MACHINERY'S DATA SHEETS

REVISED AND RE-ARRANGED IN LIBRARY FORM

No. 8

Bearings, Couplings and Clutches—Chains and Hooks

PRICE 25 CENTS

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The Industrial Press, 49-55 Lafayette Street, New York
Publishers of MACHINERY

MACHINERY'S DATA SHEET SERIES

COMPILED FROM MACHINERY'S MONTHLY DATA SHEETS AND ARRANGED WITH EXPLANATORY NOTES

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In the following pages are compiled a number of diagrams and concise tables relating to bearings, couplings, clutches, chains and crane hooks, carefully selected from MACHINERY'S monthly Data Sheets, issued as supplements to the Engineering and Railway editions of MACHINERY since September, 1898. A number of additional tables and diagrams also are included which are published here for the first time.

In order to enhance the value of the tables and diagrams, brief explanatory notes have been provided wherever necessary. In these notes a complete list of references is given to articles which have appeared in MACHINERY, and to matter published in MACHINERY'S Reference Series, giving additional information on the subject. These references will be of considerable value to readers who wish to make a more thorough study of the subject. In a note at the foot of the tables reference is made to the page on which the explanatory note relating to the table appears.

BEARINGS, COUPLINGS AND CLUTCHES

Bearings

The design of bearings presents one of the most important problems connected with machine construction. No general rule can be given for the diameter of a bearing to sustain a certain load, as a number of factors enter into the design. The lubrication, in particular, plays a very important role, and the durability of the lubricating film is affected in a great measure by the character of the load carried. Commercial oils will endure at low speeds, without rupture of the oil film, from 500 to 1,000 pounds per square inch, when the load is steady. It is not safe, however, to load a bearing to this extent, since it is only under favorable conditions that the film will stand this pressure without breaking. The approximate unit pressure which a bearing will endure without seizing is expressed by the following equation:

$$p = \frac{PK}{DN + K}$$

In this formula:

p = allowable pressure in pounds per square inch of projected area,

D = diameter of the bearing in inches,

N = number of revolutions of journal per minute,

P and K = variables depending upon the quality of oil, manner of lubrication, etc.

The value of P for ordinary cases is about 200 for collar thrust bearings, 400 for shaft bearings, 800 for car journals, 1200 for crank-pins, and 1600 for wrist-pins. The factor K depends upon the method of lubrication, the rapidity of cooling and the care which the journal is likely to get. The value of this factor is as follows: Ordinary work, drop-feed lubrication, 700; first class care, drop-feed lubrication, 1000; force-feed lubrication or ring oiling, 1200 to 1500; extreme limit for perfect lubrication and air-cooled bearings, 2000. This latter value is seldom used except in locomotive work where the rapid circulation of the air cools the journals.

In general the diameter of a shaft is determined with relation to its strength or stiffness. Having obtained the proper diameter, the next step in designing the bearing is to make it long enough so that the unit pressure shall not exceed the required value p. This length is found directly by the equation:

$$L = \frac{W}{PK}\left(N + \frac{K}{D}\right)$$

in which

L = length of bearing in inches,

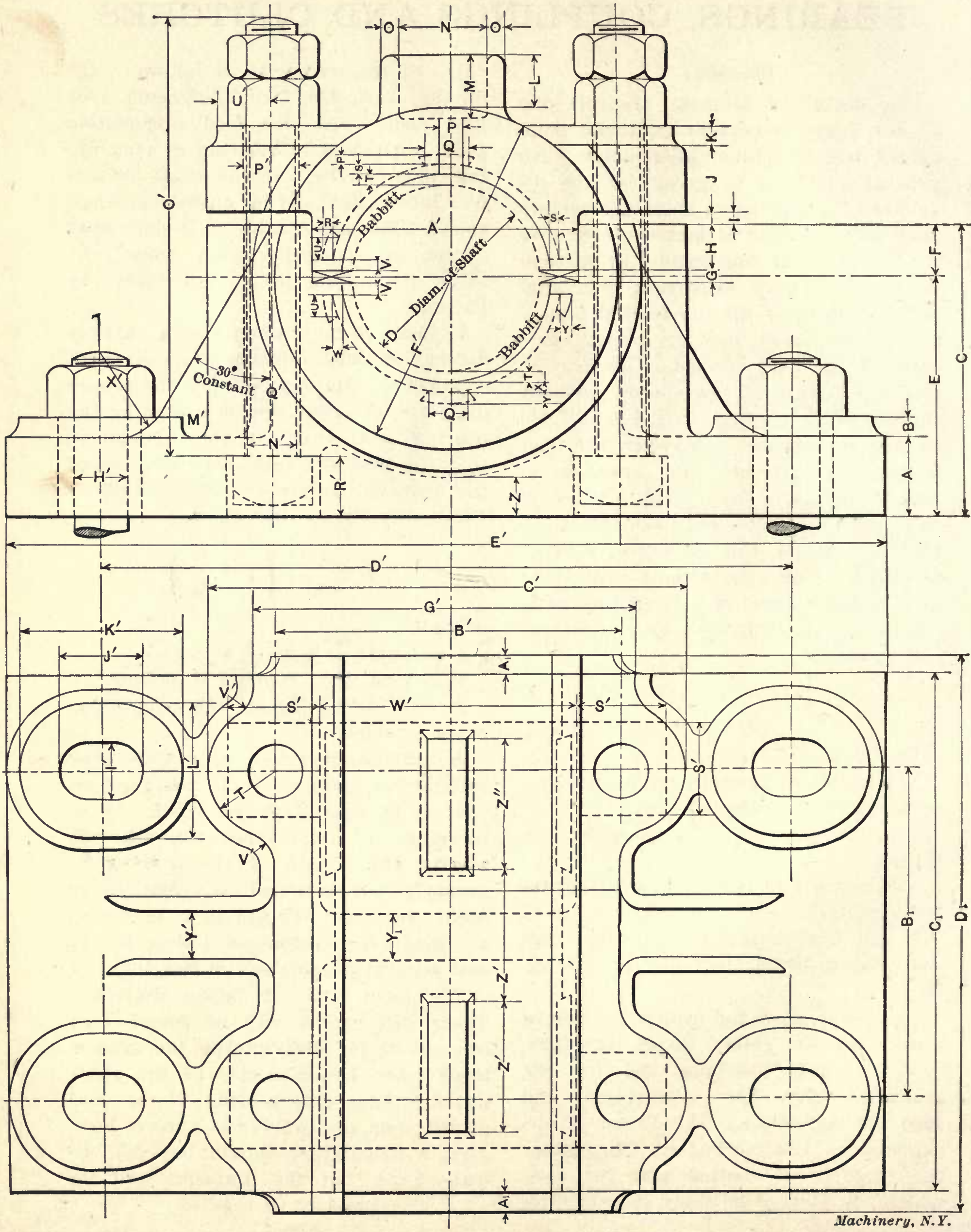
W = load upon bearing in pounds,

P, K, N and D denote the same quantities as before.

A bearing, however, may give poor satisfaction because it is too long as well as because it is too short. It is, therefore, of importance that the diameter and length of the bearing be properly proportioned in relation to each other. On pages 4 to 7, inclusive, are given dimensions of pillow blocks and general proportions of bearings for shafts from 1 to 12 inches diameter. These dimensions will be found very convenient for determining the proportions when the diameter of the shaft has first been determined. If the load placed upon the bearing is known, however, a calculation should be made to make sure that the diameter and its

(Continued on page 23.)

DIMENSIONS OF PILLOW BLOCKS.



Contributed by B. H. Reddy, MACHINERY'S Data Sheet No. 44. Explanatory note: Page 3.

DIMENSIONS OF BEARINGS—II

DIMENSIONS OF PILLOW BLOCKS.

Diam. of Shaft.	$1\frac{1}{3}H'$		$E+F$	$1\frac{1}{4}D$	$\frac{1}{4}D+$		$\frac{1}{4}D+G$	$1\frac{1}{3}G$	$1\frac{1}{3}N'$	B		$1\frac{1}{3}L$				$\frac{1}{4}D$			
D	A	B	C	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1''	$\frac{5}{8}''$	....	$1\frac{1}{2}''$	$1\frac{1}{4}''$	$\frac{1}{4}'$	$\frac{1}{16}''$	$\frac{5}{16}''$	$\frac{3}{32}''$	$\frac{1}{2}''$	....	$\frac{3}{8}''$	$\frac{1}{2}''$	$\frac{1}{2}''$	$\frac{3}{16}''$	$\frac{1}{4}''$	....	....	$\frac{1}{8}''$	$\frac{1}{16}''$
$1\frac{1}{4}$	$\frac{3}{4}$	....	$1\frac{13}{16}$	$1\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{16}$	$\frac{3}{8}$	$\frac{3}{32}$	$\frac{5}{8}$	....	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{16}$	$\frac{1}{4}$	....	....	$\frac{1}{8}$	$\frac{1}{16}$
$1\frac{1}{2}$	$\frac{3}{4}$	....	$2\frac{3}{8}$	2	$\frac{3}{8}$	$\frac{1}{16}$	$\frac{7}{16}$	$\frac{3}{32}$	$\frac{5}{8}$	....	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	....	...	$\frac{1}{8}$	$\frac{1}{16}$
$1\frac{3}{4}$	1	....	$2\frac{11}{16}$	$2\frac{1}{4}$	$\frac{7}{16}$	$\frac{1}{16}$	$\frac{1}{2}$	$\frac{3}{32}$	$\frac{7}{8}$	....	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{1}{4}$	....	....	$\frac{1}{8}$	$\frac{1}{16}$
2	1	....	3	$2\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{16}$	$\frac{9}{16}$	$\frac{3}{32}$	$\frac{7}{8}$	....	$\frac{5}{8}$	$\frac{3}{4}$	1	$\frac{3}{16}$	$\frac{5}{16}$	....	....	$\frac{3}{16}$	$\frac{1}{16}$
$2\frac{1}{4}$	$1\frac{1}{8}$	....	$3\frac{9}{16}$	3	$\frac{9}{16}$	$\frac{1}{16}$	$\frac{5}{8}$	$\frac{3}{32}$	1	....	$\frac{5}{8}$	$\frac{3}{4}$	1	$\frac{3}{16}$	$\frac{5}{16}$	....	....	$\frac{3}{16}$	$\frac{1}{16}$
$2\frac{1}{2}$	$1\frac{1}{8}$	....	$3\frac{7}{8}$	$3\frac{1}{4}$	$\frac{5}{8}$	$\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	1	....	$\frac{5}{8}$	$\frac{3}{4}$	$1\frac{1}{4}$	$\frac{3}{16}$	$\frac{5}{16}$	....	....	$\frac{3}{16}$	$\frac{1}{8}$
$2\frac{3}{4}$	$1\frac{1}{4}$	....	$4\frac{3}{16}$	$3\frac{1}{2}$	$\frac{11}{16}$	$\frac{1}{8}$	$\frac{13}{16}$	$\frac{3}{16}$	$1\frac{1}{8}$	....	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	....	....	$\frac{3}{16}$	$\frac{1}{8}$
3	$1\frac{1}{4}$	$\frac{1}{4}'$	$4\frac{1}{2}$	$3\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{8}$	$\frac{7}{8}$	$\frac{3}{16}$	$1\frac{1}{8}$	$\frac{1}{4}''$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{4}''$	$\frac{3}{16}''$	$\frac{3}{16}$	$\frac{1}{8}$
$3\frac{1}{4}$	$1\frac{1}{2}$	$\frac{3}{8}$	$4\frac{13}{16}$	4	$\frac{13}{16}$	$\frac{1}{8}$	$\frac{15}{16}$	$\frac{3}{16}$	$1\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$1\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$
$3\frac{1}{2}$	$1\frac{1}{2}$	$\frac{3}{8}$	$5\frac{3}{8}$	$4\frac{1}{2}$	$\frac{7}{8}$	$\frac{1}{8}$	1	$\frac{3}{16}$	$1\frac{1}{4}$	$\frac{3}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{4}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$
$3\frac{3}{4}$	$1\frac{5}{8}$	$\frac{3}{8}$	$5\frac{11}{16}$	$4\frac{3}{4}$	$\frac{15}{16}$	$\frac{3}{16}$	$1\frac{1}{8}$	$\frac{9}{32}$	$1\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{4}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$
4	$1\frac{5}{8}$	$\frac{3}{8}$	6	5	1	$\frac{3}{16}$	$1\frac{3}{16}$	$\frac{9}{32}$	$1\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$	2	$\frac{1}{4}$	$\frac{7}{16}$	1	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{16}$
$4\frac{1}{4}$	2	$\frac{3}{8}$	$6\frac{9}{16}$	$5\frac{1}{2}$	$1\frac{1}{16}$	$\frac{3}{16}$	$1\frac{1}{4}$	$\frac{9}{32}$	$1\frac{3}{4}$	$\frac{3}{8}$	1	$1\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{7}{16}$	1	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{16}$
$4\frac{1}{2}$	2	$\frac{3}{8}$	$6\frac{7}{8}$	$5\frac{3}{4}$	$1\frac{1}{8}$	$\frac{3}{16}$	$1\frac{5}{16}$	$\frac{9}{32}$	$1\frac{3}{4}$	$\frac{3}{8}$	1	$1\frac{1}{4}$	$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{7}{16}$	1	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{16}$
$4\frac{3}{4}$	$2\frac{1}{4}$	$\frac{3}{8}$	$7\frac{3}{16}$	6	$1\frac{3}{16}$	$\frac{3}{16}$	$1\frac{3}{8}$	$\frac{9}{32}$	$1\frac{7}{8}$	$\frac{3}{8}$	1	$1\frac{1}{4}$	$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{7}{16}$	1	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{16}$
5	$2\frac{1}{4}$	$\frac{3}{8}$	$7\frac{1}{2}$	$6\frac{1}{4}$	$1\frac{1}{4}$	$\frac{3}{16}$	$1\frac{7}{16}$	$\frac{9}{32}$	$1\frac{7}{8}$	$\frac{3}{8}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$2\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$
$5\frac{1}{4}$	$2\frac{1}{4}$	$\frac{1}{2}$	$7\frac{13}{16}$	$6\frac{1}{2}$	$1\frac{5}{16}$	$\frac{1}{4}$	$1\frac{9}{16}$	$\frac{3}{8}$	$1\frac{7}{8}$	$\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$2\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$
$5\frac{1}{2}$	$2\frac{1}{4}$	$\frac{1}{2}$	$8\frac{3}{8}$	7	$1\frac{3}{8}$	$\frac{1}{4}$	$1\frac{5}{8}$	$\frac{3}{8}$	$1\frac{7}{8}$	$\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$2\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$
$5\frac{3}{4}$	$2\frac{1}{4}$	$\frac{1}{2}$	$8\frac{11}{16}$	$7\frac{1}{4}$	$1\frac{7}{16}$	$\frac{1}{4}$	$1\frac{11}{16}$	$\frac{3}{8}$	$1\frac{7}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
6	$2\frac{1}{4}$	$\frac{1}{2}$	9	$7\frac{1}{2}$	$1\frac{1}{2}$	$\frac{1}{4}$	$1\frac{3}{4}$	$\frac{3}{8}$	$1\frac{7}{8}$	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$	3	$\frac{3}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{1}{4}$
$6\frac{1}{2}$	$2\frac{1}{2}$	$\frac{1}{2}$	$9\frac{5}{8}$	8	$1\frac{5}{8}$	$\frac{1}{4}$	$1\frac{7}{8}$	$\frac{3}{8}$	$2\frac{1}{4}$	$\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{3}{4}$	3	$\frac{1}{2}$	$\frac{9}{16}$	$1\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{1}{4}$
7	$2\frac{1}{2}$	$\frac{1}{2}$	$10\frac{1}{2}$	$8\frac{3}{4}$	$1\frac{3}{4}$	$\frac{1}{4}$	2	$\frac{3}{8}$	$2\frac{1}{4}$	$\frac{1}{2}$	$1\frac{3}{8}$	$1\frac{3}{4}$	$3\frac{1}{4}$	$\frac{1}{2}$	$\frac{9}{16}$	$1\frac{3}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{1}{4}$
$7\frac{1}{2}$	$2\frac{1}{2}$	$\frac{5}{8}$	$11\frac{3}{8}$	$9\frac{1}{2}$	$1\frac{7}{8}$	$\frac{1}{4}$	$2\frac{1}{8}$	$\frac{3}{8}$	$2\frac{1}{4}$	$\frac{5}{8}$	$1\frac{1}{2}$	2	$3\frac{1}{4}$	$\frac{1}{2}$	$\frac{5}{8}$	$1\frac{3}{4}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
8	3	$\frac{5}{8}$	12	10	2	$\frac{3}{8}$	$2\frac{3}{8}$	$\frac{9}{16}$	$2\frac{1}{4}$	$\frac{5}{8}$	$1\frac{1}{2}$	2	$3\frac{1}{2}$	$\frac{1}{2}$	$\frac{5}{8}$	2	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
$8\frac{1}{2}$	3	$\frac{5}{8}$	$12\frac{7}{8}$	$10\frac{3}{4}$	$2\frac{1}{8}$	$\frac{3}{8}$	$2\frac{1}{2}$	$\frac{9}{16}$	$2\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{8}$	$2\frac{1}{8}$	$3\frac{1}{2}$	$\frac{1}{2}$	$\frac{5}{8}$	2	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$
9	3	$\frac{5}{8}$	$13\frac{1}{2}$	$11\frac{1}{4}$	$2\frac{1}{4}$	$\frac{3}{8}$	$2\frac{5}{8}$	$\frac{9}{16}$	$2\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{8}$	$2\frac{1}{8}$	$3\frac{3}{4}$	$\frac{1}{2}$	$\frac{11}{16}$	$2\frac{1}{4}$	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{5}{16}$
$9\frac{1}{2}$	$3\frac{1}{4}$	$\frac{5}{8}$	$14\frac{3}{8}$	12	$2\frac{3}{8}$	$\frac{3}{8}$	$2\frac{3}{4}$	$\frac{9}{16}$	$2\frac{3}{4}$	$\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{3}{4}$	$\frac{5}{8}$	$\frac{11}{16}$	$2\frac{1}{4}$	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{5}{16}$
10	$3\frac{1}{4}$	$\frac{5}{8}$	15	$12\frac{1}{2}$	$2\frac{1}{2}$	$\frac{3}{8}$	$2\frac{7}{8}$	$\frac{9}{16}$	$2\frac{3}{4}$	$\frac{5}{8}$	$1\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{3}{4}$	$\frac{5}{8}$	$\frac{11}{16}$	$2\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{5}{16}$
$10\frac{1}{2}$	$3\frac{1}{4}$	$\frac{5}{8}$	$15\frac{5}{8}$	13	$2\frac{5}{8}$	$\frac{1}{2}$	$3\frac{1}{8}$	$\frac{3}{4}$	$2\frac{3}{4}$	$\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{3}{8}$	$3\frac{3}{4}$	$\frac{5}{8}$	$\frac{3}{4}$	$2\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{5}{16}$
11	$3\frac{1}{4}$	$\frac{3}{4}$	$16\frac{1}{2}$	$13\frac{3}{4}$	$2\frac{3}{4}$	$\frac{1}{2}$	$3\frac{1}{4}$	$\frac{3}{4}$	$2\frac{3}{4}$	$\frac{3}{4}$	$1\frac{7}{8}$	$2\frac{3}{8}$	4	$\frac{5}{8}$	$\frac{3}{4}$	$2\frac{3}{4}$	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{5}{16}$
$11\frac{1}{2}$	$3\frac{1}{2}$	$\frac{3}{4}$	$17\frac{3}{8}$	$14\frac{1}{2}$	$2\frac{7}{8}$	$\frac{1}{2}$	$3\frac{3}{8}$	$\frac{3}{4}$	3	$\frac{3}{4}$	2	$2\frac{1}{2}$	4	$\frac{5}{8}$	$\frac{3}{4}$	$2\frac{3}{4}$	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{5}{16}$
12	$3\frac{1}{2}$	$\frac{3}{4}$	18	15	3	$\frac{1}{2}$	$3\frac{1}{2}$	$\frac{3}{4}$	3	$\frac{3}{4}$	2	$2\frac{1}{2}$	4	$\frac{5}{8}$	$\frac{3}{4}$	3	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{5}{16}$

Contributed by B. H. Reddy, MACHINERY'S Data Sheet No. 44. Explanatory note: Page 3.

