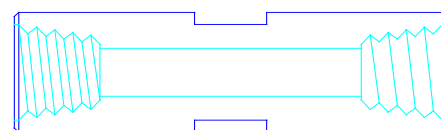
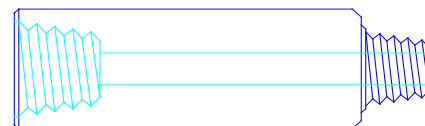
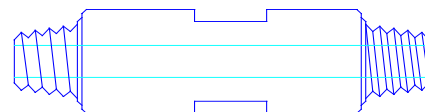
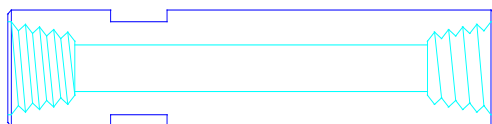
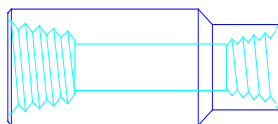
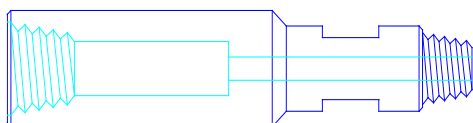


Mills Machine Rotary Substitute Adapters (Subs) are made from 4142 heat-treated alloy steel. They are made to any length, outside diameter, inside diameter or thread combination. We do inventory the most common subs in stock. We carry a large inventory of steel stock and are able to custom manufacture any sub to meet your specific requirements at competitive prices and with a quick turn around.

Subs can be made with a breakout configuration for any rig. Unless otherwise specified our standard flat is 2" long and 3/8" deep per side. We manufacture single flats, double depth flats, extra long flats, beveled flats, or flats to meet your specific needs. Breakout lugs are also available. Flats or lugs normally add to the length of the sub.

The outside and inside diameter of the sub should match up to the drill rod that you are using. We should always be aware of the largest O.D. and at the smallest I.D. in your drill string.



When going from a large connection to a smaller connection, a bottleneck may be furnished to reduce the weight of the sub and make it easier to breakout. The bottleneck is normally cut on a 45° angle and may add length to the sub.

Any box thread can be bored out to accept a float (check) valve. The valve will add length to the sub depending on the length of the valve. The valves are sized to the box thread and can be seen in the last section of this catalog (Misc. Drilling Accessories). The bored out sub can be furnished with a float valve installed. We also stock float valve repair parts, prices on request.

Please use the application questionnaire for Subs at the back of this section.

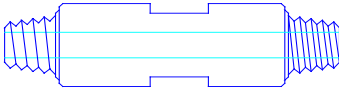
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Sub Variations

Mills Machine will furnish you any variation of the sub needed to complete your drill string or job requirements. Some of the variations that we normally find are the breakout flats, special flats, breakout lugs, extra length, bottle necks, knurling and float valves. These are listed in the following price sheets. Some of the other sub configurations are:

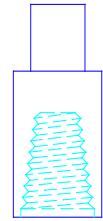
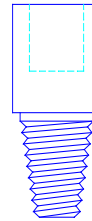
Kelly Subs or Kelly Adapters or Kelly Saver.

This terminology refers to a sub used between the Kelly or top head drive and the drill pipe. It is usually a pin to pin sub that takes the wear abuse to protect the drill pipe and the drive connection. **Mills can furnish the subs along with the fluted, hex or square Kelly Bar drive itself.**



Weld-on or Thread-on Tool Joint Subs.

These subs are designed with one end to shrink fit or screw on the end of your drill tube and then be welded. The opposite end is the pin or box of your choice.



Pin or Box to Blank Subs. Similar in use to the above subs, these have a blank face either solid or with an ID on the end opposite the pin or box.

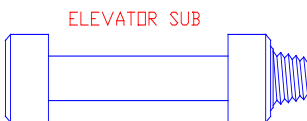


Shock Subs. These are specialized subs designed to absorb the shock vibrations created by a down-hole hammer and prevent damage to the drill string and the top head drive.

Floating or Cushion Subs. These subs absorb shock vibrations transmitted up through the drill string built to protect the pipe, the construction is simpler with more vertical movement in the sub.

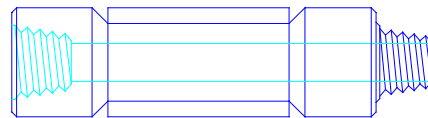
Special ID. We will furnish subs bored to a special ID, either smaller or larger than standard or for special cases with no ID bore.

Jet Subs. These subs are designed with the water flow to jet out the sides of the sub to assist cleaning the perforated pipe or screen.



Elevator Lift Subs. These narrow-necked subs provide a lifting area for use with standard pipe elevators. They are commonly used with internal flush (IF) pipe.

Break Out Lugs. Lugs are sometimes used instead of flats to give extra purchase for disconnecting subs.

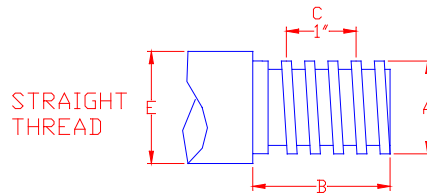
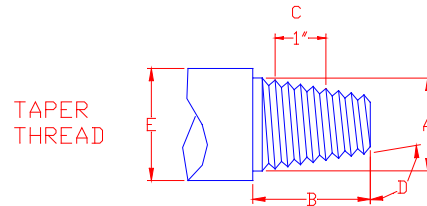


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Sub Measurement

Often we come across undefined tool joints. The thread identification is normally stamped on the tool joint. If that stamp is worn or is not present you need specific information to determine the tool joint identification. The way to define the pin tool joint (The box tool joint is hard to measure and measurement has often lead to errors) is to measure:

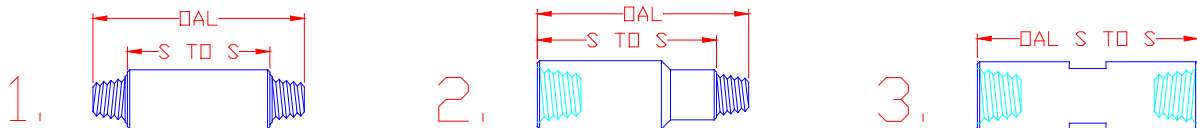
- A. The diameter of the base of the pin where it meets the sub body (shoulder).
- B. The thread length. Measured from shoulder to the end of the tool joint.
- C. The number of threads per inch - put the 0 mark of a ruler on the center of the first thread, don't count that thread, then count the threads to the one inch mark (see sketch).
- D. The thread form (taper, square, acme, special, etc.)
- E. The material OD - this may differ within threads, but is a cross check.



Your free thread ruler is at the beginning of this catalog. It will assist you in determining the thread. If you need additional copies, please contact your sales representative.

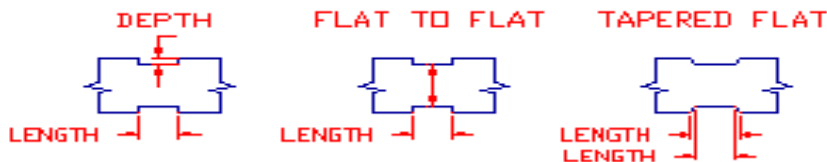
If there are problems measuring the part, send it to our engineers who can match the tool joint with one of over 600 thread gages we have in stock or in the API reference books.

Subs have two length measurements. The first is the over-all-length (OAL), this is the length from the tip to tip of the sub - the longest dimension of the sub. The second is the shoulder-to-shoulder or working length (S to S), the working dimension of the sub in the drill string. It is measured from the shoulder face of the pin to the shoulder face of a pin on pin to pin subs (1.). On a pin to box sub it is measured from the shoulder face of the pin end to the end of the box end (2). On a box to box sub the OAL and S to S are the same (3).



Flats depths on subs may be measured in two different ways. The first, and most common, is by the depth

of the flat from the diameter of the sub (1), how much material is removed. The second method of measurement is to measure the distance between the flat surface to flat surface (2), or the opening of the pipe-handling tool. If the flat has a taper, please give us the length at the top and again at the bottom of the flat (see sketch).



Mills Machine stocks the thread gages for over **600 different tool joint** connections for use in the water well, construction, mining, utility, horizontal and environmental drilling industries. The threads are manufactured to meet the specifications of the American Petroleum Industry or the Diamond Core Drilling Manufacturers Association.

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Stock Subs

Subs (Rotary Adapters or Substitutes)

The Subs listed below are what we consider to be stock standard sizes and the working length will accept standard break out flats.

