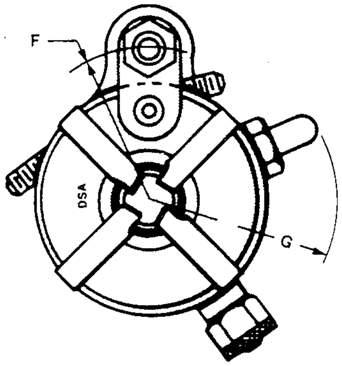
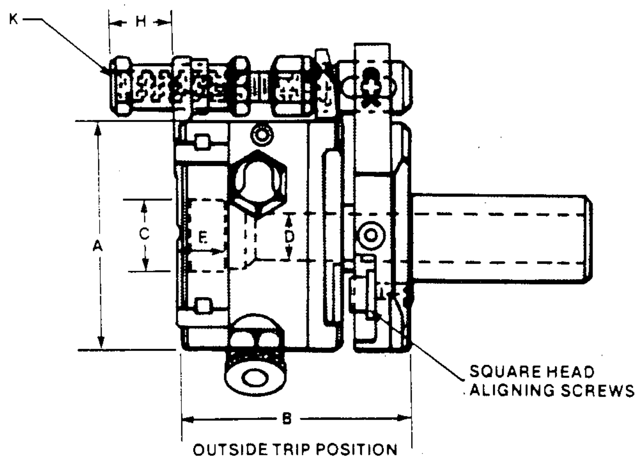
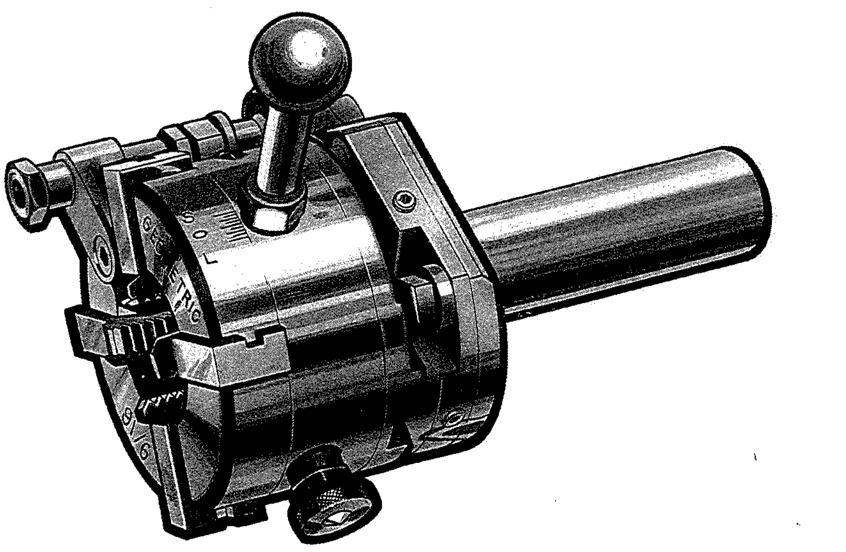
Geometric®
Standard Screw
Threading Manual

GREENFIELD
INDUSTRIES







INDUSTRIAL DISTRIBUTORS

The Distributor's Role... An Essential One.

No one works harder for you and for us than our local industrial tool distributor. First of all, we can say with pride that your Geometric distributor has taken care to provide you with the highest quality tools by selecting the Geometric line.

Without the many services the industrial distributor provides, industry would be in chaos. He has an intimate understanding of his customers' problems and his suppliers' capabilities and with that knowledge he can accurately bridge the gap between the tool user and the tool manufacturer. He provides prompt service and fast delivery. He functions as a warehouse, bookkeeper, banker and trucker to both the tool manufacturer and the end user. His knowledge of his customers' problems and methods makes it possible for him to provide the tool manufacturer with a clear picture of these problems and thus effect a quick remedy.

To the purchasing agent, whose job it is to exercise judgment as to quality and price of a vast range of industrial requirements, the distributor salesman can be of enormous value. He can provide the purchasing agent with detailed and reliable information on the products he sells.

It is with admiration and gratitude we say to our distributors, "Thank you and a hearty well done."

GEOMETRIC screw thread cutting manual

The purpose of this Handbook is to help you to get the type of production from your GEOMETRIC TOOLS that they are capable of giving under proper operating conditions.

From experience we have found that a sound fundamental knowledge of the tools and of their proper installation, operation, and care not only will avoid trouble but will pay in increased efficiency.

We hope you will read this book in its entirety so that, when occasion demands, you will know where to turn in it for help in instructing new operators, correcting threading errors or saving yourself the trouble of calling in a service engineer. And, last but not least, to so familiarize yourself with these versatile tools that you may quickly adapt them to new jobs or new requirements as they develop.

Geometric®
Greenfield Industries, Inc.
470 Old Evans Road
Augusta, GA 30809

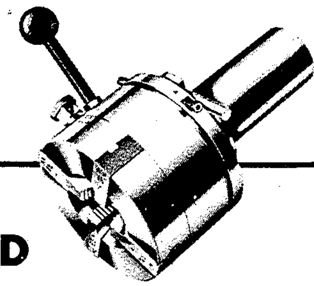
THE **GEOMETRIC** LINE OF TOOLS

On these two pages are shown the various types of threading tools in the GEOMETRIC line.

Each style of Die Head or Tap is made in a variety of sizes to accommodate different threading requirements, so no matter what type of machine you have available or what your threading problem, there is a GEOMETRIC tool to fit most any condition.

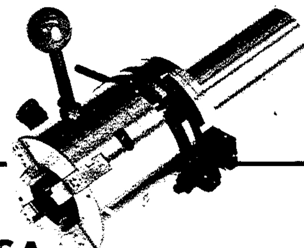
For complete specifications and price information regarding any tool illustrated, send for detailed Bulletin.

DIE HEADS *SELF OPENING* STATIONARY



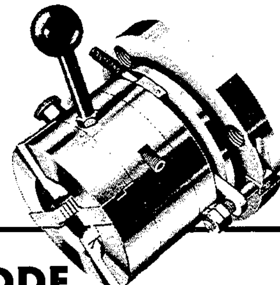
D

Without Lateral Float for Hand Screw Machines and Turret Lathes



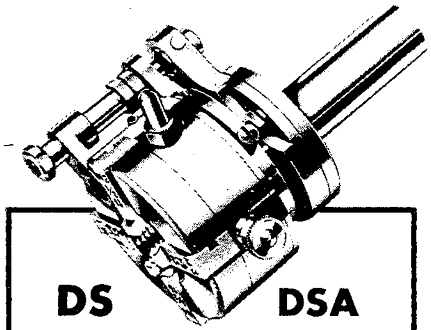
DDSA **SHANK TYPE**

With Lateral Float for Cinn. Acme, B & O, Foster, Gisholt, Libby, J & L and Warner & Swasey Turret Lathes etc.



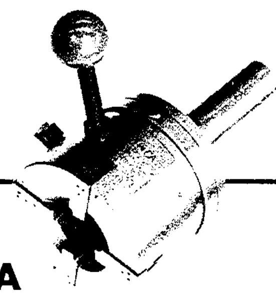
DDF **FLANGE TYPE**

With Lateral Float and Flanged Adapter for use on UNIVERSAL HOLLOW HEXAGON TURRET LATHES such as Cinn. Acme, Foster, Gisholt, Warner & Swasey



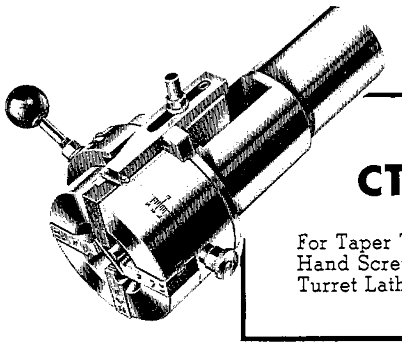
DS **DSA**

With Aligning Shank for B & S and other Single Spindle Automatics and Hand Machines.



CA

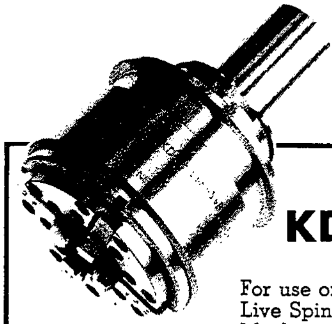
For Light Duty Threading Three Types: Pull Off Trip Convertible Outside-Inside Trip.



CT

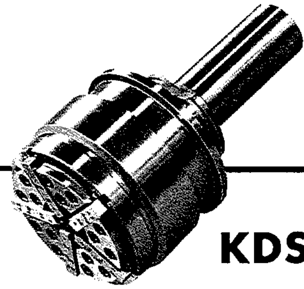
For Taper Threading on Hand Screw Machines, Turret Lathes, etc.

DIE HEADS *SELF OPENING* ROTARY



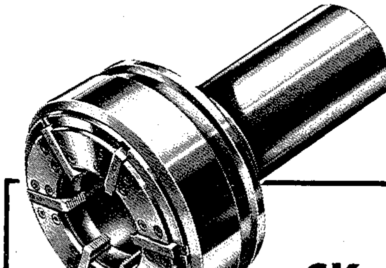
KD

For use on Live Spindle Machines



KDS

Similar in design to style KD — but employing five chasers.

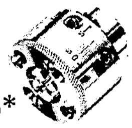


CK

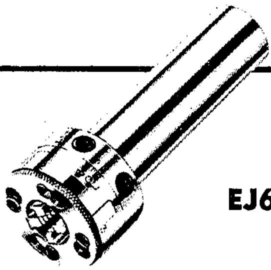
Similar in design to the Style KD — but employing smaller, lighter chasers. Designed for cutting finer pitch threads.

DIE HEADS — *SOLID ADJUSTABLE*

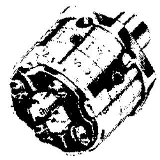
FOR ROTARY OR STATIONARY APPLICATIONS



EJ5*

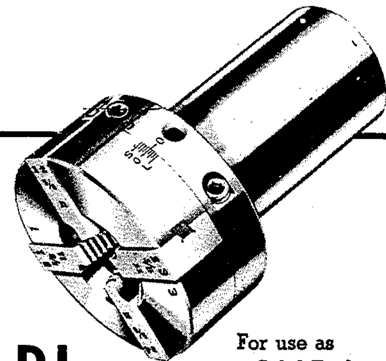


EJ5



EJ6

EJ5 For small diameter fine pitch threads on automatic screw machine. *For Swiss Automatics.



DJ For use as any Solid Tool.

TAPS *COLLAPSIBLE*

STATIONARY

S

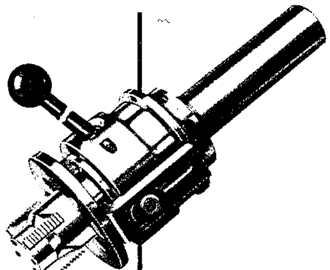


PLATE TRIP

SR

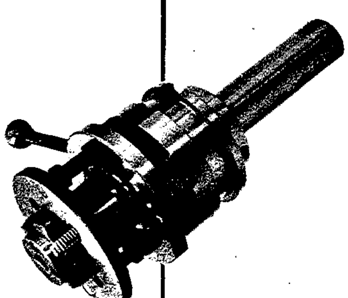
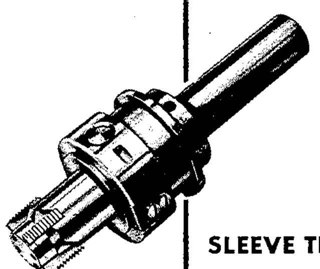
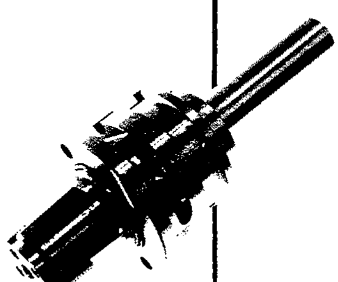


PLATE TRIP

ROTARY

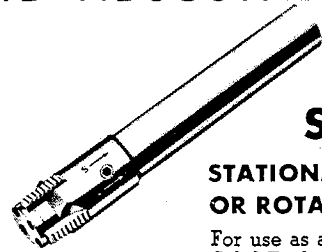


SLEEVE TRIP



SLEEVE TRIP

SOLID ADJUSTABLE



SJ

STATIONARY OR ROTARY

For use as any Solid Tool

CONTENTS

die heads

SELF OPENING

GENERAL INSTRUCTIONS

INSTALLING IN TURRET

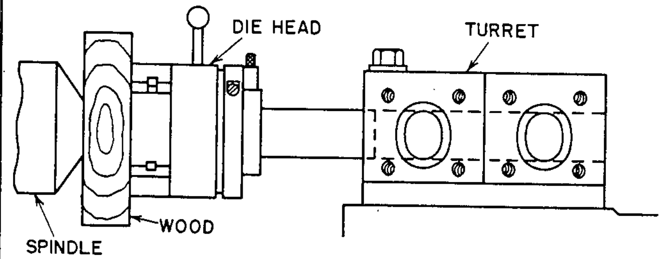
A self-opening die head is a precision tool. In order to produce accurate threads it must be kept in good condition and handled with care at all times. Proper installation of the head in the machine is of utmost importance as many threading faults may be traced to improper installation.

When putting the tool into the turret wipe out the hole to be sure there are no chips or dust.

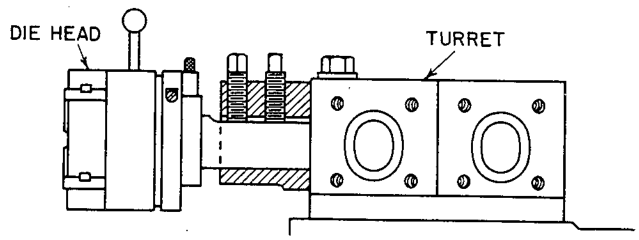
Keep the shank clean and free from set screw marks. Bind the shank in the turret securely but do not bear down so as to mar or gouge the shank. The shank of the tool, remember, locates the tool in relation to the work. A badly worn or bent shank means misalignment. Don't gouge into the shank if you value accurate threads or long tool life.

A few simple methods of putting a tool into the turret — without danger of damaging the tool or scoring the shank — are illustrated below.

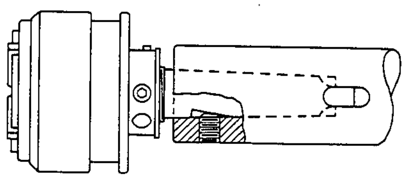
A safe, easy way to put a die head in the turret hole. With the chasers removed to prevent loosening the keys, the shank member started in turret hole and a block of wood positioned as illustrated, advance the turret gently, thus forcing the tool into its turret hole. Never hammer it in.



If you use a set screw to bind the tool in place, flat the shank and locate the screw on the flat. This method will avoid gouging and scoring of the shank.

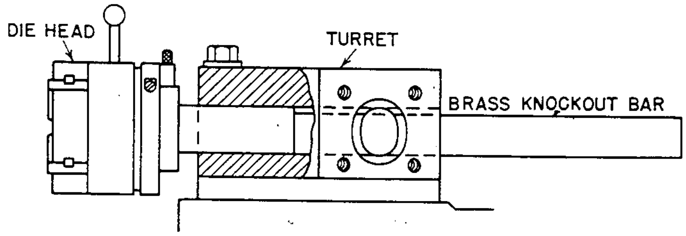


When using a tool with a Morse Taper shank don't attempt to drive with the tang alone. Drill and tap a hole securely so it will not pull out of spindle while being closed.

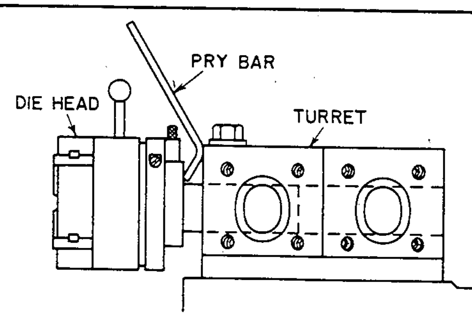


REMOVING FROM TURRET

The reasons for care when installing a tool are equally applicable when removing it from the machine. Use special care that the tool does not drop into the bed of the machine or on the floor as "internal injuries" not easily detected may result.



If there is no other interfering tooling, the simplest way to drive a tool out of the turret hole is by means of a brass knockout bar as illustrated.



Where other tooling, or construction of turret, makes use of a knockout bar impossible, pry the tool out with a pry bar. Never hammer the head.

SETTING STOP ON MACHINE FOR THREAD LENGTH

The principle of a self-opening die head is to open at the end of the cut releasing the chasers from the work, thus permitting return of the die head without reversing the spindle.

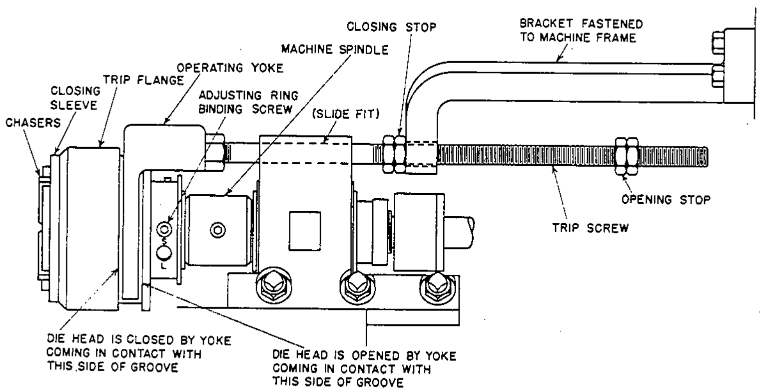
With a turret lathe, a stop is usually employed to stop the advance of the turret and allow the tool to be tripped at the predetermined length of thread. With automatic screw machines using rotary die heads, a yoke or fork is usually employed. In any case be sure the necessary adjustment is made prior to cutting a thread or you are apt to break chasers and even wreck the die head by running it into a shoulder or into the collet or chuck.

When setting a stop, keep in mind (1) the length of thread to be cut, (2) safety of the Die Head and Chasers.

Types of Stops and Closers

Most Geometric Heads have integral stop mechanisms or are hand operated. In some cases it will be necessary to provide stopping or closing mechanisms related to the machine set up. Below are a couple of typical arrangements.