DIMENSIONS OF BEARINGS—III

DIMENSIONS OF PILLOW BLOCKS.

Diam. of Shaft.	½ Ω					¼ D		A′ + 1¾ N′	B′ + 2¾ N′	C′ + 4 H′	D′ + 3½ H′	1.8 D	F′ + 2 A₁			1½ H′	L′ − I′ + J′	½ H′	
D	U	V	W	X	Y	Z	A′	B′	C′	D′	E′	F′	G′	H′	I′	J′	K′	L′	M′
1″	....	⅛″	⅛″	3/16″	....	....	1¾″	2⅜″	3½″	5″	6½″	2¼″	2½″	⅜″	7/16″	⅝″	....	....	...
1¼	....	⅛	⅛	3/16	....	....	2	2⅞	4¼	6¼	8	2¾	3	½	9/16	¾	....	....	...
1½	....	⅛	⅛	3/16	....	....	2¼	3⅛	4½	6½	8½	3	3⅜	½	9/16	¾	....	....	...
1¾	....	⅛	⅛	3/16	....	....	2½	3⅝	5¼	7¾	10	3½	3⅝	⅝	11/16	1	....	....	....
2	....	3/16	3/16	¼	....	....	3	4⅛	5¾	8¼	10½	3¾	4¼	⅝	11/16	1	....	....	....
2¼	....	3/16	3/16	¼	....	....	3¼	4½	6½	9½	12	4	4½	¾	⅞	1⅛	....	....	....
2½	....	3/16	3/16	¼	....	....	3¾	5	7	10	12½	4½	5	¾	⅞	1⅛	....	....	...
2¾	....	3/16	3/16	¼	....	....	4	5¼	7¼	10½	13½	5	5½	⅞	1	1⅜	....	....	....
3	⅜″	¼	3/16	¼	3/16″	¾″	4¼	5½	7½	11	14	5½	6	⅞	1	1⅜	2⅝″	2¼″	⅛″
3¼	⅜	¼	3/16	¼	3/16	¾	4¾	6¼	8¾	12¾	16	6	6¾	1	1⅛	1½	2⅞	2½	¼
3½	⅜	¼	3/16	¼	3/16	¾	5	6½	9	13	16½	6½	7¼	1	1⅛	1½	2⅞	2½	¼
3¾	⅜	¼	3/16	¼	3/16	¾	5¼	7	9¾	14	18	7	7¾	1⅛	1¼	1¾	3¼	2¾	¼
4	½	5/16	¼	5/16	3/16	1	5¾	7½	10¼	15	19	7½	8¼	1⅛	1¼	1¾	3¼	2¾	¼
4¼	½	5/16	¼	5/16	3/16	1	6	8	11	16	20½	7½	8¼	1¼	1⅜	2	3⅝	3	¼
4½	½	5/16	¼	5/16	¼	1	6½	8½	11½	16½	21	8	8¾	1¼	1⅜	2	3⅝	3	¼
4¾	½	5/16	¼	5/16	¼	1	6¾	9	12⅜	18¼	23½	8½	9¼	1½	1⅝	2¼	4⅜	3¾	¼
5	⅝	⅜	¼	⅜	¼	1¼	7	9¼	12⅝	18¾	24	9	9¾	1½	1⅝	2¼	4⅜	3¾	¼
5¼	⅝	⅜	¼	⅜	¼	1¼	7½	9¾	13⅛	19¼	24½	9½	10½	1½	1⅝	2¼	4⅜	3¾	⅜
5½	⅝	⅜	¼	⅜	¼	1¼	7¾	10	13⅜	19¼	24½	10	11	1½	1⅝	2¼	4⅜	3¾	⅜
5¾	⅝	⅜	¼	⅜	¼	1¼	8	10¼	13⅝	19¾	25	10½	11½	1½	1⅝	2¼	4⅜	3¾	⅜
6	¾	7/16	5/16	7/16	5/16	1½	8½	10¾	14⅛	20¼	25½	11	12	1½	1⅝	2¼	4⅜	3¾	⅜
6½	¾	7/16	5/16	7/16	5/16	1½	9	11¾	15¾	23	29	11½	12½	1¾	1⅞	2½	4⅞	4¼	⅜
7	⅞	7/16	5/16	7/16	5/16	1¾	9¾	12½	16½	23½	29½	12½	13½	1¾	1⅞	2½	4⅞	4¼	⅜
7½	⅞	½	⅜	½	5/16	1¾	10¼	13	17	24	30	13½	14¾	1¾	1⅞	2½	4⅞	4¼	⅜
8	1	½	⅜	½	5/16	2	11¼	14	18	26	33	14½	15¾	2	2⅛	3	5⅞	5	⅜
8½	1	½	⅜	½	5/16	2	11¾	14¼	18½	26½	33½	15½	16¾	2	2⅛	3	5⅞	5	⅜
9	1	9/16	7/16	9/16	⅜	2¼	12½	15½	20½	28½	35½	16	17¼	2	2⅛	3	5⅞	5	⅜
9½	1	9/16	7/16	9/16	⅜	2¼	13	16	21	29¾	38	17	18¼	2¼	2⅜	3¼	6⅜	5½	⅜
10	1¼	9/16	7/16	9/16	⅜	2½	13¾	16¾	21¾	30¾	38½	18	19¼	2¼	2⅜	3¼	6⅜	5½	⅜
10½	1¼	⅝	½	⅝	⅜	2½	14¼	17¼	22¼	30¾	39	19	20¼	2¼	2⅜	3¼	6⅜	5½	⅜
11	1¼	⅝	½	⅝	⅜	2¾	15	18	23	31¾	40	20	21½	2¼	2⅜	3¼	6⅜	5½	½
11½	1¼	⅝	½	⅝	⅜	2¾	15¾	19¼	24¾	34¾	43½	21	22½	2½	2⅝	3¾	7⅜	6¼	½
12	1½	⅝	½	⅝	⅜	3	16½	20	25½	35½	44½	22	23½	2½	2⅝	3¾	7⅜	6¼	½

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DIMENSIONS OF BEARINGS—IV

DIMENSIONS OF PILLOW BLOCKS.

Diam. of Shaft.		$C+I+J+K+2N'-R$	$N'+\frac{1}{16}''$		$1\frac{1}{4}N'$		$\frac{1}{2}(C'-B')$	$1\frac{1}{8}N'$	$\frac{1}{2}T'$	$B'-S'$	A		$1\frac{1}{4}D_1$		$C_1-3\frac{1}{2}H'$	D_1-2A_1		Center to Center of Oil Holes $\frac{1}{2}D_1$	Length of Journal half block = 65 D_1.
D	N′	O′	P′	Q′	R′	S′	T′	U′	V′	W′	X′	Y′	Z′	A_1	B_1	C_1	D_1	E_1	F_1
1″	3/8″	2 1/2″	7/16″	7/16″	1/2″	7/8	9/16″	....	1/4″	1 1/2″	....	....	....	1/8″	....	2 3/4″	3″	....	2″
1 1/4	1/2	3	9/16	9/16	5/8	1	11/16	....	5/16	1 7/8	....	....	....	1/8	....	3 3/4	4	....	2 1/2
1 1/2	1/2	3 1/2	9/16	9/16	5/8	1	11/16	....	5/16	2 1/8	....	....	....	3/16	....	4 1/8	4 1/2	....	3
1 3/4	5/8	4 1/4	11/16	11/16	3/4	1 3/8	13/16	....	3/8	2 1/4	....	....	....	3/16	....	5 1/8	5 1/2	....	3 1/2
2	5/8	4 1/2	11/16	11/16	3/4	1 3/8	13/16	....	3/8	2 3/4	....	....	....	1/4	3 1/4″	5 1/2	6	3″	4
2 1/4	3/4	5 1/4	13/16	7/8	7/8	1 1/2	1	....	1/2	3	....	....	....	1/4	4	6 1/2	7	3 1/2	4 1/2
2 1/2	3/4	5 3/4	13/16	7/8	7/8	1 1/2	1	....	1/2	3 1/2	....	....	....	1/4	4 1/2	7	7 1/2	3 3/4	5
2 3/4	3/4	6 1/4	13/16	7/8	7/8	1 1/2	1	....	1/2	3 3/4	....	....	....	1/4	5	8	8 1/2	4 1/4	5 1/2
3	3/4	6 3/4	13/16	7/8	7/8	1 1/2	1	7/8″	1/2	4	1 1/4″	3/4″	2 1/4″	1/4	5 1/2	8 1/2	9	4 1/2	6
3 1/4	7/8	7 1/4	15/16	1	1 1/8	1 3/4	1 1/4	1	5/8	4 1/2	1 1/2	3/4	2 1/2	3/8	5 3/4	9 1/4	10	5	6 1/2
3 1/2	7/8	8	15/16	1	1 1/8	1 3/4	1 1/4	1	5/8	4 3/4	1 1/2	7/8	2 1/2	3/8	6 1/4	9 3/4	10 1/2	5 1/4	7
3 3/4	1	8 3/4	1 1/16	1 1/8	1 1/4	1 7/8	1 3/8	1 1/8	11/16	5 1/8	1 5/8	7/8	2 3/4	3/8	6 1/4	10 1/4	11	5 1/2	7
4	1	9	1 1/16	1 1/8	1 1/4	1 7/8	1 3/8	1 1/8	11/16	5 5/8	1 5/8	1	2 3/4	3/8	6 3/4	10 3/4	11 1/2	5 3/4	7 1/2
4 1/4	1 1/8	10	1 3/16	1 1/4	1 3/8	2 1/8	1 1/2	1 1/4	3/4	5 7/8	2	1	3	3/8	7	11 1/4	12	6	8
4 1/2	1 1/8	10 1/2	1 3/16	1 1/4	1 3/8	2 1/8	1 1/2	1 1/4	3/4	6 3/8	2	1 1/8	3	3/8	7	11 1/4	12	6	8
4 3/4	1 1/4	11	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	6 3/4	2 1/4	1 1/8	3	3/8	6 1/2	11 3/4	12 1/2	6 1/4	8
5	1 1/4	11 1/2	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	7	2 1/4	1 1/4	3	3/8	6 1/2	11 3/4	12 1/2	6 1/4	8
5 1/4	1 1/4	11 3/4	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	7 1/2	2 1/4	1 1/4	3 1/4	1/2	6 3/4	12	13	6 1/2	8 1/2
5 1/2	1 1/4	12 1/2	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	7 3/4	2 1/4	1 3/8	3 1/4	1/2	6 3/4	12	13	6 1/2	8 1/2
5 3/4	1 1/4	12 3/4	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	8	2 1/4	1 3/8	3 1/4	1/2	7 1/4	12 1/2	13 1/2	6 3/4	9
6	1 1/4	13	1 5/16	1 3/8	1 1/2	2 1/4	1 11/16	1 7/16	7/8	8 1/2	2 1/4	1 1/2	3 1/4	1/2	7 1/4	12 1/2	13 1/2	6 3/4	9
6 1/2	1 1/2	14 1/4	1 9/16	1 5/8	1 7/8	2 5/8	2	1 11/16	1	9 1/8	2 1/2	1 1/2	3 1/2	1/2	7	13	14	7	9 1/2
7	1 1/2	15	1 9/16	1 5/8	1 7/8	2 5/8	2	1 11/16	1	9 7/8	2 1/2	1 5/8	3 3/4	1/2	8	14	15	7 1/2	10
7 1/2	1 1/2	16	1 9/16	1 5/8	1 7/8	2 5/8	2	1 11/16	1	10 3/8	2 1/2	1 5/8	4	5/8	8 1/2	14 3/4	16	8	10 1/2
8	1 1/2	17	1 9/16	1 5/8	1 7/8	2 5/8	2	1 11/16	1	11 3/8	3	1 3/4	4	5/8	8 1/4	15 1/4	16 1/2	8 1/4	11
8 1/2	1 1/2	18	1 9/16	1 5/8	1 7/8	2 5/8	2 1/8	1 11/16	1	11 5/8	3	1 3/4	4 1/4	5/8	8 3/4	15 3/4	17	8 1/2	11 1/2
9	1 3/4	18 3/4	1 13/16	1 7/8	2 1/8	3	2 1/2	2	1 1/4	12 1/2	3	1 7/8	4 1/2	5/8	9 3/4	16 3/4	18	9	12
9 1/2	1 3/4	20	1 13/16	1 7/8	2 1/8	3	2 1/2	2	1 1/4	13	3 1/4	1 7/8	4 3/4	5/8	10	17 3/4	19	9 1/2	12 1/2
10	1 3/4	20 3/4	1 13/16	1 7/8	2 1/8	3	2 1/2	2	1 1/4	13 3/4	3 1/4	2	4 3/4	5/8	10 1/2	18 1/4	19 1/2	9 3/4	13
10 1/2	1 3/4	21 1/2	1 13/16	1 7/8	2 1/8	3	2 1/2	2	1 1/4	14 1/4	3 1/4	2	5	5/8	11	18 3/4	20	10	13
11	1 3/4	22 1/2	1 13/16	1 7/8	2 1/8	3	2 1/2	2	1 1/4	15	3 1/4	2 1/8	5 1/4	3/4	11 1/2	19 1/2	21	10 1/2	13 1/2
11 1/2	2	23 3/4	2 1/16	2 1/8	2 1/2	3 3/8	2 3/4	2 1/4	1 3/8	15 7/8	3 1/2	2 1/8	5 1/2	3/4	11 3/4	20 1/2	22	11	14 1/2
12	2	24 1/2	2 1/16	2 1/8	2 1/2	3 3/8	2 3/4	2 1/4	1 3/8	16 5/8	3 1/2	2 1/4	5 1/2	3/4	12	21	22 1/2	11 1/4	15

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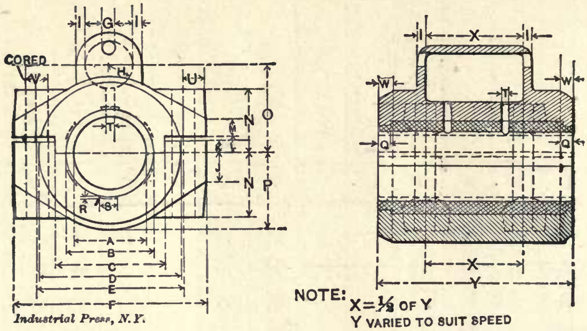
DIMENSIONS OF BEARINGS—V

STANDARD BABBITTED BEARINGS.



A	B	C	D	E	F	G	H	I	J	K	L
1½	2	2⅜	3¼	3	4¾	⅝	⅝	⅜	7/16	5/16	7/16
1¾	2¼	2¾	3¾	3½	5¼	⅝	⅝	⅜	⅝	5/16	7/16
2	2½	3	4¼	4	6	⅝	13/16	⅜	¾	5/16	7/16
2¼	2¾	3⅜	4½	4½	6¾	⅝	13/16	7/16	13/16	⅜	½
2½	3⅛	3¾	5	5	7¼	⅝	13/16	7/16	15/16	⅜	½
2¾	3⅜	4⅛	5½	5½	7¾	¾	13/16	7/16	1⅛	½	⅝
3	3⅝	4½	6	6	8½	¾	15/16	7/16	1⅛	½	⅝
3¼	3⅞	4⅞	6½	6½	9	¾	15/16	7/16	1¼	⅝	¾
3½	4¼	5¼	6¾	7	9½	¾	15/16	7/16	1 7/16	⅝	¾
3¾	4½	5⅝	7¼	7½	10¼	¾	15/16	7/16	1½	⅝	13/16
4	4¾	6	7¾	8	10¾	¾	1½	½	1⅝	11/16	⅞
4¼	5⅛	6⅜	8¼	8½	11½	⅞	1½	½	1⅞	11/16	⅞
4½	5⅜	6¾	8¾	9	12	⅞	1½	½	1⅞	¾	1
5	5⅞	7½	9¾	10	13¼	⅞	1½	½	2 3/16	¾	
5½	6½	8¼	10¾	11	14½	⅞	1½	9/16	2⅜	⅞	1⅛
6	7	9	11½	12	15½	⅞	1⅝	9/16	2⅝	⅞	1⅛
6½	7½	9¾	12½	13	17	⅞	1⅝	9/16	2¾	1	1¼
7	8	10½	13½	14	18	⅞	1⅝	9/16	2¾	1	1¼

M	N	O	P	Q	R	S	T	U	V	W	Size of Bolts.
⅜	1⅜	2	1⅝	5/16	3/16	½	3/16	⅝	11/16	¼	⅝
7/16	1½	2⅛	1⅞	5/16	3/16	½	3/16	⅝	11/16	¼	⅝
½	1¾	2½	2⅛	⅜	3/16	½	¼	¾	11/16	¼	⅝
9/16	2	2¾	2⅜	⅜	3/16	⅝	¼	⅞	⅞	⅜	¾
⅝	2¼	3	2⅝	7/16	3/16	⅝	¼	⅞	⅞	⅜	¾
11/16	2½	3¼	2⅞	7/16	3/16	¾	5/16	1	1	⅜	⅞
¾	2⅝	3½	3 3/16	½	¼	¾	5/16	1	1	½	⅞
13/16	2⅞	3¾	3 7/16	½	¼	⅞	5/16	1⅛	1⅛	½	1
⅞	3⅛	4	3 11/16	9/16	¼	⅞	5/16	1⅛	1⅛	½	1
15/16	3¼	4⅛	4	9/16	¼	1	5/16	1¼	1¼	⅝	1⅛
1	3½	5	4¼	⅝	¼	1	⅜	1¼	1¼	⅝	1⅛
1 1/16	3¾	5¼	4½	⅝	¼	1⅛	⅜	1⅜	1⅜	¾	1¼
1⅛	4	5½	4¾	11/16	¼	1⅛	⅜	1⅜	1⅜	¾	1¼
1¼	4⅜	5⅞	5 5/16	11/16	5/16	1¼	⅜	1½	1⅜	⅞	1¼
1⅜	4⅞	6⅜	5 13/16	¾	5/16	1¼	⅜	1½	1⅜	⅞	1¼
1½	5¼	6¾	6⅜	¾	5/16	1⅜	7/16	1⅝	1⅝	1	1½
1⅝	5¾	7½	6⅞	⅞	5/16	1⅜	7/16	1⅝	1⅝	1	1½
1¾	6	7½	7⅜	⅞	5/16	1½	7/16	1¾	1⅝	1	1½

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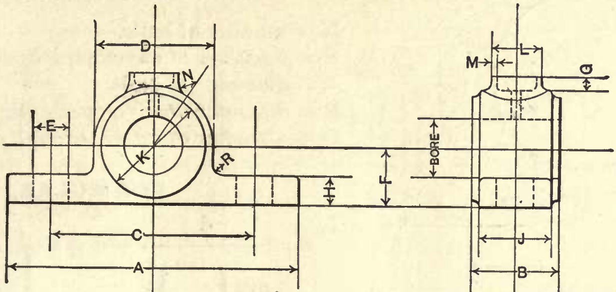
DIMENSIONS OF BEARINGS—VI

PROPORTIONS FOR PLAIN BEARINGS.



