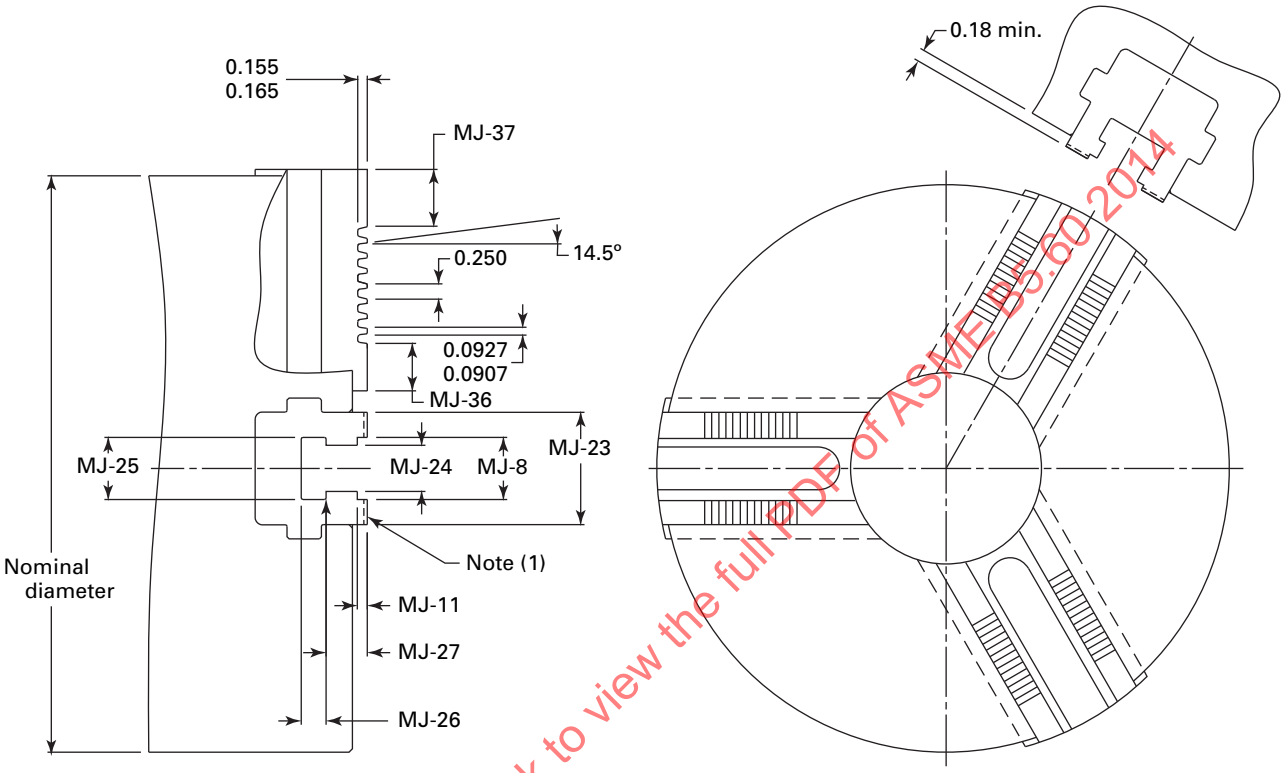
Table 3-11 Square Serrated, Heavy Duty Chucks, Three-Step Reversible Top Jaw



Nominal Size of Chuck	Center-to-Center Screw Holes, TJ-2	Screw Center to Edge of Key Slot, TJ-4	Width of Key Slot, TJ-5		Edge of Key Slot to Screw, TJ-6	Width of Tongue Slot, TJ-8		Depth of Key Slot, TJ-9		Depth of Tongue Slot, TJ-11		Drill Size for Screws, TJ-12	Size of Counter-bore for Screw Heads, TJ-16	Size of Tapped Hole (UNC-3B), TJ-17	Full Depth of Thread, TJ-19
			Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.				
8	1.438	0.344	0.746	0.747	0.375	0.751	0.753	0.380	0.385	0.22	0.24	0.531	0.797	$^{1}/_{4}$-20	0.38
10	1.750	0.375	0.996	0.997	0.500	0.751	0.753	0.380	0.385	0.22	0.24	0.531	0.797	$^{5}/_{16}$-18	0.44
12	1.750	0.375	0.996	0.997	0.500	0.751	0.753	0.380	0.385	0.22	0.24	0.531	0.797	$^{5}/_{16}$-18	0.44
15 and 18	2.500	0.500	1.488	1.489	0.750	1.001	1.003	0.380	0.385	0.22	0.24	0.781	1.188	$^{3}/_{8}$-16	0.62
21 and 24	3.000	0.750	1.488	1.489	0.750	1.001	1.003	0.380	0.385	0.22	0.24	0.781	1.188	$^{3}/_{8}$-16	0.62
28 and 36	3.000	0.750	1.532	1.533	0.766	1.188	1.190	0.380	0.385	0.22	0.24	0.906	1.375	$^{3}/_{8}$-16	0.62

GENERAL NOTES:
(a) All dimensions are in inches.
(b) See Table 3-8 for heavy duty wrench-operated or drawbar-operated chucks with square serrated master jaws.
(c) Holes located within Ø 0.012 in. of true position.

Table 3-12 Acme Serrated, Heavy Duty Chucks, Power Wrench or Drawbar Operated



Nominal Size of Chuck	Width of Tongue Slot, MJ-8		Jaw Width, MJ-23,	Depth of Tongue Slot,	Width of Throat, MJ-24		Width of Head Space, MJ-25		Depth of Head Space,	Depth of Throat,	Start of Serrations, MJ-36,	Outside Edge to First Tooth,
	Min.	Max.	Min.	MJ-11	Min.	Max.	Min.	Max.	MJ-26	MJ-27	Min.	MJ-37
10	0.750	0.752	1.76	0.25	0.687	0.697	0.97	1.03	0.44	0.56	0.62	0.50
12	0.875	0.877	1.76	0.25	0.812	0.822	1.09	1.16	0.50	0.63	0.62	0.75
15	1.000	1.002	2.12	0.31	0.937	0.947	1.28	1.34	0.63	0.75	0.88	0.75
18	1.000	1.002	2.12	0.31	0.937	0.947	1.28	1.34	0.63	0.75	0.88	0.75
21	1.250	1.252	2.94	0.31	1.187	1.197	1.59	1.66	0.75	0.88	1.12	1.00
24	1.250	1.252	2.94	0.31	1.187	1.197	1.59	1.66	0.75	0.88	1.12	1.00
28	1.250	1.252	2.94	0.31	1.187	1.197	1.59	1.66	0.75	0.88	1.18	1.00
32	1.250	1.252	2.94	0.31	1.187	1.197	1.59	1.66	0.75	0.88	1.18	1.00
36	1.250	1.252	2.94	0.31	1.187	1.197	1.59	1.66	0.75	0.88	1.18	1.00

GENERAL NOTES:

(a) All dimensions are in inches.

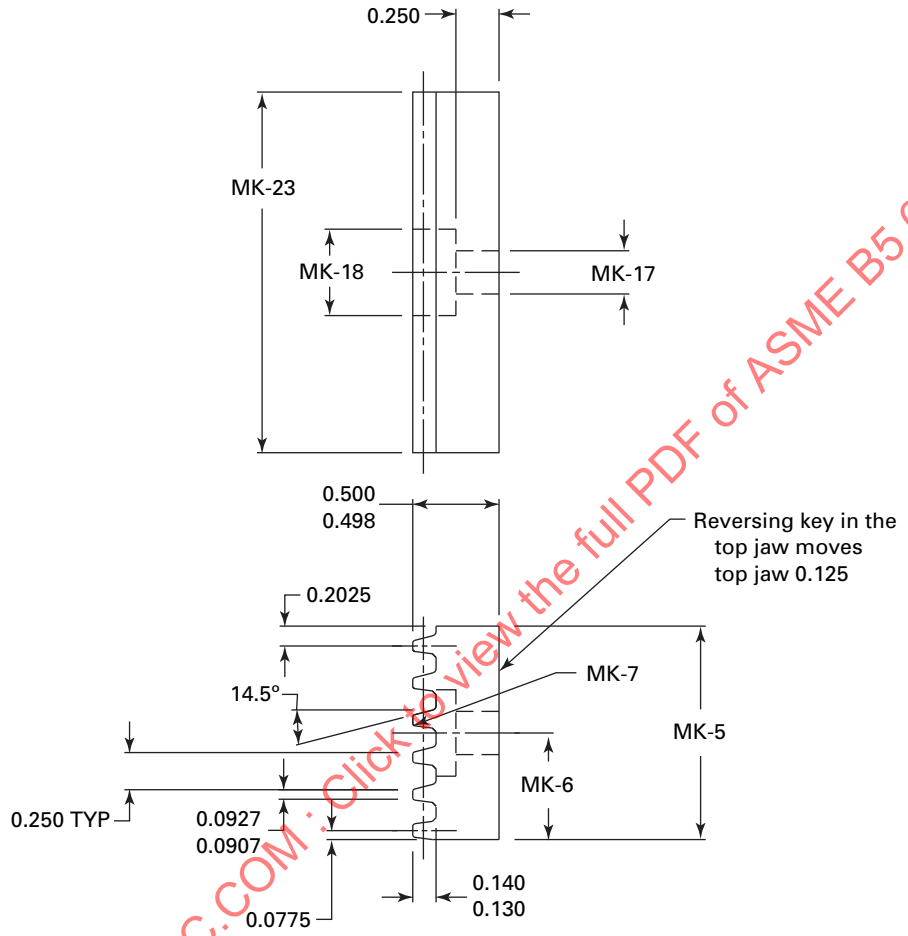
(b) Tolerances of ±0.015 are permissible unless otherwise specified.

(c) Serration pitch error not to accumulate more than 0.0002 in. per inch.

NOTE:

(1) Jaws optional above or below chuck face.