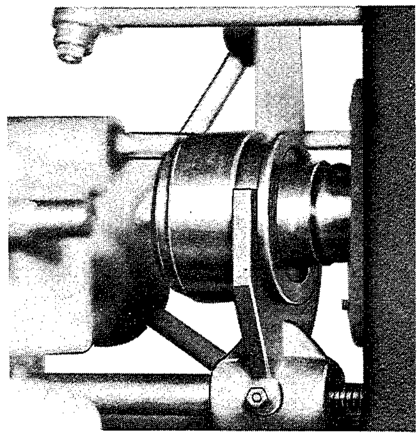
ROTARY TYPE



SETTING OPERATING YOKE ON AUTOMATICS

The drawing shows a typical example of how a Rotary Die head is operated on a multiple spindle automatic screw machine. The opening and closing of the head are controlled by adjusting the location of the nuts on the trip rod as shown.

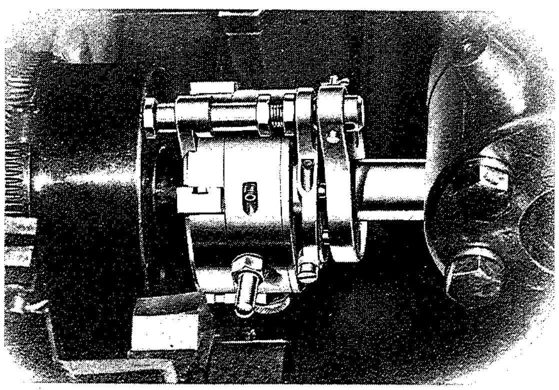
To prevent sluggish opening action the yoke should be narrow enough so that forward side of groove will not contact yoke when head trips.



FLANGE TRIP

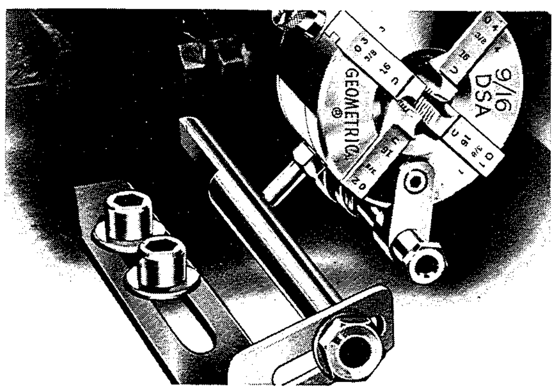
A single yoke operating in the groove of the trip flange opens and closes the die head.

STATIONARY TYPE



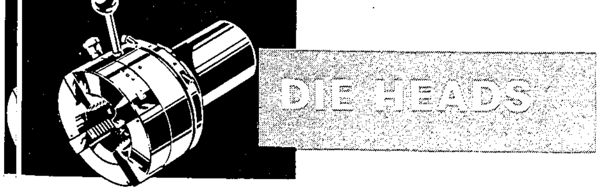
OUTSIDE TRIP ENGAGED

Note that outside trip gage contacts the spindle guard on machine when tripping.



CLOSER

This closer may be purchased from Brown & Sharpe Manufacturing Company, Providence, R.I.

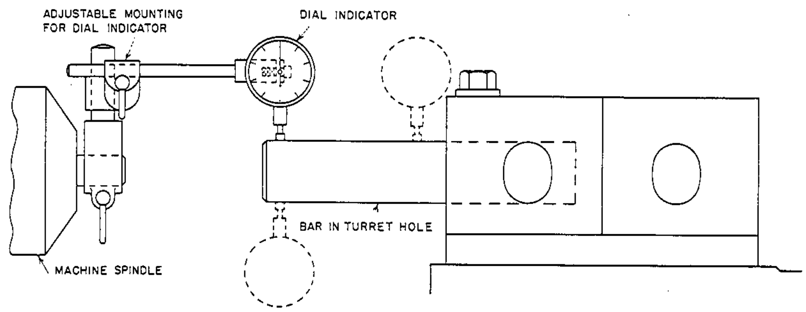


GENERAL INSTRUCTIONS

ALIGNMENT

Alignment of machine is one of the most important requirements of accurate screw thread cutting. When a die head is in true alignment with the work, all chasers of a set contact the work at the same time and the cutting of the thread is equally distributed among all the chasers of the set.

Misalignment imposes an added burden on the chasers. In addition to cutting the threads, the chasers which are bearing the heaviest on the work are constantly trying to force the turret, or threading spindle, into alignment with the work. When we consider the weight of a threading spindle or turret we can readily appreciate why chaser breakage and other thread troubles may result.



Checking alignment with indicator.

Misalignment may be due to the ways of the machine being worn or may be due to the turret hole not being in line with the work spindle, or it may be due to the turret hole being worn bell mouth allowing the threading tool to drop. A worn die head or one with a bent shank will also cause misalignment.

For checking alignment of the machine, a quick check may be made by bringing the chasers firmly up against the work which, of course, must be true and should be square at the end. Feeler gages or paper can be used in detecting which chasers do not contact the work.

The most accurate method of checking alignment is by mounting an indicator on the spindle of the machine and inserting a plug in the turret hole, the plug projecting six inches, if possible, beyond the face of the turret. See illustration above.

The indicator mounting should be substantial enough to avoid springing, thus causing an incorrect reading.

By bringing the indicator in contact with the outside of the test bar and rotating the spindle carrying the indicator, errors in concentricity between the spindle and the bar can be noted. The indicator should be set with sufficient spring pressure to counteract the spindle weight when the under side of the test bar is checked.

By setting the indicator so that it contacts the top of the bar and feeding the turret forward and backward, vertical errors in parallelism between the spindle and bar also can be detected. Horizontal errors may be checked in a similar manner on the side of the bar.

In checking for alignment be sure that the turret is in the position where it is used the most — usually the greatest wear is at the forward end.

PROPER SPEED

Threading speed depends on the diameter of the work, the number of threads per inch to be cut and the nature of the material to be threaded. Be sure you are using approximately the correct speed.

The choice of the proper speed for threading is very essential. Many people overlook the importance of this factor, although they use care in selecting the proper speeds for other tooling.

Bear in mind that a threading tool operates on a different principle than most other cutting tools in that the feed per revolution is fixed by the pitch of the thread being cut. This is not so with cutting tools such as those used in turning, forming, etc., where the amount of feed can be varied to suit conditions. Keeping this point in mind, it must be realized that care should be taken in selecting the proper speed.

Too fast a speed will often result in torn threads, burned chasers, rough threads and will, in any case, materially reduce the total life of a set of chasers.

On the following page there is a speed chart of recommended threading speeds showing both F.P.M. (surface feet per minute) and R.P.M. (revolutions per minute). This chart can only be of a general nature and must be altered to suit your own materials and your own working conditions. It will, however, offer a starting point from which you may work in either direction with the idea of obtaining maximum production with best possible finish.

Quite frequently a change in speed downward will result in smooth, shiny threads as opposed to rough, torn threads.

Speed Chart

FOR ALL TAPER THREADS PRODUCED BY JAM CUT USE 75% OF SPEED GIVEN

Material		Speed Symbol
ALUMIN.	Rod	F
	Cast	
	Die Cast	
	Stamping	
Bakelite		
BRASS	Forging	D
	Stamping	E
	Tubing	
	Cast	F
	Bar	
BRONZE	Naval	D
	Phosphor	E
	Tubing	
	Cast	
	Bar	
	Mang'nese	
	Cast Alum.	

Material		Speed Symbol
Celluloid		F
Copper		E
Everdur		C
Fibre		F
German Silver		E
IRON	Wrought	B
	Malleable	C
	Cast	D
Magnesium		F
Monel Metal		A
Nickel		D
Rubber		F
STEEL	Bess'm'r Scr. Stock	C
	Cast	

Material		Speed Symbol
STEEL	Carb. 1010-1035 1112-X1340	C
	Carb. 1040-1095	B
	Mang. T1330 T1350	
	Chrome 5120-52100	A
	Chrome Van. 6115-6195	
	Forging	
	Molybdenum 4130-4820	

Material		Speed Symbol
STEEL	Nickel 2015-2515	A
	Ni-Chrome 3115-3450	
	Nitralloy	
	Stainless Free Mach.	
	Stainless (Stringy)	
	Stamping	B
	Tool	A
	Tubing	B
	Semi-Casting	D
Zinc Die Casting		F

Speed Symbol	Surface Speed (F.P.M.) for T. P. I. 3 to 7½	8 to 15	16 to 24	25 & up
A	8	10	15	20
B	15	20	25	30
C	20	30	40	50
D	25	40	50	80
E	40	80	100	150
F	50	100	150	200

NOTE: Speeds specified are approximate and may have to be varied to obtain best results.

Table of Speeds

Surface Speed (F.P.M.) / Diam. of Work Inches	8	10	15	20	25	30	40	50	80	100	150	200
	R.P.M.											
⅛	245	305	458	611	764	917	1222	1528	2445	3056	4584	6112
¼	122	153	229	306	382	458	611	764	1222	1528	2292	3056
⅜	81.4	102	153	204	255	306	407	509	815	1019	1528	2038
½	61.2	76.5	115	153	191	229	306	382	611	764	1146	1528
⅝	48.8	61.0	91.7	122	153	183	244	306	489	611	917	1222
¾	40.8	51.0	76.4	102	127	153	204	255	407	509	764	1018
⅞	35.0	43.6	65.5	87.3	109	131	175	218	349	437	655	874
1	30.6	38.2	57.3	76.4	95.5	115	153	191	306	382	573	764
1⅛	27.2	33.9	50.9	67.9	84.9	102	136	170	272	340	509	680
1¼	24.4	30.5	45.8	61.1	76.4	91.7	122	153	244	306	458	612
1⅜	22.2	27.8	41.7	55.6	69.5	83.3	111	139	222	278	417	556
1½	20.4	25.4	38.2	50.9	63.7	76.4	102	127	204	255	382	510
1⅝	18.8	23.5	35.3	47.0	58.8	70.5	94.0	118	188	235	353	470
1¾	17.4	21.8	32.7	43.7	54.6	65.5	87.3	109	175	218	327	436
1⅞	16.3	20.3	30.6	40.7	50.9	61.1	81.5	102	163	204	306	408
2	15.3	19.1	28.7	38.2	47.7	57.3	76.4	95.5	153	191	287	382
2⅛	14.4	18.0	27.0	36.0	45.0	54.0	72.0	90.0	144	180	270	360
2¼	13.6	17.0	25.5	34.0	42.4	50.9	67.9	84.9	136	170	255	340
2⅜	12.9	16.1	24.1	32.2	40.3	48.3	64.4	80.5	129	161	242	322
2½	12.2	15.3	22.9	30.6	38.2	45.8	61.1	76.4	122	153	229	306
2⅝	11.6	14.5	21.7	29.0	36.3	43.5	58.0	72.5	116	145	218	290
2¾	11.1	13.9	20.8	27.8	34.7	41.7	55.6	69.5	111	139	208	278
2⅞	10.5	13.2	19.8	26.4	33.0	39.6	52.8	66.0	106	132	198	264
3	10.1	12.7	19.1	25.5	31.8	38.2	50.9	63.7	102	127	191	254
3¼	9.4	11.7	17.6	23.5	29.4	35.3	47.0	58.8	94.0	118	176	236
3½	8.5	10.9	16.4	21.8	27.3	32.7	43.7	54.6	87.3	109	164	218
3¾	8.1	10.2	15.3	20.4	25.5	30.6	40.7	50.9	81.5	102	153	204
4	7.6	9.5	14.3	19.1	23.9	28.7	38.2	47.7	76.4	95.5	143	191

For sizes larger than 4" diameter, it is only necessary to bear in mind that speeds change in inverse proportion to the diameter. For example where 3" diameter has 10.1 R.P.M.; 6" diameter would be 5.05 R.P.M. or one half.

PROPER LUBRICANT

Most materials should be threaded with plenty of lubricant or coolant. Be sure you are equipped with the right one and plenty of it.

We have seen threaded work that has been improved remarkably from the standpoint of finish by changing only one factor — the kind of lubricant employed.

While the general practice is to thread certain materials such as cast brass, cast iron, aluminum, etc., dry, much better results may be obtained through the use of a lubricant or coolant.

When it comes to the threading of alloy steels, steel stampings, steel forgings and other materials in that general classification, success or failure may hinge on the use of the proper lubricant and the amount of lubricant used.

We suggest that with many of these materials a mineral lard oil or oil with a sulphurized base be used. Your oil dealer has done a lot of experimenting with different grades of oil and will be glad to help you pick the proper lubricant or coolant for your work.

The chart below will give you some idea of suggested lubricants, here again these can be only suggestions. The steel stampings you are threading may differ in texture or machinability from those used in some other plant, thus requiring different speeds and lubricants from those used in that other plant on steel stampings (to name only one material as an example).

Furthermore, we cannot emphasize too strongly the necessity of getting a good supply of lubricant to the cutting points of the chasers. Remember the days when you used to brush a little white lead and oil on the chasers? That's very inefficient and very ineffective. Get a good force of high grade lubricant flowing steadily onto your chasers if you value good threads.

Be sure also to use lubricant during any trial cutting, as well as in production.

Above all bear in mind that success or failure in your thread cutting may depend on your choice of lubricant and how you use it. Furthermore, the use of a good quality lubricant is as important as the correct type.

Table of Lubricants and Coolants

Material	Soluble Oil	Dry†	Dry or Soluble Oil	Kerosene Oil	Lard Oil and White Lead	Mineral Lard (20% Lard)	Paraffin Oil	M. N. Lard (20%) or Sulphur Base
Aluminum — Cast				x				
Aluminum — Die Cast				x				
Aluminum — Rod				x				
Aluminum — Stamping				x				
Bakelite		x						
Brass — Bar							x	
Brass — Cast		x						
Basss — Forging							x	
Brass — Navel							x	
Brass — Stamping							x	
Brass — Tubing							x	
Bronze — Bar							x	
Bronze — Cast		x						
Bronze — Cast Aluminum							x	
Bronze — Manganese							x	
Bronze — Naval							x	
Bronze — Phosphor							x	
Bronze — Tubing							x	
Celluloid		x						
Copper							x	
Everdur	x							
Fibre		x						
Iron — Cast			x					
Iron — Malleable	x							
Iron — Wrought	x							
Magnesium				x				
Monel Metal						x		
Nickel						x		
Rubber		x						
Silver — German							x	
Steel — Bessemer						x		
Steel — Cast	x							
Steel — Carb. Sae 1010–1035						x		
Steel — Carb. Sae 1112–x1340						x		
Steel — Carb. Sae 1040–1095						x		
Steel — Mang. Sae T1330–T1350								x
Steel — Chrome Sae 5120–52100								x
Steel — Chrome Van Sae 6115–6195								x
Steel — Forging					x			
Steel — Moly. Sae 4130–4820								x
Steel — Nickel Sae 2015–2515								x
Steel — Ni-chrome Sae 3115–3450								x
Steel — Nitralloy								x
Steel — Stainless								x
Steel — Stamping								x
Steel — Tool						x		
Steel — Tubing								x
Steel — Semi Casting	x							
Zinc — Die Casting	x							

† Usually run dry but we recommend a coolant.

THREADING TROUBLES

"Threading Trouble" usually means that something is causing production of unsatisfactory threads on the work piece. The chart shows common thread defects and the possible causes.

The remedies, if not self evident, can be found by following the suggestions for proper operation as covered in the various sections of this book.

Experience has proved that a vast majority of threading troubles can be traced to the conditions under which the work is being done and not to original faults in the tools. It is even possible that a setup which works perfectly on one type of material will not be satisfactory for another type. So do not be too quick to lay the blame for threading troubles on the tools, check the entire setup including the material being threaded.

It will be noted that any given "symptom" might be caused by any one of a number of conditions and possibly by a combination of several.

Cause	EFFECT							
	Poor Thread Form	Rough Threads	Tapered Threads	Stripped or Torn Threads	Chattered-out of Round-Drunken Threads	Shaving	Lead Error	Incorrect Pitch Diameter
CHASERS								
Incorrect Chamfer	x	x	x	x	x	x	x	
Incorrect Face Grind	x	x	x	x	x	x	x	x
Incorrect Bearing	x	x	x	x	x	x		
Incorrect Clearance			x			x		
Too Keen	x		x		x	x	x	x
Dull	x	x	x				x	
Worn Keyways	x		x			x		
DIE HEAD								
Worn Parts	x		x	x		x		x
Misalignment	x		x	x		x	x	
MACHINE								
Improper Camming	x		x			x	x	
Incorrect Speed	x	x	x	x	x	x	x	
Inexperienced Operator	x		x	x		x	x	
LUBRICATION								
Wrong Kind		x		x				
Insufficient	x	x		x				
SHAVING	x		x	x			x	x

OPERATING SUGGESTIONS

Before starting to cut a thread check chasers carefully. If threading to a shoulder or bottom, be sure the chasers have a short enough chamfer for the work. If it is not to a shoulder, do the chasers have a long enough chamfer to do the best possible job? The longer the chamfer the easier the chasers will cut and the better thread they will produce. See chart of commonly used chamfer angles on page 30.

Also be sure chasers have correct face grind for the nature of the material to be threaded. See chart of recommended face grinds on page 33.

Do not run the die head up on the work without checking the diameter of work or adjustment of die head. A piece of work oversize or die head adjusted too small will cause chasers to remove excess stock, which is very likely to cause chaser breakage.

Make a sample cut, after which finer adjustments may be required to fit gages.

When shoulder threading, allow extra clearance to avoid running into the shoulder. Finer adjustment can then be made for proper length of thread.

Help feed the turret along while threading, following lead of the screw, thus avoid having the die head pull the entire slide along. Avoid putting too much pressure on, forcing the turret; likewise avoid holding back on turret causing a drag. Advance the turret at the same rate as the lead of the thread being cut. Learn feel of the machine for different thread leads.

Be sure to use lubricant during any trial cutting, as well as in production.

Take good care of your tools when in use, and when not in use. Keep them clean and do not abuse them by driving them into or out of the turret. This may spring the head and throw it out of alignment.

Clean chips and dust out of it regularly. Periodically take apart, remove old gummy oil, oil the working parts and put it together again. When not in use, put in a dry place with a rust preventive brushed on.

If these rules are followed carefully, there will be less chance of Die Head troubles or chaser breakage and better threads will be cut.

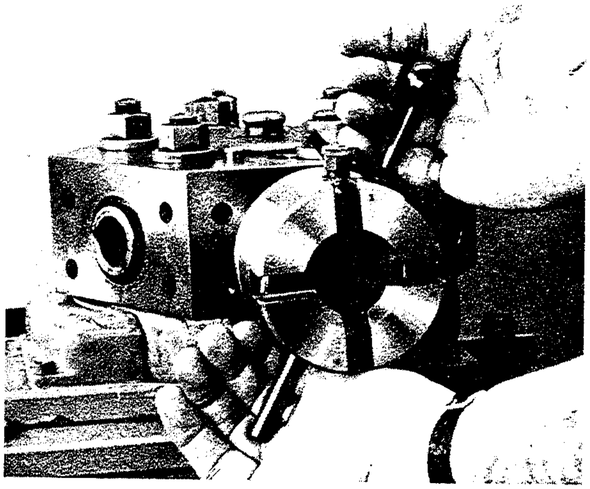
Setting up for operation

1. TRIPPING INTO OPEN POSITION

Normally the Die Head has been installed in the turret or spindle of the machine before the chasers are inserted. The first step in chaser insertion (or removal) is to trip the head into open position.