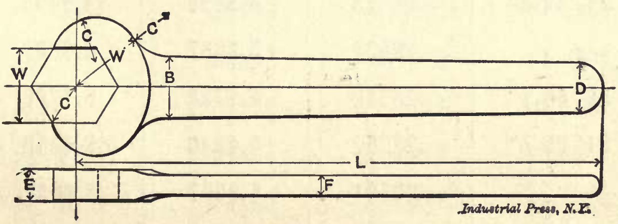
Industrial Press, N.Y.

Diam. of Shaft.	A	B	C	D	E	F	G	H	J	K	L	M	N	R
$\frac{3}{8}$–$\frac{1}{2}$	$2\frac{1}{2}$	$\frac{3}{4}$	$1\frac{3}{4}$	1	$\frac{5}{16}$	$\frac{9}{16}$	..	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{7}{8}$	..	..	..	$\frac{3}{32}$
$\frac{5}{8}$–$\frac{3}{4}$	$3\frac{3}{8}$	$1\frac{1}{8}$	$2\frac{5}{8}$	$1\frac{1}{2}$	$\frac{5}{16}$	$\frac{27}{32}$	..	$\frac{3}{8}$	$\frac{7}{8}$	$1\frac{5}{16}$	..	..	..	$\frac{1}{4}$
$\frac{7}{8}$–1	$4\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{1}{2}$	2	$\frac{7}{16}$	$1\frac{1}{8}$	..	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{4}$	..	..	..	$\frac{5}{16}$
$1\frac{1}{8}$–$1\frac{1}{4}$	$5\frac{5}{8}$	$1\frac{7}{8}$	$4\frac{3}{8}$	$2\frac{1}{2}$	$\frac{9}{16}$	$1\frac{13}{32}$	$\frac{3}{8}$	$\frac{5}{8}$	$1\frac{5}{8}$	$2\frac{1}{4}$	1	$\frac{1}{8}$	$\frac{7}{16}$	$\frac{5}{16}$
$1\frac{3}{8}$–$1\frac{1}{2}$	$6\frac{3}{4}$	$2\frac{1}{4}$	$5\frac{1}{4}$	3	$\frac{3}{4}$	$1\frac{11}{16}$	$\frac{3}{8}$	$\frac{3}{4}$	2	$2\frac{3}{4}$	$1\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{3}{8}$
$1\frac{5}{8}$–$1\frac{3}{4}$	$7\frac{7}{8}$	$2\frac{5}{8}$	$6\frac{1}{8}$	$3\frac{1}{2}$	$\frac{3}{4}$	$1\frac{31}{32}$	$\frac{1}{2}$	$\frac{7}{8}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$1\frac{1}{2}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{1}{2}$
$1\frac{7}{8}$–2	9	3	7	4	$\frac{7}{8}$	$2\frac{1}{4}$	$\frac{1}{2}$	1	$2\frac{5}{8}$	$3\frac{5}{8}$	$1\frac{3}{4}$	$\frac{3}{16}$	$\frac{5}{8}$	$\frac{5}{8}$
$2\frac{1}{4}$–$2\frac{1}{2}$	$11\frac{1}{4}$	$3\frac{3}{4}$	$8\frac{3}{4}$	5	1	$2\frac{13}{16}$	$\frac{5}{8}$	$1\frac{1}{4}$	$3\frac{3}{8}$	$4\frac{5}{8}$	2	$\frac{3}{16}$	$\frac{11}{16}$	$\frac{3}{4}$
$2\frac{3}{4}$–3	$13\frac{1}{2}$	$4\frac{1}{4}$	$10\frac{1}{2}$	6	$1\frac{1}{8}$	$3\frac{3}{8}$	$\frac{5}{8}$	$1\frac{1}{2}$	$4\frac{1}{8}$	$5\frac{5}{8}$	$2\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{4}$	1
$3\frac{1}{4}$–$3\frac{1}{2}$	$15\frac{3}{4}$	$5\frac{1}{4}$	$12\frac{1}{4}$	7	$1\frac{1}{4}$	$3\frac{15}{16}$	$\frac{3}{4}$	$1\frac{3}{4}$	$4\frac{3}{4}$	$6\frac{1}{2}$	$2\frac{3}{8}$	$\frac{1}{4}$	$\frac{13}{16}$	$1\frac{1}{4}$
$3\frac{3}{4}$–4	18	6	14	8	$1\frac{3}{8}$	$4\frac{1}{2}$	$\frac{3}{4}$	2	$5\frac{1}{2}$	$7\frac{1}{2}$	$2\frac{1}{2}$	$\frac{5}{16}$	$\frac{7}{8}$	$1\frac{3}{8}$

Formulæ:

$A = \text{bore} \times 4\frac{1}{2}$
$B = \text{“} \times 1\frac{1}{2}$
$D = \text{“} \times 2$
$F = \text{“} \times 1\frac{1}{8}$
$H = \text{“} \times \frac{1}{2}$

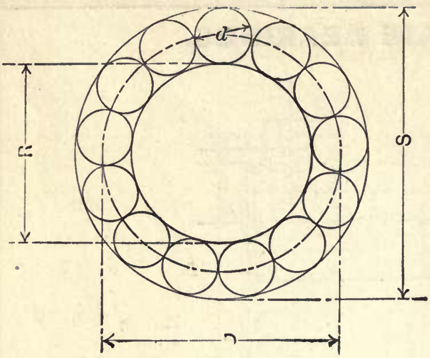
PROPORTIONS FOR LIGHT WRENCHES



Industrial Press, N.Y.

$B = W \times .8$
$D = W \times .65$
$E = W \times .4$
$F = W \times .25$
$L = W \times 7$

BALL AND ROLLER BEARINGS—I



$$S = D + d$$
$$R = D - d$$
$$D = \frac{d}{\sin\left(\frac{180}{N}\right)^\circ}$$

FORMULAS FOR BALL AND ROLLER BEARINGS.

N = number of balls.
S = diameter of enveloping cylinder.
d = diameter of balls.
R = diameter of enveloped cylinder.
D = diameter of circle through center of balls.

FORMULAS.

$$S = \frac{d}{\sin\left(\frac{180}{N}\right)^\circ} + d = d\left(\frac{1}{\sin\left(\frac{180}{N}\right)^\circ} + 1\right)$$

$$R = \frac{d}{\sin\left(\frac{180}{N}\right)^\circ} - d = d\left(\frac{1}{\sin\left(\frac{180}{N}\right)^\circ} - 1\right)$$

CONSTANTS FOR USE IN ABOVE FORMULAS.

N	$\left(\frac{180}{N}\right)^\circ$	$\sin\left(\frac{180}{N}\right)^\circ$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}+1$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}-1$
5	36°	.58779	1.7012	2.7012	0.7012
6	30°	.50000	2.0000	3.0000	1.0000
7	25° 42′ 51.4″	.43387	2.3048	3.3048	1.3048
8	22° 30′	.38268	2.6131	3.6131	1.6131
9	20°	.34202	2.9238	3.9238	1.9238
10	18°	.30902	3.2360	4.2360	2.2360
11	16° 21′ 48.3″	.28173	3.5495	4.5495	2.5495
12	15°	.25882	3.8637	4.8637	2.8637
13	13° 50′ 46.1″	.23932	4.1786	5.1786	3.1786
14	12° 51′ 25.7″	.22252	4.4940	5.4940	3.4940
15	12°	.20791	4.8097	5.8097	3.8097
16	11° 15′	.19509	5.1258	6.1258	4.1258
17	10° 35′ 17.6″	.18375	5.4422	6.4422	4.4422

Contributed by W. B. Chapin, MACHINERY'S Data Sheet No. 25. Explanatory note: Page 23.

BALL AND ROLLER BEARINGS—II

FORMULAS FOR BALL AND ROLLER BEARINGS. (Continued.)

N	$\left(\frac{180}{N}\right)^\circ$	$\sin\left(\frac{180}{N}\right)^\circ$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}+1$	$\frac{1}{\sin\left(\frac{180}{N}\right)^\circ}-1$
18	10°	.17365	5.7588	6.7588	4.7588
19	9° 28′ 25.2″	.16459	6.0755	7.0755	5.0755
20	9°	.15653	6.3925	7.3925	5.3925
21	8° 34′ 17.1″	.14904	6.7095	7.7095	5.7095
22	8° 10′ 54.5″	.14231	7.0267	8.0267	6.0267
23	7° 49′ 33.9″	.13617	7.3439	8.3439	6.3439
24	7° 30′	.13053	7.6613	8.6613	6.6613
25	7° 12′	.12533	7.9787	8.9787	6.9787
26	6° 55′ 23″	.12054	8.2963	9.2963	7.2963
27	6° 40′	.11609	8.6138	9.6138	7.6138
28	6° 25′ 42.8″	.11196	8.9314	9.9314	7.9314
29	6° 12′ 24.8″	.10812	9.2491	10.2491	8.2491
30	6°	.10453	9.5668	10.5668	8.5668
31	5° 48′ 23.2″	.10107	9.8931	10.8931	8.8931
32	5° 37′ 30″	.09801	10.2030	11.2030	9.2030
33	5° 27′ 16.3″	.09505	10.5208	11.5208	9.5208
34	5° 17′ 35.9″	.09225	10.8402	11.8402	9.8402
35	5° 8′ 33″	.08963	11.1570	12.1570	10.1570
36	5°	.08716	11.4731	12.4731	10.4731
37	4° 51′ 53.5″	.08481	11.7911	12.7911	10.7911
38	4° 44′ 12.6″	.08258	12.1095	13.1095	11.1095
39	4° 36′ 55.3″	.08047	12.4270	13.4270	11.4270
40	4° 30′	.07846	12.7456	13.7456	11.7456

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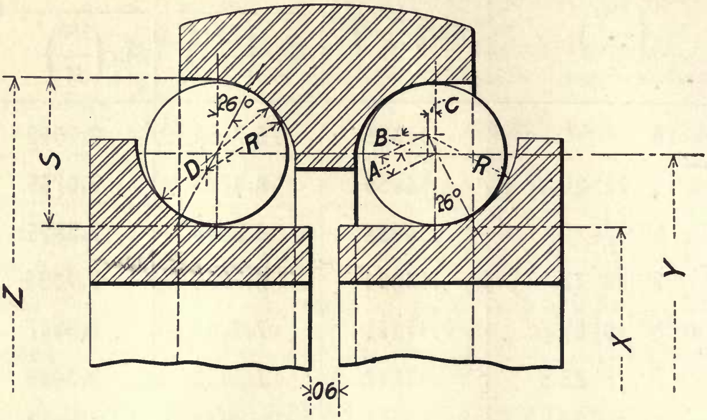
BALL BEARINGS—I

DIMENSIONS FOR TWO-POINT BALL BEARINGS



D = Diam. of Ball

R = Radius of Race

$A = R - \frac{D}{2}$

B = A Cos. 26°

C = A Sin 26°

S = 2 (R − B)

S − D = Clearance of Ball

n = Number of Balls

$$Y = \frac{D + .003}{\text{Sin} \frac{180°}{n}}$$

D	R	A	B	C	S	S-D	D	R	A	B	C	S	S-D
1/4	.175	.050	.045	.022	.260	.010	9/16	.354	.073	.065	.032	.577	.015
5/16	.205	.049	.044	.021	.322	.010	5/8	.394	.082	.073	.036	.641	.016
3/8	.240	.053	.047	.023	.386	.011	11/16	.433	.089	.080	.039	.705	.018
7/16	.275	.056	.051	.025	.449	.011	3/4	.473	.098	.088	.043	.770	.020
1/2	.315	.065	.058	.029	.513	.013	7/8	.558	.121	.109	.053	.898	.023

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BALL BEARINGS—II

TWO-POINT BALL BEARINGS
Continued

D	1/4			5/16			3/8		
n	X	Y	Z	X	Y	Z	X	Y	Z
8	.401	.661	.921	.502	.824	1.147	.602	.988	1.373
9	.480	.740	1.000	.601	.923	1.246	.720	1.106	1.492
10	.559	.819	1.080	.699	1.022	1.344	.839	1.224	1.610
11	.638	.898	1.159	.798	1.121	1.443	.957	1.342	1.728
12	.717	.978	1.238	.897	1.219	1.541	1.075	1.461	1.846
13	.797	1.057	1.318	.996	1.319	1.641	1.194	1.580	1.965
14	.877	1.137	1.398	1.096	1.418	1.741	1.314	1.699	2.085
15	.957	1.217	1.477	1.195	1.518	1.840	1.433	1.818	2.204
16	1.037	1.297	1.557	1.295	1.617	1.940	1.552	1.938	2.323
17	1.117	1.377	1.637	1.395	1.717	2.040	1.672	2.057	2.443
18	1.197	1.457	1.717	1.495	1.817	2.139	1.791	2.177	2.563
19	1.277	1.537	1.797	1.595	1.917	2.239	1.911	2.297	2.682
20	1.357	1.617	1.878	1.694	2.017	2.339	2.031	2.416	2.802
21	1.437	1.698	1.958	1.795	2.117	2.439	2.151	2.536	2.922
22	1.518	1.778	2.038	1.895	2.217	2.539	2.271	2.656	3.042
23	1.598	1.858	2.118	1.995	2.317	2.640	2.390	2.776	3.162
24	1.678	1.938	2.199	2.095	2.417	2.740	2.510	2.896	3.282
25	1.759	2.019	2.279	2.195	2.517	2.840	2.631	3.016	3.402
26	1.839	2.099	2.359	2.295	2.618	2.940	2.751	3.136	3.522
27	1.919	2.180	2.440	2.396	2.718	3.040	2.871	3.256	3.642
28	2.000	2.260	2.520	2.496	2.818	3.141	2.991	3.377	3.762
29	2.080	2.340	2.600	2.596	2.918	3.241	3.111	3.496	3.882
30	2.160	2.420	2.681	2.696	3.018	3.341	3.231	3.616	4.002

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BALL BEARINGS—III

TWO-POINT BALL BEARINGS
Continued

D	7/16			1/2			9/16		
n	X	Y	Z	X	Y	Z	X	Y	Z
8	.702	1.151	1.599	.801	1.314	1.828	.901	1.478	2.055
9	.840	1.289	1.738	.959	1.472	1.985	1.078	1.655	2.232
10	.978	1.427	1.875	1.116	1.629	2.142	1.255	1.832	2.409
11	1.115	1.564	2.013	1.273	1.786	2.300	1.432	2.009	2.586
12	1.253	1.702	2.151	1.430	1.943	2.457	1.608	2.185	2.762
13	1.392	1.841	2.290	1.589	2.102	2.615	1.786	2.363	2.940
14	1.531	1.980	2.429	1.748	2.261	2.774	1.964	2.541	3.118
15	1.670	2.119	2.568	1.906	2.420	2.933	2.142	2.719	3.296
16	1.809	2.258	2.707	2.065	2.578	3.092	2.322	2.899	3.476
17	1.949	2.397	2.846	2.224	2.738	3.251	2.501	3.078	3.655
18	2.088	2.537	2.986	2.384	2.897	3.410	2.680	3.257	3.834
19	2.228	2.676	3.125	2.543	3.056	3.569	2.859	3.436	4.013
20	2.367	2.816	3.265	2.702	3.215	3.729	3.038	3.615	4.192
21	2.507	2.956	3.404	2.862	3.375	3.888	3.217	3.794	4.371
22	2.647	3.095	3.544	3.021	3.535	4.048	3.396	3.973	4.550
23	2.786	3.235	3.684	3.181	3.694	4.207	3.575	4.152	4.729
24	2.926	3.375	3.824	3.340	3.854	4.367	3.756	4.333	4.910
25	3.066	3.515	3.964	3.500	4.014	4.527	3.936	4.513	5.090
26	3.206	3.655	4.104	3.660	4.173	4.687	4.116	4.693	5.270
27	3.346	3.795	4.244	3.820	4.333	4.847	4.296	4.873	5.450
28	3.486	3.935	4.384	3.980	4.493	5.006	4.474	5.051	5.628
29	3.626	4.075	4.523	4.139	4.653	5.166	4.653	5.230	5.807
30	3.765	4.214	4.663	4.299	4.812	5.325	4.831	5.408	5.985

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BALL BEARINGS—IV

TWO-POINT BALL BEARINGS
Continued

D	5/8			11/16			3/4		
n	X	Y	Z	X	Y	Z	X	Y	Z
8	1.000	1.641	2.282	1.099	1.804	2.510	1.198	1.968	2.738
9	1.196	1.837	2.479	1.315	2.020	2.726	1.433	2.203	2.973
10	1.392	2.034	2.675	1.531	2.236	2.942	1.669	2.439	3.208
11	1.589	2.230	2.872	1.747	2.452	3.158	1.904	2.674	3.444
12	1.785	2.426	3.068	1.963	2.668	3.373	2.140	2.909	3.679
13	1.983	2.625	3.266	2.180	2.886	3.591	2.377	3.147	3.917
14	2.181	2.823	3.464	2.398	3.104	3.809	2.615	3.385	4.154
15	2.380	3.021	3.662	2.616	3.322	4.027	2.852	3.622	4.392
16	2.578	3.219	3.860	2.834	3.539	4.245	3.090	3.860	4.630
17	2.777	3.418	4.059	3.053	3.758	4.464	3.328	4.098	4.868
18	2.975	3.617	4.258	3.271	3.977	4.682	3.567	4.337	5.107
19	3.174	3.816	4.457	3.490	4.196	4.901	4.805	4.575	5.345
20	3.373	4.015	4.656	3.709	4.414	5.119	4.044	4.814	5.583
21	3.572	4.214	4.855	3.928	4.633	5.338	4.285	5.055	5.825
22	3.772	4.413	5.054	4.147	4.852	5.557	4.522	5.291	6.061
23	3.971	4.612	5.254	4.366	5.071	5.776	4.760	5.530	6.300
24	4.170	4.811	5.453	4.585	5.290	5.996	4.999	5.769	6.539
25	4.370	5.011	5.652	4.804	5.510	6.215	5.238	6.008	6.778
26	4.569	5.211	5.852	5.014	5.729	6.435	5.478	6.248	7.017
27	4.769	5.410	6.052	5.243	5.949	6.654	5.717	6.487	7.257
28	4.968	5.610	6.251	5.463	6.168	6.873	5.956	6.726	7.496
29	5.167	5.809	6.450	5.682	6.387	7.092	6.195	6.965	7.735
30	5.367	6.008	6.649	5.901	6.606	7.311	6.434	7.204	7.974