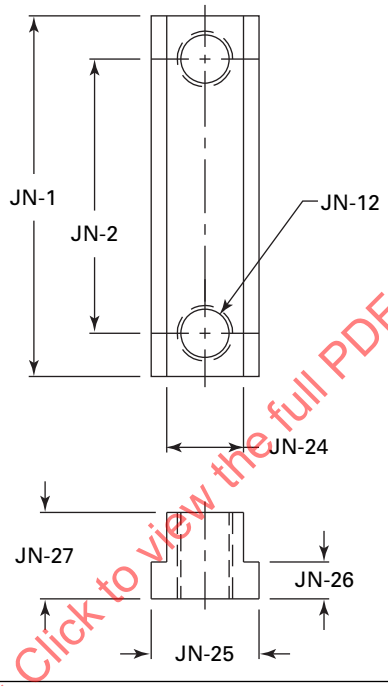
Table 3-13 Acme Serrated, Master Key



Nominal Size of Chuck	Width of Key, MK-5		Edge to Center of Screw, MK-6		Number of Teeth, MK-7	Drill Size for Screw, MK-17	Counterbore for Screw Head, MK-18	Length of Key, MK-23
	Min.	Max.	Min.	Max.				
10	1.029	1.030	0.507	0.523	4	0.344	0.469	1.625
12	1.029	1.030	0.507	0.523	4	0.344	0.469	1.875
15 and 18	1.529	1.530	0.757	0.773	6	0.406	0.594	2.375
21 to 36	1.529	1.530	0.757	0.773	6	0.469	0.594	2.875

GENERAL NOTES:
(a) All dimensions are in inches.
(b) Tolerances of ±0.015 are permissible unless otherwise specified.
(c) Serration pitch error not to accumulate more than 0.0002 in. per inch.

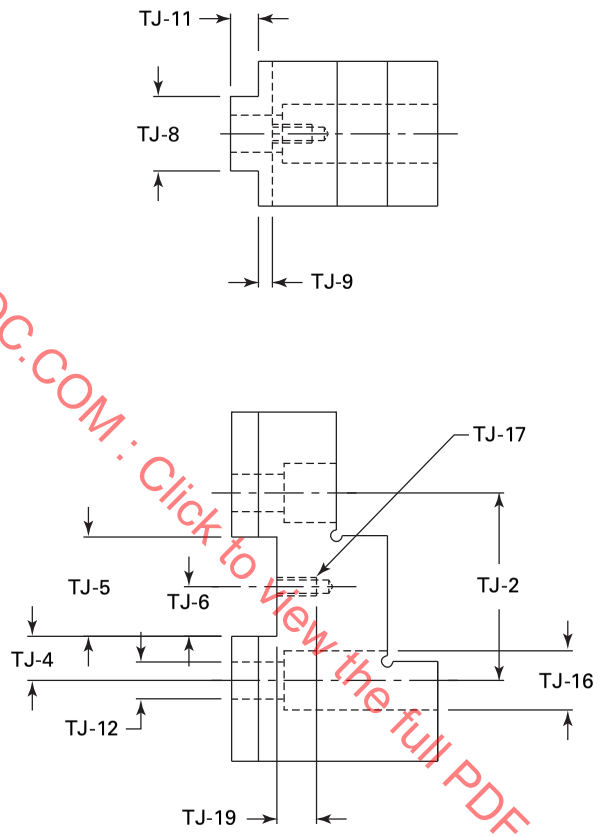
Table 3-14 Acme Serrated, Jaw Nut



Nominal Size of Chuck	Length of Nut, JN-1	Center-to-Center Tapped Holes, JN-2	Tapped Holes (UNC-3B), JN-12	Width of Tongue, JN-24		Width of Jaw Nut Flange, JN-25	Thickness of Flange, JN-26	Thickness of Nut, JN-27
				Min.	Max.			
10	2.62	1.750	$^{1}/_{2}$-13	0.675	0.680	0.94	0.94	0.62
12	3.00	2.000	$^{5}/_{8}$-11	0.800	0.805	1.06	1.06	0.75
15 and 18	3.75	2.500	$^{3}/_{4}$-10	0.925	0.930	1.25	1.25	0.94
21 and 36	4.50	3.000	$^{7}/_{8}$-9	1.175	1.180	1.56	1.56	1.18

GENERAL NOTES:
(a) All dimensions are in inches.
(b) Holes located within Ø 0.012 in. of true position.

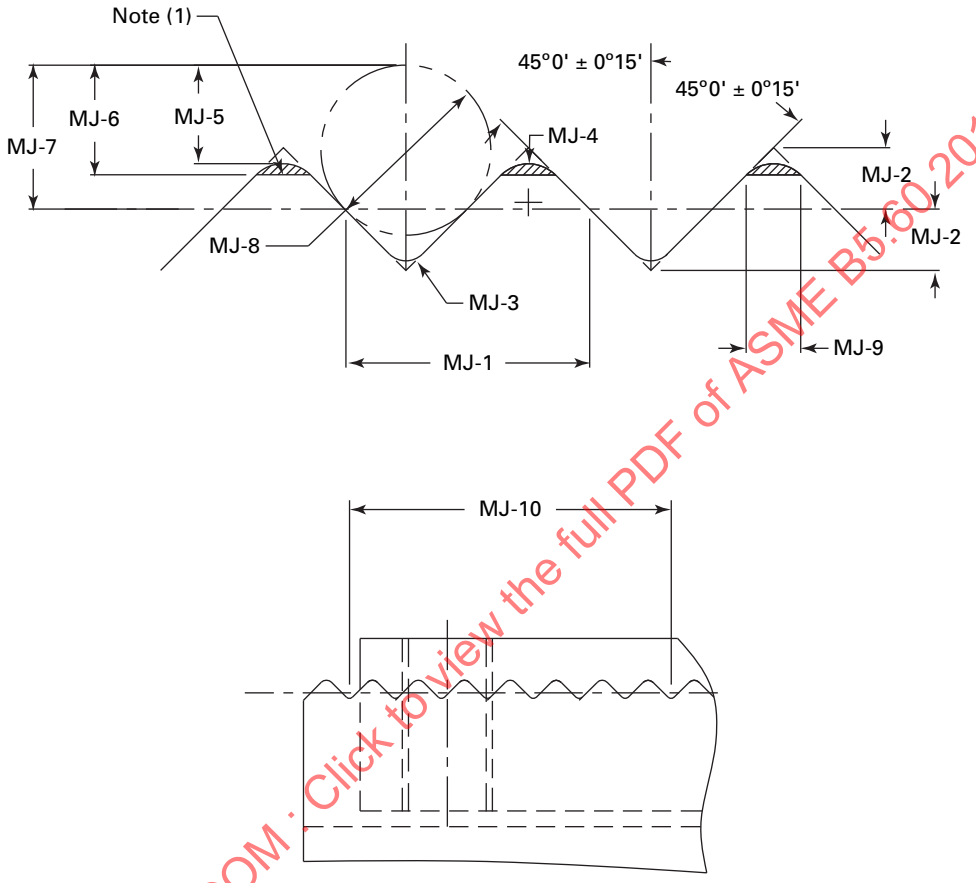
Table 3-15 Acme Serrated, Three-Step Reversible Top Jaw



Nominal Size of Chuck	Center-to-Center Bolt Holes, TJ-2	Bolt Center to Edge of Key Slot, TJ-4	Width of Key Slot, TJ-5		Edge of Key Slot to Screw, TJ-6		Width of Tongue, TJ-8		Depth of Key Slot, TJ-9		Height of Tongue, TJ-11	Drill Size for Bolts, TJ-12	Counterbore for Bolt Head, TJ-16	Tapped Holes (UNC-2B), TJ-17	Full Depth of Thread, TJ-19
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.					
10	1.750	0.375	1.030	1.031	0.507	0.523	0.747	0.749	0.375	0.377	0.19	0.531	0.781	$^{5}/_{16}$-18	0.44
12	2.000	0.500	1.030	1.031	0.507	0.523	0.872	0.874	0.375	0.377	0.19	0.656	0.906	$^{5}/_{16}$-18	0.44
15 and 18	2.500	0.500	1.530	1.531	0.757	0.773	0.996	0.998	0.375	0.377	0.25	0.781	$1^{1}/_{32}$	$^{3}/_{8}$-16	0.56
21 to 36	3.000	0.750	1.530	1.531	0.757	0.773	1.246	1.248	0.375	0.377	0.25	0.906	$1^{5}/_{32}$	$^{3}/_{8}$-16	0.56

GENERAL NOTES:
(a) All dimensions are in inches.
(b) Tapped holes located within Ø 0.012 of true position.

Table 3-16 90 deg Serrated Jaw Interface (Inch), Serration Data



Designation	Pitch of Serration, MJ-1	Theoretical Sharp Corner to Pitch Line, MJ-2	Root Radius, MJ-3	Minimum Crest Radius, MJ-4	Checking Pin to Crest, Min., MJ-5	Checking Pin to Flat, Max., MJ-6	Checking Pin to Pitch Line, Max., MJ-7	Checking Pin Diameter, MJ-8	Length of Flat, MJ-9
$^{1}/_{16}$ × 90 deg	0.0625	0.0156	0.005 to 0.007	0.010	0.025	0.028	0.037	0.0433	0.014
$^{3}/_{32}$ × 90 deg	0.0938	0.0234	0.006 to 0.010	0.016	0.038	0.043	0.055	0.0650	0.022

GENERAL NOTES:

(a) All dimensions are in inches.

(b) The checking pin diameters given are recommended values. If pins of nonstandard diameter are used, the manufacturer shall be responsible for recalculating the dimensions such that the form and geometry conform with the ISO standard form.

(c) See Table 3-17 for accumulated pitch variation.