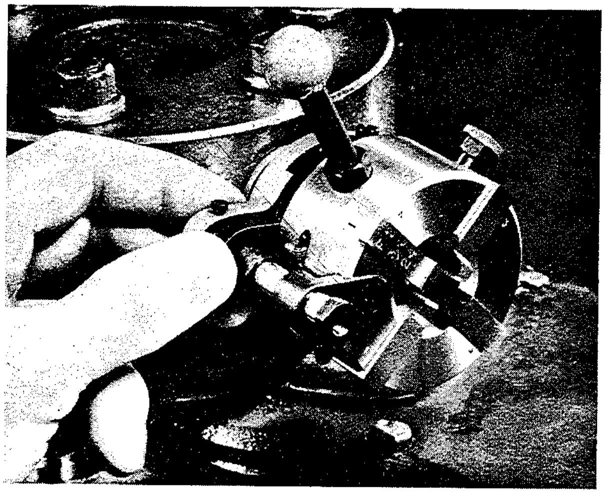
If the chasers were in the head this is the position where chasers are disengaged from the work.

Each style of Geometric Die Head is tripped in a different manner as described below.



STYLES D AND C (PULL OFF ONLY)

Pull the front part of the die head toward you by means of the closing handle until the head unlocks, allowing the cam to rotate into open position.



STYLES DS, DSA AND DD

Push back trip lever and cam will rotate into open position.

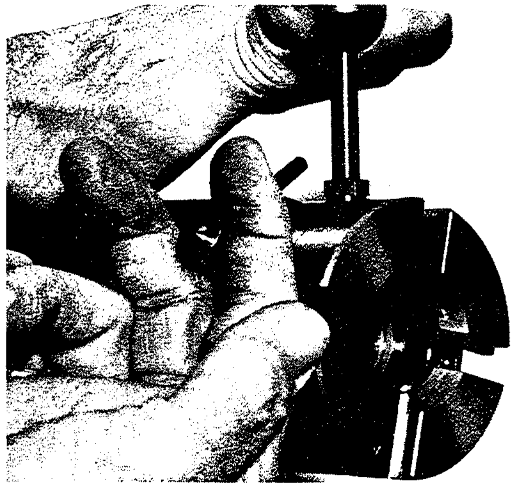
STYLES KD, KDS, CK

Push back on trip flange, causing head to trip into open position.

2. OPENING FOR CHASER INSERTION

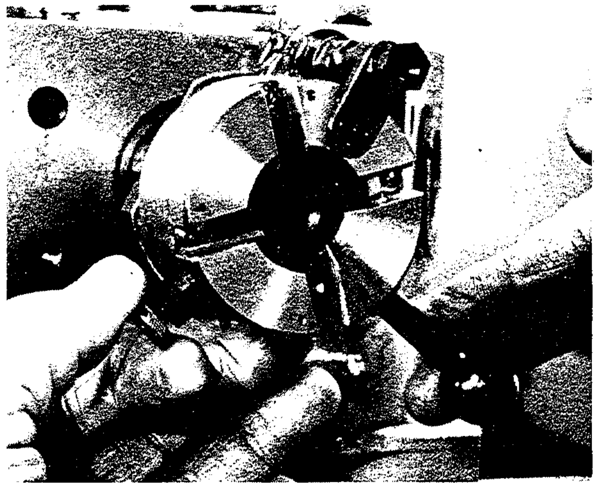
This is the *fully open* position and differs from the "open" position described on the opposite page in that the chaser slots are now "opened" or cleared of the mechanism that holds the chasers in place.

The various methods of clearing the slots for chaser insertion for the different styles of Die Heads are shown below.



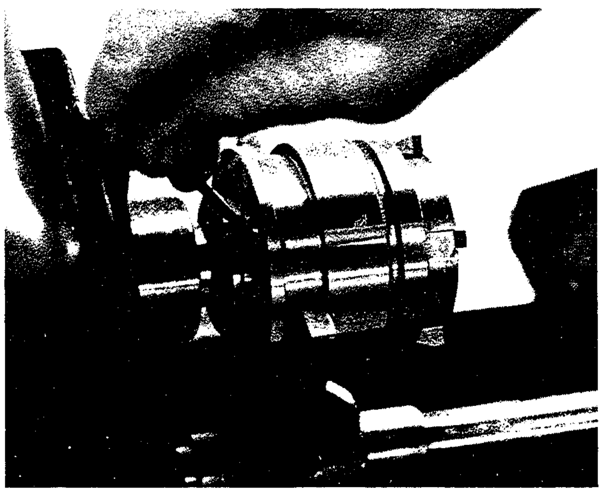
STYLES D, DD, C, CT

Relieve the pressure of the cam spring by lightly pushing on handle. At same time pull up stop plunger and the cam will rotate into fully open position.



STYLES DS, DSA

Relieve the pressure of the cam spring by lightly pushing on closing handle or pin. At same time pull up stop plunger and the cam will rotate into fully open position.



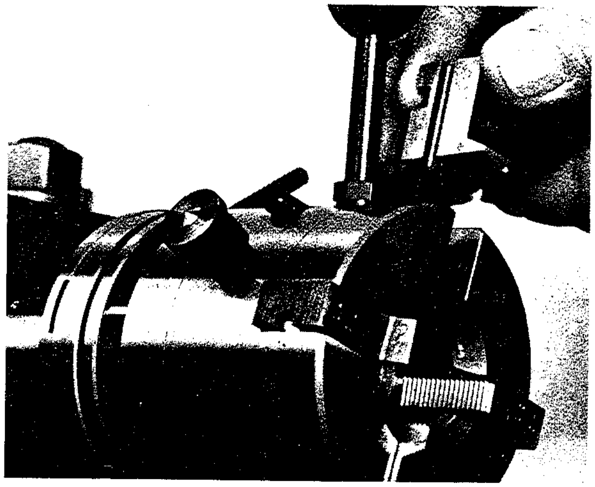
STYLES KD, KDS, CK

Depress stop lever in adjusting ring with your thumb or with some implement, allowing the springs to force back the closing sleeve into open position.

Setting up for operation

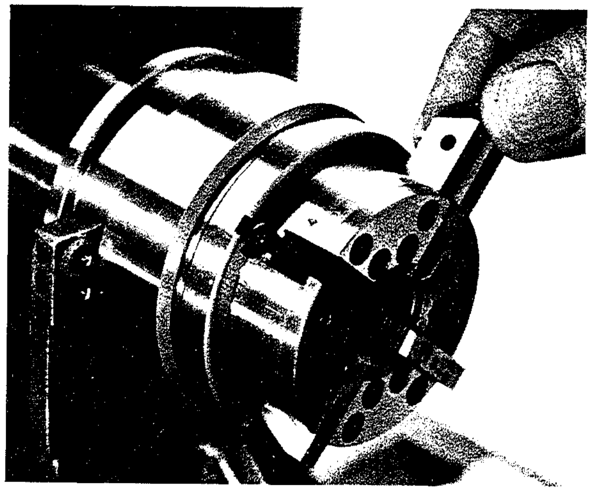
3. INSERTING CHASERS

The chaser slots on each Die Head are stamped in sequence 1, 2, 3, etc. Individual chasers in a set are also marked in this manner. It is important that each chaser be inserted in the slot with the corresponding number. So, when inserting chasers in the die head, put the chaser stamped No. 1 in the slot stamped No. 1, chaser stamped No. 2 in the slot stamped No. 2, and so on. Be sure D type chasers are positioned properly. With K chasers the pin in the bottom of the chaser should snap into the chaser spring plunger.



STYLES D, DD, C, CT, DS, and DSA

Push the D type chasers in until the push button snaps into the lug slot.

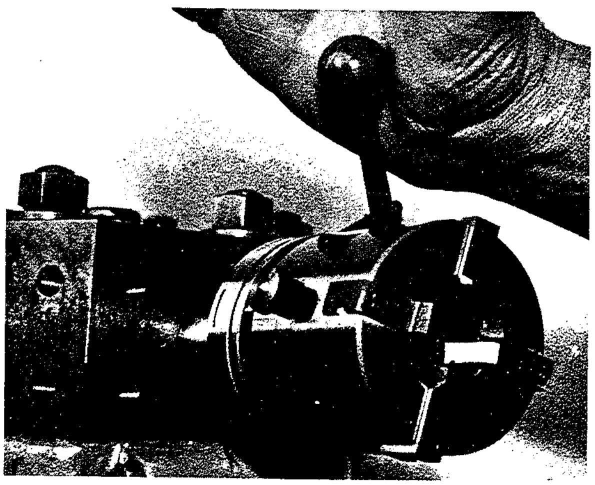


STYLES KD, KDS and CK

Push the K type chasers in until the chaser pins in chasers are firmly held in the spring plungers. This can be determined by a slight click as each chaser seats properly.

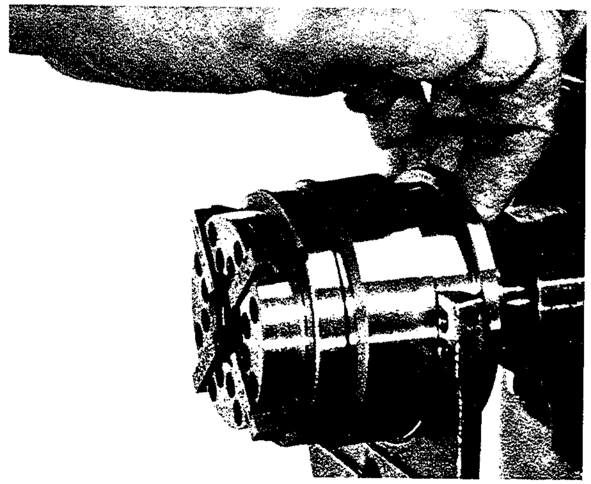
4. CLOSING THE DIE HEAD

With the chasers in the die head, close the tool so that the chasers are in cutting position, that is, with the tool completely closed and the chasers in position to cut a thread. This will lock the chasers in place so that they may not be removed until the head is again *fully opened* as described on page 13.



STYLES D, DD, C, CT and DS

Rotate cam by means of closing handle, being sure to continue rotation after the stop plunger snaps into position, and until head locks in cutting position.

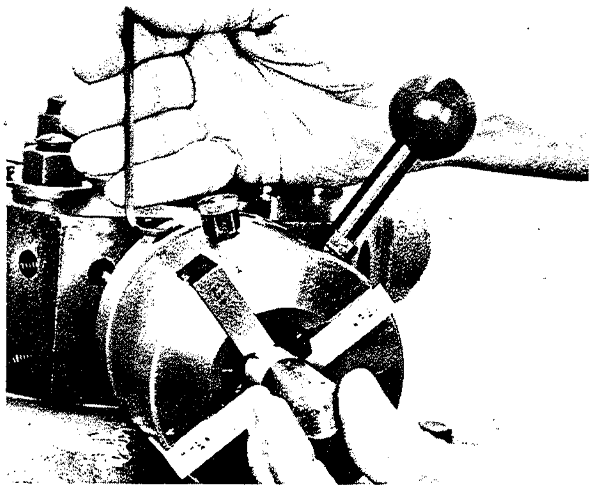


STYLES KD, KDS and CK

Pull the trip flange forward, being sure to continue the forward motion after the stop lever snaps into locking position and until head locks into cutting position (on KH2 use closing handle).

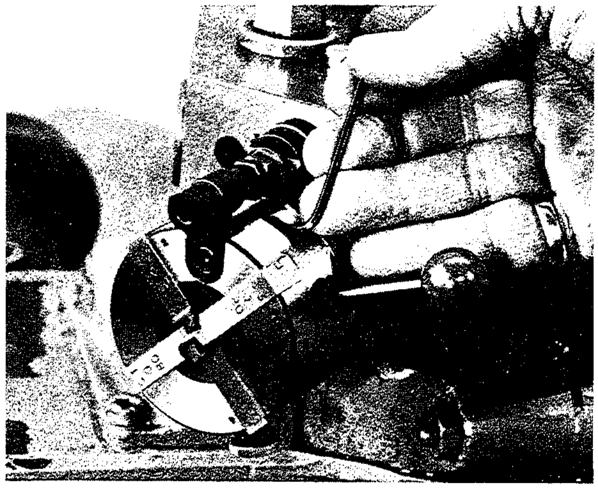
5. ADJUSTING CHASERS TO SIZE

If a sample screw is available adjust the chasers to this part. If not, use as a setting gage a piece of bar stock turned to the minor (root) diameter of the thread to be cut. Care should be taken not to force the chasers into the setting gage. The adjusting of the chasers to size varies with the type of die head employed. Illustrated below are the methods employed with some of the more commonly used types of Geometric Die Heads.



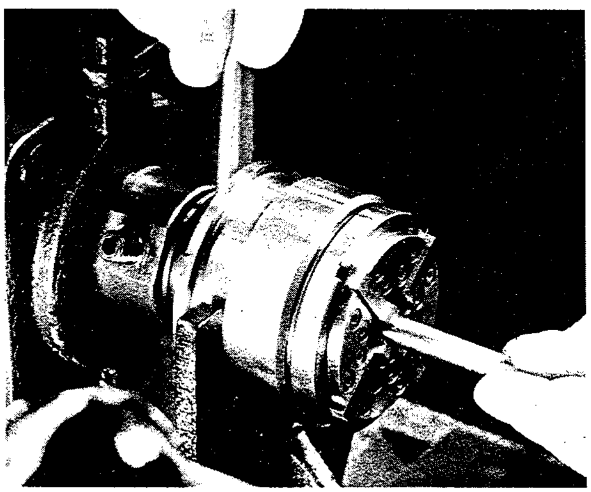
STYLES D, DD

Adjust to cutting size by loosening one adjusting screw and tightening the other. A hex key is provided for this purpose.



STYLES DS, DSA

Adjust to cutting size by loosening one adjusting screw and tightening the other. A hex key is provided for this purpose.



STYLES KD, KDS, CK

Loosen the adjusting ring binding screw using the hex key provided. Then by means of a pin inserted in the hole of the adjusting ring turn until the desired thread size is obtained. Tighten adjusting ring binding screw before cutting a thread.

6. REPLACEMENT OF PARTS

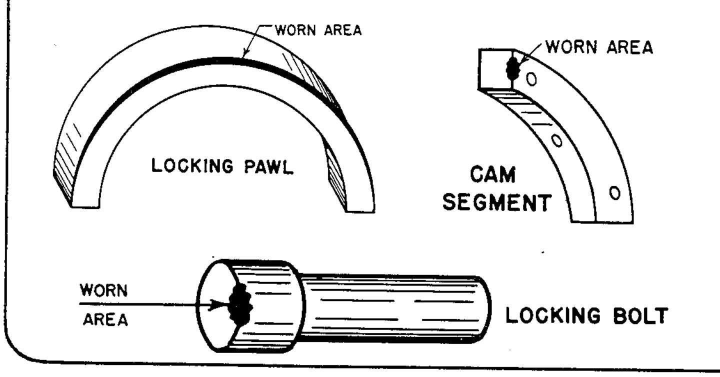
Geometric tools as a rule are noted for their simplicity of construction and freedom from mechanical faults. However, as it may be necessary occasionally to replace worn or damaged parts, a few general instructions on parts replacement will be helpful. Should you care for information on any problem of this sort that is not covered in this book, our engineers will be glad to answer specific questions at any time.

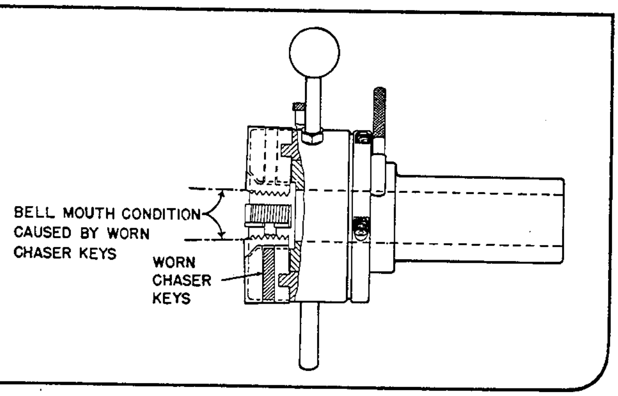
Most die heads use a number of coil springs. Check these springs now and then to be sure they have their original flexibility. If springs are used in pairs, be sure they are of equal size and strength.

Another point to check frequently is the locking medium. Whether this be a locking bolt or pawl the continual opening and closing of the tool are bound to cause wear on these essential parts. They should be renewed from time to time.

Needless to say, that part of the die head in which the chasers are located is of prime importance. The chaser slots should not show material wear nor should the chaser keys or other holding devices be permitted to wear materially without replacement.

Detailed construction of the more common tools and list of parts are shown on pages 17–25.





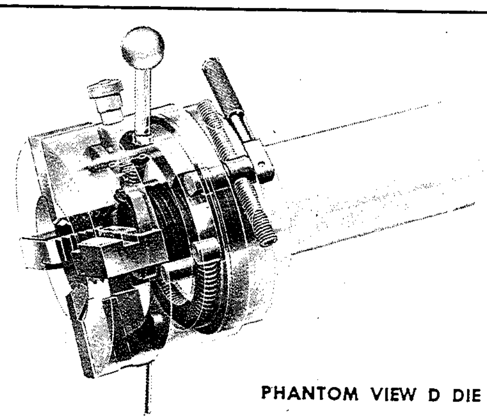
Style D Die Head

The removal of the thimble, back in the bore from the face of the tool, is necessary in order to entirely disassemble this type of tool. A broad nose screw driver will do this easily and quickly.

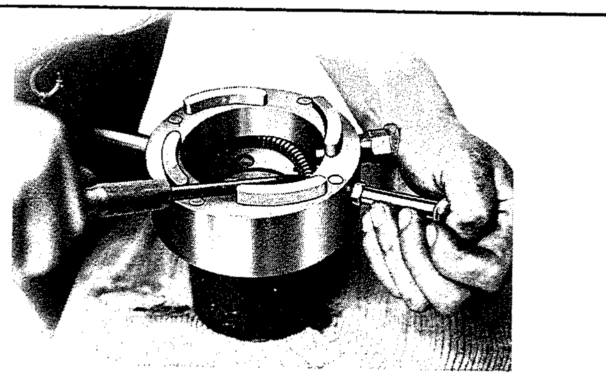
The cam spring may have to be replaced occasionally. After putting the die head in a vise, remove the front part of the head by unscrewing the thimble. Then take out the cam spring plate screws, allowing the cam spring plate and cam spring to be removed.