All of our subs are manufactured from 4142 heat treated alloy steel on computerized lathes enabling us to offer better pricing and availability.

Many other sizes are available in a multitude of configurations from the over 600 thread gages we have in stock. For quantities of ten or more please call us for special pricing.

Part Number	Box to Box	Dimensions	Working
		O.D x I. D.	Length
PSBBMJR238R	MJR to 2 3/8 Regular	2 3/4 – 3 1/8 BN x 1 1/2	10"
PSBBMJR278R	MJR to 2 7/8 Regular	2 3/4 – 3 3/4 BN x 1 1/2	10"
PSBBMJR312R	MJR to 3 1/2 Regular	2 3/4 – 4 1/2 BN x 1 1/2	10"
PSBBMJR412R	MJR to 4 1/2 Regular	2 3/4 – 5 1/2 BN x 1 1/2	12"
PSBBMR238R	MR to 2 3/8 Regular	3 1/4 x 1 1/2	10"
PSBBMR278R	MR to 2 7/8 Regular	3 1/4 – 3 3/4 BN x 2"	10"
PSBBMR312R	MR to 3 1/2 Regular	3 1/4 – 4 1/2 BN x 2"	10"
PSBBMR412R	MR to 4 1/2 Regular	3 1/4 – 5 1/2 BN x 2"	12"
PSBB238IF238R	2 3/8 IF to 2 3/8 Reg	3 1/2 x 1 1/2	10"
PSBB238IF278R	2 3/8 IF to 2 7/8 Reg	3 1/2 – 3 3/4 BN x 2"	10"
PSBB238IF312R	2 3/8 IF to 3 1/2 Reg	3 1/2 – 4 1/2 BN x 2"	10"
PSBB238IF412R	2 3/8 IF to 4 1/2 Reg	3 1/2 – 5 1/2 BN x 2"	10"
PSBB278IF312R	2 7/8 IF to 3 1/2 Reg	4 1/2 x 2"	10"
PSBB278IF412R	2 7/8 IF to 4 1/2 Reg	4 1/2 – 5 1/2 BN x 2"	10"
	Pin to Box		
PSBB312R412R	3 1/2 Reg to 4 1/2 Reg	4 1/2 – 5 1/2 BN x 1 1/2	9"

BN – Bottleneck for Break-out Flats

We also stock smaller quantities of 2 3/8 & 2 7/8 FEDP and Mayhew FH Box-Regular Box, MR & 2 3/8 IF Pin-Pin and 4 1/2 Reg Pin to 6 5/8 Reg Box.

Custom threads and other configurations (breakout flats, float valve bore, etc.) are available from over 600 thread gages in Stock!

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 Phone: 800-654-2703 or 405-273-4900 Fax: 405-273-4956

Tool Joint Thread Chart

The thread dimensions shown in the following chart are those that may be used to determine a thread type in the field. For specific details of the threads, please contact Mills Machine Co., Inc. or refer to the DCDMA Standards book.

Tool Joint Name and Nominal Size	Material		Pin Dimensions			Box Dimensions		Taper	Thread	
	O. D.	Make to Dia.	Pin Length	Pin ID	Pin Dia. At Base	Box Length	Box Max ID		Thread /Inch	Thread Form

Section 1 - Popular Sizes

API REGULAR (Reg.)

2 3/8 REG	3 1/8		3"	1"	2.625	3 1/4	1 3/4	3	5	TAPER
2 7/8 REG	3 3/4		3 1/2	1 1/4	2.990	3 3/4	2"	3	5	TAPER
3 1/2 REG	4 1/4	4 1/2	3 3/4	1 1/2	3.490	4"	2 7/16	3	5	TAPER
4 1/2 REG	5 1/2		4 1/4	2 1/4	4.600	4 1/2	3 1/4	3	5	TAPER
5 1/2 REG	6 3/4		4 3/4	2 3/4	5.515	5"	3 3/8	3	4	TAPER
6 5/8 REG	7 3/4	8"	5"	3 1/2	5.975	5 1/4	4 3/4	2	4	TAPER
7 5/8 REG	8 7/8	9"	5 1/4	3 1/2	6.975	5 1/2	5 1/4	3	4	TAPER
8 5/8 REG	10"		5 3/8	4"	7.951	6 1/4	6 5/8	3	4	TAPER

API INTERNAL FLUSH (IF)

2" IF	2 3/8		2 1/4	1 1/8	1.975	2 3/4	1 1/2	2	4	TAPER
2 3/8 IF	3 1/2		3"	1 5/8	2.860	3 1/4	2 1/8	2	4	TAPER
2 5/8 IF LH	3 3/4		3 1/4	1 3/4	3.128	3 5/8	2 1/4	2	4	TAPER
2 7/8 IF	4 1/8	4 1/2	3 1/2	2 1/8	3.385	3 3/4	2 1/2	2	4	TAPER
3 1/2 IF	4 3/4		4"	2 11/16	4.000	4 1/4	3 1/4	2	4	TAPER
4" IF (4 1/2 XH)	6"		4 1/2	3 1/4	4.828	4 3/4	3 1/2	2	4	TAPER
4 1/2 IF (5 XH)	6 1/8		4 1/2	3 3/4	5.250	4 3/4	4"	2	4	TAPER
5 1/2 IF	7 3/8		5"	4 13/16	6.390	5 1/2	5 1/16	2	4	TAPER
6 5/8 IF	9"		5"	3 3/4	7.459	5 5/8	6 1/4	2	4	TAPER

API FULL HOLE (FH)

2 7/8 FH	4 1/4	4 1/2	3 1/2	2 1/8		3 7/8	2 1/8	3	5	TAPER
3 1/2 FH	4 5/8		3 3/4	2 7/16	3.990	4"	2 7/8	3	5	TAPER
4" FH	5 1/4		4 1/2	2 13/16	4.270	4 3/4	3 1/4	2	4	TAPER
4 1/2 FH	5 3/4		4"	3"	4.782	4 1/4	3 1/4	3	5	TAPER
5 1/2 FH	7"		5"	4"	5.828	5 1/2	4 1/4	2	4	TAPER
6 5/8 FH	8"		5"	5"	6.740	5 1/2	5 1/2	2	4	TAPER

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Tool Joint Thread Chart

Tool Joint Name and Nominal Size	Material		Pin Dimensions			Box Dimensions		Taper	Thread	
	O. D.	Make to Dia.	Pin Length	Pin ID	Pin Dia. At Base	Box Length	Box Max ID		Thread /Inch	Thread Form

MAYHEW

JUNIOR (MJ)	2 3/4		2 1/4	1 1/4	2.320	2 1/2	1 11/16	2	4	TAPER
REGULAR (MR)	3 1/4		3"	1 1/2	2.555	3 1/4	2"	1 1/2	4	TAPER
FULLHOLE (MFH)	3 3/4		3 3/8	2"	3.045	3 5/8	2 3/8	1 1/2	4	TAPER

FAILING EXPLORATION

2 3/8 FEDP	3 1/8		2 3/4	1 3/8	2.480	3"	1 3/4	2	4	TAPER
2 7/8 FEDP	3 3/4		3 1/4	1 7/8	3.100	3 1/2	2 1/4	2	4	TAPER

SQUARE THREAD & DCDMA THREADS

3 THREAD N ROD	2 3/8		2 3/4	1"	1.860	3"	1 5/8		3	SQUARE
4 THREAD N ROD	2 3/8		2 3/4	1"	1.865	3"	1 5/8		4	SQUARE
A ROD	1 5/8		1 7/8	9/16	1.260	2 1/8	1 1/16		3	SQUARE
AW ROD	1 3/4		1 7/8	5/8	1.365	2 1/8	1 1/4		3	SQUARE
AWJ (AWML)	1 3/4		1 3/4	5/8	1.425	1 7/8	1"	2	5	TAPER
E ROD	1.305		1 3/4	7/16	0.996	2"	7/8		3	SQUARE
B W	2 3/8		2 1/4	3/4	1.680	2 5/8	1 3/8		3	SQUARE
BQ	2 3/16		4 3/4	1 13/16		2"	1 13/16	1/2	3	TAPER
HW	3 1/2		3 1/4	2 1/4		3 1/2	2 13/16		3	SQUARE
EW	1 3/8		1 9/16	7/16	1.050	1 3/4	7/8		3	SQUARE
NW	2 5/8		2 3/4	1 3/8	2.210	3"	2"		3	SQUARE
NWJ (NWML)	2 5/8		2 3/8	1 1/4	2.240	2 3/4	1 1/2	2	4	TAPER

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Tool Joint Thread Chart

Tool Joint Name and Nominal Size	Material		Pin Dimensions			Box Dimensions		Taper	Thread	
	O. D.	Make to Dia.	Pin Length	Pin ID	Pin Dia. At Base	Box Length	Box Max ID		Thread /Inch	Thread Form

Section 2 - Other Sizes

API X-HOLE (XH)

3 1/2 XH	4 7/8		3 1/2	2 7/16	3.800	3 7/8	2 7/8	2	4	TAPER
4 1/2 XH Same as 4 IF. Use those dimensions.										
5" XH Same as 4 1/2 IF. Use those dimensions.										