NOTE:

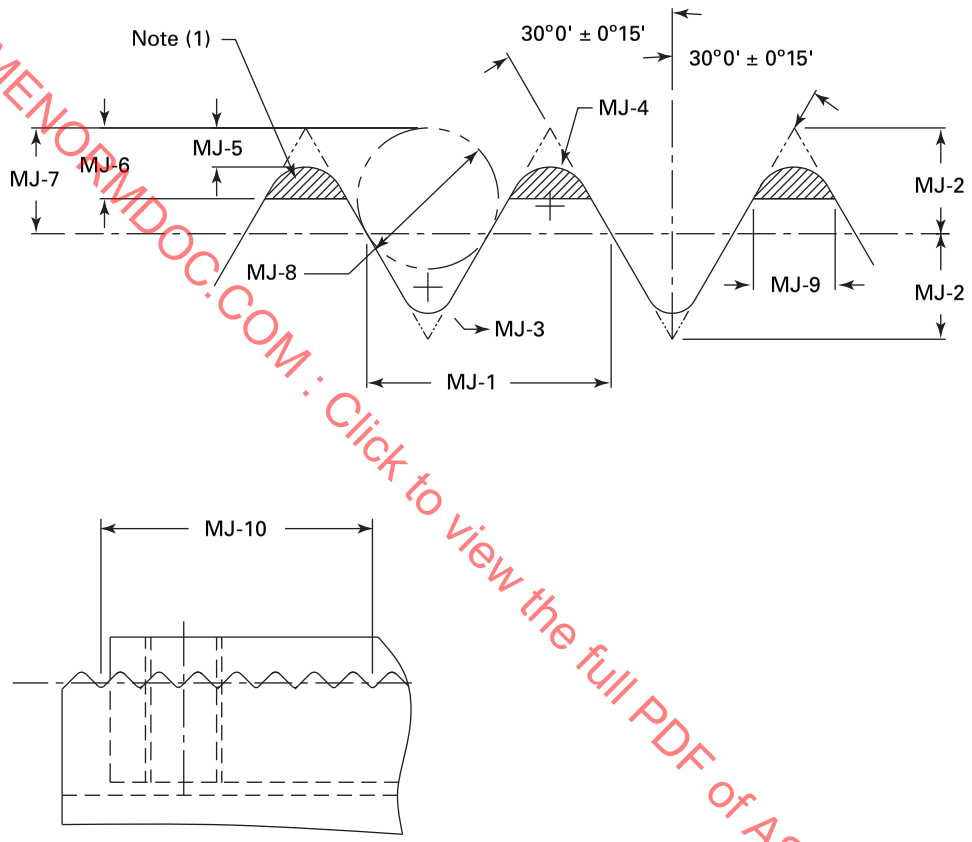
(1) Any profile contained within the hatched area is acceptable.

Table 3-17 90 deg Serrated Jaw Interface (Inch), Accumulated Pitch Variation

Serration Designation				
1/16 × 90 deg		3/32 × 90 deg		
Measuring Length, MJ-10	Number of Teeth	Measuring Length, MJ-10	Number of Teeth	Permissible Accumulated Pitch Variation
1.000	16	1.0312	11	±0.0003
2.000	32	1.9688	21	±0.0005
3.000	48	3.0000	32	±0.0006
4.000	64	4.0312	43	±0.0008
5.000	80	4.9688	53	±0.0009
6.000	96	6.0000	64	±0.0011

GENERAL NOTE: All dimensions are in inches.

Table 3-18 60 deg Serrated Jaw Interface (Metric), Serration Data



Designation	Pitch of Serration, MJ-1	Theoretical Sharp Corner to Pitch Line, MJ-2	Root Radius, MJ-3	Crest Radius, MJ-4	Checking Pin to Crest, MJ-5	Checking Pin to Flat, MJ-6	Checking Pin to Pitch Line, MJ-7	Checking Pin Diameter, MJ-8	Length of Flat (Ref.), MJ-9
1.5 × 60 deg	1.5	0.650	0.12 to 0.18	0.25 to 0.30	0.293 to 0.343	0.393 to 0.473	0.693	0.895	0.40 to 0.50
3 × 60 deg	3	1.299	0.15 to 0.25	0.40 to 0.50	0.277 to 0.377	0.506 to 0.656	1.176	1.650	0.73 to 0.90

GENERAL NOTES:

(a) All dimensions are in millimeters.

(b) The checking pin diameters (MJ-8) given are recommended values. If pins of nonstandard diameter are used, the manufacturer shall be responsible for recalculating the dimensions such that the form and geometry conform with the ISO standard form.

(c) See Table 3-19 for accumulated pitch variation.

NOTE:

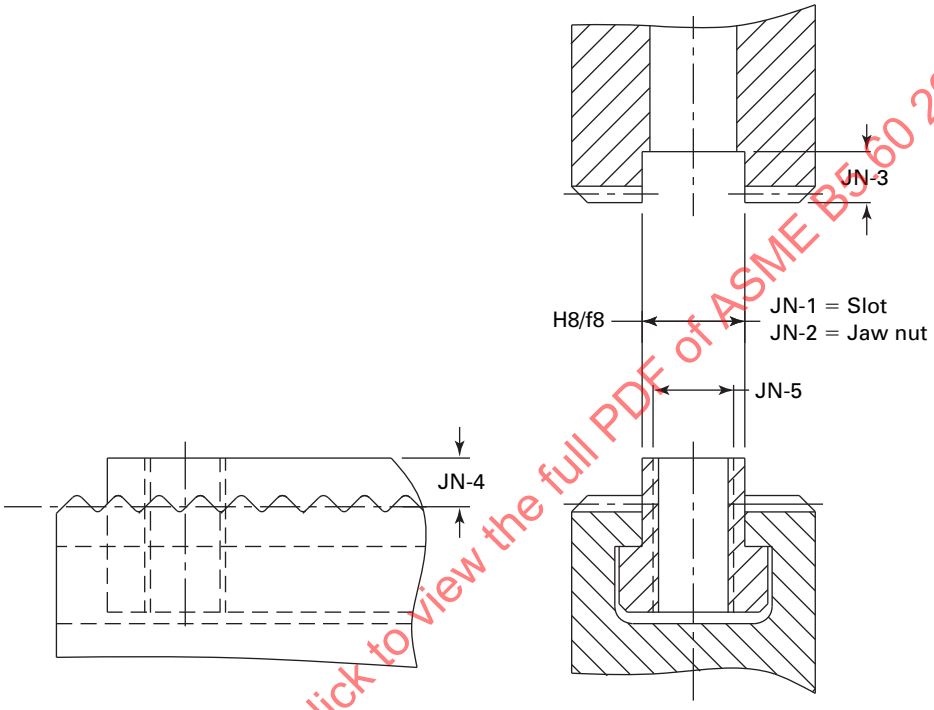
(1) Any profile contained within the hatched area is acceptable.

Table 3-19 60 deg Serrated Jaw Interface (Metric), Accumulated Pitch Variation

Serration Designation				
1.5 × 60 deg		3.0 × 60 deg		Permissible Accumulated Pitch Variation
Measuring Length, MJ-10	Number of Teeth	Measuring Length, MJ-10	Number of Teeth	
30	20	30	10	±0.008
60	40	60	20	±0.013
90	60	90	30	±0.018
120	80	120	40	±0.023
150	100	150	50	±0.028

GENERAL NOTE: All dimensions are in millimeters.

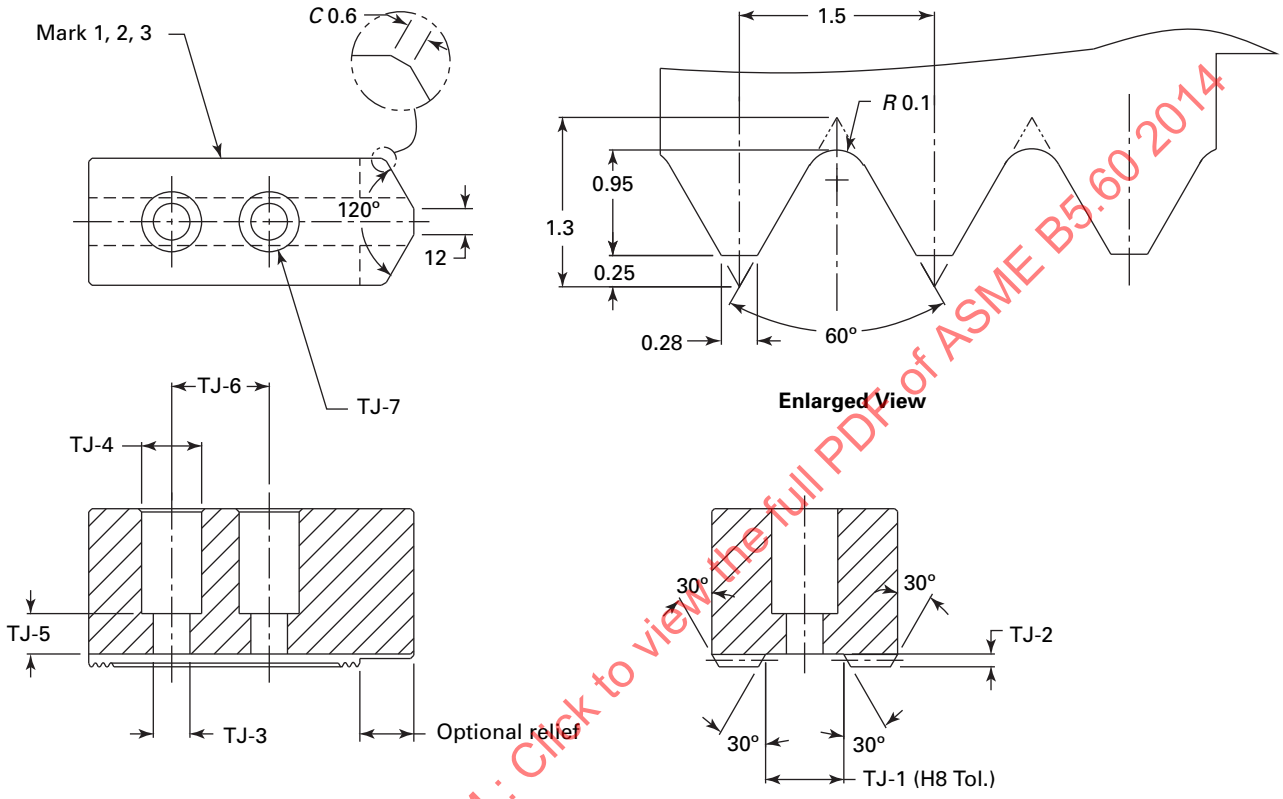
Table 3-20 60 deg Metric and 90 deg Inch Serrated Jaws and Jaw-Nut Interface