To reassemble tools 1½″ in size or smaller, first replace the cam spring plate and cam, then insert the new cam spring from the lug side of the cam.

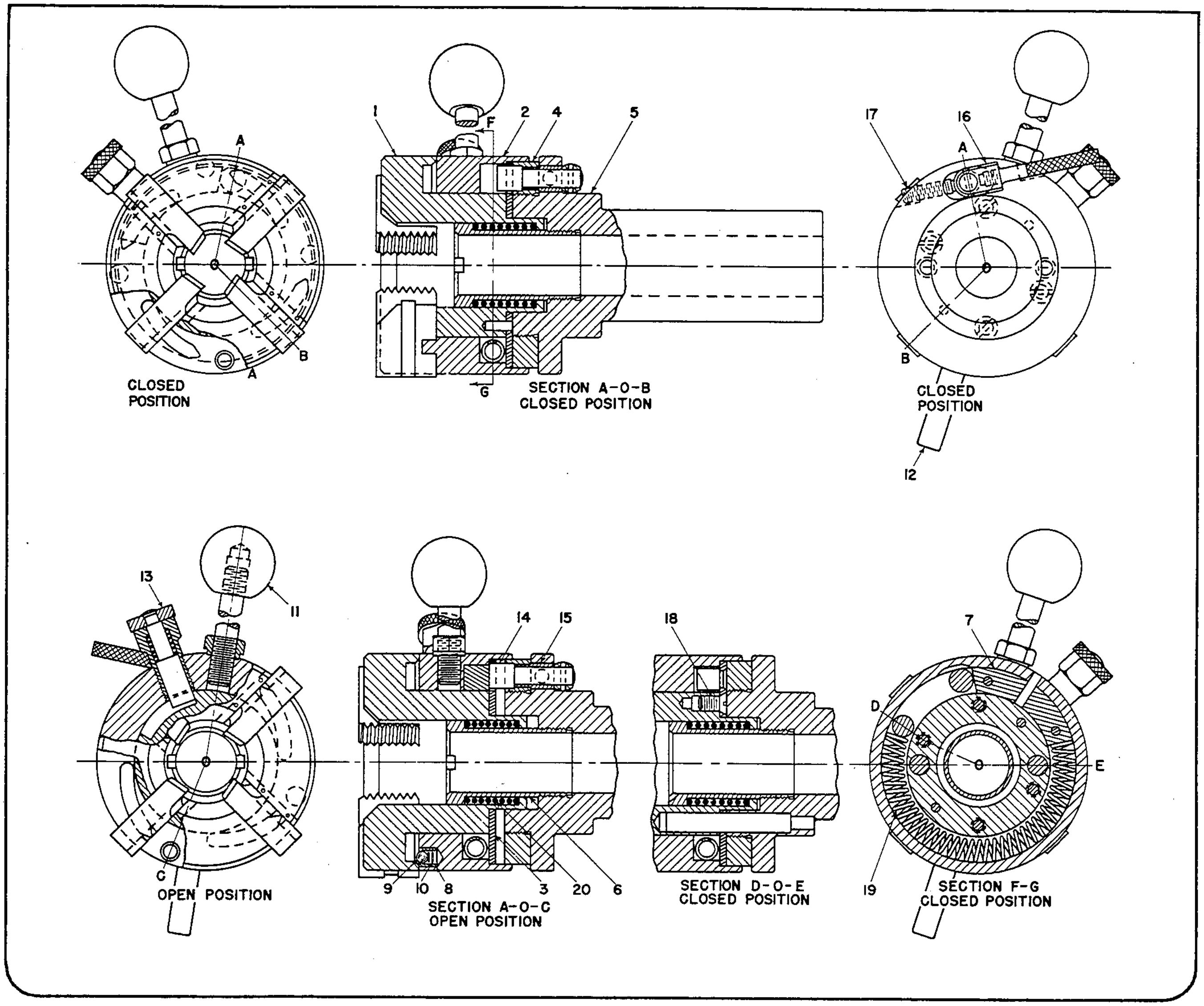
On sizes larger than 1½″ place the cam in a vise with the lugs down, holding on the lugs lightly so cam cannot turn. Insert cam spring in the cam spring chamber placing one end of the spring against the segment, with the other end of spring projecting slightly. Place the cam spring plate in position so the cam spring stop pin will pick up the end of the cam spring that is projecting. Next, rotate the cam spring plate sufficiently to allow the cam spring stop pin to drop into position. Remove this unit from the vise holding the cam and cam spring plate together so the cam spring cannot release itself. This unit can now be placed on the die head skeleton and the cam spring plate screws inserted.



PHANTOM VIEW D DIE HEAD



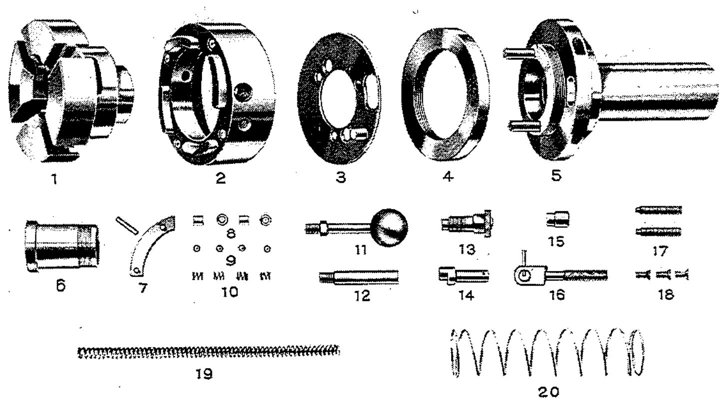
INSERTING CAM SPRING



PARTS FOR DIE HEAD — STYLE D

WHEN ORDERING REPAIR PARTS GIVE BOTH NUMBER AND NAME OF PART AND SERIAL NUMBER OF TOOL.

1—Skeleton with chaser keys and cam spring plate pins.
2—Cam with push buttons, rings and springs.
3—Cam spring plate with cam spring stop pin.
4—Adjusting ring.
5—Back part with driving pins (specify shank size when ordering).
6—Thimble.
7—Cam segment with pins.



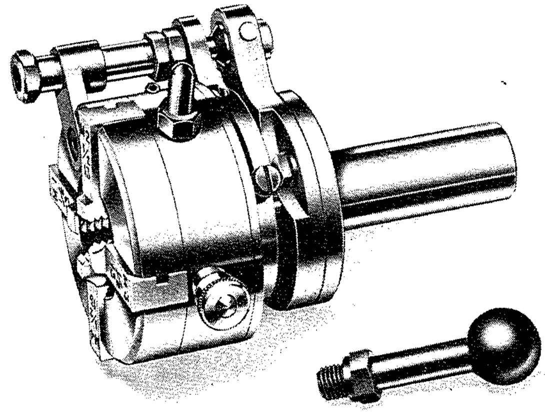
8—Push button rings.
9—Push buttons.
10—Push button springs.
11—Closing handle, assembled.
12—Closing pin.
13—Stop plunger complete.
14—Locking bolt.
15—Locking bolt bushing.
16—R&F Lever with pin.
17—Adjusting screws.
18—Cam spring plate screws.
19—Cam spring.
20—Thimble spring.

6. REPLACEMENT PARTS — CONTINUED

Style DS Die Head

DISASSEMBLY

With die head in open position and chasers and tripping mechanism removed, place face down on bench and remove the two tapered head cam spring plate screws from the rear of the die head. On some die heads to get access to the cam spring plate screws it is necessary to disassemble the shank by removing the two square head screws, however most die heads have screw driver clearance holds through shank flange. When removing the cam spring plate screws hold the die head with the fingers so the parts will not release too quickly due to pressure of springs. Remove the cam spring plate and backpart assembly, *being very careful to hold parts together* so the cam spring will not fly out. Now the two units, one the cam spring plate-back part assembly and the other the skeleton-cam assembly can be taken apart.



To disassemble skeleton-cam assembly, hold the skeleton in one hand and with the fingers of the other hand pull up the stop plunger and remove the cam.

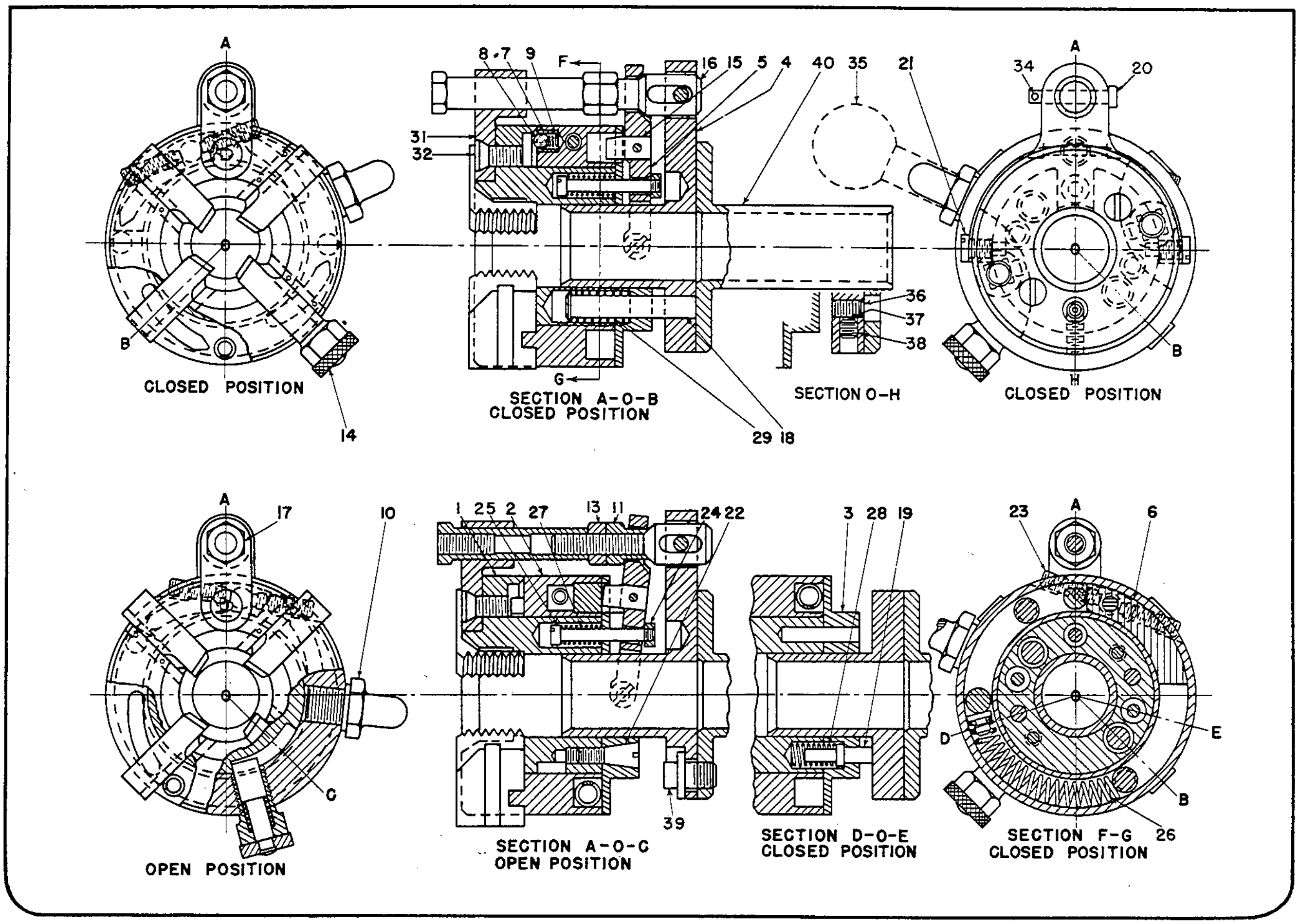
The die head is now completely disassembled with the exception of a few parts which need no explanation.

To disassemble cam spring plate-back part assembly, it is necessary to remove shank then place the cam spring plate-back part assembly back in skeleton assembly less cam, buffer pins and springs, and cam spring. Now block up the back part near the driving pins so there will be space between the cam spring plate and back part. Place the entire unit face down on the bench and knock out the driving pins from the rear with a hammer and punch. This will release the two major parts.

ASSEMBLY

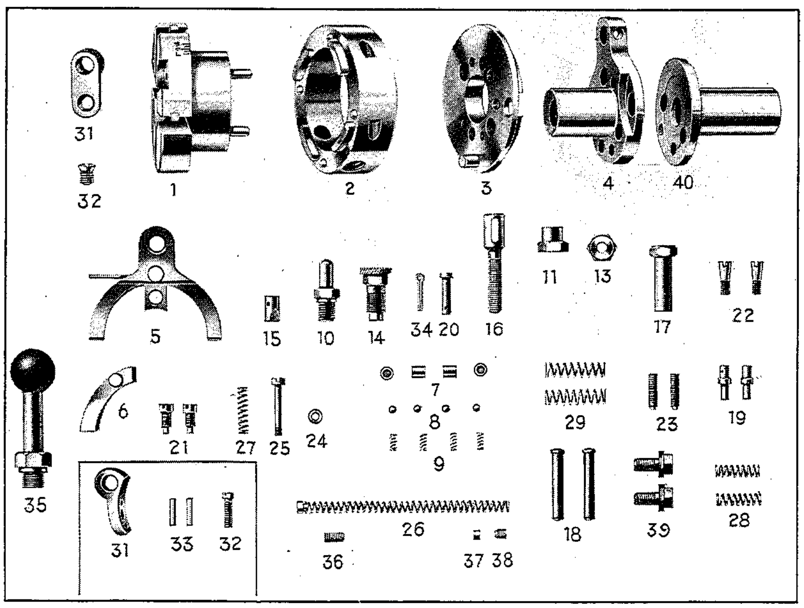
First, put the back part on the bench with the pilot facing upward. Place the cam spring plate over the pilot of back part with the hole in the trip lever in line with the trip screw hole in the back part and line up the driving pin holes between the two parts. Put springs on the driving pins and insert the small end of the pins through the cam spring plate and into the back part, using a hammer and punch to finally drive pins into position. Drive pins into position so that the ends of the driving pins will be SLIGHTLY UNDER the rear surface of the back part. Now place back part-cam spring plate assembly in the vise, holding from the flange and in a horizontal position. Place the two buffer pins in the holes in the cam spring plate, with the large end of the buffer pins in the cam spring plate. Next place the two buffer springs over the buffer pins. Assemble cam to skeleton and rotate cam until stop plunger drops into recess. Now hold skeleton-cam assembly face down on the bench and insert the cam spring. When inserting the cam spring, position the cam so that the segment is toward you, then place the cam spring in the chamber and compress spring against the pin to the left, allowing the opposite end of the spring and shoe to project slightly out of the chamber when against opposite pin. This shoe prevents spring from catching in final assembly.

Now assemble skeleton-cam assembly to back part-cam spring plate assembly as follows: — With the back part-cam spring plate assembly in vise, place the skeleton-cam assembly on the back part-cam spring plate assembly, lining up the spring and pin holes. Next, compress the two units together and when doing so pull out the stop plunger in the cam, allowing cam to rotate slightly lining up the cam spring stop pin in the cam with the one in the plate. Then rotate the cam and pick up the end of the cam spring that is projecting. By rotating the cam in this manner the cam spring stop pin in the cam spring plate will drop into position in the cam spring chamber and by additional pressure the two units can be brought together. Holding the two units together, remove entire assembly from vise and place face down on bench still holding parts in place. Now insert the two cam spring plate screws from the rear and tighten in position. Shank can now be assembled lining up clearance hole through flange with buffer action lock out screw. Reassemble tripping mechanism.



PARTS FOR DIE HEAD — STYLE DS

WHEN ORDERING REPAIR PARTS, GIVE BOTH NUMBER AND NAME OF PART AS WELL AS CONSTRUCTION NUMBER AND SERIAL NUMBER OF TOOL.



*1—Skeleton with chaser keys and cam spring plate pins
2—Cam with push buttons, rings, springs and cam spring stop pin
*3—Cam spring plate with cam spring stop pin
4—Back part
5—Trip lever with locking bolt pin
6—Cam segment with pin
7—Push button rings
8—Push buttons
9—Push button springs
10—Closing pin
11—Tripping nut
13—Outside trip gage lock nut
14—Stop plunger complete
15—Locking bolt
16—Trip screw
17—Outside trip gage
18—Driving pins
19—Buffer pins
20—Trip screw pivot pin
**21—Yoke lever pivot { Screws / Pins
22—Cam spring plate screws
23—Adjusting screws
24—Trip lever screw nut
25—Trip lever screw
26—Cam spring
27—Trip lever spring
28—Buffer springs
29—Return springs
†31—Outside trip gage bracket
†32—Outside trip gage bracket screw
33—Outside trip gage bracket pins
34—Trip screw pivot cotter pin
35—Closing handle
36—Buffer action lock out screw
37—Buffer action lock out binding screw shoe
38—Buffer action lock out binding screw
39—Aligning shank screws
40—Shank—Specify shank size when ordering

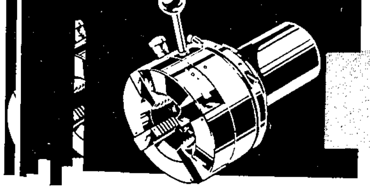
*Parts 1 and 3 ground together. They should be ordered together wherever possible, to insure interchangeability.

**On the 5/16", 9/16" and 3/4" DS, the pivots are screws. In 1" and larger DS heads, the pivots are pins.

†Parts No. 31 and 32 are used in 9/16" and larger sizes. The parts shown in the box at the lower left are used in 5/16" size only.

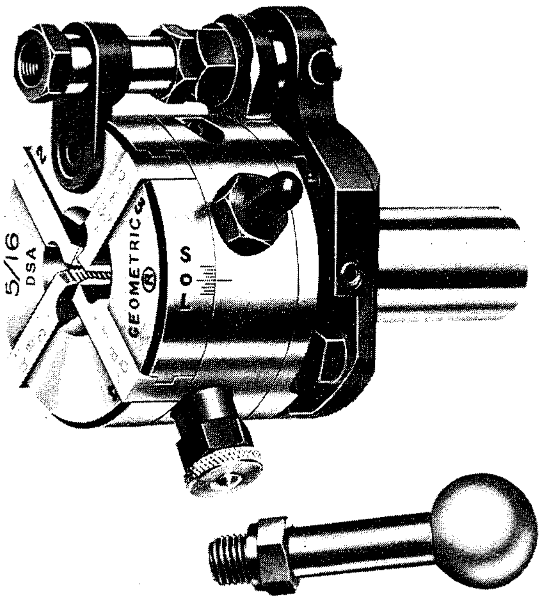
NOTE: Construction of the 1-1/4" DS is somewhat different from the other sizes. If difficulty in determining the correct parts for this size is encountered, the order should be accompanied by a complete description or a sketch of the part desired.