HACKER

JUNIOR	3 1/8		2 1/4	1 7/8	2.685	2 3/4	2 1/8	1 3/4	5	TAPER
SENIOR	3 1/2		2 1/2	1 3/4	2.895	2 3/4	2 1/4	1 1/2	4	TAPER
4" HACKER	5 7/8		3 5/8	3 3/4	5.215	4"	4 3/8	1 1/2	4	TAPER
6 5/8 HACKER	7 1/2		3 1/16	6"	6.935	3 1/2	6 1/4	1 1/2	4	TAPER
8 5/8 HACKER	10 1/2		4 1/2	7 1/2	9.460	5"	8"	2	4	TAPER

BECO

3 1/2 BECO	4 3/4		3 3/4	1 1/2	3.970	4 1/4	2 1/4	3	2	TAPER
4 1/2 BECO	5 3/4 or 6 1/2		4 1/4	2 1/4	5.000	5"	3 1/4	3	2	TAPER
5 1/4 BECO	7"		5 3/4	2 13/16	5.750	5 1/2	3 3/4	3	2	TAPER
6" BECO	7 5/8 or 8 3/4		6 1/2	3"	6.500	5 1/2+	4 1/2	3	2	TAPER
8" BECO	10 3/4 or 12 3/4		4 7/8	5"	8.500	5 1/2+	6 1/4	3	2	TAPER

CA-21 (DEEP ROCK)

CA 21	2 1/4		1 1/4	1 1/8	1.765	1 1/2	1 1/2	1 1/2	6	TAPER
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E U E

Nominal Size	API Size										
3/4	1.050	1.560		1 1/8	1.315	0.825	1 3/8		3/4	10	TAPER
1	1.315	1.900		1 1/4	1.469	1.049	1 1/2		3/4	10	TAPER
1 1/4	1.660	2.200		1 3/8	1.825	1.380	1 3/4	1 1/2	3/4	10	TAPER
1 1/2	1.900	2.500		1 7/16	2.093	1.610	1 7/8	1 3/4	3/4	10	TAPER
2"	2 3/8	3.063		1 15/16	2.625	1.995	2 3/8	2 1/4	3/4	8	TAPER
2 1/2	2 7/8	3.668		2 1/8	3.113	2.441	2 1/2	2 1/2	3/4	8	TAPER
3"	3 1/2	4.500		2 3/8	3.795	2.992	2 3/4	3 5/16	3/4	8	TAPER
3 1/2	4"	5.000		2 1/2	4.250	3.476	2 7/8		3/4	8	TAPER
4"	4 1/2	5.563		2 5/8	4.790	3.958	3"		3/4	8	TAPER

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Tool Joint Thread Chart

Tool Joint Name and Nominal Size	Material		Pin Dimensions			Box Dimensions		Taper	Thread	
	O. D.	Make to Dia.	Pin Length	Pin ID	Pin Dia. At Base	Box Length	Box Max ID		Thread /Inch	Thread Form

HACKER FAILING

6 5/8 HF	8"		3 1/2	6"	7.310	4 1/2	6 1/2	1.5	4	TAPER
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*Also, known as 7" Hacker

MOBILE

2 5/8 MOBILE	2 5/8		2 1/2	1 1/4	2.240	2 7/8	1 3/4	2	5	TAPER
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NATIONAL PIPE THREAD

1" NPT	1 3/4		1"	1"	1.325	1 1/4	1 1/8	3/4	11 1/2	TAPER
1" NPT LH	1 3/4		1"	1"	1.325	1 1/4	1 1/8	3/4	11 1/2	TAPER
1 1/4 NPT	2"		1"	1 1/4	1.660	1 1/4	1 3/8	3/4	11 1/2	TAPER
1 1/2 NPT	2 1/4		1 1/8	1 1/2	1.950	1 3/8	1 5/8	3/4	11 1/2	TAPER
2" NPT	2 3/4		1 1/8	2"	2.385	1 5/8	2 1/8	3/4	11 1/2	TAPER
2" NPT LH	2 3/4		1 1/8	2"	2.385	1 5/8	2 1/8	3/4	11 1/2	TAPER
2 1/2 NPT	3 1/4		1 9/16	2 1/2	2.875	1 3/4	2 5/8	3/4	8	TAPER
3" NPT	4"		1 5/8	3"	3.500	1 7/8	3 1/8	3/4	8	TAPER
3" NPT LH	4"		1 5/8	3"	3.500	1 7/8	3 1/8	3/4	8	TAPER
3 1/2 NPT	4 5/8		1 11/16	3 1/2	4.000	2 1/16	3 5/8	3/4	8	TAPER
3 1/2 NPT LH	4 5/8		1 11/16	3 1/2	4.000	2 1/16	3 5/8	3/4	8	TAPER
4" NPT	5 1/4		1 3/4	4"	4.510	2 1/4	4 1/8	3/4	8	TAPER
4" NPT LH	5 1/4		1 3/4	4"	4.510	2 1/4	4 1/8	3/4	8	TAPER
4 1/4 NPT				4 1/4	4.250			3/4	8	TAPER
5" NPT	6 5/16		2"	5"	5.563	2 1/2	5 1/4	3/4	8	TAPER
6" NPT	7 3/8		2"	6"	6.625	2 1/2	6 1/4	3/4	8	TAPER

P K RED DEVIL

P K Red Devil	2 7/8		3 7/8	1 3/8	2.300	4 1/4	1 7/8	3/4	8	TAPER
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ROCKMASTER

ROCKMASTER	2 3/4		3"	1 1/8	2.030	3 1/4	1 3/4		3	ACME
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WINTER WEISS

2 3/8 WW MOD.	3 1/4		3"	1 1/2	2.535	3 1/4	2"	1.5	4	TAPER
2 7/8 WW MOD.	3 7/16		3"	1 1/2	2.535	3 1/4	2"	1.5	4	TAPER

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

SUB Application Questionnaire

SUB

Rotary Substitute Adapter

Company _____
Address _____
City, State Zip _____
Contact _____

Phone _____
Fax _____
E-mail _____

Quantity**: _____

Top Connection**: _____ Pin

Box

Bottom Connection**: _____ Pin

Box

****Must fill out these items. Fill out more if possible or custom product requested.**

Length: Shoulder to Shoulder _____

OR Overall _____

Top Neck Dimensions: OD _____ ID _____

Knurled Length _____

Bottom Neck Dimensions: OD _____ ID _____

Knurled Length _____

Breakout Flats: Two Sided Four Sided
Special _____

Flat Length _____

Dimensions: Flat to Flat _____

OR Depth per Side _____

Location _____

Lugs: Drill Pipe OD _____

Hour Glass: Location _____ Dimensions _____

Float Valve: Bore Only Install: Customer Furnished

Mills Furnished

Brand _____ Model & Size _____

Special Requirements: _____

Sketch:

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www.MillsMachine.com

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0504

5a-9

Rock Bits

Mills stocks a wide variety and size of rock bit (also known as a roller cone roller bit). The **steel or milled tooth** design features forged steel teeth with cast carbide inserts. The shape of the tooth varies with hardness of the formation being cut. The **tungsten carbide insert (TCI) button** bits use cemented carbide, again designed for the specific formation. The bearings are conventional (roller bearing) or the sealed journal bearing (SJB).

Rock bits have a specific pin tool joint depending on the size of the bit as follows:

Up to 2 15/16 Dia.	4 Thd, Rod
From 3 7/8 to 4 1/2 Dia.	2 3/8 API Reg.
From 4 3/4 to 5 1/8 Dia.	2 7/8 API Reg.
From 5 5/8 to 7 3/8 Dia.	3 1/2 API Reg.
From 7 5/8 to 9 Dia.	4 1/2 API Reg.
From 9 1/2 to 12 1/4 Dia.	6 5/8 API Reg.
From 13 3/4 to 26 Dia.	6 5/8, 7 5/8 or 8 5/8 API Reg.

Steel Tooth Bits:

Steel tooth bits are available as new, limited service, good retip or water well quality as follows:

New - These bits have never been used to drill a hole.