Nominal Size of Chuck	Slot Size, Master Jaw and Top Jaw (H8 Tol.), JN-1		Jaw Nut Size (f8 Tol.), JN-2		Slot Depth in Top Jaw, JN-3	Jaw Nut Above Master Jaw, JN-4	Internal Thread, JN-5	Designation of Serration
	Min.	Max.	Min.	Max.				
100	10.000	10.022	9.965	9.987	4.5	2.5	M6	1/16 in. × 90 deg or 1.5 mm × 60 deg
125	12.000	12.027	11.957	11.984	4.5	2.5	M8	1/16 in. × 90 deg or 1.5 mm × 60 deg
160	14.000	14.027	13.957	13.984	4.5	2.5	M10	1/16 in. × 90 deg or 1.5 mm × 60 deg
200	17.000	17.027	16.957	16.984	4.5	2.5	M12	1/16 in. × 90 deg or 1.5 mm × 60 deg
250	21.000	21.033	20.947	20.980	4.5	2.5	M16	1/16 in. × 90 deg or 1.5 mm × 60 deg
315	21.000	21.033	20.947	20.980	4.5	2.5	M16	1/16 in. × 90 deg or 1.5 mm × 60 deg
400	25.500	25.533	25.447	25.480	5.5	3.5	M20	3/32 in. × 90 deg or 3.0 mm × 60 deg
500	25.500	25.533	25.447	25.480	5.5	3.5	M20	3/32 in. × 90 deg or 3.0 mm × 60 deg
630	25.500	25.533	25.447	25.480	5.5	3.5	M20	3/32 in. × 90 deg or 3.0 mm × 60 deg

GENERAL NOTES:
(a) Unless otherwise specified, all dimensions are in millimeters.
(b) For tolerance grade of thread (JN-5), see ISO 965-3.

Table 3-21 1.5 mm × 60 deg Serrated Top Jaw (Metric)



Nominal Size of Chuck	Slot Width (H8 Tol.), TJ-1		Slot Depth, TJ-2	Screw Clearance Drill Diameter, TJ-3	Screw Counterbore Diameter, TJ-4	Screw Counterbore Depth, Min., TJ-5	Screw Center-to-Center Distance, TJ-6	Screw Size, TJ-7
	Min.	Max.						
100	10.000	10.022	4.5	6.80	11.25	5.0	14.00	M6
125	12.000	12.027	4.5	8.80	14.25	6.0	18.00	M8
160	14.000	14.027	4.5	10.80	17.25	6.0	20.00	M10
200	17.000	17.027	4.5	12.80	19.25	8.0	25.00	M12
250	21.000	21.033	4.5	16.75	25.50	10.0	30.00	M16
315	21.000	21.033	4.5	16.75	25.50	10.0	30.00	M16

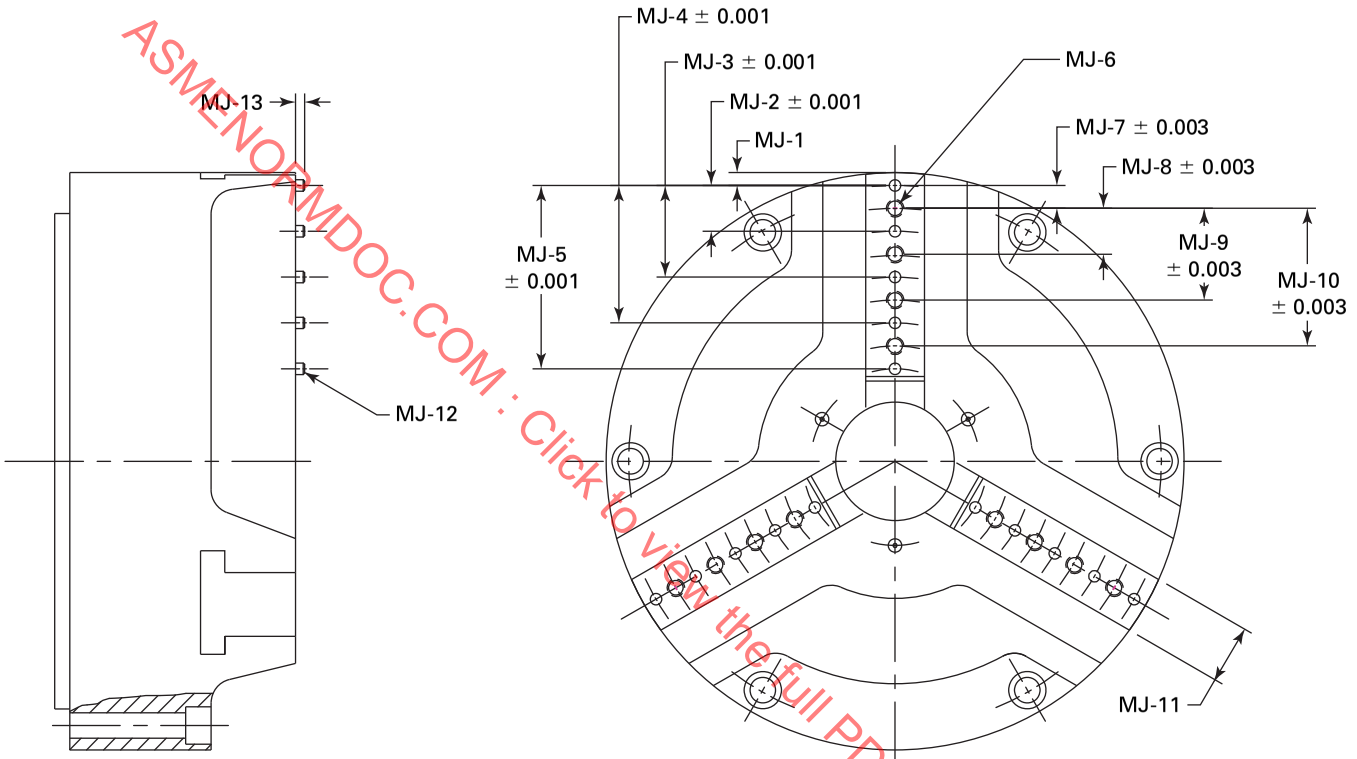
GENERAL NOTES:

(a) All dimensions are in millimeters.

(b) Serration pitch error not to accumulate more than 0.005 mm per 25 mm.

(c) Tapped holes located within Ø 0.2 mm of true position.

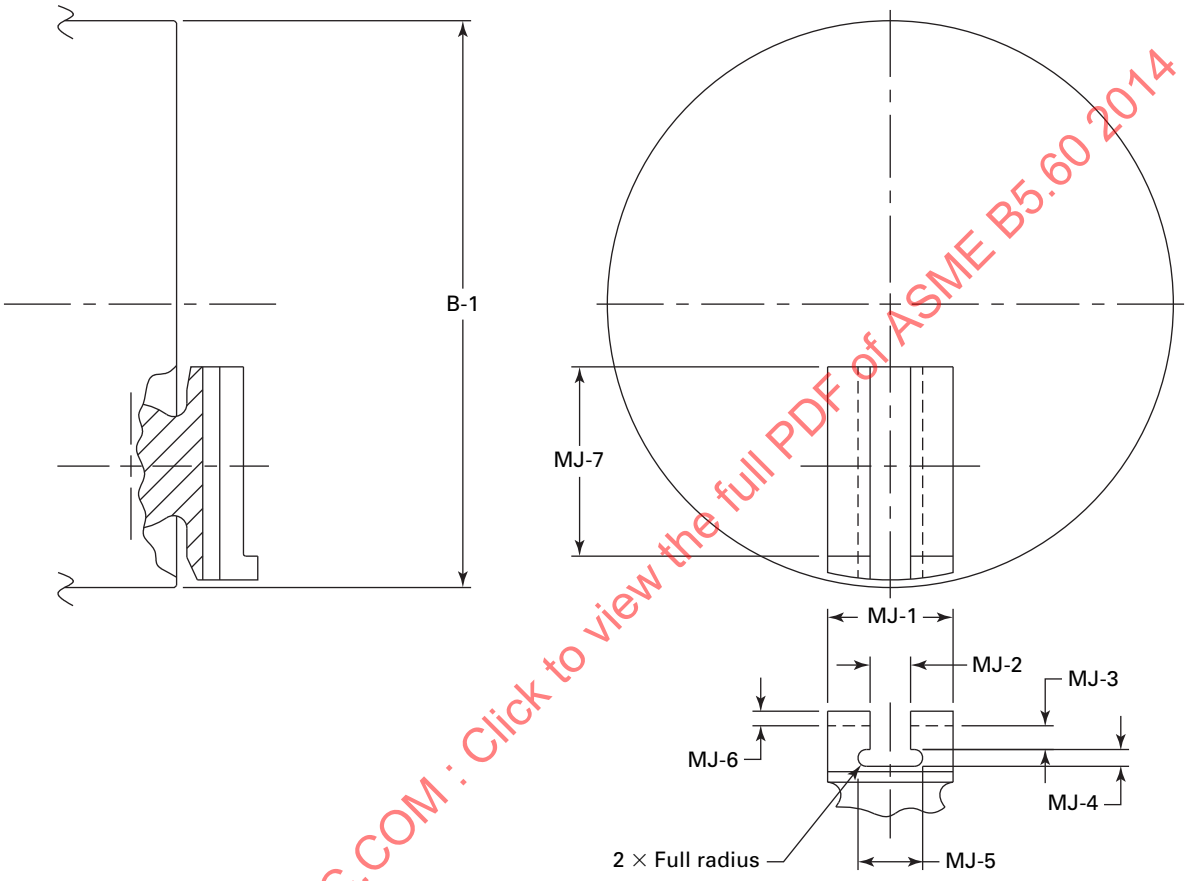
Table 3-22 Pin Locator Chucks, Master Jaw