Parts 4 and 40 are integral in sizes 1-1/4" and 1-3/4".



6. REPLACEMENT PARTS — CONTINUED

Style DSA Die Head

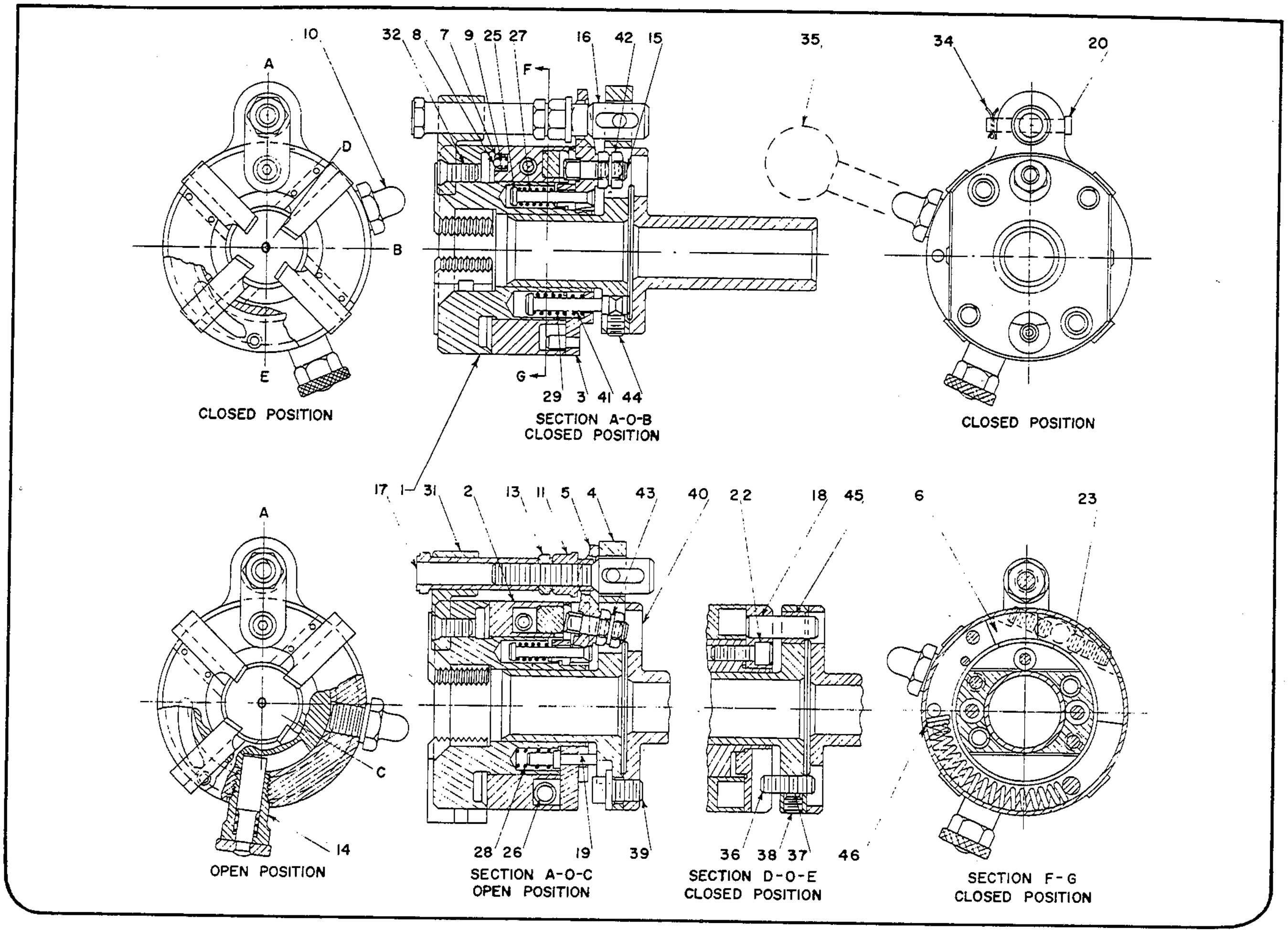


DISASSEMBLY

Remove chasers and tripping mechanism and with the die head in open position, loosen the two return spring pin binding screws on the flatted sides of the backpart. Loosen these screws until a slight click is heard but do not remove them completely. The front portion of the die head can now be removed from the backpart and shank. Using another size hex key remove the cam spring plate screws from the back of the front portion of die head. Remove the cam spring plate assembly being careful to prevent the cam spring from coming out. To disassemble skeleton and cam pull out on stop plunger in case it is engaged. Other smaller parts can be easily disassembled.

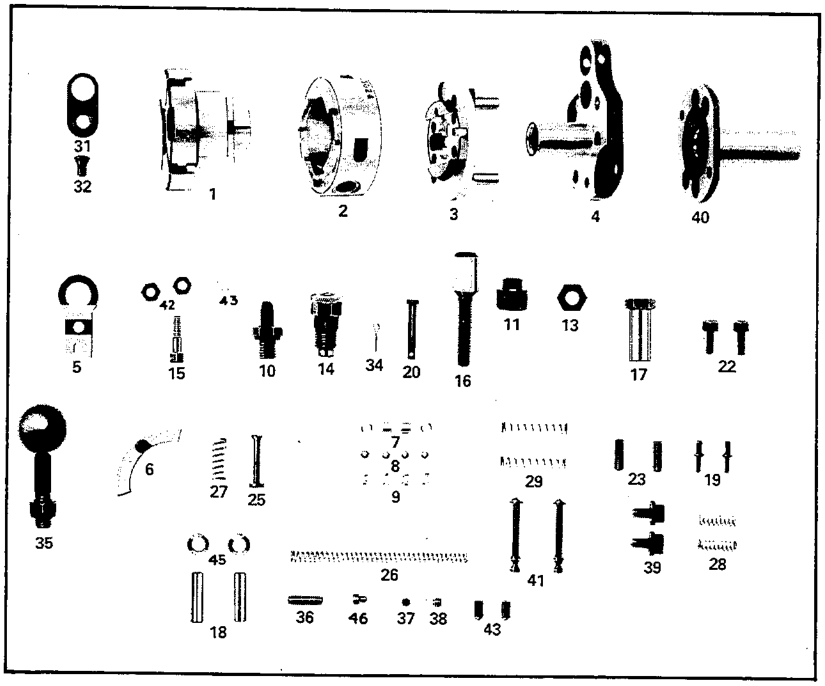
ASSEMBLY

Install cam spring in cam between pins with the shoe end of cam spring toward the two pins in cam. Assemble cam and skeleton. Assemble trip lever spring and spring pin in trip lever slot in cam spring plate. Next compress trip lever spring so trip lever can be inserted and the head of pin inserted in trip lever. Place return springs on return spring pins and assemble to cam spring plate working from inside bore. The cam spring plate assembly can now be assembled to the cam and skeleton by inserting the return spring and trip lever springs in proper holes. The cam should be rotated on the skeleton so that the cam spring stop pin in the cam spring plate can be inserted in the space provided between the shoe on the cam spring and the stop pin in the cam. Cam spring plate screws can now be inserted and tightened. Now cam can be rotated on skeleton until locking bolt is engaged and the front portion of die head assembled to the backpart and shank. Care should be taken to get the return spring pins in holes and compress the buffer action before tightening the two return pin binding screws. Assemble tripping mechanism and die head is ready for use.



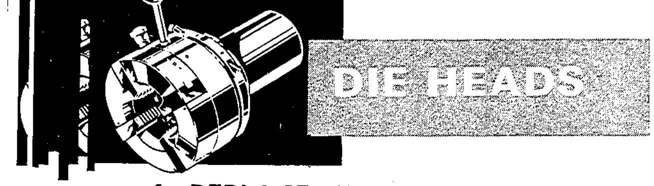
PARTS FOR DIE HEAD — STYLE DSA

WHEN ORDERING REPAIR PARTS, GIVE BOTH NUMBER AND NAME OF PART AS WELL AS CONSTRUCTION NUMBER AND SERIAL NUMBER OF TOOL.



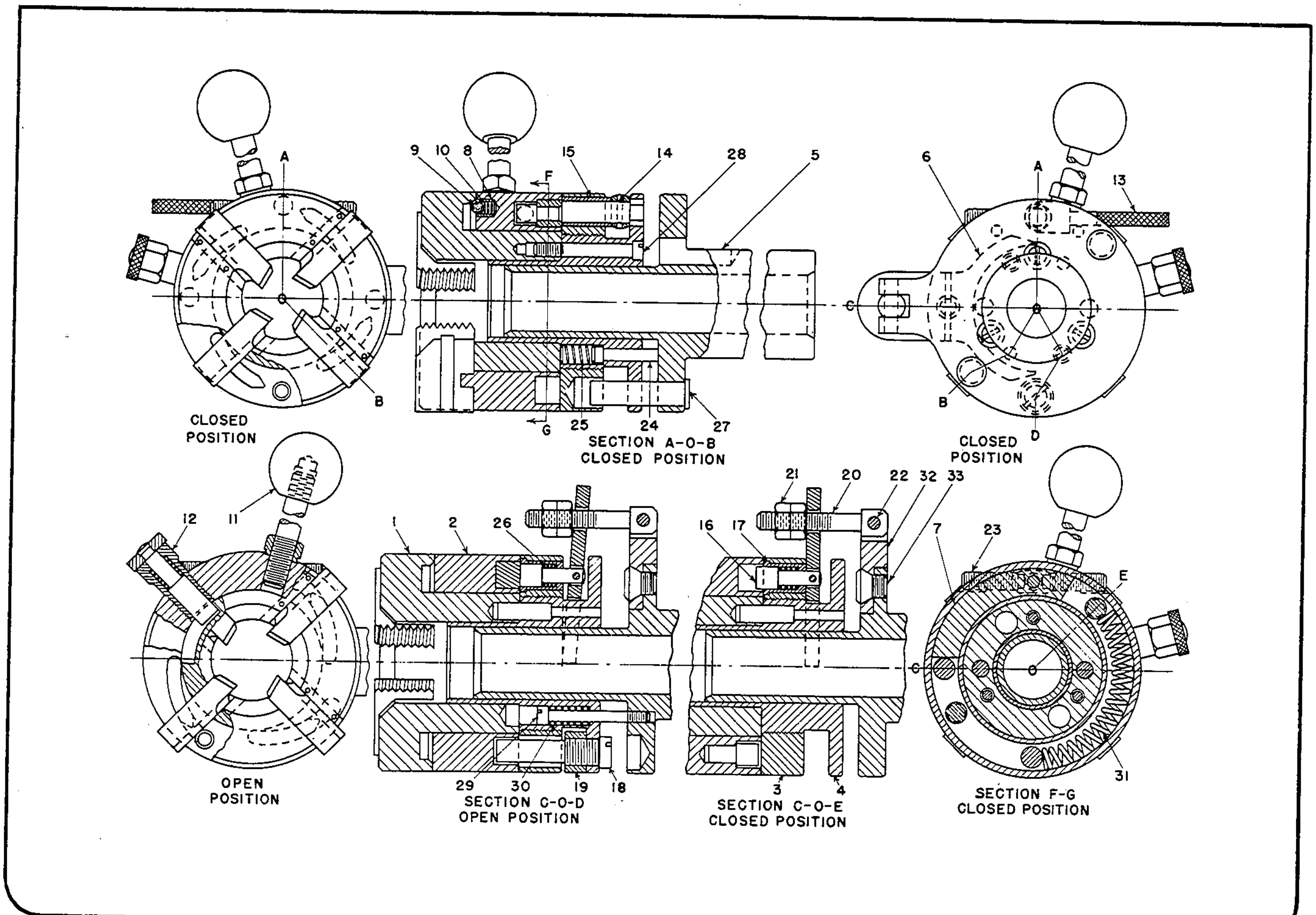
1. Skeleton with chaser keys
2. Cam with push buttons, rings, springs and cam spring stop pins
3. Cam spring plate with cam spring stop pin and driving pins
4. Back part and driving pin bushings
5. Trip lever
6. Cam segment with pin
7. Push button rings (6*)
8. Push buttons (6*)
9. Push button springs (6*)
10. Closing pin
11. Tripping nut
13. Outside trip gage lock nut
14. Stop plunger complete
15. Locking bolt
16. Trip screw
17. Outside trip gage
18. Driving pins
19. Buffer pins
20. Trip screw pivot pin
22. Cam spring plate screws (4*)
23. Adjusting screws
25. Trip lever pin
26. Cam spring
27. Trip lever spring
28. Buffer springs
29. Return springs
31. Outside trip gage bracket
32. Outside trip gage bracket screw
34. Trip screw pivot cotter pin
35. Closing handle complete
36. Buffer action lock out screw
37. Buffer action lock out binding screw shoe
38. Buffer action lock out binding screw
39. Aligning shank screws (3*)
40. Shank—Specify shank size when ordering
41. Return spring pins
42. Locking bolt nuts
43. Locking bolt lock washer
44. Return spring pin binding screws
45. Driving pin bushing
46. Cam spring shoe

*Number of parts required in 2¼″ DSA Die Head



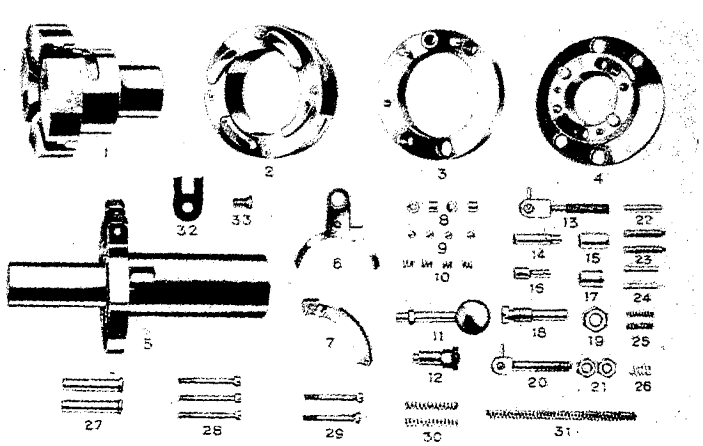
6. REPLACEMENT PARTS—CONTINUED Styles DD and C

Style DD



PARTS FOR DIE HEAD—STYLE DD

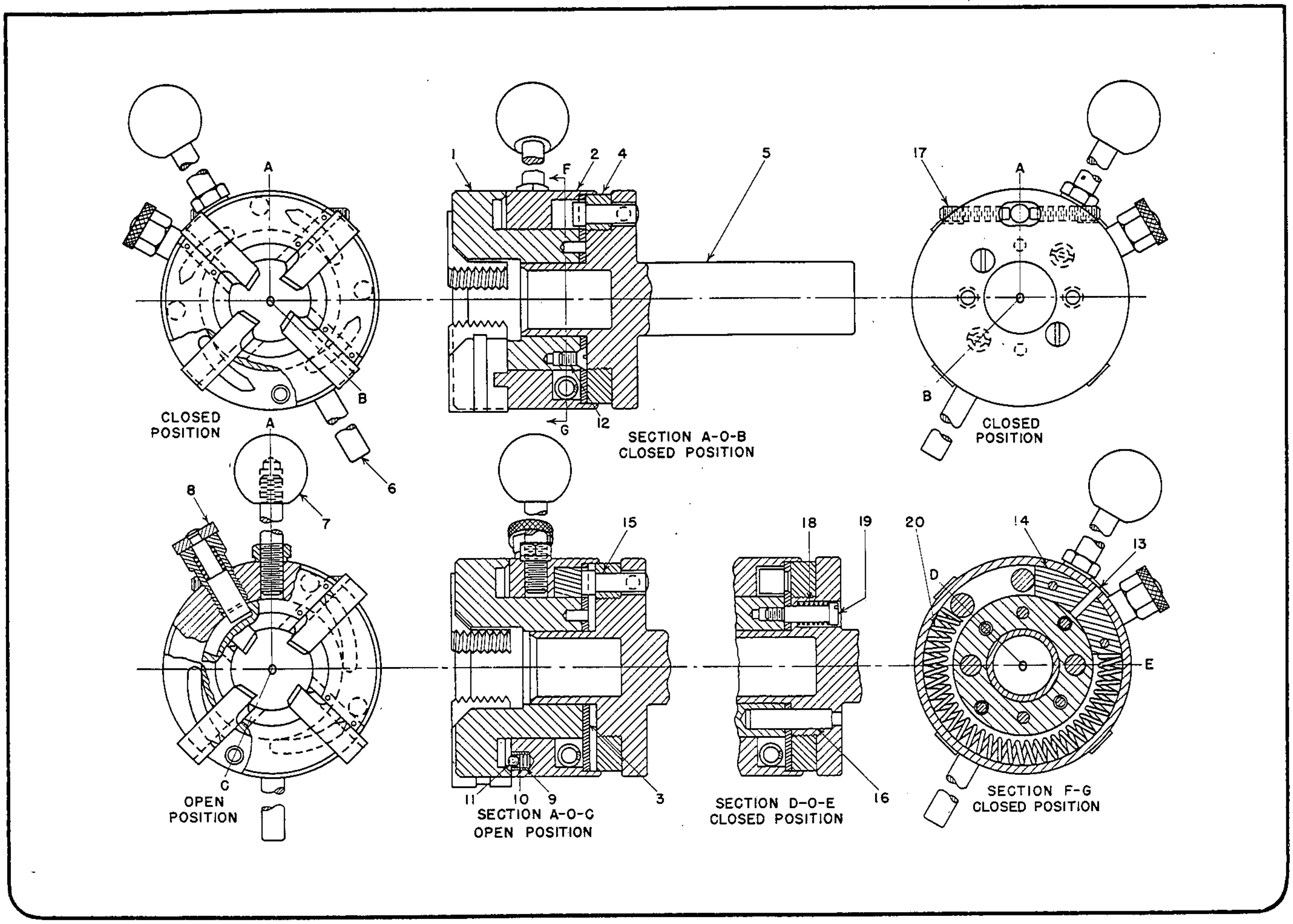
WHEN ORDERING REPAIR PARTS, GIVE BOTH NUMBER AND NAME OF PART AS WELL AS CONSTRUCTION NUMBER AND SERIAL NUMBER OF TOOL



1—Skeleton with chaser keys.
2—Cam with push buttons, rings, springs, and cam spring stop pins.
3—Back part ring with locking bolt bushing, eccentric bushing and lever stop pins.
4—Back part with back part pins.
*5—Shank (specify shank size when ordering).
6—Trip lever with locking bolt pin.
7—Cam segment with pin.
8—Push button rings.
9—Push buttons.
10—Push button springs.
11—Closing handle, assembled.
12—Stop plunger complete.
13—R&F lever with pin.
14—R&F eccentric.
15—R&F eccentric bushing.
16—Locking bolt.
17—Locking bolt bushing.
18—Cam spring stop screw.
19—Cam spring stop screw nut.
20—Trip screw with pin.
21—Trip screw nuts.
22—Trip screw pivot pin.
23—Adjusting screws.
24—Buffer pins.
25—Buffer springs.
26—Locking bolt spring.
27—Driving pins.
28—Back part screws.
29—Return spring screws.
30—Return springs.
31—Cam spring.
32—Trip screw head
33—Trip screw head screw.