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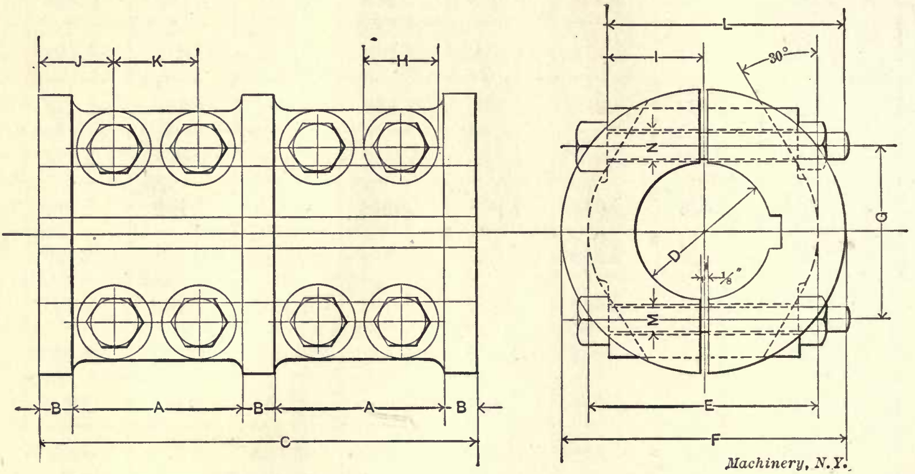
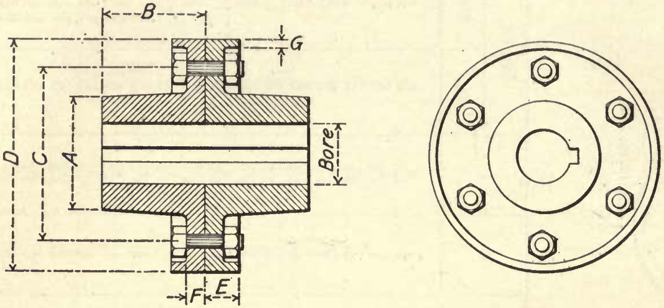
CLAMP COUPLINGS.



Size of Coupling.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Key.
1 1/4"	2 17/32"	5/16"	6"	1 1/4"	2 1/8"	3"	1 7/8"	1"	13/16"	15/16"	1 5/16"	2 5/8"	1/2"	9/16"	3/8 x 1/4"
1 1/2	2 17/32	5/16	6	1 1/2	2 1/2	3 3/8	2 1/8	1	7/8	15/16	1 5/16	2 3/4	1/2	9/16	1/2 x 11/32
1 3/4	3 11/22	7/16	8	1 3/4	2 7/8	4	2 1/2	1 3/8	1 1/16	1 5/16	1 5/8	3	5/8	11/16	1/2 x 11/32
2	3 11/32	7/16	8	2	3 3/8	4 3/8	2 3/4	1 3/8	1 3/16	1 5/16	1 5/8	3 1/2	5/8	11/16	5/8 x 13/32
2 1/4	3 21/32	9/16	9	2 1/4	3 7/8	5 1/4	3 1/8	1 5/8	1 5/16	1 7/16	1 7/8	3 3/4	3/4	13/16	5/8 x 13/32
2 1/2	4 1/16	5/8	10	2 1/2	4 1/4	5 9/16	3 3/8	1 5/8	1 7/16	1 9/16	2 1/8	4	3/4	13/16	5/8 x 13/32
2 3/4	4 15/32	11/16	11	2 3/4	4 5/8	6	3 3/4	1 7/8	1 9/16	1 3/4	2 5/16	4 1/2	7/8	15/16	3/4 x 1/2
3	4 7/8	3/4	12	3	5	6 5/16	4	1 7/8	1 11/16	1 15/16	2 1/2	4 3/4	7/8	15/16	3/4 x 1/2
3 1/4	5 1/32	13/16	12 1/2	3 1/4	5 7/16	6 3/4	4 1/4	1 15/16	2 1/2	2 1/16	2 17/32	6 1/4	7/8	15/16	7/8 x 19/32
3 1/2	5 3/16	7/8	13	3 1/2	5 11/16	7	4 1/2	2	2 5/8	2 1/8	2 11/16	6 1/2	7/8	15/16	7/8 x 19/32
3 3/4	5 7/16	7/8	13 1/2	3 3/4	6 1/4	7 3/4	4 7/8	2 5/16	2 11/16	2 5/16	2 11/16	7	1	1 1/16	1 x 5/8
4	5 11/16	7/8	14	4	6 3/4	8 1/4	5 1/4	2 5/16	2 7/8	2 3/8	2 3/4	7 1/4	1	1 1/16	1 x 5/8
4 1/4	5 3/4	1	14 1/2	4 1/4	7 1/8	8 3/4	5 1/2	2 5/16	3	2 7/16	2 13/16	7 1/2	1	1 1/16	1 1/8 x 3/4
4 1/2	6	1	15	4 1/2	7 1/2	9 1/4	5 3/4	2 5/16	3 1/8	2 9/16	2 7/8	7 3/4	1	1 1/16	1 1/8 x 3/4
4 3/4	6 1/16	1 1/8	15 1/2	4 3/4	8	9 3/4	6 1/8	2 5/8	3 1/4	2 11/16	2 7/8	8	1 1/8	1 3/16	1 1/4 x 3/4
5	6 5/16	1 1/8	16	5	8 3/8	10 1/4	6 3/8	2 5/8	3 3/8	2 3/4	3 1/16	8 3/4	1 1/8	1 3/16	1 1/4 x 3/4

PLATE COUPLINGS



Bore	A	B	C	D	E	F	G	Bolts No.	Bolts Diam.	Bolts Length
1 3/16	2 1/2	3	4 3/8	6 1/4	1 1/16	9/16	1/4	3	1/2	1 11/16
1 5/16	2 1/2	3	4 3/8	6 1/4	1 1/16	9/16	1/4	3	1/2	1 11/16
1 7/16	3	3 1/4	5 1/8	7	1 1/16	9/16	1/4	3	1/2	1 11/16
1 11/16	3 1/2	3 1/2	5 3/4	7 3/4	1 1/16	9/16	5/16	4	1/2	1 11/16
1 15/16	4	3 7/8	6 3/8	9	1 5/16	11/16	3/8	3	3/4	2 5/16
2 3/16	4 1/2	4 1/4	6 7/8	9 1/2	1 3/8	3/4	3/8	3	3/4	2 5/16
2 7/16	5	4 1/2	7 5/8	10 1/4	1 3/8	3/4	7/16	4	3/4	2 5/16
2 11/16	5 1/4	4 7/8	8 1/4	11	1 3/4	1	7/16	4	3/4	2 11/16
2 15/16	5 3/4	5 1/4	9	11 3/4	1 3/4	1	7/16	6	3/4	2 11/16
3 3/16	6 1/4	5 1/2	9 3/4	12 1/2	1 3/4	1	7/16	7	3/4	2 11/16
3 7/16	6 5/8	5 7/8	10 1/8	13 1/2	2	1 1/8	1/2	5	1	3 3/8
3 15/16	7 1/2	6 1/2	11 1/8	14 1/2	2	1 1/8	1/2	6	1	3 3/8
4 7/16	8 1/2	7 1/4	12 1/4	16	2 3/4	1 3/4	5/8	7	1	4 5/8
4 15/16	9 1/2	7 7/8	14 1/4	18	2 3/4	1 3/4	5/8	8	1	4 5/8

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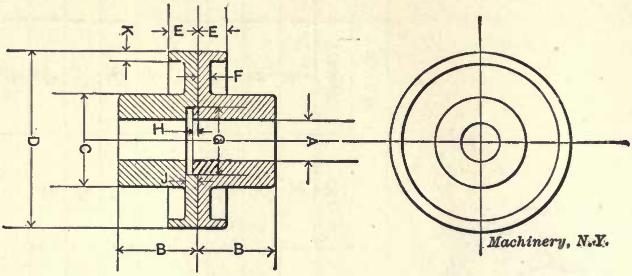
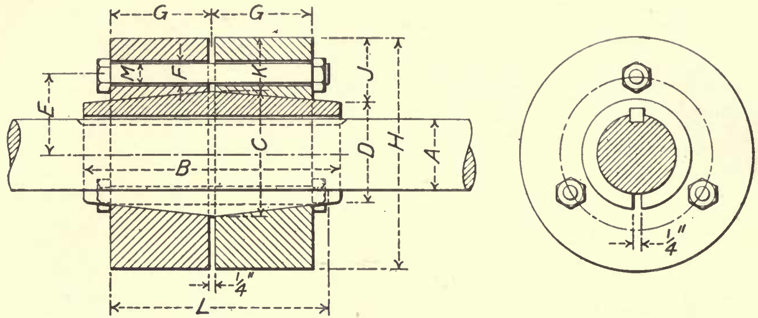
SAFETY FLANGE COUPLINGS.



A	B	C	D	E	F	G	H	J	BOLTS, No.	BOLTS, Dia.	K
1	1 3/4	2 1/4	4	11/16	5/16	1 1/2	1/4	9/32	5	3/8	1/4
1 1/4	2 3/16	2 3/4	5	13/16	3/8	1 7/8	1/4	9/32	5	7/16	1/4
1 1/2	2 5/8	3 3/8	6	15/16	7/16	2 1/4	1/4	9/32	5	[illegible]	1/4
1 3/4	3 1/16	4	7	1 1/16	1/2	2 5/8	1/4	9/32	5	9/16	1/4
2	3 1/2	4 1/2	8	1 3/16	9/16	3	1/4	9/32	5	5/8	5/16
2 1/4	3 15/16	5 1/8	9	1 5/16	5/8	3 3/8	1/4	9/32	5	11/16	5/16
2 1/2	4 3/8	5 5/8	10	1 7/16	11/16	3 3/4	1/4	9/32	5	3/4	5/16
2 3/4	4 13/16	6 1/4	11	1 9/16	3/4	4 1/8	1/4	9/32	5	13/16	5/16
3	5 1/4	6 3/4	12	1 11/16	13/16	4 1/2	1/4	9/32	5	7/8	3/8
3 1/4	5 11/16	7 3/8	13	1 13/16	7/8	4 7/8	1/4	9/32	5	15/16	3/8
3 1/2	6 1/8	8	14	1 15/16	15/16	5 1/4	1/4	9/32	5	1	3/8
3 3/4	6 9/16	8 1/2	15	2 1/16	1	5 5/8	1/4	9/32	5	1 1/16	3/8
4	7	9	16	2 1/4	1 1/8	6	1/4	9/32	5	1 1/8	7/16
4 1/2	7 7/8	10 1/4	18	2 1/2	1 1/4	6 3/4	1/4	9/32	5	1 1/4	7/16
5	8 3/4	11 1/4	20	2 3/4	1 3/8	7 1/2	1/4	9/32	5	1 3/8	7/16
5 1/2	8 3/4	11 1/4	20	2 3/4	1 3/8	7 1/2	1/4	9/32	5	1 3/8	7/16
6	10 1/2	12 3/8	22	2 15/16	1 1/2	8 1/4	5/16	11/32	5	1 7/16	1/2
6 1/2	11 3/8	13 1/2	24	3 1/8	1 5/8	9	5/16	11/32	5	1 1/2	1/2
7	12 1/4	14 5/8	26	3 1/4	1 3/4	9 3/4	5/16	11/32	6	1 1/2	9/16
7 1/2	13 1/8	15 3/4	28	3 7/16	1 7/8	10 1/2	5/16	11/32	6	1 9/16	9/16
8	14	16 7/8	28	3 1/2	2	10 7/8	5/16	11/32	7	1 1/2	5/8
8 1/2	14 7/8	18	30	3 11/16	2 1/8	11 1/4	5/16	11/32	7	1 9/16	5/8
9	15 3/4	19 1/8	31	3 3/4	2 1/4	11 5/8	5/16	11/32	8	1 1/2	11/16
9 1/2	16 5/8	20 1/4	32	3 15/16	2 3/8	12	5/16	11/32	8	1 9/16	11/16
10	17 1/2	21 3/8	34	4 1/8	2 1/2	12 3/4	5/16	11/32	8	1 5/8	3/4
10 1/2	18 3/8	22 1/2	35	4 1/4	2 5/8	13 1/8	5/16	11/32	10	1 5/8	3/4
11	19 1/4	23 5/8	36	4 7/16	2 3/4	13 1/2	5/16	11/32	10	1 11/16	7/8
11 1/2	20 1/8	24 3/4	37	4 5/8	2 7/8	13 7/8	5/16	11/32	10	1 3/4	7/8
12	21	25 7/8	38	4 13/16	3	14 1/4	5/16	11/32	10	1 13/16	1

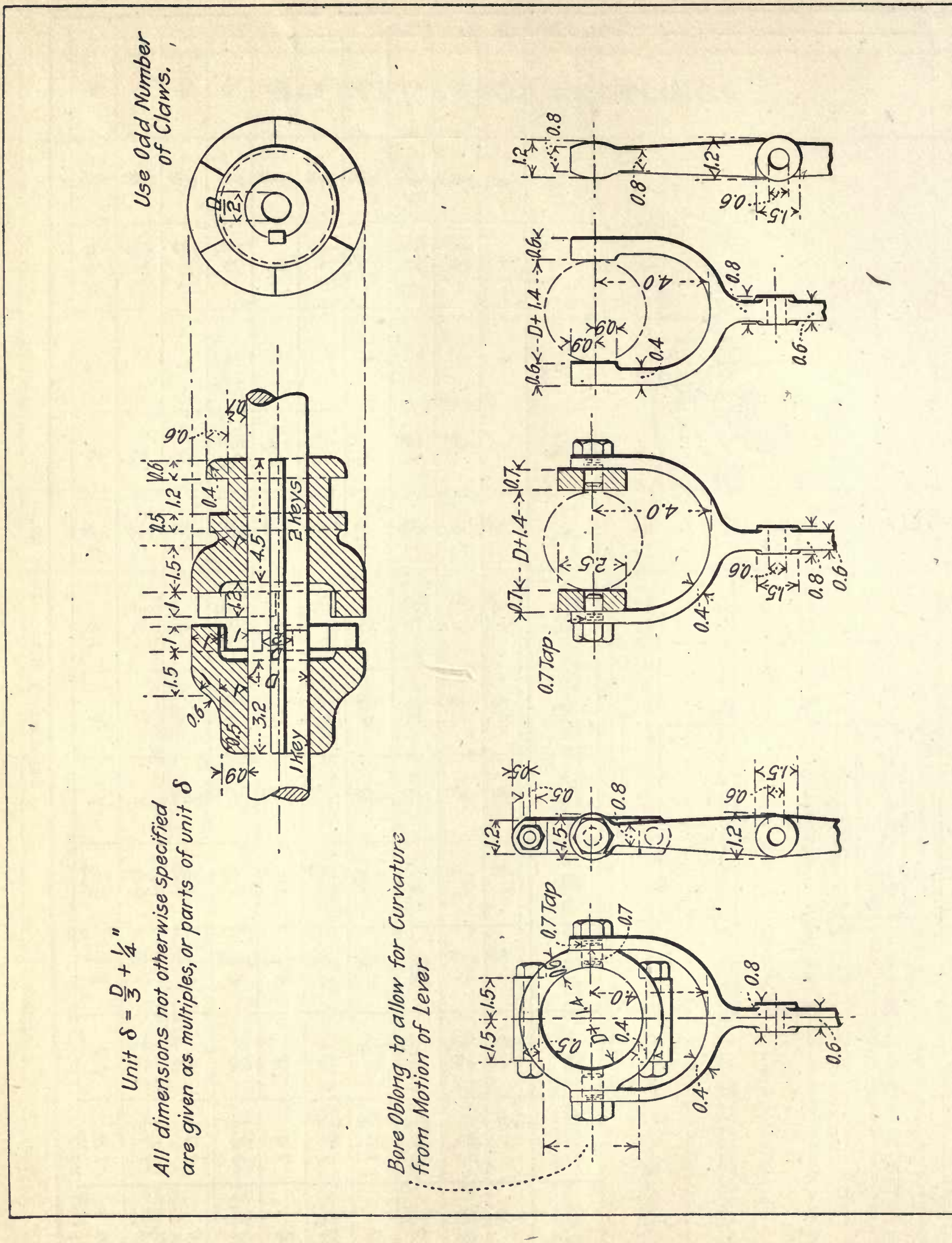
Contributed by Oscar Stegeman, MACHINERY'S Data Sheet No. 47. Explanatory note: Page 30.

SHAFT COUPLINGS



A	B	C	D	E	F	G	H	J	K	Number of Keys	L	M	Number of Bolts
1 7/16	5 1/4	2 3/4	2 1/8	1 5/8	5/8	2 1/8	4 3/4	1 1/8	1	1	5	1/2	3
1 15/16	7	3 1/2	2 7/8	2 1/8	5/8	2 3/4	6 1/4	1 1/8	1 3/8	1	6 1/4	1/2	3
2 7/16	8 3/4	4 5/16	3 5/8	3	3/4	3 1/2	7 13/16	1 7/8	1 3/4	1	7 7/8	5/8	3
3	10 1/2	5 1/2	4 3/32	3 1/2	3/4	4 3/16	9	2 1/4	2	1	9 1/2	5/8	3
3 1/2	12 1/4	7	5 3/8	4 3/8	7/8	5 1/16	11 1/4	2 5/8	2 1/8	1	11 1/4	3/4	4
4	14	7	5 1/2	4 3/4	7/8	5 1/2	12	3 3/4	2 1/2	1	12	3/4	4
4 1/2	15 1/2	8	6 7/8	5 1/4	7/8	6 3/4	13 1/2	3 3/4	2 3/4	1	14 1/2	3/4	4
5	17	9	7 1/4	5 3/4	7/8	7	15	3 3/4	3	1	15 1/4	3/4	4
5 1/2	17 1/2	9 1/2	7 3/4	6 1/4	1	7	15 1/2	3 3/4	3	1	15 1/4	7/8	4
6	18	10	8 1/4	6 3/4	1	7	16	3 3/4	3	2	15 1/4	7/8	4

Explanatory note: Page 30.