Nominal Chuck Diameter	Edge to First Locating Pin, MJ-1	First to Second Locating Pin, MJ-2	First to Third Locating Pin, MJ-3	First to Fourth Locating Pin, MJ-4	First to Fifth Locating Pin, MJ-5	Thread for Mounting Screws, in. (UNF-2B), MJ-6	First Locating Pin to First Screw, MJ-7	First Screw to Second Screw, MJ-8	First Screw to Third Screw, MJ-9	First Screw to Fourth Screw, MJ-10	Master Jaw Width, MJ-11	Locating Pin Diameter, MJ-12	Locating Pin Height, MJ-13
3	0.14	0.610	. . .	. . .	. . .	1/4-28	0.30	. . .	. . .	. . .	0.63	0.1250	0.10
4	0.14	0.500	1.000	. . .	. . .	10-32	0.25	0.50	. . .	. . .	0.63	0.1250	0.10
6	0.14	0.500	1.000	1.500	2.000	10-32	0.25	0.50	1.00	1.50	0.63	0.1250	0.10
7	0.25	2.000	. . .	. . .	. . .	3/8-24	0.45	1.10	. . .	. . .	1.26	0.2500	0.25
8	0.30	1.100	2.200	. . .	. . .	3/8-24	0.55	1.10	. . .	. . .	1.26	0.2500	0.25
10	0.30	1.100	2.200	3.300	. . .	3/8-24	0.55	1.10	2.20	. . .	1.26	0.2500	0.25
12	0.47	3.440	. . .	. . .	. . .	5/8-24	0.72	2.00	. . .	. . .	1.53	0.4375	0.31

GENERAL NOTE: Dimensions are in inches unless otherwise specified.

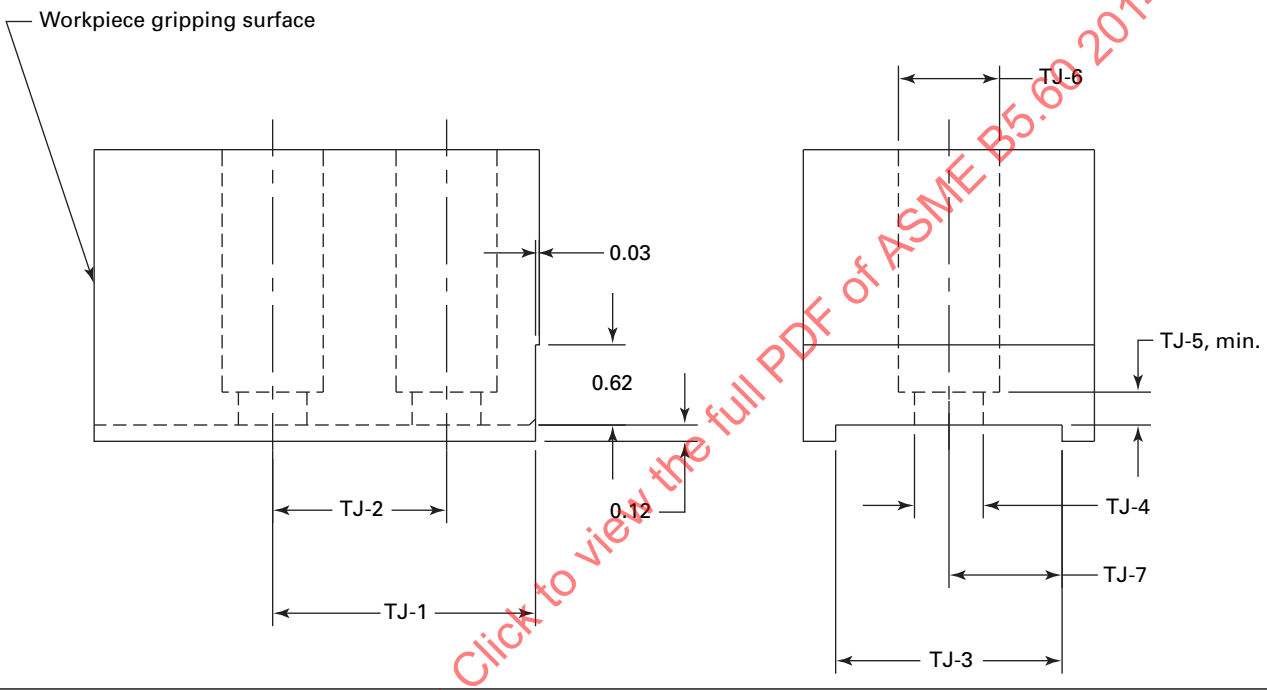
Table 3-23 Ball Style Chucks, Master Jaw



Nominal Size of Chuck, B-1	Jaw Width, MJ-1		Jaw Nut Slot Width, MJ-2		Top of Jaw Platform to Top of Slot, MJ-3		Jaw Slot Height, MJ-4		Jaw Slot Width, MJ-5		Master Jaw Support Height, MJ-6		Mounting Face Length, MJ-7
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
6	1.497	1.499	0.498	0.503	0.250	0.260	0.198	0.206	0.801	0.811	0.245	0.255	2.19
8	1.747	1.749	0.560	0.565	0.312	0.322	0.230	0.240	0.895	0.905	0.190	0.205	2.63
10	2.247	2.249	0.748	0.754	0.411	0.421	0.292	0.302	1.115	1.125	0.222	0.237	3.00
12	2.247	2.249	0.748	0.754	0.411	0.421	0.292	0.302	1.115	1.125	0.222	0.237	3.25
15	2.622	2.624	0.873	0.878	0.442	0.452	0.292	0.302	1.302	1.312	0.222	0.237	4.16
18	2.622	2.624	0.873	0.878	0.442	0.452	0.292	0.302	1.302	1.312	0.222	0.237	4.16

GENERAL NOTE: All dimensions are in inches.

Table 3-24 Ball Style Chucks, Top Jaw



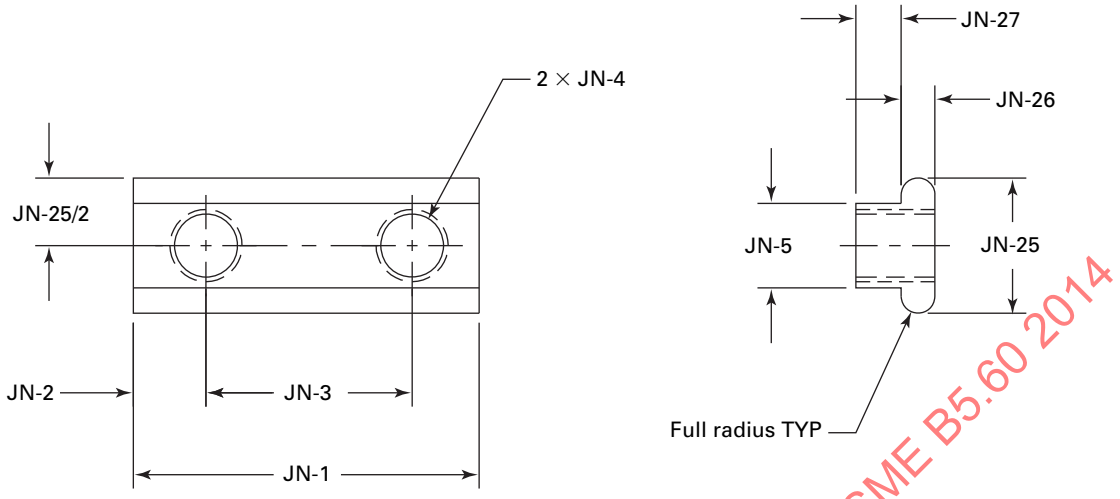
Nominal Size of Chuck	Back Edge to Inner Screw, TJ-1 [Note (1)]	Center-to-Center Screw Holes, TJ-2 [Note (1)]	Mounting Width, TJ-3		Screw Clearance Hole Diameter, TJ-4	Screw Counterbore Depth, TJ-5, Min.	Screw Counterbore Diameter, TJ-6	Setup Dimension, TJ-7
			Min.	Max.				
6	1.734	1.156	1.500	1.502	0.469	0.203	0.688	0.750
8	2.031	1.344	1.750	1.752	0.531	0.250	0.781	0.875
10	2.500	1.750	2.250	2.252	0.656	0.312	1.000	1.125
12	2.500	1.750	2.250	2.252	0.656	0.312	1.000	1.125
15	3.062	2.125	2.625	2.627	0.812	0.312	1.188	1.312
18	3.062	2.125	2.625	2.627	0.812	0.312	1.188	1.312

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Table 3-25 Ball Style Chucks, Jaw Nut



Nominal Size of Chuck	Overall Length, JN-1	Location of First Screw Hole, JN-2 [Note (1)]	Center-to-Center Screw Holes, JN-3 [Note (1)]	Tapped Hole Size (UNC-2B), JN-4	Width of Tongue, JN-5		Width of Tee, JN-25		Height of Tee, JN-26		Height of Tongue, JN-27	
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
6	2.16	0.53	1.156	7/16-14	0.483	0.493	0.781	0.791	0.183	0.193	0.228	0.238
8	2.38	0.56	1.344	1/2-13	0.545	0.555	0.875	0.885	0.215	0.225	0.290	0.300
10	3.03	0.78	1.750	5/8-11	0.733	0.743	1.095	1.105	0.277	0.287	0.384	0.394
12	3.03	0.78	1.750	5/8-11	0.733	0.743	1.095	1.105	0.277	0.287	0.384	0.394
15	3.56	0.84	2.125	3/4-10	0.858	0.868	1.277	1.292	0.277	0.287	0.415	0.425
18	3.56	0.84	2.125	3/4-10	0.858	0.868	1.277	1.292	0.277	0.287	0.415	0.425

GENERAL NOTE: All dimensions are in inches.

NOTE:

(1) Holes located within Ø 0.012 in. of true position.

Chapter 4
Performance Testing

4-1 SCOPE

This Chapter covers geometric test procedures for measuring accuracy of self-centering jaw-type chucks. It addresses the procedures for the inspection of rotational and axial accuracy, centering, and repeatability of the chuck by using a qualified test piece.