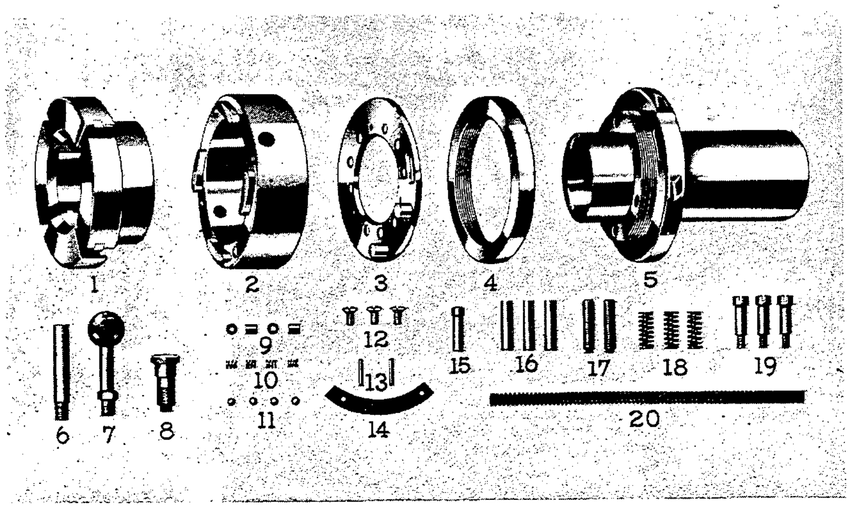
*Used with Style DD hand type only.

Style C — Pull-Off Trip Type



PARTS FOR DIE HEAD — STYLE C — Pull-Off Trip Type

WHEN ORDERING REPAIR PARTS, GIVE BOTH NUMBER AND NAME OF PART AS WELL AS CONSTRUCTION NUMBER AND SERIAL NUMBER OF TOOL.

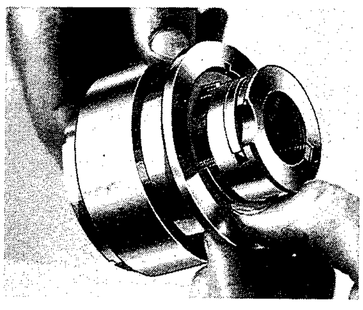


1—Skeleton with Chaser Keys and Cam Spring Plate Pins.
2—Cam with Push Buttons, Rings and Springs.
3—Cam Spring Plate with Cam Spring Stop Pins.
4—Adjusting Ring.
5—Back Part (specify shank size when ordering).
6—Closing Pin.
7—Closing Handle.
8—Stop Plunger Complete.
9—Push Button Rings.
10—Push Button Springs.
11—Push Buttons.
12—Cam Spring Plate Screws.
13—Cam Segment Pins.
14—Cam Segment.
15—Locking Bolt.
16—Driving Pins.
17—Adjusting Screws.
18—Return Springs.
19—Return Spring Screws.
20—Cam Spring.

NOTE—Some "C" Heads are arranged with Roughing and Finishing Attachments. In this case the Locking Bolt No. 15 has an eccentric end. The extra parts are the Locking Bolt Bushing and Roughing and Finishing Lever with Pin—not shown in illustration.

6. REPLACEMENT PARTS — CONTINUED Styles KD and CK Die Heads

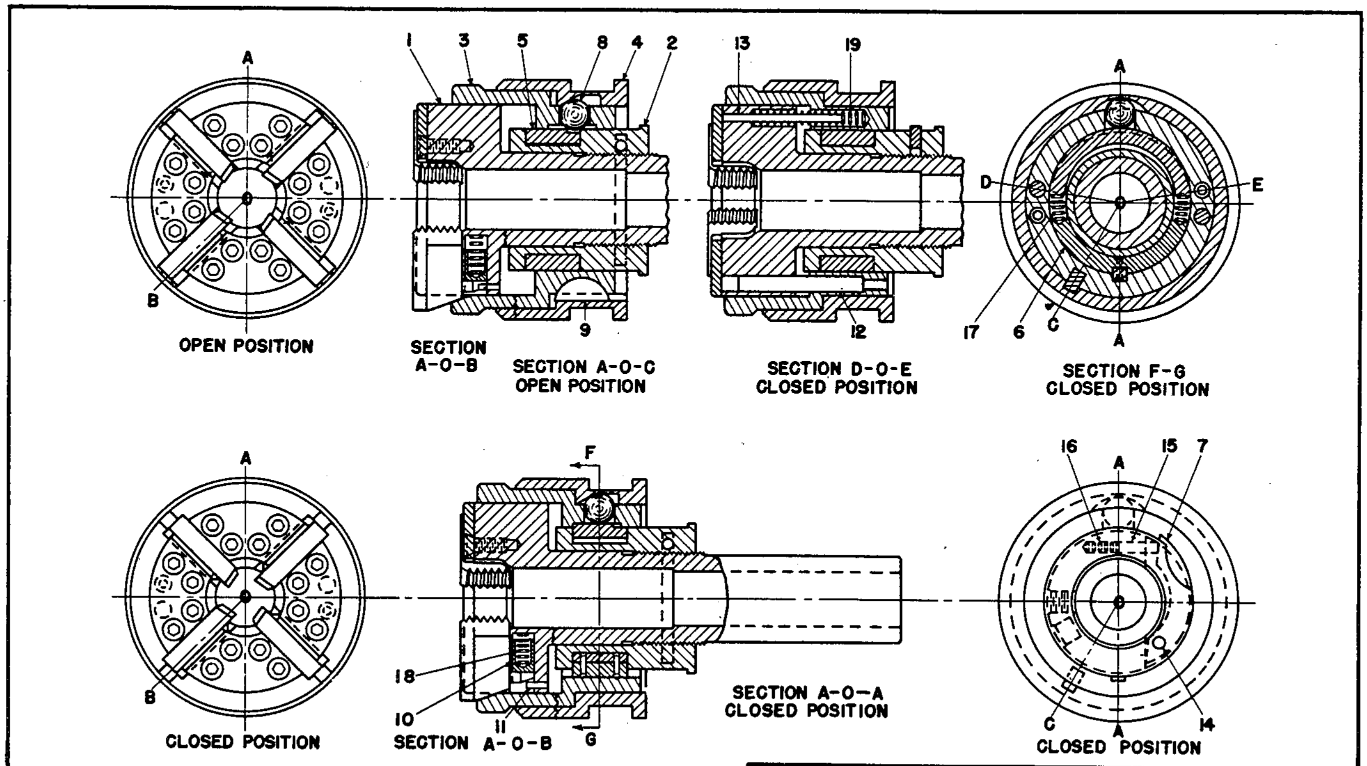
No tools, except a small hex key, are necessary for disassembly of the KD and CK Die Heads. With the head closed, release the screw in the adjusting ring. Then unscrew the adjusting ring from the shank of the skeleton, now pull the skeleton forward from the assembled trip flange, closing sleeve and adjusting ring. With your thumbs pushing forward against the closing sleeve, reach inside the assembly and release the adjusting ring by pushing it backward and out with your fingers. When disassembling the closing sleeve and trip flange care should be taken to prevent the ball dropping out. See sectional view below.



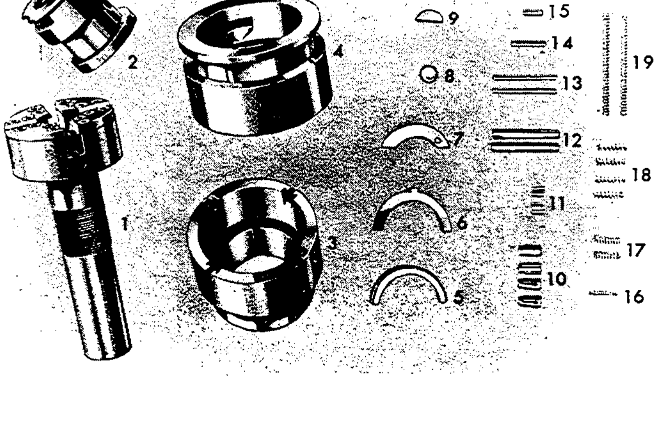
To reassemble, replace pawl and segment in groove of adjusting ring, being sure the broader face of the pawl is toward the narrower rim of the groove.

Keep the pawl springs under tension as you replace the adjusting ring.

Be careful to line up the springs in the closing sleeve with the corresponding holes in the skeleton; keep the closing sleeve forward while screwing the adjusting ring on to the skeleton. Then tighten the set screw in the adjusting ring.



PARTS FOR DIE HEADS — KD AND CK



WHEN ORDERING REPAIR PARTS GIVE BOTH NUMBER AND NAME OF PART, ALSO CONSTRUCTION NUMBER AND SERIAL NUMBER OF TOOL.

1—Skeleton with front plates and front plate screws. Skeleton Assembly also includes 2 Closing Sleeve Spring Pins.
2—Adjusting Ring with binding shoe and set screw. Adjusting Ring Assembly also includes Stop Lever, Stop Lever Pivot Pin, Stop Lever Spring Pin and Stop Lever Spring.
3—Closing Sleeve. Closing Sleeve Assembly includes Closing Sleeve Guide Pins.
4—Trip Flange.
5—Pawl.
6—Segment with Key.
7—Stop Lever.
8—Ball.
9—Woodruff Key.
10—Chaser Spring Plungers.
*11—Chaser Spring Plunger Retaining Pins.
12—Closing Sleeve Guide Pins.
13—Closing Sleeve Spring Pins.
14—Stop Lever Pivot Pin
15—Stop Lever Spring Pin.
16—Stop Lever Spring.
17—Pawl Springs.
18—Chaser Springs.
19—Closing Sleeve Springs.

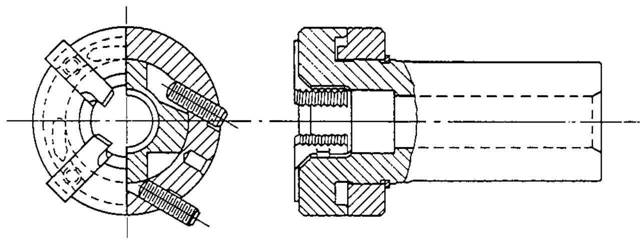
*Screws with Lock Washers replace these pins on 1" size Die Head and larger.

IMPORTANT NOTE: The construction of the Style KD and the Style CK is identical with the following exceptions: The 2¾" and 3¼" CK have two pawls (Part No. 5); no segment (Part No. 6); the adjusting ring (Part No. 2) is shorter in length; they also have one additional part (not shown) known as a skeleton ring.

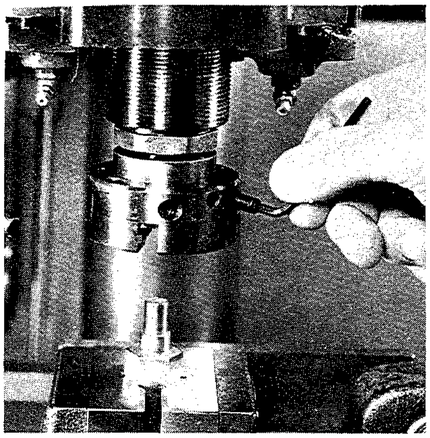
SOLID ADJUSTABLE

Style DJ

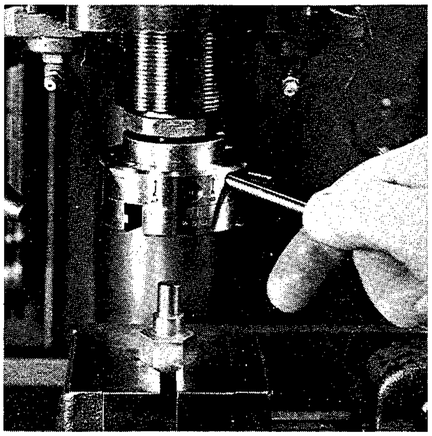
Everything that has been said about the operating conditions and care of Self Opening Die Heads on the foregoing pages is equally applicable to Solid Adjustable Die Heads. However, not having the self opening mechanism they are much simpler in construction. There are just two major parts — the Skeleton which holds Chasers in place, and a Cam which acts as both a locking and size adjustment medium.



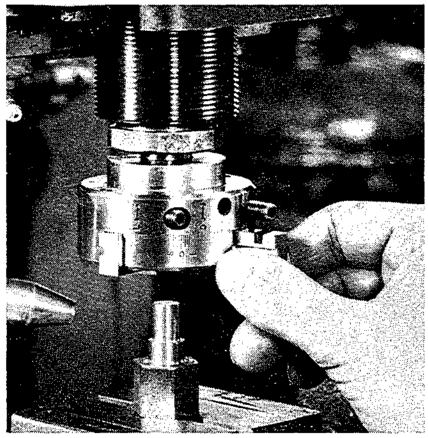
CAM POSITION
TO INSERT CHASERS



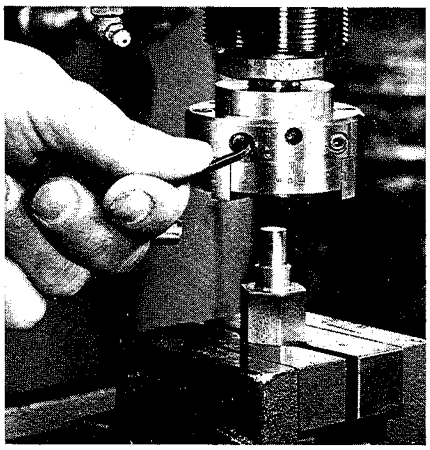
1. Before inserting or removing chasers, first back out the adjusting screw shown in illustration.



2. Insert a pin in the hole on the periphery of the Cam and revolve the Cam on the Skeleton toward the left.



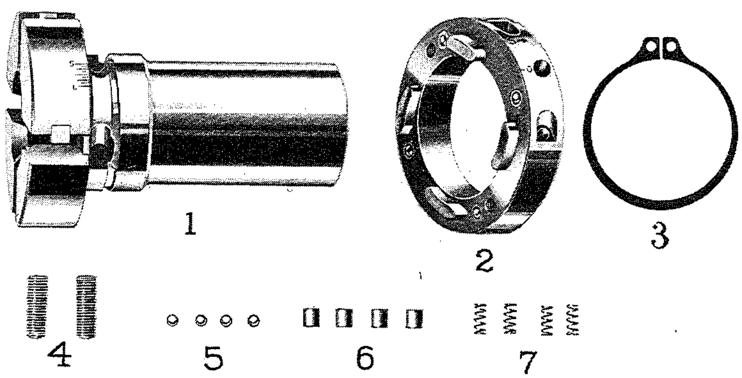
3. The Chasers, which are held in by Push Buttons, can then be taken out (or inserted) with the fingers. Insert Chaser No. 1 in slot No. 1, No. 2 in slot No. 2, and so on.



4. Adjust to cutting size loosening one adjusting screw and tightening another. Set to a slightly larger diameter than you intend to cut. Then, adjust in the small direction until the desired size is obtained. In this way backlash is eliminated.

PARTS FOR DIE HEAD — STYLE DJ

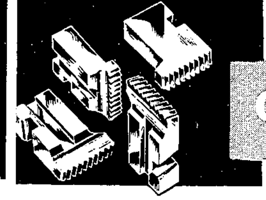
WHEN ORDERING REPAIR PARTS, GIVE BOTH NUMBER AND NAME OF PART PLUS SIZE, CONSTRUCTION NUMBER AND SERIAL NUMBER OF THE DIE HEAD.



1. Skeleton with Chaser Keys. (Specify Shank size.)
2. Cam with Push Buttons, Rings, and Springs.
3. Cam Retaining Ring. Older models and present 6" Head have Cam Retaining Keys and Key Screws instead of Ring.
4. Adjusting Screws.
5. Push Buttons.
6. Push Button Rings.
7. Push Button Springs.

DIE HEAD CHASERS

die head chasers



CHASERS

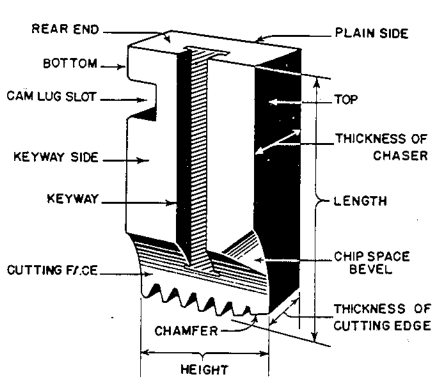
STYLES

Die Heads of any type would be useless without cutters. These cutters are called CHASERS and the fact that they are adjustable is what gives to Die Heads their great advantage over solid dies. Chasers usually come in sets of four but a set may consist of more depending on the size of the Die Head.

Since the correct operation of your Die Heads will depend largely on the performance of the Chasers, we cannot emphasize too strongly the importance of top quality chasers to begin with, and the utmost care in selecting the correct chaser for the job in hand.

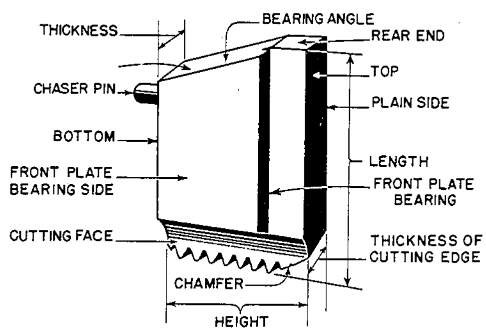
To equip all types of Geometric Die Heads, there are three chaser styles as illustrated below

STYLE D



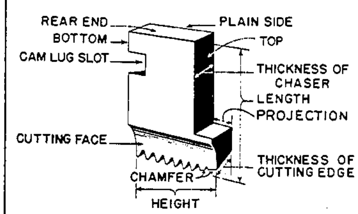
Will fit Geometric Die Heads D, DD, DS, DSA, DJ and C.