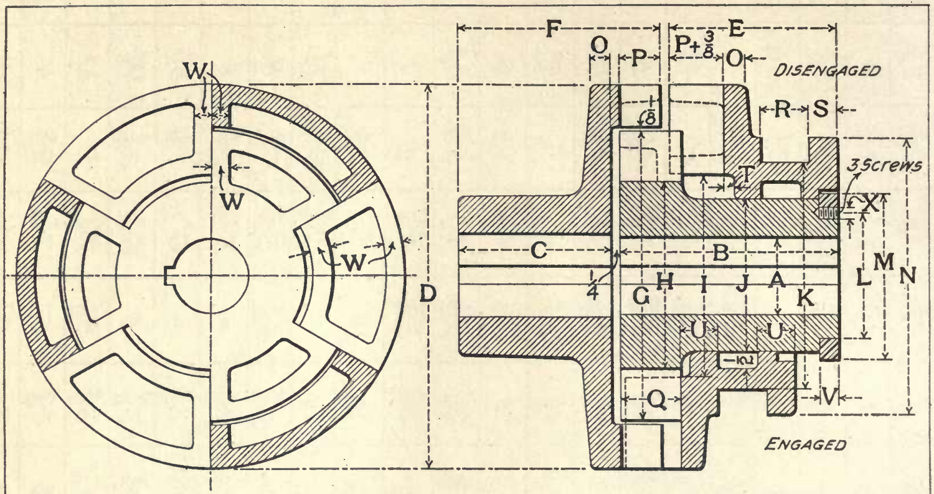
Contributed by C. A. Carson, MACHINERY'S Data Sheet No. 58. Explanatory note: Page 30.

PROPORTIONS OF CRAB COUPLINGS—II

D	δ	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.5	3.2	4.0	4.5	D+1.4
1	0.58	1/4	5/16	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1 1/2	1 7/8	2 3/8	2 1/2	1 15/16
1 1/4	0.67	5/16	"	3/8	7/16	1/2	5/8	3/4	7/8	1	1 5/8	2 1/8	2 3/4	3	2 3/16
1 1/2	0.75	3/8	3/8	7/16	1/2	5/8	"	"	"	1 1/8	1 7/8	2 1/2	3	3 1/2	2 1/2
1 3/4	0.83	"	1/2	1/2	9/16	"	3/4	7/8	1	1 1/4	2	2 3/4	3 1/2	3 3/4	2 7/8
2	0.92	"	"	5/8	5/8	3/4	"	"	1 1/8	1 3/8	2 1/4	3	3 3/4	4	3 1/4
2 1/4	1.00	7/16	"	"	3/4	"	7/8	1	1 1/4	1 1/2	2 1/2	3 1/4	4	4 1/2	3 5/8
2 1/2	1.08	"	9/16	"	"	7/8	1	1 1/8	1 3/8	1 5/8	2 3/4	3 1/2	4 1/2	5	4
2 3/4	1.17	1/2	5/8	3/4	7/8	1	"	"	"	1 3/4	2 7/8	3 3/4	4 3/4	5 1/4	4 3/8
3	1.25	"	"	"	"	"	1 1/8	1 1/4	1 1/2	1 7/8	3 1/8	4	5	5 1/2	4 3/4
3 1/4	1.33	"	3/4	"	1	"	1 1/4	1 3/8	1 5/8	2	3 1/4	4 1/4	5 1/2	6	5 1/8
3 1/2	1.42	5/8	"	7/8	"	1 1/8	"	1 1/2	1 3/4	2 1/8	3 1/2	4 1/2	5 3/4	6 1/2	5 1/2
3 3/4	1.48	"	"	"	1 1/8	1 1/4	1 3/8	"	"	2 1/4	3 3/4	4 3/4	6	7	5 3/4
4	1.58	"	7/8	1	"	"	"	1 5/8	1 7/8	2 3/8	4	5	6 1/2	"	6 1/4
4 1/4	1.67	3/4	"	"	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/2	"	5 1/4	6 3/4	7 1/2	6 1/2
4 1/2	1.75	"	"	"	"	"	"	"	"	2 5/8	4 1/2	5 1/2	7	8	7
4 3/4	1.83	"	"	1 1/8	"	1 1/2	1 5/8	1 7/8	2 1/4	2 3/4	"	5 3/4	7 1/2	"	7 1/4
5	1.92	"	1	"	"	"	1 3/4	2	"	2 7/8	"	6	7 3/4	8 1/2	7 5/8
5 1/2	2.08	7/8	"	1 1/4	1 1/2	1 5/8	1 7/8	2 1/8	2 1/2	3 1/8	5	6 3/4	8 1/2	9 1/2	8 1/2
6	2.25	"	"	1 3/8	"	1 7/8	2	2 1/4	2 3/4	3 3/8	5 1/2	7 1/4	9	10	9
6 1/2	2.42	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	3	3 5/8	6	7 3/4	9 3/4	11	10
7	2.58	"	"	"	"	2 1/8	2 3/8	2 5/8	"	3 7/8	6 1/2	8 1/4	10 1/2	12	10 1/2

Contributed by C. A. Carson, MACHINERY'S Data Sheet No. 58. Explanatory note: Page 30.

DIMENSIONS OF CAST-IRON TOOTHED CLUTCHES



Bore A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
2	6	4 1/4	10 3/4	4 5/8	5 5/8	8 1/8	5 1/4	5 5/8	4 1/4	6 1/4	3 1/2	4 5/8	7 3/4	9/16	1 1/8	1 3/4	1 3/8	3/4	1/4	1	1/2	5/8	3/8
2 1/4	6 1/2	4 3/4	11 3/4	5	6 1/4	9	5 3/4	6 1/8	4 5/8	6 3/4	3 3/4	5	8 3/8	5/8	1 1/4	1 7/8	1 1/2	13/16	1/4	1 1/16	1/2	11/16	3/8
2 1/2	7	5 1/4	12 3/4	5 3/8	6 7/8	9 7/8	6 1/4	6 3/4	5 1/8	7 3/8	4 1/4	5 1/2	9 1/8	11/16	1 3/8	2	1 5/8	7/8	1/4	1 1/8	1/2	3/4	3/8
3	7 3/4	6	14 5/8	6	7 3/4	11 1/2	7 1/4	7 7/8	6	8 1/2	5	6 3/8	10 1/2	3/4	1 1/2	2 1/8	1 3/4	15/16	1/4	1 3/16	1/2	13/16	3/8
3 1/2	8 1/2	6 3/4	16 1/2	6 5/8	8 5/8	13 1/8	8 1/4	9	6 3/4	9 1/2	5 3/4	7 1/4	11 3/4	13/16	1 5/8	2 1/4	1 7/8	1	5/16	1 1/4	9/16	7/8	7/16
4	9 1/4	7 1/2	18 1/4	7 1/4	9 1/2	14 5/8	9 1/4	10 1/8	7 1/2	10 1/2	6 3/8	8 1/8	13	7/8	1 3/4	2 3/8	2	1 1/16	5/16	1 5/16	9/16	15/16	7/16
4 1/2	10 1/4	8 1/4	20	8 1/8	10 3/8	16	10 1/4	11 1/4	8 3/8	11 1/2	7	9	14 1/4	1	1 7/8	2 1/2	2 1/8	1 1/8	5/16	1 3/8	9/16	1	7/16
5	11 1/4	9	21 3/4	9	11 1/4	17 3/8	11 1/4	12 3/8	9 1/4	12 1/2	7 5/8	9 7/8	15 1/2	1 1/8	2	2 5/8	2 1/4	1 1/4	3/8	1 1/2	5/8	1 1/16	7/16
5 1/2	12 1/8	9 5/8	23 1/2	9 3/4	12	18 3/4	12 1/8	13 1/2	10 1/8	13 1/2	8 1/4	10 3/4	16 3/4	1 1/4	2 1/8	2 3/4	2 3/8	1 3/8	3/8	1 5/8	3/4	1 1/8	1/2
6	13 1/8	10 1/8	25	10 5/8	12 5/8	19 7/8	13	14 1/2	11	14 3/8	9	11 3/4	17 7/8	1 3/8	2 1/4	2 7/8	2 1/2	1 1/2	3/8	1 3/4	3/4	1 1/8	1/2

Contributed by Albert Gottschalk, MACHINERY'S Data Sheet No. 96. Explanatory note: Page 30.

corresponding length, as given in the table, are sufficient to prevent excessive unit pressure. On page 8 are given dimensions for standard babbitted bearings, the diameter *A* of the shaft being the basic dimension. On page 9 proportions for plain bearings are given; the formulas upon which the more important dimensions are based are given beneath the table. [MACHINERY, December, 1906, January and February, 1907, Design of Bearings; November, 1907, Causes of Hot Bearings; MACHINERY'S Reference Series No. 11, Bearings, Chapters I and II.]

Ball Bearings

The permissible load to which two-point ball bearings having one row of balls may be subjected is given by the following formula by Prof. Stribeck:

$$P = K \times 0.44\, d^2 z$$

in which formula

P = load in pounds,

K = constant depending on the properties of the material, the form of the ball race, and the angular speed of the bearing,

z = number of balls,

d = diameter of ball in units of 1/8 inch. (For example, if the diameter of the ball is 1/8 inch, then $d = 1$. If the diameter of the ball is 7-16 inch, then $d = 3.5$, etc.)

For ball bearings made of high-grade material and accurately machined, *K* has the following approximate values for steady loads and uniform speeds:

Revolutions per Minute	Values of K
10	20
150	18
300	15
500	10
1000	7.5
1500	5

On the basis of these figures, it is apparent that the given bearing will carry only one-fourth the load at a speed of 1500 revolutions per minute that it will carry at 10 revolutions per minute. The table and the formulas given relate to radial bearings. For determining the permissible load on a thrust bearing, we have the formula:

$$P = 2.2\, K d^2 z,$$

in which the various letters denote the same quantities as before. This formula applies to steady loads and uniform speeds. The values of *K* to be used for thrust bearings are given in the following table:

Revolutions per Minute	Values of K
10	12.5
150	4.5
300	3.5
500	3
1000	2
1500	1.5

For parts which have very little motion, such as crane hooks, for example, *K* may be taken as high as 18 to 20. For very high speeds, above 1500 revolutions per minute, ordinary thrust bearings are impractical for taking end thrusts. Centrifugal force at such high speeds plays a very important part. The manner in which the permissible load varies with the speed is apparent from the following table, calculated for a specific bearing:

Revolutions per Minute	Load in Pounds
10	11,000
150	3,740
300	2,640
500	2,420
1000	1,760
1500	1,540

The formulas and tables just given make it possible to determine for any given bearing the load it may be expected to carry, or, if the load is known, to determine the diameter and number of balls required at any given speed. Besides, there are a number of other calculations required in the design of

(Continued on page 30.)

H.P. = horse-power transmitted,

N = revolutions of crank-shaft per minute,

r = mean radius of friction cone, in inches,

r_1 = large radius of friction cone, in inches,

r_2 = small radius of friction cone, in inches,

R_1 = outside radius of leather band, in inches.

R_2 = inside radius of leather band, in inches,

v = velocity of a point at distance r from the center, in feet per minute,

F = tangential force acting at radius r, in pounds,

P_n = total normal pressure between cone surfaces, in pounds,

P_s = spring pressure, in pounds,

α = angle of clutch surface with axis of shaft = 7 to 13 degrees,

β = included angle of clutch leather, when developed, in degrees,

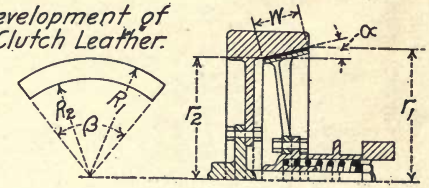
f = coefficient of friction = 0.20 to 0.25 for greasy leather on iron,

p = allowable pressure per square inch of leather band = 7 to 8 pounds,

W = width of clutch leather, in inches.

Development of Clutch Leather.

Cone Clutch.



$$R_1 = \frac{r_1}{\sin\alpha}$$

$$R_2 = \frac{r_2}{\sin\alpha}$$

$$\beta = \sin\alpha \times 360$$

$$r = \frac{r_1 + r_2}{2}$$

$$v = \frac{2\pi r N}{12}$$

$$F = \frac{H.P. \times 33000}{v}$$

$$W = \frac{P_n}{2\pi r p}$$

$$H.P. = \frac{P_n f r N}{63025}$$

Engagement with some slip:

$$P_n = \frac{P_s}{\sin\alpha}$$

$$P_s = \frac{H.P. \times 63025 \sin\alpha}{f r N}$$

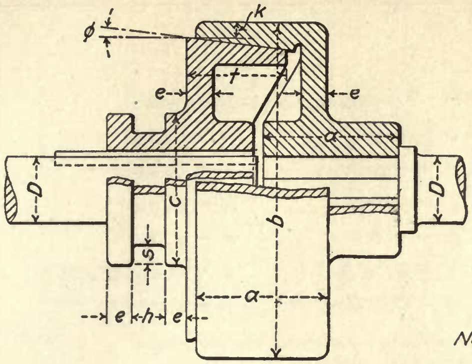
Engagement without slip:

$$P_n = \frac{P_s}{\sin\alpha + f\cos\alpha}$$

$$P_s = \frac{H.P. \times 63025 (\sin\alpha + f\cos\alpha)}{f r N}$$

Contributed by C. A. Schaefer, MACHINERY'S Data Sheet No. 116. Explanatory note: Page 30.

PROPORTIONS OF CAST-IRON FRICTION CLUTCHES



For sizes not given below.

a – 2 D

b = 4 to 8 D

c = 2 1/4 D

t = 1 1/2 D

e = 3/8 D

h = 1/2 D

s = 5/16 D Nearly

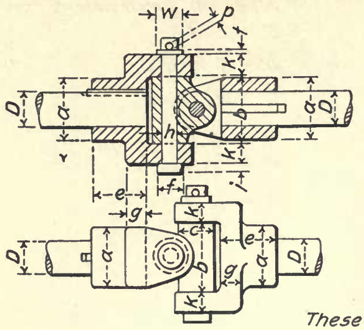
k = 1/4 D

Note: The angle ϕ of the cone may be from 4° to 10°

D	a	b	c	t	e	h	s	k
1	2	4 — 8	2 1/4	1 1/2	3/8	1/2	5/16	1/4
1 1/4	2 1/2	5 — 10	2 7/8	1 7/8	1/2	5/8	3/8	5/16
1 1/2	3	6 — 12	3 3/8	2 1/4	5/8	3/4	1/2	3/8
1 3/4	3 1/2	7 — 14	4	2 5/8	5/8	7/8	5/8	7/16
2	4	8 — 16	4 1/2	3	3/4	1	5/8	1/2
2 1/4	4 1/2	9 — 18	5	3 3/8	7/8	1 1/8	5/8	9/16
2 1/2	5	10 — 20	5 5/8	3 3/4	1	1 1/4	3/4	5/8
2 3/4	5 1/2	11 — 22	6 1/4	4 1/8	1	1 3/8	7/8	11/16
3	6	12 — 24	6 3/4	4 1/2	1 1/8	1 1/2	7/8	3/4
3 1/4	6 1/2	13 — 26	7 3/8	4 7/8	1 1/4	1 5/8	1	13/16
3 1/2	7	14 — 28	7 7/8	5 1/4	1 3/8	1 3/4	1	7/8
3 3/4	7 1/2	15 — 30	8 1/2	5 5/8	1 3/8	1 7/8	1 1/4	15/16
4	8	16 — 32	9	6	1 1/2	2	1 1/4	1
4 1/4	8 1/2	17 — 34	9 1/2	6 3/8	1 5/8	2 1/8	1 3/8	1 1/16
4 1/2	9	18 — 36	10 1/4	6 3/4	1 3/4	2 1/4	1 3/8	1 1/8
4 3/4	9 1/2	19 — 38	10 3/4	7 1/8	1 3/4	2 3/8	1 1/2	1 3/16
5	10	20 — 40	11 1/4	7 1/2	1 7/8	2 1/2	1 1/2	1 1/4
5 1/4	10 1/2	21 — 42	11 3/4	7 7/8	2	2 5/8	1 5/8	1 5/16
5 1/2	11	22 — 44	12 3/8	8 1/4	2	2 3/4	1 3/4	1 3/8
5 3/4	11 1/2	23 — 46	13	8 5/8	2 1/4	2 7/8	1 3/4	1 7/16
6	12	24 — 48	13 1/2	9	2 1/4	3	1 7/8	1 1/2

Contributed by Alex Theuerkauf, MACHINERY's Data Sheet No. 99. Explanatory note: Page 30.

PROPORTIONS OF UNIVERSAL JOINTS



For Sizes Not Given Below:

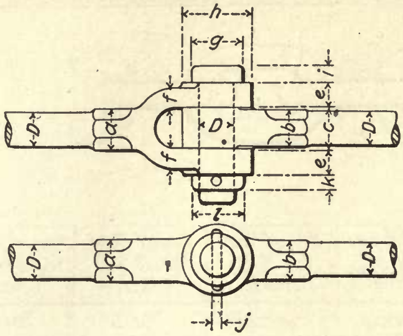
a – 1.8 D	h – 0.5 D
b – 2.0 D	i – 0.25 D
c – 1.0 D	k – 0.6 D
e – 1.6 D	w – 1.0 D
f – 0.75 D	t – 0.075 D Approx.
g – 0.6 D	p – 0.125 D

These proportions hold good for forgings or steel castings.

D	a	b	c	e	f	g	h	i	k	w	t	p
1/2	7/8	1	1/2	7/8	3/8	5/16	1/4	1/8	5/16	1/2	1/16	1/16
3/4	1 3/8	1 1/2	3/4	1 1/4	9/16	7/16	3/8	3/16	7/16	3/4	1/16	1/16
1	1 3/4	2	1	1 5/8	3/4	5/8	1/2	1/4	5/8	1	1/16	1/8
1 1/4	2 1/4	2 1/2	1 1/4	2	15/16	3/4	5/8	5/16	3/4	1 1/4	1/8	1/8
1 1/2	2 3/4	3	1 1/2	2 3/8	1 1/8	7/8	3/4	3/8	7/8	1 1/2	1/8	3/16
1 3/4	3 1/8	3 1/2	1 3/4	2 3/4	1 5/16	1 1/16	7/8	7/16	1 1/16	1 3/4	1/8	3/16
2	3 5/8	4	2	3 1/4	1 1/2	1 3/16	1	1/2	1 3/16	2	3/16	1/4
2 1/4	4	4 1/2	2 1/4	3 5/8	1 11/16	1 3/8	1 1/8	9/16	1 3/8	2 1/4	3/16	1/4
2 1/2	4 1/2	5	2 1/2	4	1 7/8	1 1/2	1 1/4	5/8	1 1/2	2 1/2	3/16	5/16
2 3/4	5	5 1/2	2 3/4	4 3/8	2 1/16	1 11/16	1 3/8	11/16	1 11/16	2 3/4	1/4	5/16
3	5 1/2	6	3	4 7/8	2 1/4	1 13/16	1 1/2	3/4	1 13/16	3	1/4	3/8
3 1/4	5 7/8	6 1/2	3 1/4	5 1/4	2 7/16	1 15/16	1 5/8	13/16	1 15/16	3 1/4	1/4	3/8
3 1/2	6 3/8	7	3 1/2	5 5/8	2 5/8	2 1/8	1 3/4	7/8	2 1/8	3 1/2	5/16	7/16
3 3/4	6 3/4	7 1/2	3 3/4	6	2 13/16	2 1/4	1 7/8	15/16	2 1/4	3 3/4	5/16	7/16
4	7 1/4	8	4	6 3/8	3	2 3/8	2	1	2 3/8	4	5/16	1/2
4 1/4	7 5/8	8 1/2	4 1/4	6 7/8	3 3/16	2 9/16	2 1/8	1 1/16	2 9/16	4 1/4	5/16	1/2
4 1/2	8	9	4 1/2	7 1/4	3 3/8	2 11/16	2 1/4	1 1/8	2 11/16	4 1/2	3/8	9/16
4 3/4	8 1/2	9 1/2	4 3/4	7 5/8	3 9/16	2 7/8	2 3/8	1 3/16	2 7/8	4 3/4	3/8	9/16
5	9	10	5	8	3 3/4	3	2 1/2	1 1/4	3	5	3/8	5/8

Contributed by Alex Theuerkauf, MACHINERY'S Data Sheet No. 99. Explanatory note: Page 33.