NOTE: For specific limits and specifications, contact the chuck manufacturer.

4-2 SPINDLE VERIFICATION

All of the geometric tests to be carried out involve chuck rotation. The mounting of the chuck may be made either directly on the test spindle (Fig. 4-1) or with an adapter placed between the spindle and the chuck (Fig. 4-2). Where an adapter is used, these tests shall be carried out on the adapter that has been mounted on the spindle. This spindle or adapter shall have been previously tested for the accuracy of size, centering, and concentricity with the spindle axis, and the absence of camming of the spindle or adapter.

4-3 GEOMETRIC TESTS

Geometric tests for both manual and power chucks are illustrated in Fig. 4-3.

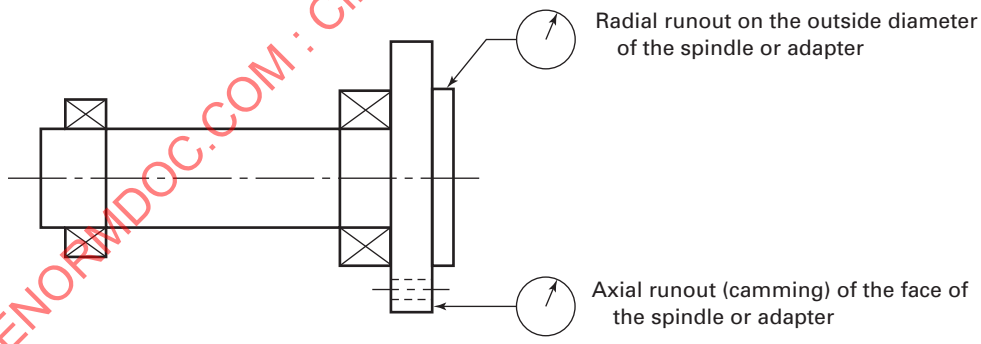
4-4 CHECKING OF CENTERING ACCURACY AND REPEATABILITY OF MANUAL-SCROLL CHUCKS

A test for checking accuracy and repeatability of outside-diameter grip is presented in Fig. 4-4. Refer to Fig. 4-5 for a test of accuracy and repeatability of jaw steps.

4-5 CHECKING OF CENTERING ACCURACY AND REPEATABILITY OF POWER CHUCKS

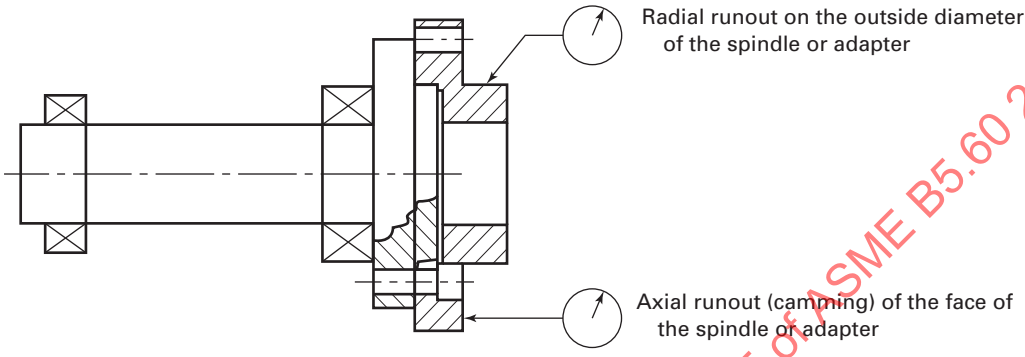
External chucking is presented in Fig. 4-6. Internal chucking is presented in Fig. 4-7.

Fig. 4-1 Spindle Verification Test for Chuck Mounted Directly on the Test Spindle



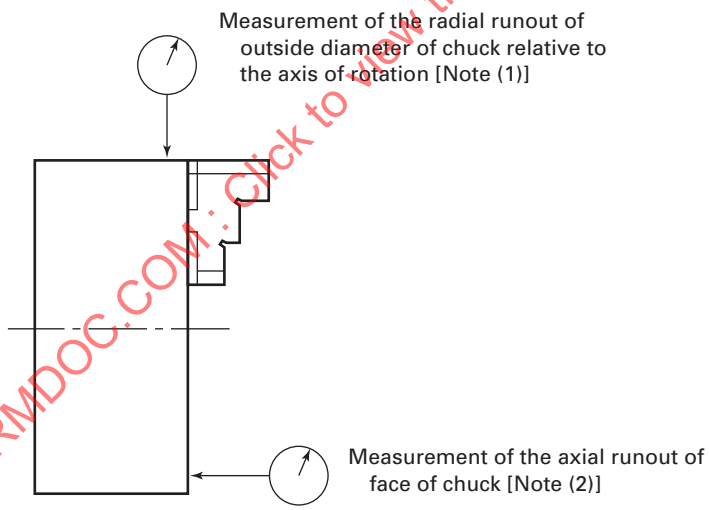
GENERAL NOTE: The maximum total indicator reading (TIR) for both objectives is 0.005 mm (0.0002 in.). Deviations in excess of these specifications will adversely affect the accuracy of the chuck.

Fig. 4-2 Spindle Verification Test for Chuck Mounted on an Adapter



GENERAL NOTE: The maximum total indicator reading (TIR) for both objectives is 0.005 mm (0.0002 in.). Deviations in excess of these specifications will adversely affect the accuracy of the chuck.

Fig. 4-3 Geometric Tests



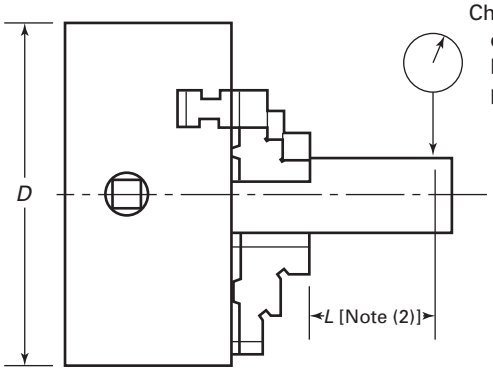
GENERAL NOTE: The measured radial and axial runout should be compared to the chuck manufacturer's specifications.

NOTES:

(1) The contact point of the indicator shall be placed on the largest uninterrupted diameter closest to the chuck face or on the qualified indicating band provided by the chuck manufacturer.

(2) The contact point of the indicator shall be placed on the face of the chuck as near to the periphery as practical.

Fig. 4-4 Manual-Scroll Chucks: Checking Centering Accuracy and Repeatability of Outside-Diameter Grip



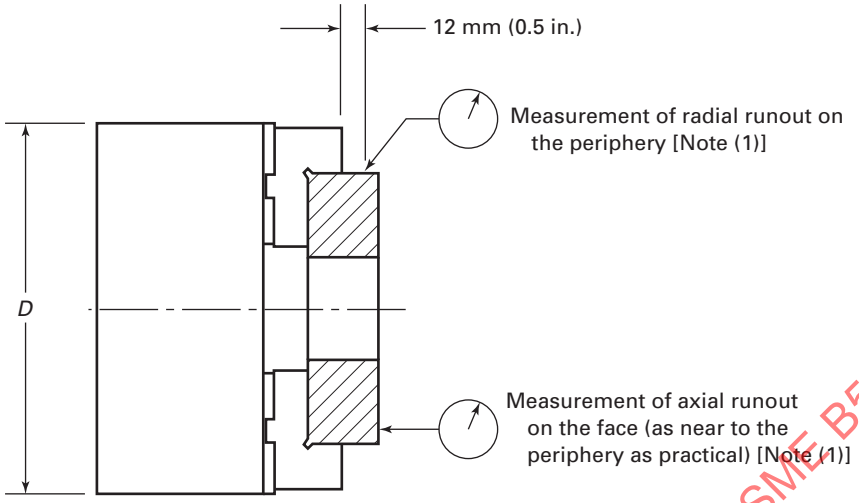
LEGEND:
D = nominal diameter of chuck
L = minimum distance of indicator contact point from the jaw face

GENERAL NOTES:
(a) Five test bars of different diameters shall be used.
(b) The sizes of the test-bar diameters shall be proportional to the scroll pitch so that the various scroll positions differ from one test bar to another through an arc of approximately 90 deg of scroll movement.
(c) To ensure the maximum stability of grip, the test-bar diameter shall not exceed the diameter of the bore in the chuck.
(d) The contact on the test bars shall be made along the centerline of each jaw.
(e) Test bars shall be made of heat-treated steel to withstand the grip of the jaws without deformation, internal or superficial, and shall be round and straight within 0.005 mm (0.0002 in.) for up to 400 mm (16 in.), 0.010 mm (0.0004 in.) for up to 630 mm (24 in.), and 0.025 mm (0.0010 in.) for up to 1 000 mm (40 in.) chuck diameter.
(f) For geometric tests, the input torque shall be approximately two-thirds of the maximum allowed.

NOTES:
(1) This test shall be repeated no less than three times and maximum runout shall be reported.
(2) Determination of minimum distance of indicator contact point from the jaw face, L, is as follows:

Nominal Diameter of Chuck, D		Minimum Distance of Indicator Contact Point From the Jaw Face, L	
mm	in.	mm	in.
$D < 250$	$D < 10$	50	2
$250 < D < 400$	$10 < D < 16$	75	3
$400 < D < 630$	$16 < D < 24$	100	4
$630 < D < 1\,000$	$24 < D < 40$	125	5

Fig. 4-5 Manual-Scroll Chucks: Checking Centering Accuracy and Repeatability of Jaw Steps



GENERAL NOTES:

(a) Each jaw step shall be tested. A single test piece should be used for each step.

(b) The external diameter of the test piece shall be equal to or smaller than the diameter at which the steps of the jaws have been manufactured.