Limited Service - These bits are in like new condition and at a casual glance would pass for a new bit.



Steel Tooth Bit

Good Retip - These bits have totally been reconditioned. The dull teeth have been rebuilt back to working condition with crushed tungsten carbide. The bearings have been greased and in some extreme cases on the Regular roller bits, oversize bearings are installed to tighten up the cones. These bits are suitable for reentry into the shallow drilling market and possess about 50% of the life of a new bit.

Water Well Quality - This is the lowest quality bit available and only limited footage can be expected. Wear check will show relatively loose bearings and weak seals. The teeth have been rebuilt back to gage and the bit will look like a good quality retip.



TCI Button Bit

TCI Button Bits:

The **TCI button bits** are available as new, limited service, good rerun and water well quality as follows:

New - These bits have obviously never been used to drill a hole.

Limited Service - These bits would pass for new at a casual glance. However, they do have a few hours wear that is indicated by slight gage wear. Most of these bits have only been used to complete a hole and thus have limited wear.

Good Rerun - This type of bit normally has 50% life left in it and has been reconditioned to a point of reentry to the shallow well drilling market. Wear is indicated by slight gage wear, slightly weak seals, and slightly worn buttons.

Water Well Quality - This is the lowest quality bit available for even the shallow drilling market as shown by the lower price. The wear indicators for this bit are: weak seals, additional gage wear, possible pump wash, and dull buttons. These bits will offer only limited footage and are usually bought when competitive price is a factor.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Rock Bits

General and IADC Codes

Proper **application** of roller cone bits is mainly **dependent on the formation and hardness** of the material being drilled. It is important that this information be given for the selection of the proper bit for the job.

Rock bits are classified by a three space IADC code. These classifications of letters and numbers spell out the type of teeth, the formation hardness and the bit construction. A short description follows:

- 1-X-X Steel tooth, soft formation having low compressive strength and high drillability.
- 2-X-X Steel tooth, medium to medium hard formation with high compressive strength.
- 3-X-X Steel tooth, hard semi-abrasive formations.
- 5-X-X Button bit, soft to medium formations with low compressive strength.
- 6-X-X Button bit, medium hard formations of high compressive strength.
- 7-X-X Button bit, hard, semi-abrasive and abrasive formations.

The second position designates formation hardness sub-classification from softest to hardest within each series.

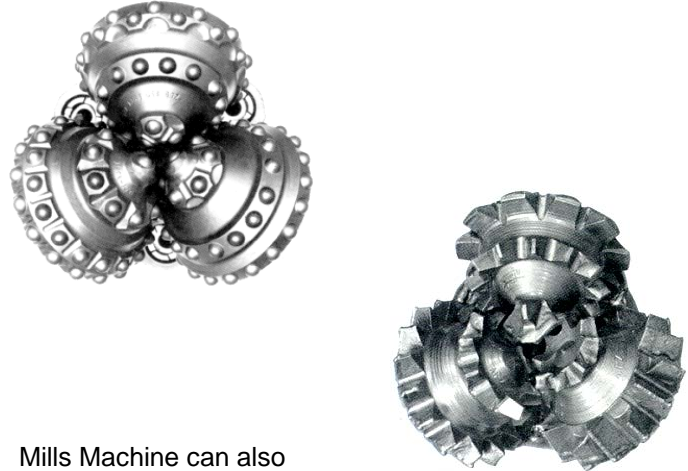
- X-1-X
- X-2-X
- X-3-X
- X-4-X

The third position designates the common construction features.

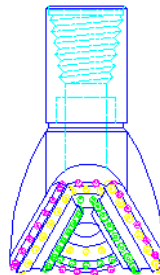
- X-X-1 Standard 3 cone rock bit
- X-X-2 T type gage row teeth.
- X-X-3 Tungsten carbide inserts in face.
- X-X-4 Sealed roller bearings.
- X-X-5 Sealed bearings with inserts in gage face.
- X-X-6 Sealed friction bearings.
- X-X-7 Sealed friction bearings and inserts in gage face.

Call for pricing on the **readily available new, retip or rerun bits**. We will find the limited service and water well quality bits for you as required.

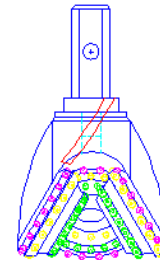
There is no guarantee concerning the footage these bits will drill. The quality of the used bits is determined by our years of experience using sight and feel.



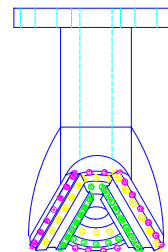
Mills Machine can also modify rock bits to special requirements such as box up, reverse circulation or hex mount as you may require. Our objective is to serve the needs of the drilling industry. How can we help you?



Box Tool Joint



Hex Pin Tool Joint



Reverse Circulation Flange Mount

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Check our Web site:
www.MillsMachine.com

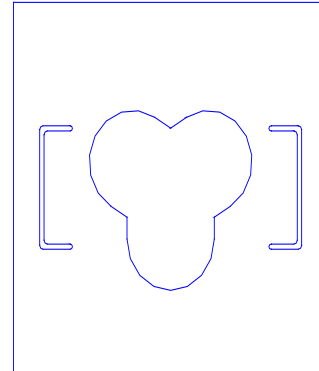
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5b-2

Rock Bit Breakout Plates

Rock bit breakout plates are designed to hold the bit in place while using the rig to remove the bit from the bottom of the drill string. They can be manufactured to the specific dimensions of your drill rig table or opening. The heavy duty steel plate has two handles for ease of use. This handy tool can also be offered with a triangular catch basket to prevent the bit from falling through the bottom.



Basket **NO Basket** **WITH**

Size	Dimensions In Inches	Weight		Dimensions In inches	Weight	
		Lbs	Kgs		Lbs	Kgs
6 3/4	10 x 10	18	8.1	10 x 10 x 4	21	9.5
7 7/8	13 x 13	24	10.9	13 x 13 x 4	27	12.2
8 3/4	14 x 14	27	12.2	14 x 14 x 4	30	13.6
9 7/8	15 x 15	30	13.6	15 x 15 x 4	33	15.0
12 1/4	18 x 18	38	17.2	18 x 18 x 5	46	20.9
15"	21 x 21	56	25.4	21 x 21 x 6	64	29.0
17 1/2	24 x 24	66	29.9	24 x 24 x 6	74	33.5
22"	28 x 28	80	36.3	28 x 28 x 6	90	40.8

For sizes in between the above ranges use the size of the larger breakout plate. Please furnish the dimensions of your rig table (square and depth). We can build the plate specifically for your table. Custom Breakout Plates are non-returnable.

***Breakout plates for down hole hammers bits** are also available.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Application Questionnaire

Rock Bit

Rock Bit

Company _____

Phone _____

Address _____

Fax _____

E-mail _____

City, State Zip _____

Contact _____

Quantity**: _____ Size _____

Pin Size**: _____

Bearing**: Conventional Sealed

Steel Tooth**: New Retip IADC Code _____

Formation: Soft , Med. Soft , Medium ,
Med. Hard , Hard

OR

TCI Button Bit**: New Rerun IADC Code _____

Formation: 1 , 2 , 3 , 4 , 5 ,
6 , 7 , 8 , 9

****Must fill out these items. Fill out more if possible
or custom product requested.**

Jet Size: Standard Special _____ Center Out

Circulation: Air: CFM _____ PSI _____

Fluid: GPM _____ PSI _____

Special Requirements: _____

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

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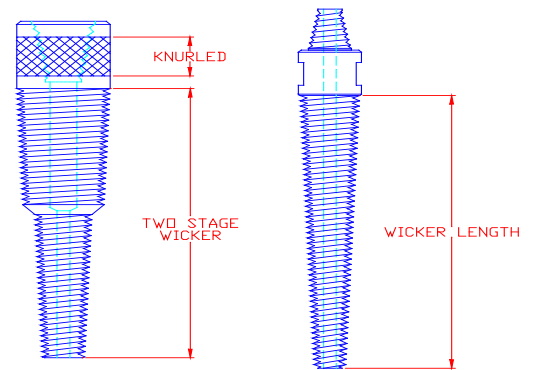
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5b-4

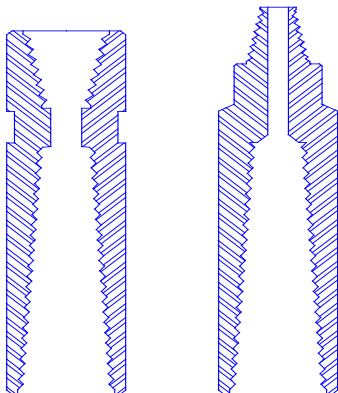
Fishing Tools

Taper Taps: Mills Machine stocks a variety of **casehardened, heat-treated taper taps designed to thread into the ID of the object (fish) lost down the hole.** These tools are stocked with standard tool joints to meet your specific requirement. Our experience has taught us that when a taper tap is required it's needed immediately. We are prepared to meet your emergency requirements. We also, stock a variety of subs to adapt our taper taps to your drill string.