STYLE K



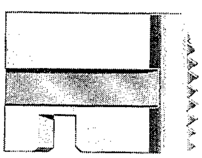
Will fit any Geometric Die Head which has the letter K in its type designation.

STYLE EJ



Will fit any Geometric Die Head which has the letters EJ in its type designation.

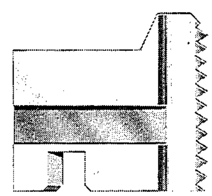
TYPES



REGULAR

For the general run of work under ordinary conditions.

Chasers are also classified as "Regular" or "Projection." The projection type, as the name implies, project out beyond the face of the Die Head when in place. This is not only an advantage when threading close to a shoulder but because of the longer threaded section they permit of a larger number of rechamferings.



PROJECTION

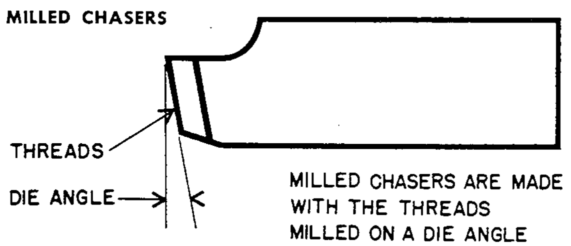
For close to shoulder threading.

TAPPED VS "MILLED" CHASERS

In addition to classification by Style and Type, Die Head chasers may also be classified by conformation of the thread profile, i.e., "Milled" and "Tapped."

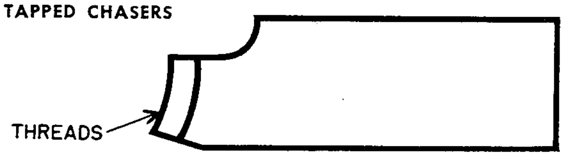
These two terms may, however, be misleading as by custom they refer to the shape and not necessarily, as the names imply, to the manner in which the threads were generated. In other words, "Milled" refers to a straight die angle no matter how it was generated, whether milled or ground, and "Tapped" merely indicates a concave profile.

MILLED CHASERS



MILLED CHASERS ARE MADE WITH THE THREADS MILLED ON A DIE ANGLE

TAPPED CHASERS

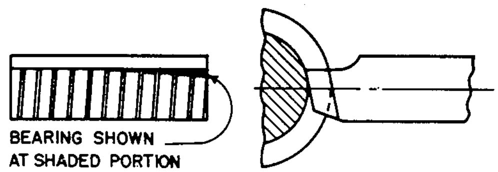


TAPPED CHASERS ARE MADE WITH THE THREADS ON A CONCAVED SURFACE AS SHOWN ABOVE

TERMS RELATING TO CHASERS

BEARING

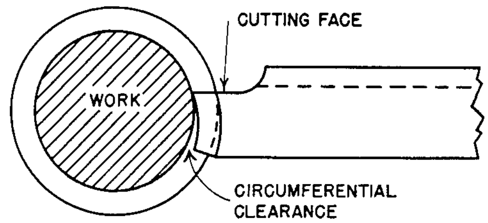
This is the surface in contact between the chaser and the work when cutting the thread.



CIRCUMFERENTIAL CLEARANCE

(Tapped Form and S Chasers)

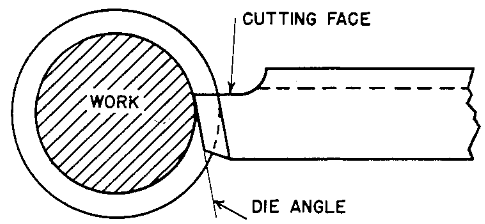
To provide relief circumferentially between chaser and work as shown so that the chaser will contact the work at the cutting face only.



DIE ANGLE

(Milled, Ground thread or Tapped Form Chasers)

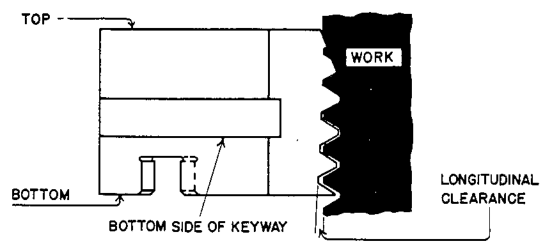
Relief between the chaser and the work is provided by the Die Angle, i.e., the angle at which threads are milled.



LONGITUDINAL CLEARANCE

(Milled, Ground thread or Tapped Form Chasers)

To provide clearance longitudinally between the chaser and work as shown so all of the cutting will be done at the chamfer.

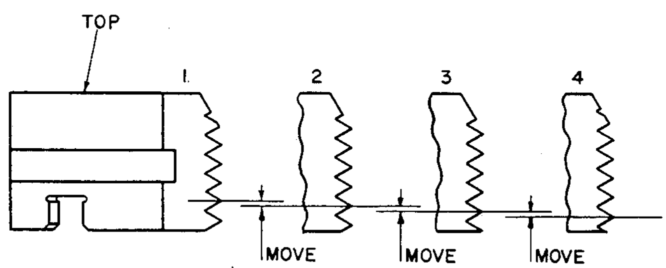


MOVE (Single Thread)

The distance or advance of a given thread from chaser to chaser is the "MOVE." The distance is the same from one chaser to the next in a set (on single thread).

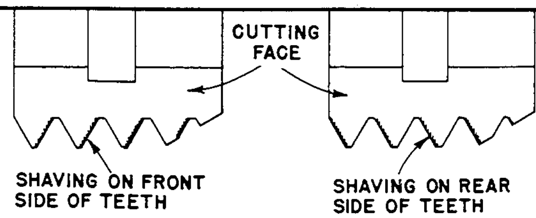
TRACKAGE

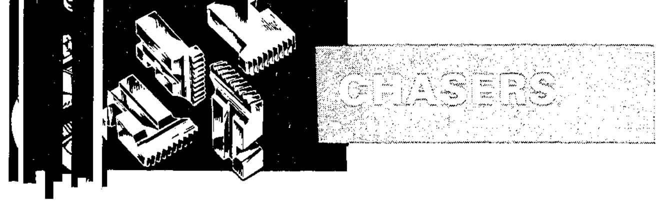
Chasers "track" properly when all chasers of a set follow exactly in the groove cut by the preceding chaser or chasers. (See move).



SHAVING

Shaving is the side cutting action of one or more chasers resulting in thin threads. For further information see page 37.





Before starting to cut a thread there are several fundamental things that should be checked.

First of all, examine the blueprint of the work to be produced and make certain you have the proper tools for the work. Check especially carefully the chasers furnished. The chasers can make all the difference between success or failure on a threading job.

The chamfer (often called throat or lead) of a chaser is the beveled portion which leads the tool onto the work. As the cutting is all done by the chamfer and first full tooth back of the chamfer, it is important that the chamfers be right for the job.

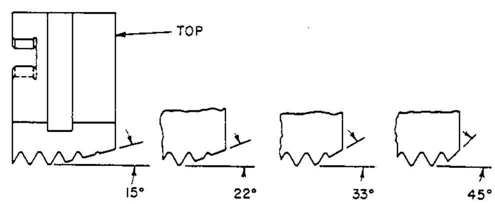
If you are threading to a shoulder or bottom, be sure the chasers have a short enough chamfer for the work. If it is not to a shoulder, do the chasers have a long enough chamfer to enable them to do the best possible job? The longer the chamfer the better the distribution of chips. This means easier cutting, better finish on the work and longer chaser life.

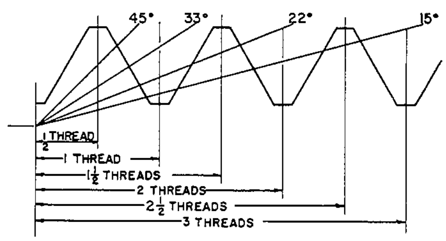
Chasers should also have the correct face grind for the material to be threaded. In fact incorrect face grind will result in more trouble than any other one factor in threading. It is very important to distinguish between chamfer grinding and face grinding.

CHAMFER ANGLES

The correct chamfer angle depends on the type of work to be threaded. For shoulder threading 45° is usually employed. For straightaway threading a 22° chamfer is standard. On tough alloy steels a longer chamfer should be used where permissible.

The figures in the chart are based on American National or V threads. On Acme, Worm, Modified Square and similar thread forms, a two-thread chamfer is approximately 15°, a one-thread chamfer approximately 33°.





SHARPENING CHASERS

Nothing contributes more to the production of accurate threads, and low cost per thread, than accurate sharpening of chasers. Frequent light grinding or touching up will not only give better threads but will greatly extend the life of the chasers. Partial dullness leads to chipping as well as poor threads.

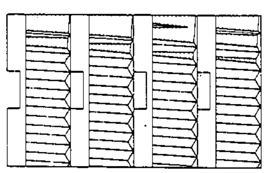
Therefore, to obtain the best results from any chasers they should be resharpened frequently and before they become dull. They should be resharpened by machine using an appropriate grinding fixture. They should not be resharpened free hand. See pages 34-35 for sharpening fixtures.

Chamfer Grinding

One point which should be stressed is the necessity of resharpening chasers at the chamfer. On milled chasers, in fact, practically all resharpening should be done at the chamfer with the cutting face only touched up lightly from time to time as needed.

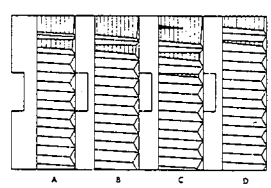
For quick recognition of correct and incorrect chamfers, a few are illustrated here.

CORRECTLY GROUND SET



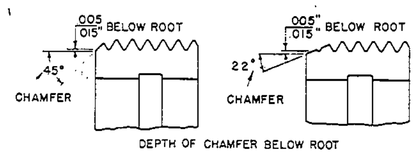
Note that chamfer is slightly different on each chaser of set. For explanation see illustration of "Move" on page 29.

INCORRECTLY GROUND SET



Chaser B is correctly ground. Chaser C has been ground with too long a chamfer. Chaser D has too short a chamfer. Also Chaser A is too thin and not of the same thickness as the other three chasers of the set.

DEPTH OF CHAMFER



The chamfer should start .005" to .015" below the root of the chaser teeth. All chasers of a set should be ground at uniform angle and depth so that each chaser will start cutting at the same time.

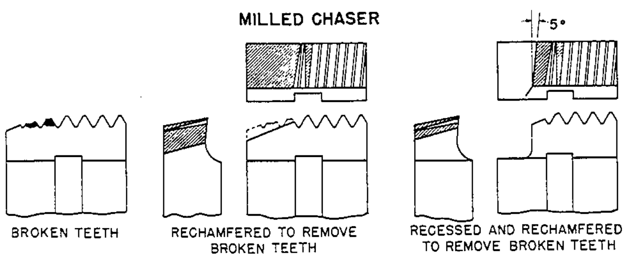
RECESSING AND RECHAMFERING

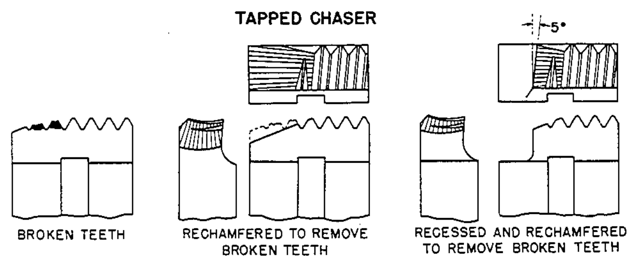
For shoulder threading where a long chamfer is not permissible, it is frequently necessary to recess the front face of the chasers to remove dull, worn or chipped teeth. The chasers must then be rechamfered with a one thread chamfer, which is the minimum recommended for shoulder threading.

Incidentally, this same method of recessing is used when only long chamfer chasers are available and you want to use them for shoulder threading. Here again the chasers must be rechamfered after recessing.

All chasers must be recessed uniformly, with 5° rake.

When projection chasers are employed, grind back the projection sufficiently to remove any worn or chipped teeth. Be sure that chasers for shoulder threading have a 5° rake ground on top so that they will have only a single point contact with the work in case of accidentally hitting shoulder. Projection chasers must be rechamfered after grinding back the projection.





CHAMFER CLEARANCE

In sharpening chasers, not only must the chasers have correct angle of chamfer but they must also have the proper chamfer clearance.

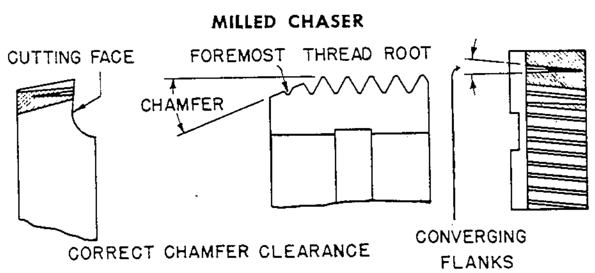
Too much chamfer clearance will cause chattered threads, tapered threads and poor lead. Reverse chamfer clearance will prevent the chasers from cutting freely and perhaps result in broken chasers.

In setting up the chasers for rechamfering, first select the chaser of a set having the foremost thread root at the chamfer.

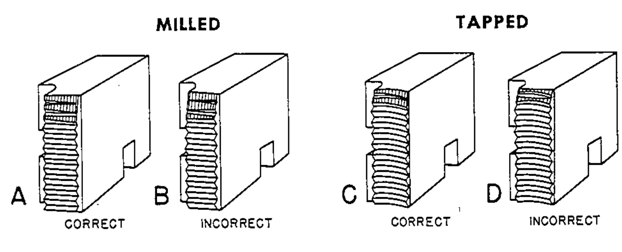
Second, set up the chaser in a fixture so that in grinding, the flanks of the chamfered teeth will converge as shown, thus indicating that the chamfer has proper clearance.

It is good practice to observe the amount of clearance on the chaser before regrinding so it can be duplicated readily.

The amount of clearance is, to a certain extent, dependent upon the nature of material being threaded. The amount of clearance on the chamfer of the milled type of chaser is approximately ½° to 1° more than the die angle measured on the helix of the chaser. For tapped chasers, clearance should be slightly more than the circumferential clearance. When threading aluminum the amount of clearance should be double that for other materials.



The correct chamfer clearance can be determined by observation and does not require gaging or measuring instruments.



Figures A and C have chamfer correctly ground, with clearance from the cutting edge back. Figures B and D are incorrectly ground straight across without clearance, forming the appearance of a reverse chamfer clearance.

SHARPENING CHASERS (Continued)

Grinding Cutting Face

On the preceding pages we have stressed the importance of grinding chasers, especially milled chasers, principally at the chamfer.

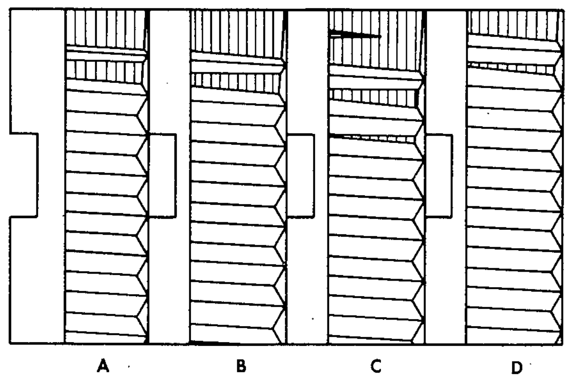
However, chasers must also be resharpened occasionally on the cutting face. With milled chasers rechamfer first. Should the cutting edges show dullness, then touch up the cutting face lightly, removing only .002" to .003".

Tapped chasers can be resharpened on the cutting face much more freely. When threading to a shoulder with tapped chasers it is usual to do most of the resharpening on the cutting face but they should be rechamfered if the chamfered teeth are badly worn.

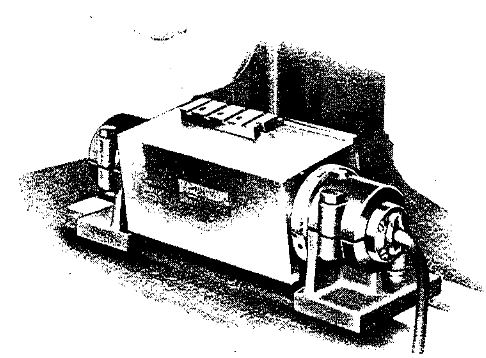
It is important that the width of the land or thickness of cutting edge should be uniform on all chasers of a set or the load of cutting will be thrown entirely upon the thicker chaser or chasers, resulting in unsatisfactory threads.

Never grind chasers free hand. Always use a grinding fixture or grind them on a surface grinder equipped with a suitable work holder. The usual procedure is to employ a magnetic chuck on a surface grinder thus enabling you to resharpen all chasers of a set at one set-up. This, of course, insures equal resharpening of all chasers.

Before setting up, be sure you know what face grind should be employed. Use the chart on the opposite page as a guide.



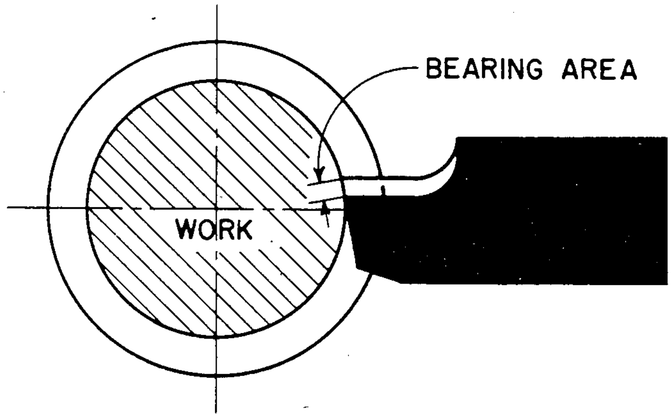
Result of uneven grinding. Cutting edge A is thinner than others. Chamfer is also incorrect.

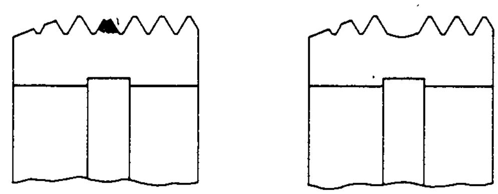


Grinding a complete set of chasers on a surface grinder with magnetic chuck.

The illustration shows how milled chasers contact the work. Note the "Bearing Area." As soon as this area is removed by grinding back the cutting face, chasers will chatter. Therefore it is important that the cutting face of milled chasers be ground only lightly — a few thousandths of an inch at any one resharpening.