PROPORTIONS OF KNUCKLE JOINTS



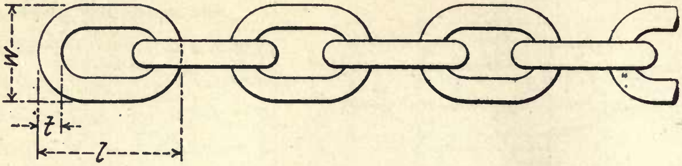
For sizes not given below:

a – 1.2 D
b – 1.1 D
c – 1.2 D
e – 0.75 D
f – 0.6 D
g – 1.5 D.
h – 2 D
i – 0.5 D
j – 0.25 D
k – 0.5 D
l – 1.5 D

D	a	b	c	e	f	g	h	i	j	k	l
1/2	5/8	9/16	5/8	3/8	5/16	3/4	1	1/4	1/8	1/4	3/4
3/4	7/8	3/4	7/8	9/16	7/16	1 1/8	1 1/2	3/8	3/16	3/8	1 1/8
1	1 1/4	1 1/8	1 1/4	3/4	5/8	1 1/2	2	1/2	1/4	1/2	1 1/2
1 1/4	1 1/2	1 3/8	1 1/2	15/16	3/4	1 7/8	2 1/2	5/8	5/16	5/8	1 7/8
1 1/2	1 3/4	1 5/8	1 3/4	1 1/8	7/8	2 1/4	3	3/4	3/8	3/4	2 1/4
1 3/4	2 1/8	2	2 1/8	1 5/16	1 1/16	2 5/8	3 1/2	7/8	7/16	7/8	2 5/8
2	2 3/8	2 1/4	2 3/8	1 1/2	1 3/16	3	4	1	1/2	1	3
2 1/4	2 3/4	2 1/2	2 3/4	1 11/16	1 3/8	3 3/8	4 1/2	1 1/8	9/16	1 1/8	3 3/8
2 1/2	3	2 3/4	3	1 7/8	1 1/2	3 3/4	5	1 1/4	5/8	1 1/4	3 3/4
2 3/4	3 1/4	3	3 1/4	2 1/16	1 5/8	4 1/8	5 1/2	1 3/8	11/16	1 3/8	4 1/8
3	3 5/8	3 1/4	3 5/8	2 1/4	1 13/16	4 1/2	6	1 1/2	3/4	1 1/2	4 1/2
3 1/4	4	3 5/8	4	2 7/16	2	4 7/8	6 1/2	1 5/8	13/16	1 5/8	4 7/8
3 1/2	4 1/4	3 7/8	4 1/4	2 5/8	2 1/8	5 1/4	7	1 3/4	7/8	1 3/4	5 1/4
3 3/4	4 1/2	4 1/8	4 1/2	2 13/16	2 1/4	5 5/8	7 1/2	1 7/8	15/16	1 7/8	5 5/8
4	4 3/4	4 3/8	4 3/4	3	2 3/8	6	8	2	1	2	6
4 1/4	5 1/8	4 3/4	5 1/8	3 3/16	2 9/16	6 3/8	8 1/2	2 1/8	1 1/16	2 1/8	6 3/8
4 1/2	5 1/2	5	5 1/2	3 3/8	2 3/4	6 3/4	9	2 1/4	1 1/8	2 1/4	6 3/4
4 3/4	5 3/4	5 1/4	5 3/4	3 9/16	2 7/8	7 1/8	9 1/2	2 3/8	1 3/16	2 3/8	7 1/8
5	6	5 1/2	6	3 3/4	3	7 1/2	10	2 1/2	1 1/4	2 1/2	7 1/2

Contributed by Alex Theuerkauf, MACHINERY'S Data Sheet No. 99. Explanatory note: Page 33.

STRAIGHT LINK CRANE CHAIN

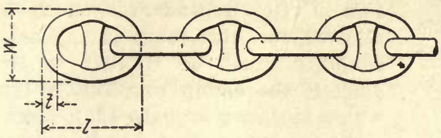


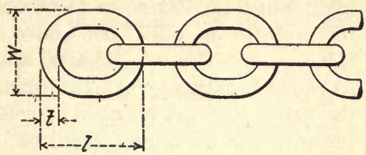
Size of Chain in Inches	Length of Link Inches	Width of Link Inches	Weight per Foot of Chain	Proof Test for B B Chain	Proof Test for B B B Chain	Proof Test for Dredge Chain
t	l	w	Pounds	Tons	Tons	Tons
3/16	1 3/8	13/16	0.50	0.39	0.45	0.50
1/4	1 1/2	1	0.75	0.66	0.75	0.80
5/16	1 3/4	1 3/16	1.10	1.37	1.60	1.70
3/8	2	1 3/8	1.55	1.92	2.21	2.36
7/16	2 1/4	1 9/16	2.00	2.64	3.05	3.33
1/2	2 1/2	1 3/4	2.65	3.41	3.92	4.42
9/16	2 7/8	1 15/16	3.25	4.29	4.93	5.53
5/8	3 1/4	2 1/8	4.20	5.28	6.07	6.67
11/16	3 1/2	2 5/16	5.00	6.32	7.28	8.02
3/4	3 3/4	2 1/2	5.90	7.59	8.74	9.24
13/16	4	2 11/16	7.00	8.91	10.30	10.70
7/8	4 1/4	3	8.00	10.30	11.90	12.10
15/16	4 1/2	3 1/4	9.00	11.80	13.60	14.50
1	4 3/4	3 1/2	10.00	13.50	15.60	16.30
1 1/8	5 1/2	3 7/8	12.50	16.20	18.60	19.60
1 1/4	6	4 1/4	16.00	20.10	23.10	24.00
1 3/8	6 1/2	4 3/4	19.00	24.20	27.80	28.70
1 1/2	7 1/4	5 1/4	21.00	28.90	33.20	34.60
1 5/8	7 7/8	5 3/4	25.00	34.90	39.00	41.00

Note: Safe working loads of chains are one-half of proof test loads.

Contributed by F. E. Walker. Explanatory note: Page 33.

CABLE CHAIN





Size of Chain in Inches	Stud Link				Close Link			
	Length of Link in Inches	Width of Link in Inches	Weight per Foot of Chain	Proof Test	Length of Link in Inches	Width of Link in Inches	Weight per Foot of Chain	Proof Test
t	l	W	Pounds	Tons	l	W	Pounds	Tons
3/4	4 3/8	2 3/4	5.5	10.1				
13/16	4 3/4	3	6.3	12.0				
7/8	5	3 1/4	8.2	13.7				
15/16	5 3/8	3 1/2	9.2	15.7				
1	5 7/8	3 3/4	10.2	18.0	4 5/8	3 1/2	10.3	12.0
1 1/16	6 1/4	3 7/8	11.5	20.3	5	3 5/8	11.8	12.5
1 1/8	6 1/2	4 1/8	12.3	22.8	5 3/8	3 7/8	12.7	15.1
1 3/16	6 3/4	4 1/4	13.5	25.5	5 1/2	4 1/8	13.7	16.9
1 1/4	7 1/8	4 1/2	15.0	28.1	5 3/4	4 1/4	15.2	18.7
1 5/16	7 3/8	4 5/8	16.2	31.0	6	4 1/2	16.5	20.6
1 3/8	7 3/4	4 7/8	18.3	34.0	6 1/4	4 3/4	18.8	22.6
1 7/16	8 1/8	5 1/8	18.8	37.2	6 5/8	5	19.7	24.7
1 1/2	8 1/2	5 3/8	21.2	40.5	6 7/8	5 1/4	21.7	27.0
1 9/16	8 7/8	5 5/8	23.8	44.0	7 1/4	5 1/2	23.0	29.2
1 5/8	9 1/4	5 7/8	25.0	47.5	7 1/2	5 3/4	25.3	31.6
1 11/16	9 5/8	6	26.2	51.2				
1 3/4	10	6 1/4	28.8	55.2				
1 7/8	10 1/2	6 3/4	33.8	63.3				
1 15/16	10 3/4	7	35.8	67.5				
2	11 1/8	7 1/4	38.8	72.0				
2 1/16	11 1/2	7 1/2	42.3	76.5				
2 1/8	12	7 3/4	46.0	81.2				
2 3/16	12 1/2	8	48.3	86.1				
2 1/4	13	8 1/4	50.0	91.0				

Note: Safe working loads of chains are one-half of proof test loads.

Contributed by F. E. Walker. Explanatory note: Page 33.

ball bearings. On pages 10 and 11 are given formulas and tables for determining the dimensions of the enveloping and enveloped cylinder in ball bearings, when the diameter of the ball and the number of balls are known. This table is, of course, equally applicable to roller bearings, when the diameter of the roller and the number of rollers are known. The formulas required for determining the dimensions are given at the head of the table on page 10, and in the body of the tables are given the values of the constants entering in these formulas for number of balls varying from 5 to 40.

On pages 12 to 15, inclusive, are given dimensions for two-point ball bearings. The table in the lower part of page 12 gives the dimensions relating specifically to the shape of the races when the diameter of the ball is known, while the dimensions in the tables on pages 13, 14 and 15 give the diameters of the ball races as determined from the number and diameter of the balls.

Assume as an example that it is required to find the dimensions of a two-point ball bearing having 20 balls of 3/8 inch diameter. From the table on page 12 we find:

Radius of race $R = 0.240$ inch,
Dimension $A = 0.053$ inch,
Dimension $B = 0.047$ inch,
Dimension $C = 0.023$ inch,
Dimension $S = 0.386$ inch,
Clearance $(S—D) = 0.011$ inch.

From the table on page 13 we find that for 20 balls of 3/8 inch diameter, diameter X, or the diameter of the inner ball race, equals 2.031 inches; diameter Y, or the diameter through the center of the balls, equals 2.416 inches, and diameter Z, or the diameter of the outer ball race, equals 2.802 inches. [MACHINERY, December, 1907, and January, 1908, Ball Bearings; May, 1909, Some Notes on Ball Bearings; MACHINERY'S Reference Series No. 56, Ball Bearings.]

Shaft Couplings

The types of shaft couplings in general use vary greatly in appearance and construction. The method of construction is often dependent upon the space allowed for the coupling. When the coupling must be limited to its diameter, the clamp coupling, a type of which is shown on page 16, is especially suitable. When there are no limitations on the diameter of the coupling, plate or flange couplings, as shown on pages 17 and 18, are often used. Another simple form of coupling is shown on page 19. This coupling consists of a sleeve or muff, split on one side, which is placed over the shafts and their key; the outside of this sleeve is tapered at both ends, and it is clamped upon the shafts by means of two taper rings firmly held together by bolts. The crab coupling shown on page 20, dimensions for which are tabulated on page 21, should be classified as a clutch rather than as a coupling, a clutch, in general, being understood to mean a coupling which can be disengaged at will. Dimensions for the various classes of couplings are given beneath the illustrations referred to.

Clutches

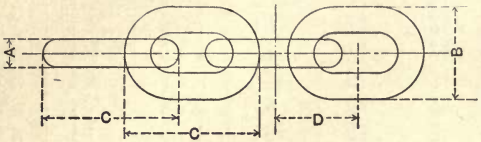
Clutches, as already mentioned, may be defined as disengaging couplings. Clutches may be divided, in general, into two classes, toothed clutches and friction clutches. The crab coupling, shown on page 20 and already referred to in the previous section, is an example of a toothed clutch. In this clutch one part, that to the left, is fastened to its shaft laterally, as well as keyed to the shaft to prevent turning. The part to the right is free to slide back and forth upon its shaft, but is, of course, also prevented from turning on the shaft by a key. The sliding motion for engaging or disengaging the clutch is accomplished by a forked lever

(Continued on page 33.)

CRANE CHAIN AND EYE BOLTS

CRANE CHAIN.

(United States Navy Standard.)

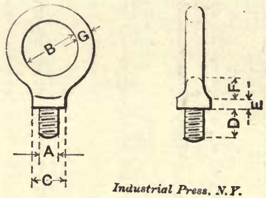


Industrial Press, N.Y.

A	B	C	D	Lbs. per Foot.	Load in Pounds.	
					Ultimate.	Working.
1/4″	7/8″	1 5/16″	25/32″	.875	3360	670
5/16″	1 1/16″	1 1/2″	27/32″	1.000	5040	1000
3/8″	1 1/4″	1 3/4″	31/32″	1.70	7280	1460
7/16″	1 3/8″	2 1/16″	1 5/32″	2.00	10080	2020
1/2″	1 11/16″	2 3/8″	1 11/32″	2.50	13440	2690
9/16″	1 7/8″	2 5/8″	1 15/32″	3.20	16800	3360
5/8″	2 1/16″	3″	1 23/32″	4.125	20720	4140
11/16″	2 1/4″	3 1/4″	1 27/32″	5.00	25200	5040
3/4″	2 1/2″	3 1/2″	1 31/32″	5.875	30240	6050
13/16″	2 11/16″	3 3/4″	2 3/32″	6.70	35280	7060
7/8″	2 7/8″	4″	2 7/32″	8.00	40880	8180
15/16″	3 1/16″	4 3/8″	2 15/32″	9.00	47040	9410
1″	3 1/4″	4 5/8″	2 19/32″	10.70	53760	10750
1 1/16″	3 9/16″	4 7/8″	2 23/32″	11.20	60480	12100
1 1/8″	3 3/4″	5 1/8″	2 27/32″	12.50	68320	13660
1 3/16″	3 7/8″	5 9/16″	3 5/32″	13.70	76160	15230
1 1/4″	4 1/8″	5 3/4″	3 7/32″	16.00	84000	17000
1 5/16″	4 3/8″	6 1/8″	3 15/32″	16.50	91840	18400
1 3/8″	4 9/16″	6 3/8″	3 5/8″	18.40	101360	20300
1 7/16″	4 3/4″	6 11/16″	3 25/32″	19.70	109760	21900
1 1/2″	5″	7″	3 31/32″	21.70	120960	24200

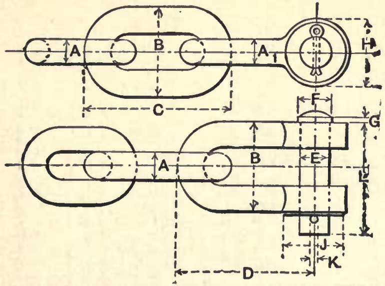
TABLE FOR EYE BOLTS.

(Contributed by H. A. H)



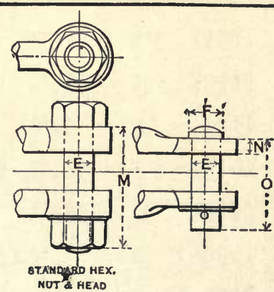
Industrial Press, N.Y.

A	B	C	D	E	F	G	Number of Threads per Inch.	Strength at Bottom of Thread S = 10,000 Pounds.	Strength of Unstudded Chain Made from G Size Bar.
.375	2.	.75	.625	.1875	.375	.25	16	677	750
.5	2.125	1.	.75	.25	.5	.3125	13	1257	1172
.625	2.25	1.25	1.	.3125	.625	.4375	11	2018	2296
.75	2.375	1.4375	1.125	.3125	.6875	.5	10	3020	3000
.875	2.5	1.6875	1.375	.375	.75	.625	9	4194	4687
1.	2.75	1.875	1.5	.4875	.875	.75	8	5509	6750
1.125	2.875	2.125	1.625	.5	1.	.8125	7	6931	7921
1.25	3.	2.375	1.75	.5	1.125	.875	7	8899	9188
1.375	3.125	2.625	1.875	.5625	1.1875	1.	6	10541	12000
1.5	3.25	2.75	2.	.625	1.25	1.0625	6	12938	13546
1.625	3.375	3.	2.125	.6825	1.375	1.125	5.5	15149	15187
1.75	3.5	3.25	2.25	.75	1.5	1.25	5	17441	18750
1.875	3.625	3.5	2.375	.8125	1.625	1.3125	5	20490	20671
2.	3.75	3.75	2.5	.875	1.75	1.375	4.5	23001	22686



CHAIN END LINK AND NARROW SHACKLE.

(United States Navy Standard.)