Our standard stock sizes are designed to pick up most standard small to large drill rod sizes. We also offer a quick turnaround for **custom manufactured tools to meet your specific requirements** with options consisting of breakout flats, right-hand or left-hand wickers, any thread, special lengths, oversize guides, mill guides or wall hooks.

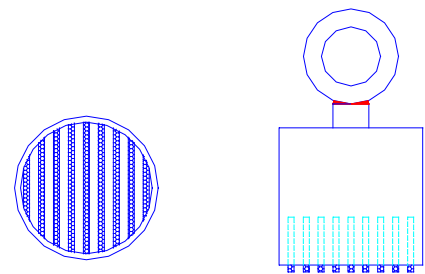
Information of taper taps is on page 5-13 and an application questionnaire on taper taps is at the back of this section.



Overshots: Overshots (rotary die collar) are manufactured like taper taps except they are **made to go over the OD of the object lost down hole** (pages 5-14). Like taper taps, overshots are **stocked in a variety of sizes** and connections so we are able to **ship immediately.** Overshots and taper taps share the same options.

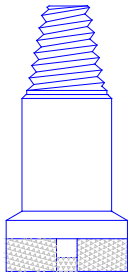
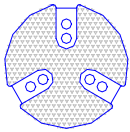
Information of overshots is on page 5-14 and an application questionnaire is at the back of this section.

Fishing Magnets: When taper taps and overshots cannot be used fishing magnets may be the answer to getting your fish out of the hole. Several sizes are carried in stock for your emergency needs. We need to know the ID of the pipe or open hole and the approximate weight of the object. Magnets can lift a specific weight only if there is full contact with the magnet surface. Round or dirty objects reduce the pulling capacity of the magnet. **Circulating magnets that flush the cuttings out of the way are quoted upon request.**

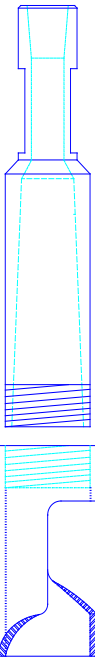


Sizes of fishing magnets are listed on catalog page 5-15 of this section.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"



Junk Mills: Our junk mills, described in detail on catalog page 5-16, are **designed to eliminate steel objects that cannot be fished** by milling them up with a special carbide coated face.

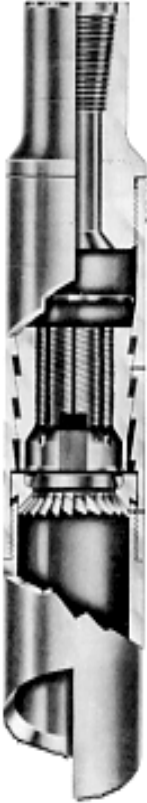


OVERSHOT W/ WALL HOOK

We also offer a variety of other fishing tools and accessories that range from simple to complex fishing tools and their accessories. The releasing and circulating overshoot is the strongest external catch fishing tool designed to let go of the fish if it becomes stuck in the hole. When the pipe is imbedded into the sidewall of the hole, a wall hook may be used to catch and guide it into the overshoot. If the hole is larger than the fish an oversize guide may be required to center the overshoot or taper tap in the hole. Multi-step fishing tools can catch different sizes.

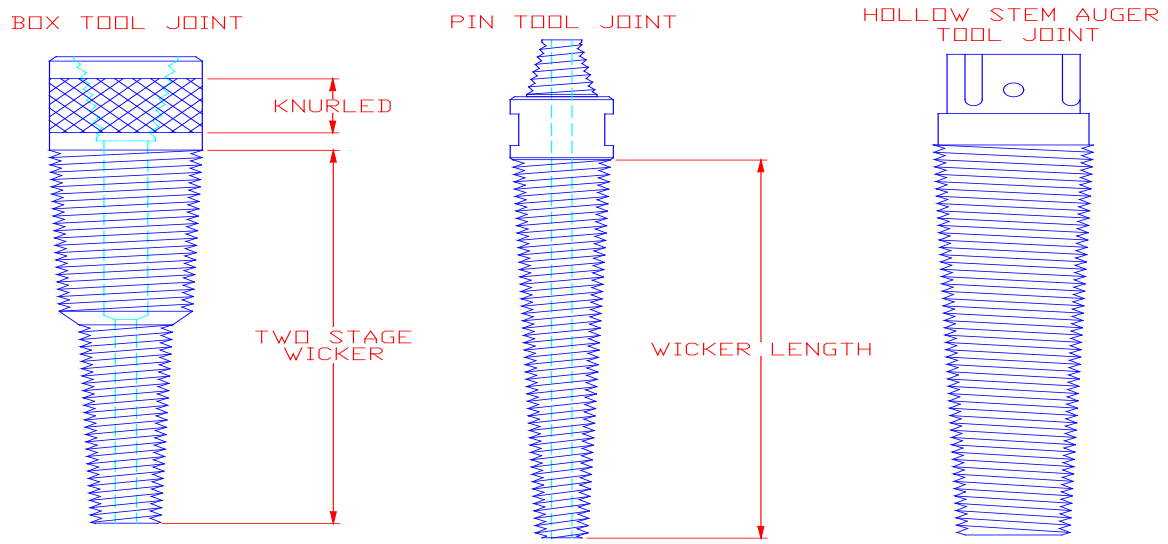


Internal releasing spears are available and work just like the releasing overshoot designed to release the fish if it becomes stuck in the hole. These spears are sized to the specific pipe being used and normally require a little longer lead-time.



"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Taper Taps



Mills stocks a variety of **casehardened, heat-treated** taper taps with standard tool joints to meet your specific requirement. Heat-treating toughens the taper tap making it difficult to damage and easier for you to use. When it takes a special sub to match your tool joint with the taper tap we have in inventory, we can make that sub immediately.

We **stock** several different sizes with standard connections. We also manufacture to your **special requirements** with options of breakout flats, right-hand or left-hand wickers, any thread, special length, oversize guides, mill guide or wall hooks.

Also carried in stock are **Internal Auger Fishing Tools** (A taper tap with left-hand wicker for retrieving hollow stem augers).

Due to the variety of auger tool joints, we stock the heat-treated tap without tool joints and add the tool joint when your order is received.

The carbonized threads on taper taps are extremely hard and brittle. Be extra careful to avoid impact. In use slowly lower the tool down the hole until the fish is engaged. Then slowly rotate the tool while applying some down pressure. Mark the drill rod to tell how far into the fish you have penetrated.

Taper taps can be reworked by annealing, re-threading the tap and then heat treating the re-threaded area. We will quote you pricing as necessary.

Please use the application questionnaire for Taper Taps at the back of this section.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Die Collar Overshot

The Mills Machine Overshot is a **rugged, external catch, fishing** tool that is economical and simple to use. Overshots are manufactured like taper taps except they go over the OD of the fish. Like taper taps, overshots are **stocked** in a variety of sizes and standard connections so we are able to get something to you rapidly.

To build an overshot from scratch takes four to six days due to the heat treat process necessary to harden the teeth. It is speedier to build a sub to fit a stocked overshot and match your needs than to build the entire product.