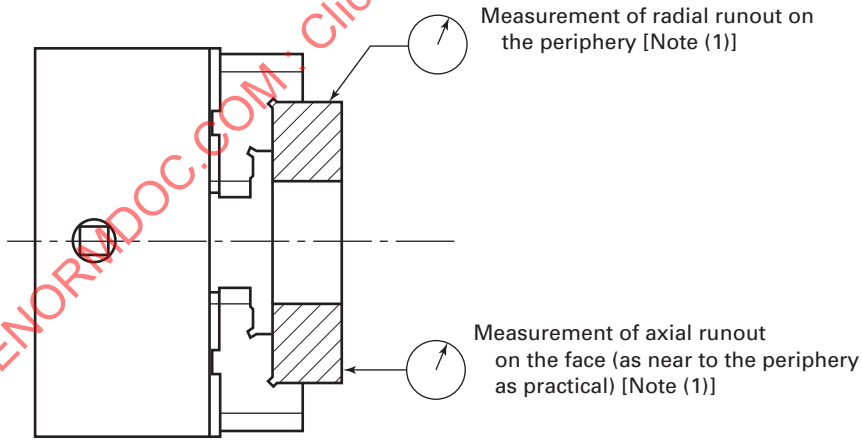
(c) Test pieces shall be made of heat-treated steel to withstand the grip of the jaws without deformation, internal or superficial, and shall be round, straight, and square within 0.005 mm (0.0002 in.) for up to 400 mm (16 in.), 0.010 mm (0.0004 in.) for up to 630 mm (24 in.), and 0.025 mm (0.0010 in.) for up to 1 000 mm (40 in.) chuck diameter.

(d) For geometric tests, the input torque shall be approximately two-thirds of the maximum allowed.

NOTE:

(1) This test shall be repeated no less than three times and maximum runout shall be reported.

Fig. 4-6 Power Chucks: Checking Centering Accuracy and Repeatability for External Chucking



GENERAL NOTES:

(a) A test piece with an outside diameter of approximately 60% of the chuck outside diameter, *D*, shall be used.

(b) Test piece shall be gripped in jaws manufactured to the chuck manufacturer's specified procedure.

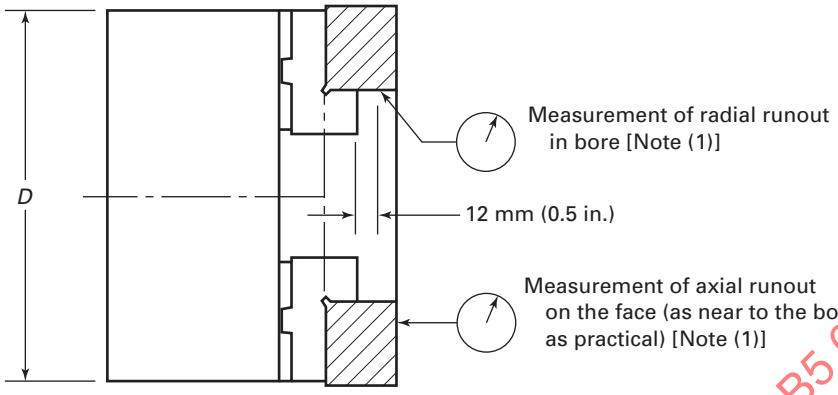
(c) Test pieces shall be made of heat-treated steel to withstand the grip of the jaws without deformation, internal or superficial, and shall be round, straight, and square within 0.005 mm (0.0002 in.) for up to 400 mm (16 in.), 0.010 mm (0.0004 in.) for up to 630 mm (24 in.), and 0.025 mm (0.0010 in.) for up to 1 000 mm (40 in.) chuck diameter.

(d) For geometric tests, the input torque shall be approximately two-thirds of the maximum allowed.

NOTE:

(1) This test shall be repeated no less than three times and maximum runout shall be reported.

Fig. 4-7 Power Chucks: Checking Centering Accuracy and Repeatability for Internal Chucking



GENERAL NOTES:

(a) A test piece with an outside diameter of approximately 30% of the chuck outside diameter, *D*, shall be used.

(b) Test piece shall be gripped in jaws manufactured to the chuck manufacturer's specified procedure.

(c) Test pieces shall be made of heat-treated steel to withstand the grip of the jaws without deformation, internal or superficial, and shall be round, straight, and square within 0.005 mm (0.0002 in.) for up to 400 mm (16 in.), 0.010 mm (0.0004 in.) for up to 630 mm (24 in.), and 0.025 mm (0.0010 in.) for up to 1 000 mm (40 in.) chuck diameter.

(d) For geometric tests, the input torque shall be approximately two-thirds of the maximum allowed.

NOTE:

(1) This test shall be repeated no less than three times and maximum runout shall be reported.

Chapter 5
Safety Code of Practice

5-1 SCOPE

This Chapter covers the safety requirements for jaw-type workholding chucks that are primarily used in turning applications.

It addresses the requirements and/or measures to minimize the hazards and reduce the risks associated with workholding chucks.

There are hazards inherent in the design, use, and operation of jaw-type chucks. Ignoring safety considerations will result in personal injury, including death.

NOTE: For specific limits and specifications, contact the workholding manufacturer.

5-2 DESIGN AND CONSTRUCTION OF WORKHOLDING CHUCKS AND TOP JAWS

5-2.1 Workholding Chucks

The original chuck design shall address, at a minimum, the following:

(a) Chuck and actuating equipment shall be compatible.

(1) The input force of the actuating equipment shall meet or exceed the chuck's requirements.

(2) The stroke of the actuating equipment shall meet or exceed the chuck's requirements (power chuck).

(3) The maximum allowable speed of the actuating equipment shall meet or exceed the chuck's requirements (power chuck).

(b) Chuck components shall be positively prevented from being flung out by centrifugal force.

(1) The chuck's internal and external components shall have design features ensuring integrity at the maximum allowable speed.

(2) Limits on the mass of top jaws and radial position shall be defined in the chuck's manual (i.e., the restrictions of speed and input force with regard to top jaws).

(c) Balance of the chuck shall ensure safe operation up to the maximum allowable speed.

(1) The chuck and actuator shall be balanced within 3 g at outside diameter as the standard.

(2) The chuck's design shall allow for field balancing (if required). This could be done at the areas of the chuck prescribed for addition or removal of weight as per (1) above.

(d) Chucks shall be equipped with means for safe handling per ASME B18.15M (e.g., provision for lifting eyebolt).

(e) The chuck's design shall have a convenient and reasonably accessible method for lubrication of the workholding chuck.

(f) The power chuck and/or actuating equipment shall have stroke detection and/or confirmation provisions (e.g., sensing devices).

(g) There shall be provisions to maintain clamping force until the spindle comes to a safe stop in the event of loss of input force.

(h) The chuck and/or actuating equipment shall have provisions to maintain clamping force until the spindle comes to a safe stop in the event of power loss.

5-2.2 Top Jaws

The top jaw design shall address, at a minimum, the following:

(a) Top jaws and chucks shall be compatible.

(1) Any top jaws used on a specific chuck shall have compatible mating surfaces.

(2) Top jaw design shall address weight, position, and speed limitations.

(3) Top jaw material shall also be considered for strength and durability.

(4) Replacement top jaws shall adhere to original workholding manufacturer's mounting dimensions and tolerances as specified by the chuck manufacturer. Deviations from these specifications could cause loss of gripping force, damage to the chuck, and injury.

(b) Top jaws/components shall be positively prevented from being flung out by centrifugal force.

(1) The mechanical connection between top jaws and master jaws shall be of an interlocking design that will resist separation, under centrifugal force, when properly connected with the specified fasteners. Other types of stops, blocks, and clamps properly bolted in place may be used.

(2) Welded jaws shall not be used.

(c) Jaw nuts and mounting bolts shall be compatible with the specifications of the original workholding manufacturer.

5-3 MARKING

5-3.1 Workholding Chucks

Marking shall be durable and last for the life of the product. Minimum requirements for marking shall include the following:

(a) manufacturer's name and model/identification number

(b) maximum input force
(c) maximum static clamping force

5-3.2 Top Jaws

Marking shall be durable and last for the life of the product. Minimum requirements for marking shall include the manufacturer's name and/or logo, model, and/or identification number on a surface that is visible (when mounted) and not likely to be removed.

5-4 SAFETY INSTRUCTIONS

5-4.1 Workholding Chucks

The original chuck manufacturer shall provide an instruction manual.

Items to be addressed in the instruction manual, at a minimum, shall include the following:

(a) general specifications (e.g., dimensions, maximum speeds, and forces)
(b) instructions for the handling and installation of the workholding chuck
(c) instructions for the usage of the workholding chuck
(1) jaw forming/boring
(2) jaw mounting
(3) component clamping
(d) methods for determining chuck forces
(1) maximum drawbar-pull (Mandatory Appendix I, para. I-1)
(2) static gripping force (Mandatory Appendix I, para. I-2)
(3) dynamic gripping force and centrifugal force (Mandatory Appendix I, para. I-3)
(4) driving torque (Mandatory Appendix I, para. I-4)
(5) maximum rotational speed (Mandatory Appendix I, para. I-5)
(e) instructions for maintenance
(1) assembly and disassembly instructions
(2) assembly/component views
(3) parts list
(4) lubrication instructions
(f) periodic performance checks
(1) jaw stroke
(2) static clamping forces

5-4.2 Top Jaw

The original top-jaw manufacturer shall provide safety instructions.

Items to be addressed, at minimum, shall include the following:

(a) method for calculating the maximum rpm
(b) mounting hardware to be specified (e.g., dimensions, grade/class)
(c) mounting instructions
(d) statements to be included
(1) "Follow chuck manufacturer's mounting and usage specs as outlined in the original workholding manufacturer's manual."
(2) "Specific limits and specifications: contact the top-jaw manufacturer."
(3) "Maintenance recommendations — when applicable."

5-5 MACHINE TOOL BUILDER RESPONSIBILITIES

The machine tool builder's minimum responsibilities shall include those in the paragraphs below.

5-5.1 Selection

A workholding system compatible with the machine tool shall be selected.

(a) The machine-tool builder shall select a workholding chuck based on the performance capability of the chuck being compatible with the machine tool's cutting capabilities. The items to be considered include, but are not limited to, maximum spindle rpm, machine swing, spindle horsepower, axis thrust, spindle nose, headstock length, chuck weight, maximum part diameter, length, and weight.
(b) The machine-tool builder shall limit (lock out) the maximum spindle speed so that it does not exceed the maximum rpm of the workholding system.