A	A_1	B	C	D	E	F	G	H	J	K	L	M	N	O
1/2"	9/16"	1 7/8"	3 1/2"	2 1/2"	3/4"	1 1/16"	3/16"	1 1/2"	1 3/8"	3/16"	2 3/8"	2 3/4"	...	...
9/16"	5/8"	2 1/16"	3 5/8"	2 3/4"	3/4"	1 1/16"	3/16"	1 1/2"	1 3/8"	3/16"	2 5/8"	2 7/8"	...	...
5/8"	11/16"	2 1/4"	4 3/8"	3"	1"	1 7/16"	1/4"	2"	1 7/8"	3/16"	3"	3 3/8"	...	...
11/16"	3/4"	2 1/2"	4 5/8"	3 1/4"	1"	1 7/16"	1/4"	2"	1 7/8"	3/16"	3 1/4"	3 5/8"	...	...
3/4"	13/16"	2 11/16"	5"	3 1/2"	1 1/8"	1 9/16"	1/4"	2 1/4"	2 1/8"	3/16"	3 1/2"	4"	...	...
13/16"	7/8"	2 7/8"	5 1/4"	3 3/4"	1 1/8"	1 9/16"	5/16"	2 1/4"	2 1/8"	3/16"	3 3/4"	4 1/8"	...	...
7/8"	1"	3 1/4"	5 3/4"	4 1/8"	1 1/4"	1 11/16"	5/16"	2 1/2"	2 3/8"	1/4"	4 1/8"	4 5/8"	5/8"	3 1/2"
15/16"	1 1/16"	3 9/16"	6"	4 3/8"	1 1/4"	1 11/16"	5/16"	2 1/2"	2 3/8"	1/4"	4 1/2"	5"	5/8"	3 5/8"
1"	1 1/8"	3 3/4"	6 5/8"	4 5/8"	1 1/2"	2 1/16"	3/8"	3"	2 3/4"	1/4"	4 7/8"	5 3/8"	5/8"	3 7/8"
1 1/16"	1 3/16"	3 7/8"	6 7/8"	4 7/8"	1 1/2"	2 1/16"	3/8"	3"	2 3/4"	1/4"	5"	5 5/8"	5/8"	4"
1 1/8"	1 1/4"	4 1/8"	7 1/2"	5 1/8"	1 3/4"	2 5/16"	7/16"	3 1/2"	3 1/4"	5/16"	5 1/2"	6"	3/4"	4 1/2"
1 3/16"	1 5/16"	4 3/8"	7 3/4"	5 3/8"	1 3/4"	2 5/16"	7/16"	3 1/2"	3 1/4"	5/16"	5 3/4"	6 1/4"	3/4"	4 3/8"
1 1/4"	1 3/8"	4 9/16"	8 1/8"	5 3/4"	1 7/8"	2 7/16"	7/16"	3 3/4"	3 1/2"	5/16"	6"	6 5/8"	3/4"	4 3/4"
1 5/16"	1 7/16"	4 3/4"	8 3/8"	5 7/8"	1 7/8"	2 7/16"	1/2"	3 3/4"	3 1/2"	5/16"	6 1/4"	6 3/4"	3/4"	4 7/8"
1 3/8"	1 1/2"	5"	8 3/4"	6 1/4"	2"	2 11/16"	1/2"	4"	3 1/2"	5/16"	6 1/2"	7 1/8"	7/8"	5 1/4"
1 7/16"	1 9/16"	5 3/16"	9"	6 1/2"	2"	2 11/16"	1/2"	4"	3 1/2"	5/16"	6 3/4"	7 3/8"	7/8"	5 3/8"
1 1/2"	1 5/8"	5 3/8"	9 5/8"	6 7/8"	2 1/4"	3 1/16"	9/16"	4 1/2"	4"	3/8"	7"	7 3/4"	7/8"	5 1/2"
1 9/16"	1 11/16"	5 5/8"	9 7/8"	7 1/8"	2 1/4"	3 1/16"	9/16"	4 1/2"	4"	3/8"	7 1/4"	8"	7/8"	5 5/8"
1 5/8"	1 3/4"	5 13/16"	10 1/2"	7 3/8"	2 1/2"	3 7/16"	5/8"	5"	4 1/2"	3/8"	7 1/2"	8 1/2"	1"	6 1/8"
1 11/16"	1 13/16"	6"	10 3/4"	7 3/4"	2 1/2"	3 7/16"	5/8"	5"	4 1/2"	3/8"	7 3/4"	8 3/4"	1"	6 1/4"
1 3/4"	1 7/8"	6 1/4"	11 3/8"	8"	2 3/4"	3 11/16"	11/16"	5 1/2"	5"	7/16"	8"	9 1/8"	1"	6 3/8"
1 13/16"	1 15/16"	6 7/16"	11 5/8"	8 1/4"	2 3/4"	3 11/16"	11/16"	5 1/2"	5"	7/16"	8 1/4"	9 3/8"	1"	6 1/2"
1 7/8"	2"	6 11/16"	11 3/4"	8 1/2"	2 3/4"	3 11/16"	11/16"	5 1/2"	5"	7/16"	8 1/2"	9 5/8"	1 1/8"	6 3/4"
1 15/16"	2 1/16"	6 7/8"	12"	8 3/4"	2 3/4"	3 11/16"	11/16"	5 1/2"	5"	7/16"	8 3/4"	9 7/8"	1 1/8"	6 7/8"

MACHINERY'S Data Sheet No. 33. Explanatory note: Page 33.

as shown. Another form of toothed clutch of special design is shown on page 22.

The second type of clutches are the friction clutches, of which the cone clutch is the most common. There appears to be considerable misunderstanding, or perhaps rather lack of understanding, of the formulas for cone clutches. A number of formulas are given in various hand-books and treatises on machine design, many of which do not at first sight seem to agree. While the various formulas may be correct, the difficulty met with is caused by the fact that in cone clutch design different formulas are developed according to whether the clutch surfaces are assumed to engage with or without some slip. On page 24 is given a set of formulas which takes both of these conditions into consideration. These formulas will be found very convenient for ready reference when designing new cone clutches or when checking designs already made. On page 25 dimensions for cast-iron cone clutches are given, and formulas are added so that sizes not given in the table beneath the illustration can be proportioned if necessary. [Machinery, November, 1908, Clutches for Power Presses; October, 1909, Formulas for Cone Clutches.]

Universal and Knuckle Joints

Universal joints are made in many forms. One type which will be found suitable for ordinary conditions is shown on page 26. A table of dimensions is given, and formulas are provided for proportioning sizes not contained in the table. When universal joints are used, the two shafts connected by means of the joint do not move at a uniform rate of motion in relation to each other. If the driving shaft moves at a uniform rate of motion, then the driven shaft will have a slightly variable motion. The variation, however, is so slight, particularly for small angles, as to be negligible in most cases occurring in machine construction, where the universal joint is used merely for transmitting motion without specific reference to its uniformity. The universal joint is used particularly for feed motions on various machine tools; it does not work well when the angle between the two shafts is more than 45 degrees. Dimensions of knuckle joints are given on page 27, together with formulas to be used for sizes not given in the table.

CHAINS AND HOOKS

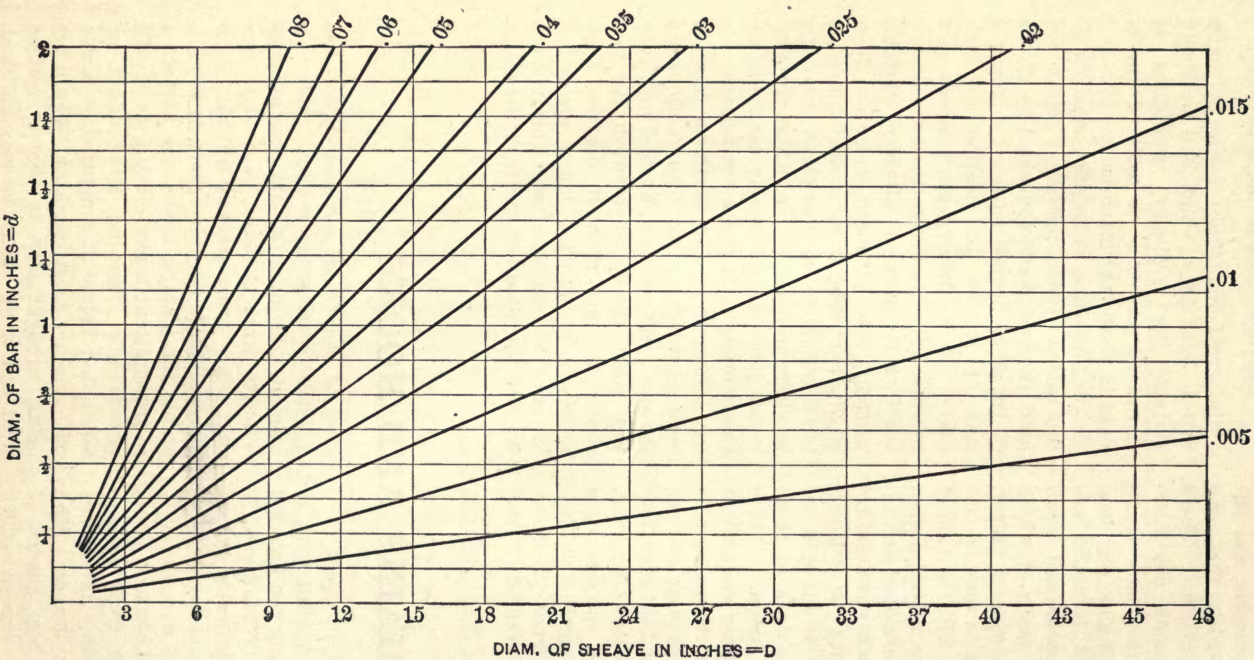
Chain for Hoisting Purposes

The only class of chain dealt with in the following will be chain for hoisting purposes. Chain of this character is made with oblong or elliptically shaped links. The best material to use for chain is a good grade of wrought iron, such as Swedish or Lowmoor iron, either of which is freer from silicon, phosphor, sulphur and other impurities than the more common brands. The tensile strength of the best grades of wrought iron does not exceed 46,000 pounds per square inch, while mild steel of about 0.15 per cent carbon has a tensile strength of nearly double this amount. The ductility and toughness of wrought iron, however, is greater than that of any other grade of ordinary commercial steel; for this reason it is preferable for making appliances subjected to intermittent heavy strains, as it will always give warning by bending or stretching before it fractures or snaps off. Another most important reason for using wrought iron is that a perfect weld can more easily be accomplished.

(Continued on page 38.)

DIAGRAM OF CHAIN FRICTION

SHOWING RESISTANCE DUE TO ONE BEND OF CHAIN.



This diagram is based upon a coefficient of friction = 0.4. Consequently the chain friction $= 0.4 \frac{d}{D} \times L.$

Where d = diameter of bar of which chain is made, in inches.
D = diameter of sheave, in inches.
L = load on chain, in pounds.

Example:
Diameter of sheave = 30 inches.
Diameter of bar = ¾ inches.
Load on chain = 500 pounds.

Required: The amount of chain friction.

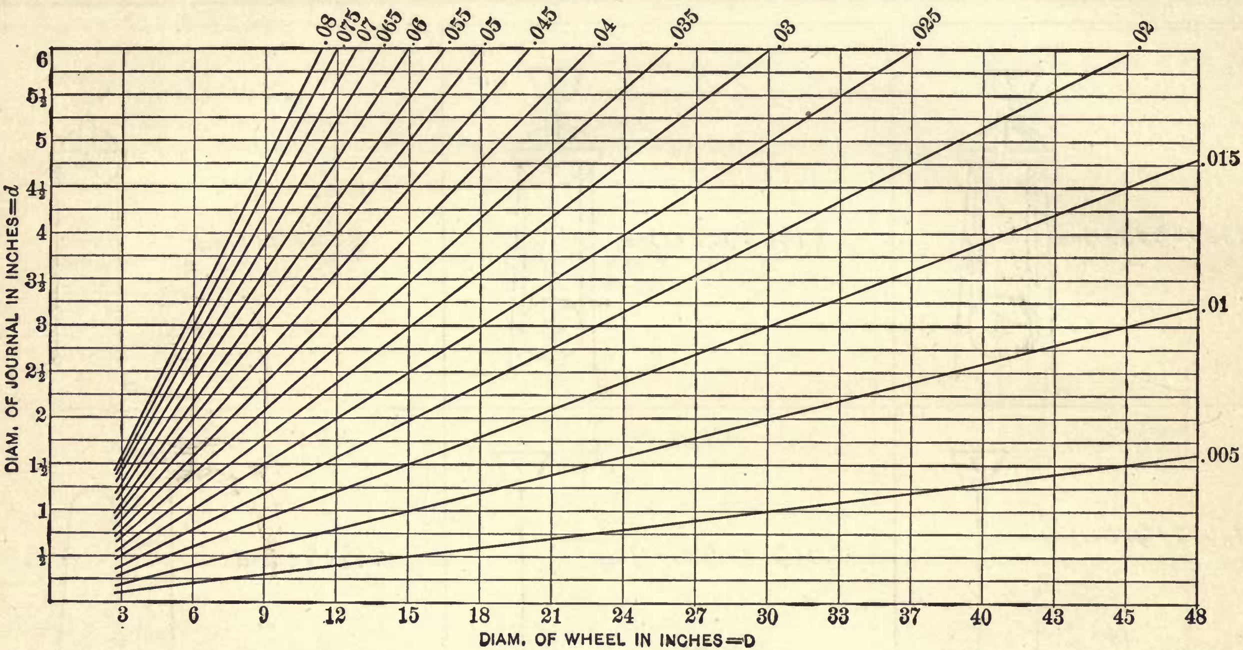
Following horizontally from the ¾ in the left-hand column, indicating the diameter of bar; and vertically from the 30 in the horizontal line, giving the diameters of sheaves; the intersection will fall upon the diagonal line .01. Then,

Chain friction = .01 × 500 pounds = 5 pounds.

Contributed by R. A. Greene, MACHINERY'S Data Sheet No. 30. Explanatory note: Page 38.

DIAGRAM OF JOURNAL FRICTION

SHOWING RESISTANCE AT PITCH DIAMETER OF WHEEL IN TERMS OF LOAD ON THE JOURNAL.



This diagram is based upon a coefficient of friction of .15. Consequently the journal friction $= .15 \frac{d}{D} \times L$.

Where d = diameter of journal, in inches.
D = diameter of wheel, in inches.
L = load on journal, in pounds.

Example:

Diameter of wheel = 30 inches.
Diameter of journal = 5 inches.
Load on journal = 300 pounds.

Required: The amount of journal friction.

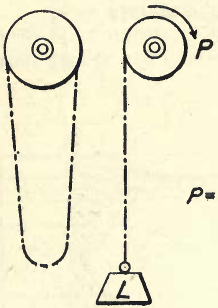
Following horizontally from the 5 in the left-hand column, indicating diameters of journals, and vertically from the 30 in the horizonal line giving the diameters of wheels, the intersection will fall upon the diagonal line marked .025. Then,

Journal friction = .025 × 300 = 7.5 pounds.

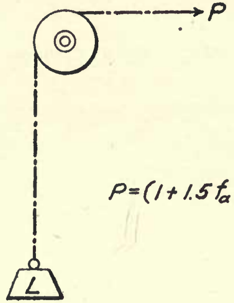
FORCE REQUIRED FOR HOISTING

P = force required to hoist, f_a = journal friction,

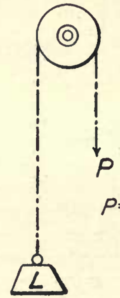
L = load, f_c = chain friction.



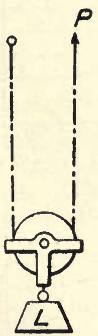
$$P=(1+f_a+f_c)L$$



$$P=(1+1.5f_a+2.1f_c)L$$



$$P=(1+2.1f_a+2.1f_c)L$$



$$P=(1+f_a+f_c)\frac{L}{2}$$

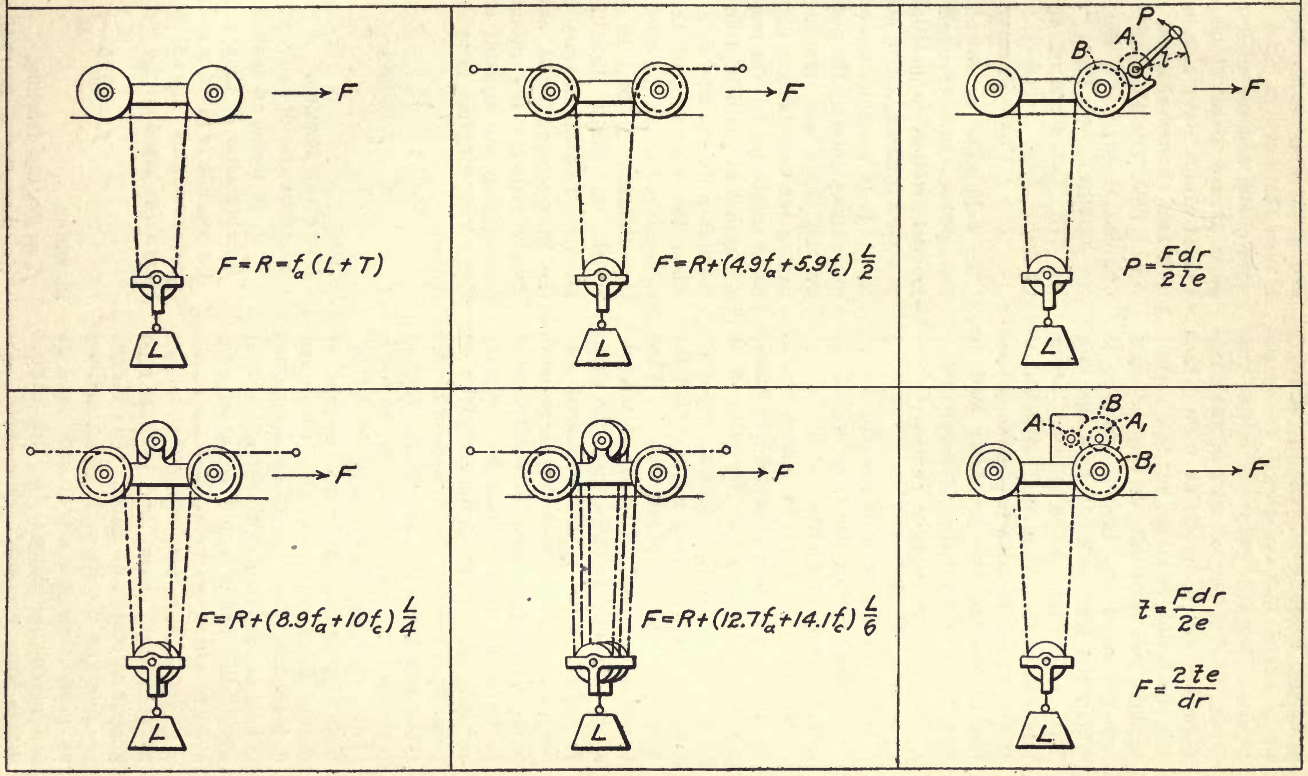
$$P=(1+3.1f_a+3f_c)\frac{L}{4}$$

$$P=(1+5.5f_a+5.2f_c)\frac{L}{6}$$

Contributed by D. W. Bradford. Explanatory note: Page 38.

FORCE REQUIRED TO MOVE CRANE TROLLEYS

F = force required to move trolley,
T = weight of trolley,
d = diam. of driving wheel in inches,
r = ratio of diam. of gear A to gear B,
e = efficiency of gears,
t = inch-pounds torque at motor;
L = load,
l = length of crank arm in inches,
P = force at crank handle,
f_a = journal friction;
f_c = chain friction.



Contributed by D. W. Bradford. Explanatory note: Page 38.

In calculating the strength of chains it should be observed that the strength of a chain link subjected to tensile stresses is not equal to twice the strength of a bar of iron of the same diameter as the material from which the chain link is made, but is a certain amount less than this, due to the bending action caused by the manner in which the load is applied to the link. The weld also reduces the actual strength of the chain link. The following empirical formula is commonly used for calculating the breaking load in pounds of wrought iron crane chains:

$$W = 54{,}000\ D^2$$

in which

W = breaking load in pounds,

D = diameter of bar from which the link is made, in inches.