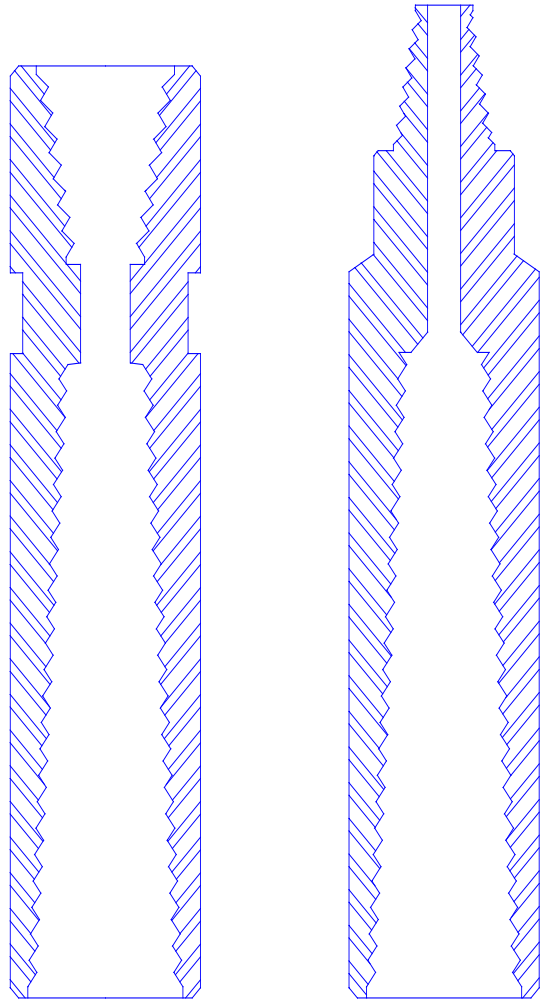
We can build the overshot with oversize guides to more easily catch the fish or with a wall hook to snag behind a fish leaning against the drill hole wall.

Your Mills sales representative will work with you to get the fastest solution to your problem at the lowest cost.

The carbonized threads on overshots are extremely hard and brittle. Be extra careful to avoid impact. In use, slowly lower the tool down the hole until the fish is engaged. Then slowly rotate the tool while applying some down pressure. Mark the drill rod to tell how far into the fish you have penetrated

Overshots can be reworked by annealing, re-threading the overshot and then re-heat treating the re-threaded area. We will quote you pricing as necessary.

Please use the application questionnaire for overshots at the back of this section.



“PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES”

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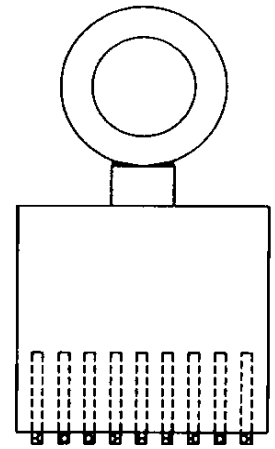
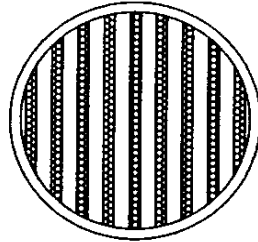
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0504

5c-4

Fishing Magnets

This **Magnetic Fishing Tool** is an Alnico permanent magnet (never needs recharging) that can be lowered into the hole and magnetically latch onto the fish. We recommend this tool for retrieving small objects only! To achieve maximum lift requires a flat clean surface, which is rarely found down the hole.



Magnet sizes that we normally keep in stock are listed below but other sizes are available upon request.

3 1/2 Diameter	150 # lift*
4 1/2 Diameter	350 # lift*
5 1/2 Diameter	600 # lift*
6 1/2 Diameter	800 # lift*

The magnet is lowered into the hole with wire cable or rope. The inside diameter of the eyebolt is 1 1/4.

*** A guaranteed lift capacity is not feasible except on a flat, clean magnetic surface at least 1/4 thick.**

The magnet is shipped with a flat steel plate on the magnetic surface. This protection plate must be removed for use and returned to the magnet for storage.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

0504

5c-5

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Junk Mills

If you cannot fish it out or if you run into concrete and rebar, it is time for the Junk

Mill. Mills Machine manufactures these rugged mills from 4142 heat treated steel and a **composite matrix of large chunks of cutting grade or milling grade, crushed tungsten carbide** rod 1 1/2 to 2" thick on the face.

With this mill you can eliminate anything in your way - rock, drill pipe, casing, tool joints, reamers, and rock bits. To order please specify:

Size O.D. _____

Object to be Milled _____

Footage to be Milled _____

Tool Joint _____

Flats or Knurl _____

Face Structure: Flat, concave, convex, tapered or pilot reamer face.

Circulation _____

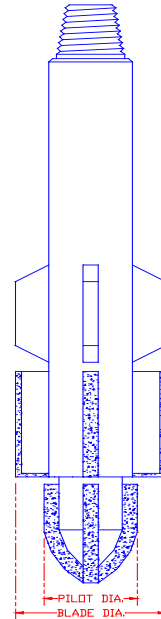
Stabilizer ribs _____

Fishing neck dimensions _____

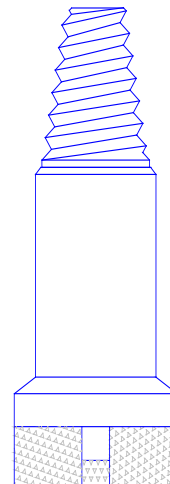
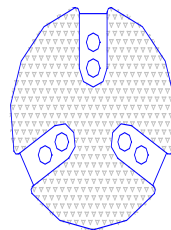
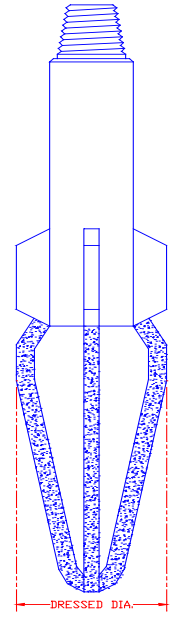
Hole size or if inside casing, casing size _____

These mills can be reworked several times to lengthen their life. Please call for rework prices. If its down hole and you need to get rid of it, the Junk Mill is the tool to use.

PILOT MILL



TAPER MILL



"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

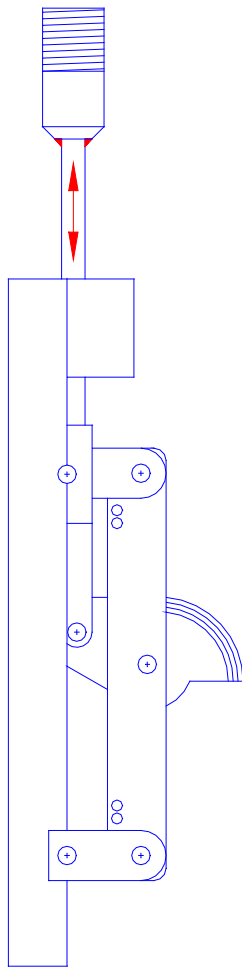
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0504

5c-6

Casing Perforators



The casing perforator (known as a Mills Knife) is used to perforate pipe or casing by punching vertical slots through the casing wall. This tool is designed to cut through steel casing with a maximum wall thickness of .300 and requires a two-line rig. The main wire line is for holding the tool in the hole and plumbing black pipe is used to lower the knife into the hole and trip the perforator blade. The secondary line is a wire line or bailer line to support the knife while the pulling rods are lifted.

As the knife is lowered into the hole the pulling rods are added by joint until the desired depth is reached. A location mark is made on the pipe to show the position of the punched hole. The rod is pulled up with a 3000 to 4000 pound force to extend the knife blade and pierce the pipe. The blade penetration of the steel is felt as a slight jerk through the rod. Lowering the rod releases the knife. The pipe is then rotated the desired degrees if a series of holes is required at that depth.

It is recommended that you practice near the surface to see and feel the operation of the knife before going down hole. Pulling too hard or pulling after penetration can split the pipe. After the perforations are made at the lowest level the drilling rod is raised to the next desired level. This prevents fowling of the wireline.

The top connection is a 2 inch NPT pin. The standard perforator is for 6 inch I. D. casing with no more than .300 wall thickness. Backing Shoes are available that expand the 6" perforating knife to 8" or 10". The 12" perforator can handle a .375 wall and also has backing shoes to expand out to 14 or 16 inches. Other sizes can be quoted upon request.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Application Questionnaire

Taper Tap

Taper Tap

Company _____ Date _____
Address _____ Phone _____
City, State Zip _____ Fax _____
Contact _____

Sketch:

Quantity **: _____
Object to be Retrieved ** _____
Object ID** & OD _____
Top Connection **: _____ Pin Box

****Must fill out these items. Fill out more if possible or custom product requested.**

Depth to fish _____ Weight of fish _____

Length: Shoulder to Shoulder _____

OR Overall _____

Top Neck: OD _____ ID _____ Length _____

Knurl

Breakout Flats:

Two Sided Four Sided

Flat Length _____ Location _____

Dimensions: Flat to Flat _____

OR Depth per Side _____

Wicker: Large OD _____

Small OD _____

Length _____

RH (Standard) OR LH

Special: Oversize Guide _____

Wall Hook _____

Other _____

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0504

5c-8

Application Questionnaire

Die Collar Overshot

Die Collar Overshot

Company	_____	Date	_____
Address	_____	Phone	_____
	_____	Fax	_____
City, State Zip	_____	Contact	_____

Sketch:

Quantity **: _____
Object to be Retrieved** _____
Object ID & OD** _____

Top Connection **: _____ Pin Box

**** Must fill out these items. Fill out more if possible or custom product requested.**

Depth to fish _____ Weight of fish _____

Length: Shoulder to Shoulder _____

OR Overall _____

Top Neck: OD _____ ID _____ Length _____

Knurl

Breakout Flats:

Two Sided Four Sided

Flat Length _____ Location _____

Dimensions: Flat to Flat _____

OR Depth per Side _____

Wicker: Large OD _____

Small OD _____

Length _____

RH (Standard) OR LH

Special: Oversize Guide _____

Wall Hook _____

Other _____

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

0504

5c-9

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Stabilizers

Mills Machine custom manufactured stabilizers are used to keep the drill rod centered in the hole. They are available in a wide range of construction with all wear surfaces coated with carbide hard facing.