5-5.2 Documentation

The chuck manufacturer's manual shall be provided with the machine's documentation.

The machine-tool builder shall provide a copy of the chuck manufacturer's manual with the machine tool's documentation.

5-5.3 Safety Instructions

Safety instructions shall include safe-operation guidelines for workholding.

The machine tool manufacturers shall address the following issues in their manuals:

(a) *Safety.* The end user shall read, understand, and adhere to the chuck manufacturer's safety manual.
(b) *Chuck Gripping Force.* Requirements for review and determination of the proper gripping force required for the process being performed shall be explained.
(c) *Constant Surface Speed.* The effects and safe corrective action when using constant surface speed shall be explained.
(d) *Jaw-Gripping Area.* The machine-tool builder shall describe the importance of proper jaw-gripping area [para. 5-4.1(c)].
(e) *Unbalanced Workpieces.* The effects of an unbalanced workpiece/workholding system shall be explained.

(f) Alteration to Workholding System. Before making any alterations or changes to the workholding system, the chuck manufacturer should be consulted.

(g) Bar Applications. An explanation of the effects of bar passing through the spindle, and the required cautions, should be provided.

(h) Double Chucking. The use of multiple workholding systems on the same machine should be addressed.

(i) Additional Information. Information recognized by the machine-tool builder to improve the safe operation of the workholding system should be included.

5-5.4 Safety Placard

Provide the safety placard with the following minimum information:

(a) Chuck and/or Cylinder Make/Model Numbers. The manufacturer shall list the chuck and cylinder models selected and installed on the machine.

(b) Maximum Input Pressure (Cylinder). The placard shall indicate the maximum input pressure that can be applied to the cylinder for the specific chuck installed.

(c) Maximum Rated rpm. The maximum rpm capability of the workholding system shall be indicated.

(d) Reference to Chuck Manual. The placard shall inform the user to review the chuck manufacturer's manual.

5-5.5 Power-Chuck Clamped Confirmation

A suitable system for power-chuck clamped confirmation shall be provided.

The machine tool builder shall provide a positive means for determining if the chuck is in the clamped position. Spindle rotation shall be inhibited when the chuck is not in the clamped position.

5-6 WORKHOLDING USER RESPONSIBILITIES

Workholding user minimum responsibilities include those in the paragraphs below.

5-6.1 Power and Manual Chucks

(a) The user shall read, understand, and adhere to the instruction manual.

(b) The user shall select a workholding system compatible with the machine tool.

(1) The user shall select a workholding chuck based on the performance capability of the chuck being compatible with the machine tool's cutting capabilities. The items to be considered include, but are not limited to, spindle rpm, maximum chuck size, spindle horsepower, axial thrust, spindle nose, headstock length, chuck weight, maximum part diameter, length, and weight.

(2) The user shall limit (lock out) the maximum spindle speed so that it does not exceed the maximum rpm of the workholding system.

(c) The chuck shall be installed in accordance with manufacturer's recommendations to ensure the following:

(1) specified mounting bolts at recommended torque

(2) proper jaw travel

(3) balance within specifications

(4) maximum input force is not exceeded

(d) Adequate guarding shall protect the chuck and workpiece, when rotating.

(e) The spindle shall never be run exceeding the maximum allowable chuck speed.

(f) Jaws should not extend beyond the outside diameter of the chuck body.

(g) Top-jaws screws should be as specified with minimum thread engagement and torque to manufacturer's recommendation.

(h) The chuck shall be disassembled, cleaned, inspected, and lubricated according to the manufacturer's maintenance schedule. The user shall

(1) verify jaw travel

(2) regularly inspect top jaws

(3) regularly inspect mounting hardware

(4) take remedial actions to comply with the instruction manual

(5) provide a documented maintenance schedule to original manufacturer's specifications

(6) provide means of measuring static jaw-clamping forces

A sample maintenance schedule sheet for scheduled lubrication of the workholding device is found in Form 5-1.

5-6.2 Manual Chucks

(a) An extension bar or hammer shall never be used on the chuck wrench.

(b) The spindle should never be run without a part clamped in the chuck.

5-6.3 Power Chucks

The user shall

(a) position jaws to clamp the workpiece at midstroke of chuck

(b) validate the minimum jaw force and the maximum chuck speed before each application (using Mandatory Appendix I, paras. I-1 through I-5)

(c) check static jaw force periodically, in accordance with manufacturer's maintenance schedule

(d) with loss of static jaw force, service chuck in accordance with manufacturer's recommendations

A sample log sheet for scheduled validation of the gripping force for the workholding device is found in Form 5-2.

Form 5-1 Sample Maintenance Schedule Sheet

Date: _____ Machine ID: _____

Operator name: _____ Workholding device ID: _____

Lubrication frequency: _____ Lubrication ID: _____

Lubrication points: _____

Procedure: This procedure is the regular, scheduled lubrication of this workholding device. Be sure to follow all safety guidelines.

(1) Clean all grease fittings/zerks to eliminate possibility of contamination.
(2) Visually inspect the workholding device for signs of wear and/or damage.
(3) Lubricate all points as indicated; document amount of lubricant used.
(4) Actuate the workholding device.
(5) Document all points below.

Date	Time	Operator Initials	Lubrication Points	Notes

Form 5-2 Sample Grip Force Log Sheet

Date: _____ Machine ID: _____

Operator name: _____ Workholding device ID: _____

Test frequency: _____ Top tooling ID: _____

Hydraulic cylinder input pressure: _____

Procedure: This procedure is the regular, scheduled checking of gripping force for this workholding device. Be sure to follow all safety guidelines.

(1) Mount testing top tooling (torque to specs).
(2) Adjust hydraulic cylinder input force to specs.
(3) Insert jaw force analyzer unit into the workholding device.
(4) Check that workholding device is in middle of stroke and properly gripping the jaw force analyzer unit.
(5) Check the jaw static gripping force and document results.
(6) Repeat steps above to ensure accurate readings and repeatability of test.

Date	Time	Operator Initials	Check #1	Check #2	Check #3

MANDATORY APPENDIX I
CALCULATION OF FORCE, TORQUE, AND SPEED

I-1 MAXIMUM DRAW-PULL

All chucks are limited to a maximum draw-pull, $F_{t\,max}$, at the draw tube (drawbar) based on the sizes of the internal parts. The chuck manufacturer provides this value in the technical-features section of the catalog or it is inscribed on the chuck face. The draw-pull, in the case of drawing with a hydraulic cylinder, is calculated by multiplying the piston area of the cylinder, the oil feed pressure, and the efficiency, η, which can be recognized as 0.95. In all cases, forces will be expressed in kilonewtons (1 kN = 225 lbf).

$$F_t = A \times p \times 0.95$$

where

A = piston area of the cylinder
F_t = maximum draw-pull
p = pressure applied to the cylinder
0.95 = efficiency factor of the cylinder

If we know the maximum draw-pull allowed and wish to solve this equation for p (the maximum pressure that can be applied to the cylinder), the formula then becomes

$$p = \frac{F_t}{A \times 0.95}$$

EXAMPLE: On a typical 210-mm, three-jaw power chuck, the maximum draw-pull is 38 kN (8,550 lbf). The draw-pull is supplied by a cylinder with a 0.0138 m^2 (21.4 $in.^2$) piston area. The equation for p (the maximum hydraulic pressure to apply) becomes

$$p = \frac{38}{0.0138 \times 0.95} = 2\,898 \text{ kPa (420 psi)}$$

where

$$1 \text{ psi} = 6.9 \text{ kPa}$$

and

$$1 \text{ kPa} = 1 \text{ kilopascal} = 1\,000 \text{ Pa} = 1\,000 \text{ N/m}^2$$

A higher force at the draw-tube than the rated maximum shall never be applied. Excessive draw-pull can cause breakage of the internal parts of the chuck.

I-2 STATIC GRIPPING FORCE

A power chuck converts the axial stroke of the draw tube to a radial stroke of the jaws by means of an inclined plane (wedge) system.

The wedge changes the draw-pull into a much greater gripping force by a factor of 2.5 to 3 times the draw-pull. This gripping force is applied to the workpiece, providing the necessary force to hold the workpiece securely and overcome the torque created by the cutting tools during the machining cycle. The maximum gripping force, $F_{s\,max}$ (which is the maximum gripping force a power chuck should apply to a workpiece) and the maximum draw force, $F_{t\,max}$ (which is the maximum draw-pull that should be applied to a power chuck) are contained in the technical features provided by the chuck manufacturer, or inscribed on the face of the power chuck. To calculate the static gripping force, F_{so} (which is the gripping force when the power chuck is gripping the workpiece without rotating), for each draw-pull, F_t (which is the varying levels of draw-pull applied to the power chuck), use constant, K, typical of every power chuck. The value of K can be calculated easily with the technical features in catalogs or on the face of the power chuck.

$$K = \frac{F_{s\,max}}{F_{t\,max}} = \frac{F_{so}}{F_t}$$

where

$F_{s\,max}$ = maximum gripping force the chuck can apply
F_{so} = any level of gripping force
F_t = draw-pull necessary to create F_{so}
$F_{t\,max}$ = maximum draw-pull allowed for the chuck
K = constant representing the ratio of gripping force to draw-pull

Therefore, each value of F_t (gripping force) corresponds to a value of F_{so} (draw-pull) according to the following formula:

$$F_{so} = F_t \times K$$

where K is the constant calculated by the given values of maximum draw-pull and maximum gripping force.

EXAMPLE: For a typical 210-mm, three-jaw chuck, F_{so} (static gripping force) for F_t = 30 kN (6,750 lbf) will be determined. The assumed values from the technical features of this power chuck will be an $F_{s\,max}$ of 110 kN and an $F_{t\,max}$ of 38 kN.

$$K = \frac{F_{s\,max}}{F_{t\,max}} = \frac{110 \text{ kN}}{38 \text{ kN}} \cong 3$$

$$F_{so} = 30 \times 3 = 90 \text{ kN}$$