The working load to which chains should be subjected should never exceed more than one-third of the value of W thus determined, and in many cases not even as high a stress as one-third the breaking load is permissible. When the load does not act in direct tension, as, for example, in cases when the chain is wound round a heavy casting and severe bending stresses thus introduced, a much greater factor of safety ought to be used. Dimensions for ordinary straight link crane chain are given on page 28. Besides the dimensions, this table also gives the weight per foot of the chain in pounds and the strength of the chain, as ascertained by "proof" tests for three different classes of chain, designated as *BB*, *BBB* and dredge chain. The "proof" usually applied is half of the estimated ultimate load at which the chain would collapse. On page 29 are given dimensions for standard cable chains, both of the type known as stud link chain, and of the type known as close link chain. The weight per foot and the strength as ascertained by proof tests are given. On page 31 are given dimensions for the United States Navy standard crane chain. According to this standard a factor of safety of 5 is used. On the same page are given dimensions for eye bolts of a type that may be used in connection with chain, and for other purposes. On page 32 are given dimensions for the United States Navy standard chain end link and narrow shackle. [MACHINERY, April, 1909, The Forging of Hooks and Chains; MACHINERY'S Reference Series No. 61, Blacksmith Shop Practice, Chapter III, The Forging of Hooks and Chains.]

Chain Friction

To determine by calculation exactly the power lost through chain and journal friction in hoisting machinery is a very difficult, not to say impossible, task. It is possible, however, to determine approximately the power consumed by the chain and journal friction by basing the calculations upon known experimental results. On page 34 is given a diagram of chain friction showing the resistance due to one bend of the chain when the diameter of the sheave, in inches, over which the chain is laid, and the diameter of bar, in inches, from which the chain link is made, are known. The explanatory note beneath the diagram and the example given clearly indicate the method used for determining the amount of chain friction. This diagram is based on the formula:

$$f_c = 0.04 \frac{d}{D}$$

in which

f_c = chain friction,

d = diameter of bar from which chain is made, in inches,

D = diameter of sheave, in inches.

On page 35 is given a similar diagram for determining journal friction. This diagram is based on the formula:

$$f_a = 0.15 \frac{d}{D}$$

in which

f_a = journal friction,

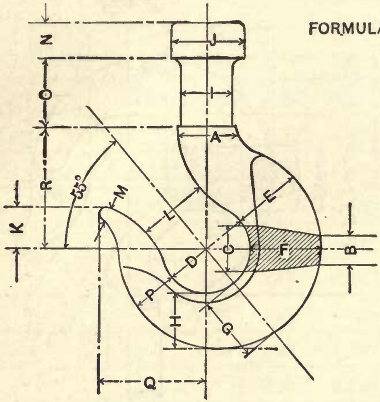
d = diameter of journal, in inches,

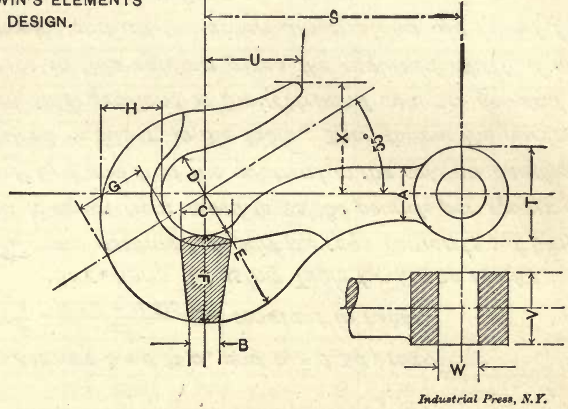
(Continued on page 43.)

DIMENSIONS OF CRANE HOOKS—I

PROPORTIONS OF HOOKS.

FORMULAS FROM UNWIN'S ELEMENTS OF MACHINE DESIGN.





Industrial Press, N.Y.

Tons.	Lbs.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
		Common to Both.								Swivel Hook.										Plain Hook.					
1/8	250	5/8	5/32	35/64	1 5/16	11/16	27/32	3/4	23/32	9/16	13/16	15/16	1	5/16	21/64	9/16	21/32	1 11/16	1 11/16	3	1 1/8	1 1/8	13/16	9/16	1 1/4
1/4	500	11/16	11/64	5/8	1 3/8	3/4	59/64	53/64	25/32	5/8	7/8	31/32	1 1/16	11/32	3/8	5/8	47/64	1 3/4	1 3/4	3 1/4	1 1/4	1 1/4	7/8	5/8	1 3/8
1/2	1000	3/4	3/16	21/32	1 1/2	13/16	1	29/32	55/64	11/16	15/16	1 1/16	1 1/8	3/8	7/16	11/16	51/64	1 15/16	1 15/16	3 9/16	1 3/8	1 3/8	15/16	11/16	1 1/2
1	2000	1 1/16	17/64	15/16	1 3/4	1 5/32	1 27/64	1 9/32	1 13/64	15/16	1 3/8	1 7/32	1 5/16	17/32	41/64	7/8	1 1/8	2 1/4	2 1/4	5	1 7/8	1 7/8	1 3/8	15/16	2 1/8
1 1/2	3000	1 1/4	5/16	1 3/32	2	1 23/64	1 43/64	1 1/2	1 27/64	1 1/8	1 9/16	1 3/8	1 1/2	5/8	51/64	1 1/16	1 5/16	2 9/16	2 9/16	6	2 1/4	2 1/4	1 9/16	1 1/8	2 1/2
2	4000	1 3/8	11/32	1 7/32	2 1/4	1 1/2	1 27/32	1 21/32	1 9/16	1 1/4	1 3/4	1 9/16	1 11/16	11/16	29/32	1 1/4	1 29/64	2 15/16	2 15/16	6 1/2	2 1/2	2 1/2	1 3/4	1 1/4	2 3/4
3	6000	1 3/4	7/16	1 17/32	2 3/4	1 57/64	2 11/32	2 7/64	1 63/64	1 9/16	2 3/16	1 7/8	2	7/8	1 3/16	1 5/8	1 27/32	3 9/16	3 9/16	8 3/8	3 1/8	3 1/8	2 3/16	1 9/16	3 1/2
4	8000	2	1/2	1 3/4	3 1/4	2 11/64	2 43/64	2 13/32	2 17/64	1 3/4	2 1/2	2 1/4	2 7/16	1	1 21/64	2	2 7/64	4 3/16	4 3/16	9 1/2	3 1/2	3 1/2	2 1/2	1 3/4	4
5	10000	2 1/4	9/16	1 31/32	3 3/4	2 7/16	3	2 45/64	2 35/64	2	2 13/16	2 9/16	2 13/16	1 1/8	1 35/64	2 3/8	2 3/8	4 13/16	4 13/16	10	4	4	2 13/16	2	4 1/2
6	12000	2 1/2	5/8	2 3/16	4 1/4	2 45/64	3 11/32	3	2 27/32	2 3/16	3 1/8	2 7/8	3 3/16	1 1/4	1 45/64	2 3/4	2 5/8	5 1/2	5 1/2	10 1/4	4 3/8	4 3/8	3 1/8	2 3/16	5
8	16000	2 7/8	23/32	2 1/2	5 1/4	3 1/8	3 27/32	3 29/64	3 1/4	2 1/2	3 5/8	3 9/16	3 15/16	1 7/16	1 31/32	3 1/2	3 1/32	6 3/4	6 3/4	10 3/8	5	5	3 5/8	2 1/2	5 3/4
10	20000	3 1/4	13/16	2 13/16	6 1/4	3 1/2	4 11/32	3 29/32	3 11/16	2 7/8	4	4 1/4	4 11/16	1 5/8	2 9/32	4 1/4	3 7/16	8	8	10 1/2	5 3/4	5 3/4	4	2 7/8	6 1/2

DIMENSIONS OF CRANE HOOKS—II

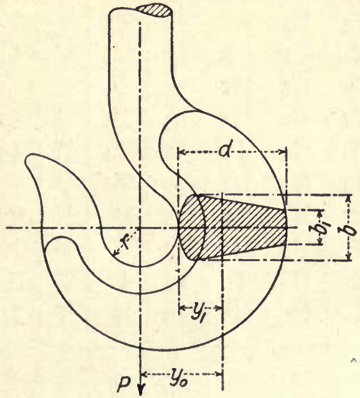


Fig. 1.

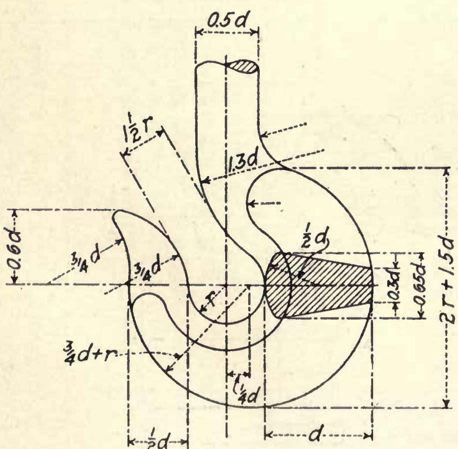


Fig. 2.

Formulas for Crane Hooks.

A = area of section shown in the illustration, in square inches,
f = allowable fiber stress in pounds per square inch
P = load in pounds,
R^2 = square of the radius of gyration in inches.
For b, b_1, d, r, y_0, and y_1, see Fig. 1.

$$\frac{P}{f} = \frac{A}{1 + \frac{y_1 y_0}{R^2}} \qquad A = \frac{b+b_1}{2} \times d$$

$$y_1 = \frac{b+2b_1}{b+b_1} \times \frac{d}{3} \qquad y_0 = \frac{b+2b_1}{b+b_1} \times \frac{d}{3} + r$$

$$R^2 = \frac{(b^2+4bb_1+b_1^2)\,d^2}{18(b^2+2bb_1+b_1^2)}$$

Assume $b = 0.65\,d$, and $b_1 = 0.3d$; then

$$\frac{P}{f} = \frac{d^3}{7.2d + 11.615r} = \text{constant in table.}$$

Directions for using Table for Crane Hooks.

P, f and r are assumed, to suit the requirements; f may be assumed to equal from 16,000 to 25,000 pounds per square inch. Divide P by f and find the quotient in the column headed by the required radius r in the table. Then follow the horizontal line from this quotient to the left-hand column headed d. The figure in this column gives the required width d of the crane hook, and all the other dimensions are found from Fig. 2 as functions either of d or r.

Contributed by H. J. Mastenbrook, MACHINERY'S Data Sheet No. 110. Explanatory note: Page 43.

DIMENSIONS OF CRANE HOOKS—III

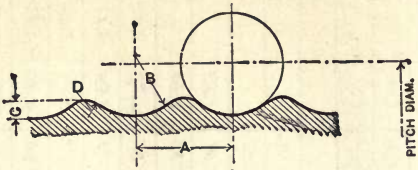
d	Values of r																	
	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	8.00
2.00	0.39	0.34	0.30	0.27	0.25	0.23	0.21	0.18	0.16	0.14	0.13							
2.25	0.51	0.45	0.40	0.37	0.33	0.31	0.28	0.25	0.22	0.20	0.18							
2.50		0.58	0.52	0.48	0.44	0.40	0.37	0.33	0.29	0.26	0.24	0.22						
2.75		0.73	0.66	0.60	0.55	0.51	0.48	0.42	0.38	0.34	0.30	0.28						
3.00			0.81	0.74	0.69	0.64	0.60	0.53	0.47	0.43	0.39	0.36	0.34					
3.50			1.16	1.08	1.00	0.94	0.88	0.79	0.71	0.65	0.60	0.55	0.51					
4.00				1.47	1.38	1.30	1.23	1.10	1.00	0.92	0.85	0.79	0.73	0.69				
4.50				1.94	1.82	1.72	1.63	1.48	1.35	1.24	1.15	1.07	1.00	0.94				
5.00					2.34	2.22	2.11	1.92	1.76	1.63	1.51	1.41	1.33	1.25	1.18			
5.50					2.92	2.78	2.65	2.42	2.23	2.08	1.93	1.81	1.70	1.60	1.52			
6.00						3.40	3.25	2.99	2.77	2.57	2.41	2.26	2.13	2.01	1.91	1.82		
6.50						4.08	3.91	3.61	3.36	3.13	2.94	2.76	2.61	2.48	2.35	2.24		
7.00							4.66	4.32	4.03	3.77	3.54	3.34	3.16	3.00	2.86	2.72	2.60	
7.50							5.46	5.08	4.75	4.46	4.20	3.96	3.76	3.58	3.41	3.25	3.11	
8.00								5.91	5.54	5.21	4.92	4.76	4.43	4.21	4.02	3.84	3.68	3.42
8.50								6.80	6.40	6.03	5.68	5.41	5.14	4.91	4.68	4.49	4.30	3.96
9.00									7.32	6.92	6.55	6.24	5.94	5.67	5.42	5.20	4.99	4.62
9.50									8.30	7.86	7.47	7.11	6.77	6.47	6.20	5.96	5.72	5.31
10.00										8.88	8.44	8.05	7.68	7.37	7.06	6.78	6.52	6.07
10.50										9.96	9.48	9.06	8.66	8.30	7.97	7.67	7.38	6.87
11.00											10.60	10.10	9.70	9.31	8.95	8.61	8.28	7.73
11.50											11.70	11.20	10.80	10.30	9.97	9.62	9.27	8.66
12.00												13.70	13.10	12.60	12.10	11.70	11.20	10.50

Figures in body of table are values of $\frac{P}{f}$

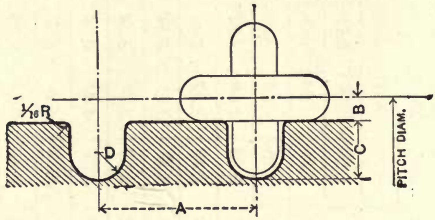
Contributed by H. J. Mastenbrook, MACHINERY'S Data Sheet No. 110. Explanatory note: Page 43.

DRUM SCORES FOR ROPE AND CHAIN

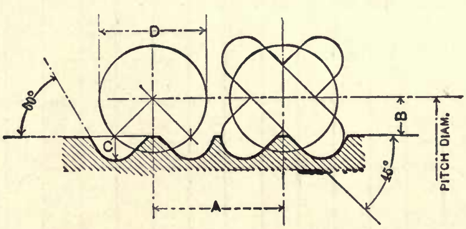
STANDARD DRUM SCORES.



Rope	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
A	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16
B	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	17/32
C	3/32	7/64	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/4
D	3/32	3/32	3/32	1/8	1/8	1/8	5/32	5/32	5/32	3/16	3/16



Chain	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
A	1 1/2	1 11/16	1 7/8	2 1/16	2 5/16	2 1/2	2 11/16	2 7/8	3 1/8	3 5/16	3 1/2
B	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2
C	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16
D	3/16	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2	17/32	9/16



Chain	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
A	1 1/4	1 7/16	1 9/16	1 3/4	1 7/8	2 1/16	2 3/16	2 3/8	2 1/2	2 11/16	2 13/16
B	11/32	3/8	7/16	15/32	17/32	9/16	5/8	21/32	23/32	3/4	13/16
C	3/16	7/32	1/4	9/32	5/16	11/32	3/8	13/32	7/16	15/32	1/2
D	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4

Contributed by R. A. Greene. MACHINERY'S Data Sheet No. 30.

D = diameter of circle at the periphery of which the load is applied.

On page 36 formulas are given for determining the total force required to hoist a given load with different kinds of hoisting apparatus when the chain and journal frictions are taken into consideration. On page 37 formulas are given for determining the force required to move crane trolleys when a certain load is suspended and the chain and journal friction are taken into consideration. The values of the journal friction f_a and the chain friction f_c to be inserted into these formulas are obtained from the diagrams on pages 34 and 35. In this case the values used are, of course, the values read off on the upper and right-hand sides of these diagrams.

Crane Hooks

On page 39 are given proportions of crane hooks based upon the formulas given by Prof. Unwin. The dimensions here given include hooks of a capacity up to 10 tons, which is the capacity to which tables of dimensions of crane hooks found in hand-books usually apply. Hooks of these capacities are largely the result of practice, and are forged from a rod of uniform cross-section for reasons of economy in manufacture. They are, however, not always as economical as regards the use of the material as might be desired. In designing a hook of large capacity the matter of weight is of much more importance than the cheapness of production, and it is important to distribute the metal in the most economical manner and to obtain the necessary strength with a minimum of weight. The shape of the cross-section of a hook is such that it does not lend itself readily to exact mathematical treatment, but approximations may be made which are fairly accurate and which experience has shown to be safe. On page 40 is given a set of fundamental formulas for the design of crane hooks of large capacities, and on page 41 a table of dimensions is given, by means of which the work of determining the size of crane hooks for various capacities is greatly facilitated. Hooks designed by this table have been thoroughly tested in practice and have given entire satisfaction. For ordinary service, a fiber stress of from 16,000 to 25,000 pounds may be safely used.

When using the table on page 41 for designing crane hooks, the load P, in pounds, which the hook will be required to carry, is first determined. Then the allowable fiber stress f is assumed, and the quotient $\frac{P}{f}$ obtained. This quotient is found in the body of the table under the value of the radius r required in the hook. When the nearest value to $\frac{P}{f}$ in the table has been located in the vertical column under the radius, follow the line horizontally to the left-hand column, which gives the dimension d directly. All the other dimensions are proportioned from the dimension d, as shown in the engraving Fig. 2 on page 40.

As an example, assume that a crane hook for a 50-ton crane is to be designed, that the radius r is required to be 3 inches, and that the allowable unit fiber stress is 20,000 pounds. Expressed in pounds, $P = 100,000$ pounds. This divided by 20,000 gives us the quotient 5, which is found in the table in the vertical column under 3-inch radius. It will be seen that the nearest value to 5 is 4.75, and following the horizontal line in which 4.75 is found, to the left-hand column for d, we find $d = 7.5$ inches. All the other dimensions can now be found by inserting this value of d in the formulas in Fig. 2, page 40.

Most of the available information relative to hooks is better suited to meet the needs of the designer than the maker, and a few remarks relative to the making of crane hooks may be of interest in this connection. When hooks of either of the types shown on page 39 are to be made, stock of the diameter *A* of the hook should be used. If a hook is made in proportion to a chain to which it is to be attached, the easiest and simplest manner of determining the right diameter of material to use is to multiply the diameter of the material of which the chain is made by 2.5. For obtaining the length of the material for the hook, multiply the diameter of the stock for the hook by 7. Take, for example, a chain of standard pattern made from material one-half inch in diameter, which is generally recognized as the proper size for a working load of 1½ ton. Thus, ½ inch × 2.5 = 1¼ inch = required diameter of stock for hook. In order to find the length of the material to use, we have 1¼ × 7 = 8¾ inches. Therefore 8¾ inches of material 1¼ inch in diameter is the proper amount of stock to use for a hook that will support a working load of 1½ ton. If properly forged, a hook made from this material will be according to the dimensions given for crane hooks on page 39. The best material for hooks is a good grade of wrought iron. [MACHINERY, April, 1909, Crane Hooks, and The Forging of Hooks and Chains; MACHINERY'S References Series No. 61, Blacksmith Shop Practice, Chapter III, The Forging of Hooks and Chains.]

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