All stabilizers are made with heavy walled steel pipe. Stabilizers larger than 8 1/2 OD are normally made with an inner as well as an outer pipe for rigidity and strength. There is full, direct flow circulation provided. We will discuss the specific design with you before accepting your order.

All stabilizers are made with 4142 heat-treated, steel tool joints. All ribs are fully welded on both sides and have hard facing. Optional replaceable cast carbide ribs are available to increase the gage life.

Mills offers **five standard styles of stabilizers**.

The first type is the **Smooth Stabilizer** that is normally a couple of inches smaller than the borehole ID and can have an inner and outer barrel.

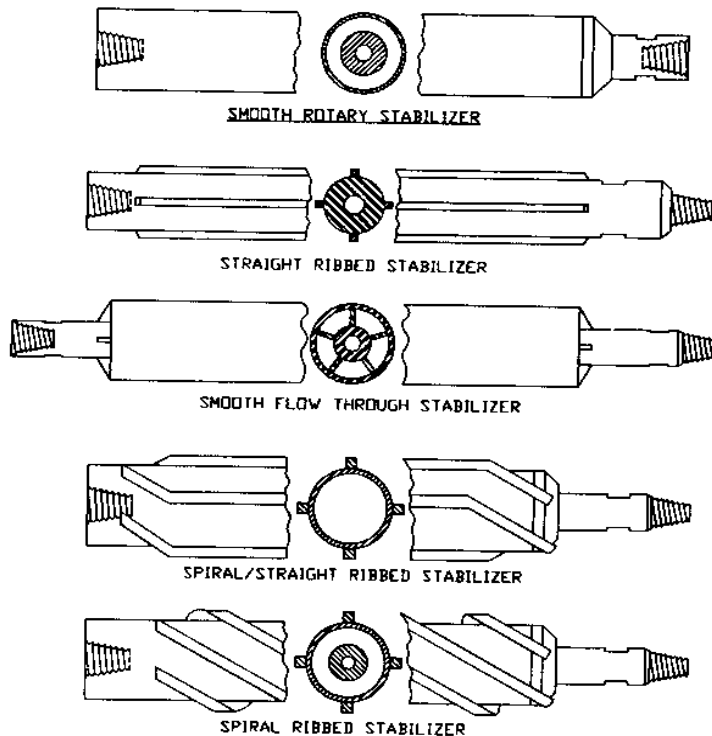
The **Flow Through** is another variation for larger diameters that allow the cuttings to flow between the inner and outer barrel.

Straight Ribbed Stabilizers can have three or more ribs (4 ribs is the most common) depending on the application. The ribs are welded to the steel tubing and are hard faced down the entire length to extend the gage life.

A variation on the straight rib design is the **Spiral Ribbed** stabilizer. The hard faced ribs are hand spiraled around the steel body to give 360 degree wall contact and assist in cutting removal.

The combination **Spiral-Straight Ribbed** stabilizer shown below gives the wall contact of the spiral stabilizer while reducing the cost of the spiraling process.

Finally, there is the **Overhammer Stabilizer** shown in more detail on the following page.



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Phone: 800-654-2703 or 405-273-4900 Fax: 405-273-4956

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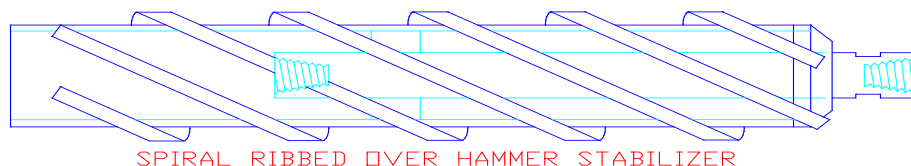
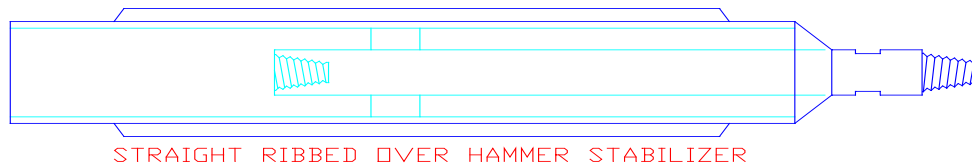
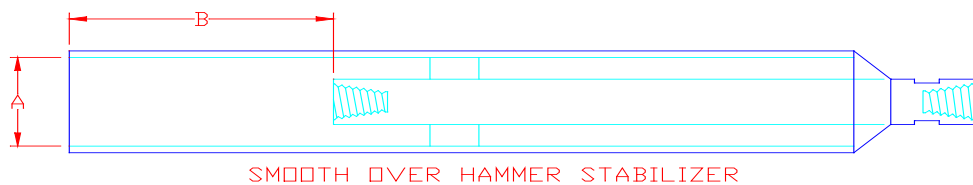
Over-Hammer Stabilizers

The Mills Machine over-hammer stabilizer is built with the rugged construction that is standard for our units and with the ability to take the punishment of direct connection to the down hole hammer. The stabilizer is designed for the specific hammer that it is coupled with.

Although more often of smooth design it can be built with straight or spiral ribs. The top connection matches the drill pipe while the bottom is designed to overlap and protect the hammer.

We can design the top neck to your specific requirements. A float valve can be inserted into the bottom box connection if required.

It is essential that the over-hammer stabilizer application questionnaire at back of this section be filled out for the proper design of the stabilizer.



In building a stabilizer we will build the stabilizer ID, dimension A above, to fit the case diameter. The case housing length, dimension B above, is the length of the stabilizer case over the hammer. These dimensions must be specified.

"PLEASE CALL FOR CUSTOM OPTIONS AND OTHER ACCESSORIES"

Application Questionnaire

Stabilizers **Stabilizers**

Company _____	Phone _____
Address _____	Fax _____
_____	E-mail _____
City, State Zip _____	Contact _____

Sketch:

Quantity **: _____ Length: Shoulder to Shoulder _____
OR Overall _____

Hole Size **: _____

Top Connection **: _____ Pin Box

Bottom Connection **: _____ Pin Box

Stabilizer Type **: Straight Ribbed Spiral Ribbed
Smooth

Ribs **: Quantity _____ Finished OD _____

****Must fill out these items. Fill out more if possible or custom product requested.**

Carbide Specs _____

Barrel: Outer OD _____ Outer ID _____
Inner OD _____ Inner ID _____

Top Neck Dimensions: OD _____ ID _____
Knurled Length _____

Bottom Neck Dimensions: OD _____ ID _____
Knurled Length _____

Flats: Two Sided Four Sided

Special _____

Flat Length _____ Location _____

Dimensions: Flat to Flat _____
OR Depth per Side _____

Lugs: Drill Pipe OD _____ Hour Glass _____

Location _____ Dimensions _____

Float Valve: Bore Only Install: Customer Furnished
Mills Furnished

Brand _____ Model & Size _____

Special Requirements: _____

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Application Questionnaire

Overhammer Stabilizers **Overhammer Stabilizers**

Company _____

Phone _____

Address _____

Fax _____

E-mail _____

City, State Zip _____

Contact _____

Quantity **: _____ Length: Shoulder to Shoulder _____

Sketch:

OR Overall _____

Top Connection **: _____ Pin Box

Bottom Connection **: _____ Pin Box

Stabilizer Type **: Straight Ribbed Spiral Ribbed

Smooth

Ribs **: Quantity _____ Finished OD _____

Hammer **: Brand _____

Case OD _____

Body Length _____

Case Housing Length _____

See Dimension B on opposite page.

Removable Barrel Design Yes No

****Must fill out these items. Fill out more if possible or custom product requested.**

Carbide Specs _____

Barrel: Outer OD _____ Outer ID _____

Inner OD _____ Inner ID _____

Top Neck Dimensions: OD _____ ID _____

Knurled Length _____

Flats: Two Sided Four Sided

Special _____

Flat Length _____ Location _____

Dimensions: Flat to Flat _____

OR Depth per Side _____

Lugs: Drill Pipe OD _____ Hour Glass _____

Location _____ Dimensions _____

Float Valve: Bore Only Install: Customer Furnished

Mills Furnished

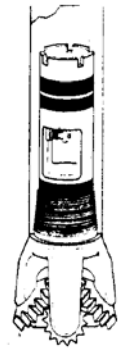
Brand _____ Model & Size _____

Special Requirements: _____

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Drilling Accessories

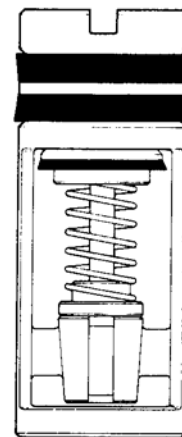
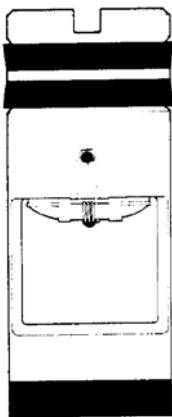
Mills Machine Co. stocks a wide variety of float valves at very competitive prices to sell separately or to install in our subs and stabilizers. We also stock the metal or rubber repair kits. Please contact us if you are not sure which type of float valve to use.



Baker Poppet Style	Baker Flapper Style	Demco Poppet Style	Box Tool Joint Size	Valve Diameter	Valve Length
1R, Model F			2 3/8 API Regular	1 21/32	5 7/8
1F-2R, Model F		27R	2 7/8 API Regular 2 7/8 API Full Hole 2 7/8 API Internal Flush	1 29/32	6 1/4
2F-3R, Model F	2F-3R, Model G	35R	3 1/2 API Regular 2 7/8 API Full Hole 2 7/8 API Internal Flush	2 13/32	6 1/2
3 F, Model F	3 F, Model G		3 1/2 API Full Hole	2 13/16	10"
3 1/2, Model F			3 1/2 API Internal Flush	3 1/8	10"
4R, Model F	4R, Model G	45R	4 1/2 API Regular	3 15/32	8 5/16
4F, Model F	4F, Model G		4 1/2 API Full Hole 4" API Internal Flush	3 21/32	12"
5R, Model F	5R, Model G		5 1/2 API Regular	3 7/8	9 3/4
5F-6R, Model F	5F-6R, Model G	65R	6 5/8 API Regular	4 25/32	11 3/4
6F, Model F			8 5/8 API Regular	5 11/16	14 5/8

Baker is the Registered trademark of Supply Products Division, Baker Oil Tool Co.
Demco is the Registered trademark of Retsco, Inc.

The Poppet (plunger) Style Valve provides positive and instantaneous shut-off against high or low pressure, assuring continuous flow of the fluid during drilling. It prevents flow-back when adding joints and keeps cuttings out of the drill pipe, preventing plugging while making connections.



The Flapper Style Valve incorporates a specially designed flapper which opens quickly and fully to provide a completely unrestricted bore through the hole. When circulation stops the flapper closes instantly to prevent cuttings from entering the drill string and plugging the bit. The flapper style compliments primary blowout prevention equipment.

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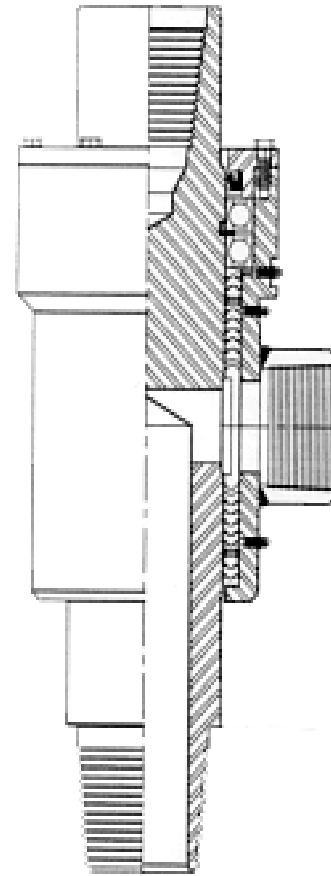
Drilling Accessories

Water Swivels

Available are the top mounted swivels or the side inlet swivels. The top mounted swivel comes with a U-bolt bail for conventional drilling or with studs when used as a rotating head. The lower NPT connection can be right or left hand, depending on the drill rig, while the top connection is the standard right hand thread, straight up or with a goose neck.

The side feed swivels is used with hydraulic, top-head drive rigs to insure the prevention of contamination of the hydraulic fluid. They are also used with auger rigs to convert them to circulating, rotary drilling rigs. The bottom connection will be matched to your specific requirements while the side connection is a standard NPT thread. The top is a 1 5/8 or 2" hex pin.

Please specify the bottom connection, water connection and, for side feed, the tops drive connection. These connections will determine the water course diameter.



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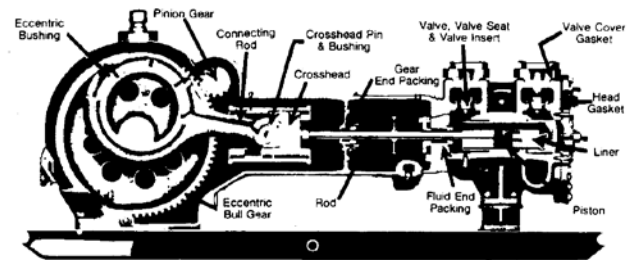
Mud Pump Parts

Mills Machine Co., Inc. is your source for parts for the following mud pumps:

Gardner-Denver	Fluid end and gear end parts
Wheatly	Fluid end parts
Armstrong	Fluid end parts
Failing	Fluid end parts
Gaso	Fluid end parts
Harrisburg	Fluid end parts
L-K Industries	Fluid end parts
Worthington	Fluid end parts

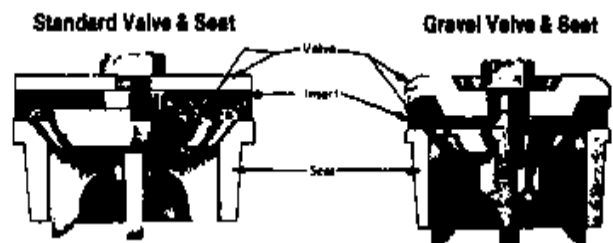
These are just a few of the pumps with parts available. When you call please have the following information available:

Name of pump,
Pump size,
Part Number and
Description of the part.



Some of the parts available are:

Liner - Chrome and Premium
Rods
Pistons
Piston Rubber
Valve Seat - Standard and Gravel
Valve Seat - Standard and Gravel
Valve Insert - Standard and Gravel
Valve Spring
Liner Packing
Rod Packing
Head Gasket
Valve Cover Gravel
Junk Ring
Lantern Ring
Gear End Packing
Eccentric Gear (Bull)
Eccentric Bushing
Pinion Gear (Driver)
Cross Pin
Cross Pin Bushing

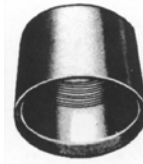


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Drilling Accessories

Drive Shoes

Steel Drive Shoes are available in threaded or weld on design. They are designed to be attached to the bottom of the casing enabling it to be driven into bedrock at the bottom of the hole. We will need to know the size, weight per foot, thread and inner or outer taper design.



Centralizers



The Centralizers are designed to attach to the casing or pipe and keep it centered in the hole to insure even distribution during the grouting process. Please specify the pipe diameter and carbon or stainless steel.

Pipe Thread Compound

Pipe Thread Compound is carried in stock in one gallon buckets but other sizes are available. The different types available are; JLS –multi purpose tool joint compound, Z-40 or Z-50 Zinc base tool joint compounds. We also stock Pipe Dope Brushes for application of the pipe thread compounds.



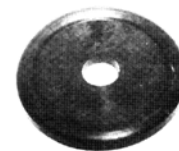
Pipe Thread Protectors



We stock both plastic and steel thread protectors in a broad range of thread types and sizes. We use this product to protect the threads on our hole openers, stabilizers, etc. during shipping.

Pipe Wipers

Pipe wipers come in a range of styles and diameters and include reinforced steel rings for rigidity and strength. Many sizes are available on request. Please let us know if you need the solid or split style.



Pipe Packers



Packers with either single or multiple sealing flanges are available with the expander tool assembly. Please call for price and availability.

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