Sometimes a tooth here or there is broken. Often these broken teeth may be ground out. Care should be taken not to disturb flanks of teeth adjoining the broken tooth.





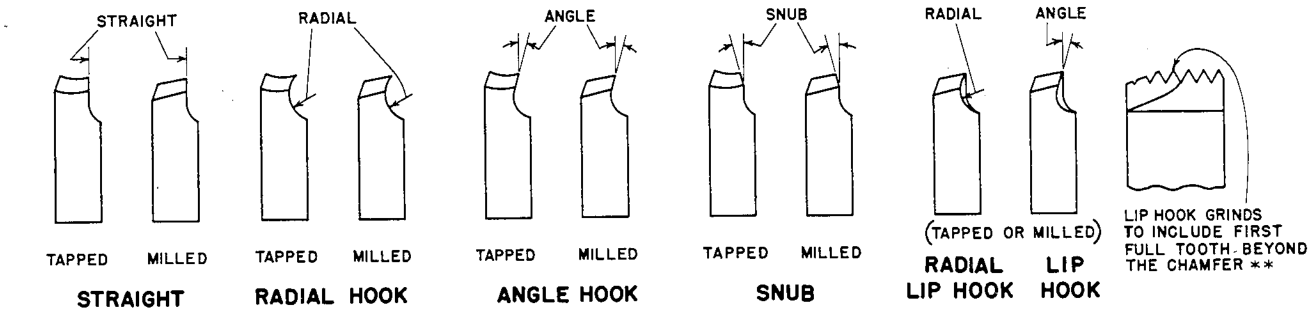
REMOVING BROKEN TOOTH BY GRINDING

CHASER FACE GRINDING CHART

DIE HEAD CHASERS — ALL STYLES

RIGHT HAND CHASERS — Use this Chart.
LEFT HAND CHASERS — Use this Chart.
TAPPER DIE HEAD CHASERS
Use same Grind as for Straight Thread Chasers.
MULTIPLE THREAD MILLED CHASERS
Instructions furnished with each set of Chasers.
ALL OTHER DIE HEAD CHASERS
Instructions furnished upon request.

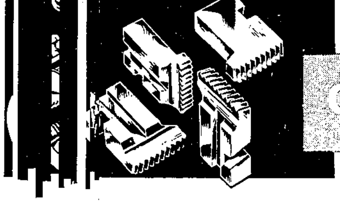
The Cutting Face Grinds specified are approximate and due to conditions may have to be varied to obtain best results.



**Lip Hook Grinds not recommended for Shoulder or Bottoming Work, in this case use the same angle but omit the lip.

Material	Milled Form and Tapped Form	
	Straight Thread	Taper Thread
Aluminum — Cast	15° Radial Hook	10° Radial Hook
Aluminum — Die Cast	15° Radial Hook	10° Radial Hook
Aluminum — Rod	15° Radial Hook	10° Radial Hook
Aluminum — Stamping	15° Radial Hook	10° Radial Hook
Bakelite	5° Snub	5° Snub
Brass — Bar	5° Hook	Straight
Brass — Cast	5° Snub	5° Snub
Brass — Forging	10° Hook	5° Hook
Brass — Stamping	10° Hook	5° Hook
Brass — Tubing	10° Hook	5° Hook
Brass — Naval	10° Hook	5° Hook
Bronze — Bar	10° Hook	5° Hook
Bronze — Cast	Straight	Straight
Bronze — Cast Aluminum	10° Hook	5° Hook
Bronze — Manganese	10° Hook	5° Hook
Bronze — Naval	10° Hook	5° Hook
Bronze — Phosphor	10° Hook	5° Hook
Bronze — Tubing	10° Hook	5° Hook
Celluloid	Straight	Straight
Copper	15° Radial Lip Hook	10° Radial Hook
Everdur	10° Hook	5° Hook
Fibre	5° Snub	5° Snub
Iron — Cast	Straight	Straight
Iron — Malleable	10° Hook	5° Hook
Iron — Wrought	10° Hook	5° Hook

Material	Milled Form and Tapped Form	
	Straight Thread	Taper Thread
Magnesium	15° Radial Hook	10° Radial Hook
Monel Metal	10° Hook	5° Hook
Nickel	15° Hook	10° Hook
Rubber	5° Snub	5° Snub
Silver — German	10° Hook	5° Hook
Steel — Bessmr. Scr. Stock	10° Hook	5° Hook
Steel — Cast	10° Hook	5° Hook
Steel — Carb. SAE 1010-1035	10° Hook	5° Hook
Steel — Carb. SAE 1112-X1340	10° Hook	5° Hook
Steel — Carb. SAE 1040-1095	15° Hook	10° Hook
Steel — Mang. SAE T1330-T1350	15° Hook	10° Hook
Steel — Chrome SAE 5120-52100	15° Hook	10° Hook
Steel — Chrome Van. SAE 6115-6195	15° Hook	10° Hook
Steel — Forging	15° Hook	10° Hook
Steel — Molybdenum SAE 4130-4820	15° Hook	10° Hook
Steel — Nickel SAE 2015-2515	15° Hook	10° Hook
Steel — Ni-Chrome SAE 3115-3450	15° Hook	10° Hook
Steel — Nitralloy	15° Hook	10° Hook
Steel — Stainless	15° Hook	10° Hook
Steel — Stamping	15° Hook	5° Hook
Steel — Tool	15° Hook	10° Hook
Steel — Tubing	15° Hook	5° Hook
Steel — Semi-Casting	Straight	Straight
Zinc — Die Casting	15° Radial Hook	10° Radial Hook



RESHARPENING FIXTURES

The accuracy of finished threads is largely dependent upon the precision with which chasers are chamfered. Uneven chamfers throw the cutting on one or two chasers of a set. That means lead errors, taper threads, poor threads.

You can't get uniform and accurate chamfers by grinding free hand. They can, however, be easily achieved with the chaser grinding fixtures described on this and the opposite page.

Should the Style A Fixture be used with 5/16" DS, 5/16" K Chasers or 3/16" EJ5 Chasers, special Holders as shown in Figure 3 are required. The Holder shown can be used for the 5/16" DS or the 5/16" K. (The Chasers located on the key with the 5/16" DS; forced against the key with the 5/16" K.) Still another holder of similar design is required with 3/16" EJ5 Chasers. None of these special Holders are included with the Style A Fixture but must be purchased at a slight additional Cost.

Style A Fixture

Milled, Ground and Supermetric Die Head Chasers, may be rechamfered with the Geometric Style A Chamfer Grinding Fixture.

The graduations permit setting the Fixture Table to desired angle of chamfer clearance.

Both right and left hand chasers can be rechamfered — the Table being tilted down for right hand chasers, and up for left hand chasers.

Figure 1 is a side view of Style A Fixture. An adjustable stop governs the position of the chaser in respect to the grinding wheel.

The adjustable stop has ends of varying height. Use low end whenever possible. This adjustable stop must contact the teeth at back end of chaser. In operation the key in the top of the Fixture engages the keyway in D type chasers and acts as a guide while grinding. Clearance should be allowed between the adjustable stop and the bottom of D type chasers.

With K type chasers the bottom of chaser should be located against that side of the adjustable stop which has been milled out for clearance for the chaser pin. Clearance should be allowed between the key and front plate bearing of K chasers.

Figure 2 is Style A Fixture from the opposite side. The graduations permit swiveling the Fixture Table to desired angle of chamfer. Both short and long chamfers may be produced by setting table the desired angle, i.e., 45°, 33°, 22°, and 15°.

To use the Fixture, first set at the proper chamfer clearance angle. (See Fig. 1.) Lock in place by means of hexagon nut. Next swivel the table to desired chamfer angle locking the table in place by means of thumb screw. The Fixture is, of course, securely fastened to the table of the grinding machine.

The usual grinding procedure is shown in Fig. 3. The chaser is fed forward by hand against the side of the wheel until it contacts the adjustable stop. Grind the other members of the set at the same setting to insure uniformity of chamfer.

It is possible to feed the machine table forward in which case the chaser is held firmly against the adjustable stop on the Fixture, the table being fed forward to a stop arranged on the machine.

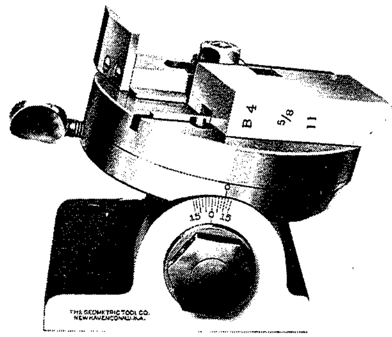


FIGURE 1

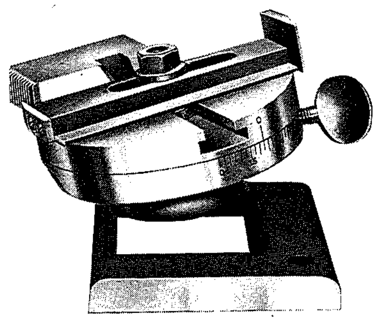


FIGURE 2

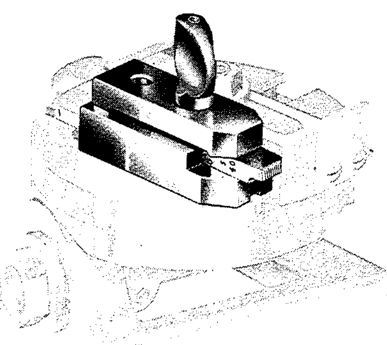
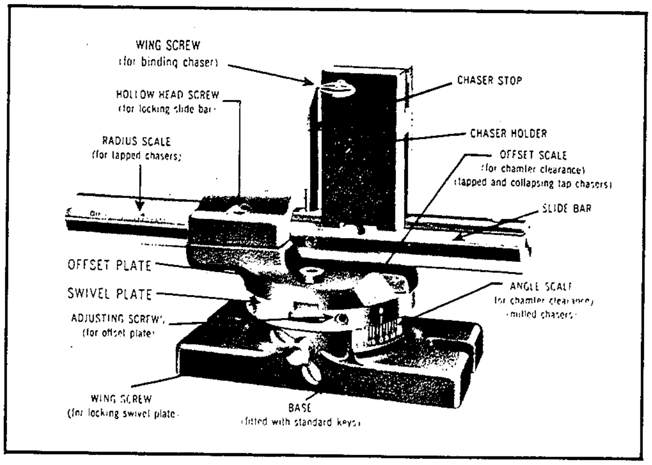


FIGURE 3

GEOMETRIC STYLE "E"
UNIVERSAL CHASER GRINDING FIXTURE

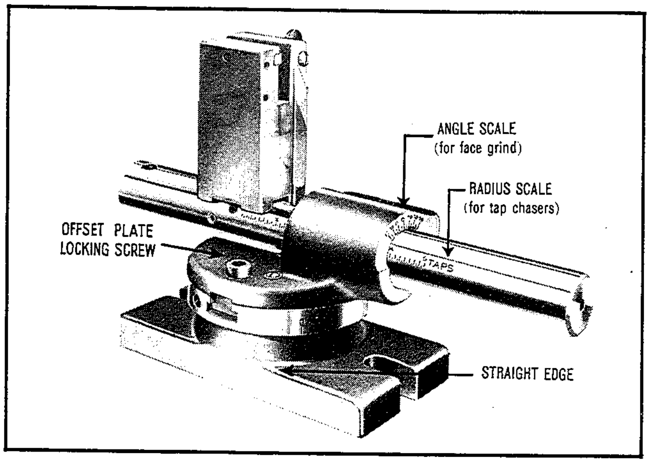


Here's a Universal Fixture that's inexpensive, simple and compact, yet one which, while designed primarily for grinding all types of Chasers on the chamfer, can also be used for grinding the cutting face. Milled, Ground and Supermetric Chasers with a flat chamfer, Tapped Chasers with a concave chamfer, Collapsing Tap Chasers with a convex chamfer, all may be easily and quickly reground by making a few changes in the set-up of the Fixture and Holders. Both Right and Left Hand Chasers may be sharpened with equal ease.

special features

The Style E Fixture can be used with most universal grinding machines.

A Swivel Plate permits the Chaser Holder to be offset to give the proper chamfer clearance to Tapped (Hobbed) Chasers or Collapsing Tap Chasers. This plate is equipped with Opposed Adjusting Screws for providing fine adjustment which may be readily made and then locked solidly in place, thus permitting the easy duplication of grinds. The tongue and groove method of locating the Chaser Holder on the Slide Bar gives an accurate location and sturdy support.



a complete unit The Fixture is a complete unit in itself. One Chaser Holder for one tool size of Geometric Chaser is furnished with every Fixture at no additional cost. Additional Chaser Holders for Geometric Chasers can be obtained at a nominal charge. (See page 38.) For grinding other makes of Chasers, blank Chaser Holders can be furnished which can readily be altered by the user.

simple to use It is a very simple matter to use this Fixture. It is easy to set for the distinct type of Chaser you wish to sharpen, being equipped with readily visible scale readings and when once set, all the Chasers of the set can be uniformly reground without again altering the set-up.

need not be an expert One of the big advantages of this Fixture is that any mechanic can quickly and easily set up the Fixture and adjust it, thus making unnecessary the employment of a special grinding expert.

all chasers should be sharpened To obtain the best results from any Chasers they should be sharpened frequently and before they become dull. If accuracy and production per set of Chasers are desirable, then the Chasers must be ground accurately on both the cutting face and chamfer. (Milled, Ground and Supermetric Chasers, however, must be ground only lightly on the cutting face. (See pages 32 & 37.) Unequal grinding of the Chasers in a set causes the Chasers to cut unevenly and poor threading results are inevitable. Chasers should never be ground by hand.

uniform grinding We have just pointed out the dangers of hand grinding, or machine grinding not uniformly done. With the Geometric Universal Grinding Fixture, once the Fixture is adjusted all the Chasers in a set are bound to be uniformly reground.

INSTRUCTIONS FOR USE

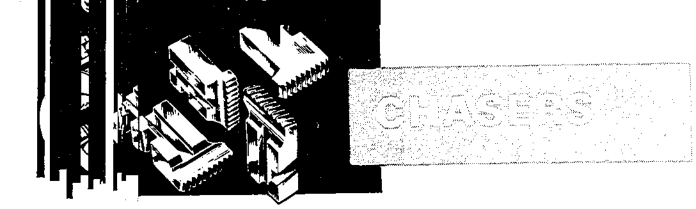
chamfering milled, ground and supermetric chasers

(1) With the Radius Scale marked "Dies", the Base Scale "B" Fig. 1, and the Slide Bar Locking Screw all facing toward you insert Slide Bar into fixture.

(2) Clamp the suitable Chaser Holder in position as Shown in Fig. 1, using the inner screw hole in the Slide Bar with the head of Wing Screw in Holder toward you. Insert the Chaser Stop at the left of the Holder.

(3) Set the Slide Bar so that its center line (at "A" Fig. 1) is at zero and lock it tightly. (Radius Scale not used for Milled, Ground and Supermetric Chasers.)

(4) Insert the Chaser with chamfer up in the Holder, bringing the threaded end against the Chaser Stop and lock in position by means of the Wing Screw in Chaser Holder. "D" Type Chasers should be located



on the Key provided in the Chaser Holder. The Keys are reversed in the Holders when grinding 5/16" and 9/16" "K" Type Chasers and removed entirely for all larger sizes of "K" Chasers. To follow or duplicate the original grind as to chamfer, adjust the Machine until the contact between the periphery of the Grinding Wheel and chamfer will produce the desired angle of chamfer.

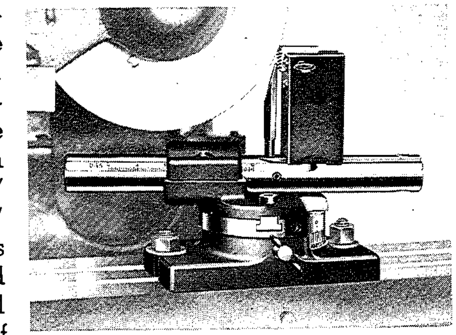


Figure 1

(5) The Swivel Plate should now be set to an angle (See B, Fig. 1) which will coincide with the original chamfer clearance angle of the Chaser, and locked in place by means of the Wing Screw (See C, Fig. 1). Be sure Offset Plate Locking Screws (See D, Fig. 1) are tight before any grinding is done. (No Offset Plate adjustment required for Milled, Ground and Supermetric Chasers.)

(6) Feed the Chaser forward carefully against the Grinding Wheel by means provided on the Machine and at the same time pass the Chaser back and forth across the periphery of the Wheel, grinding very lightly to see that the chamfer clearance is correct. A Stop on the Machine, or other suitable means, should be provided so that all Chasers of the set will be ground an equal amount.

chamfering tapped die head chasers

(1) With the Radius Scale marked "Dies", the Base Scale "B" Fig. 1, and the Slide Bar Locking Screw all facing toward you insert the Slide Bar into fixture. (See Fig. 2.)

(2) Clamp the suitable Chaser Holder in position as shown in Fig. 2, using the inner screw hole in the Slide Bar with the head of Wing Screw in Holder toward you. Insert the Chaser Stop at the left of the Holder.

(3) Set the Slide Bar so that the reading on the Radius Scale marked "Dies" (A, Fig. 2) will equal as nearly as possible half of the minor (root) diameter of the thread. See page 69 for method of figuring minor diameter.

(4) Set the Slide Bar so that its center line (At "E" Fig. 2) is at zero and lock it tightly.

(5) Insert the Chaser with chamfer up in the Holder, bringing the threaded end against the Chaser Stop and lock in position by means of the Wing Screw in Chaser Holder. "D" Type Chasers should be located on the Key provided in the Chaser Holder. The Keys are reversed in the Holders when grinding 9/16" "K" Type Chasers and removed entirely for all larger sizes of "K" Chasers.

(6) To follow original grind as to chamfer, adjust the Machine until the contact between the periphery of Grinding Wheel and chamfer will produce the desired angle of chamfer. (See Fig. 2.)

(7) Loosen two Offset Plate Locking Screws (At "B" Fig. 2) and adjust Offset Plate by means of Adjusting Screws (See C, Fig. 2) to proper amount (use Scale at D, Fig. 2) to provide for proper clearance on chamfer. With the Slide Bar as shown in Fig. 2 the direction of offset should be away from you for Right Hand Chasers, and towards you for Left Hand Chasers. If figures are unavailable judge amount of offset by original clearance on Chasers being reground. Once having obtained correct chamfer clearance, lock Offset Plate in position by means of Offset Plate Locking Screws (See B, Fig. 2).

(8) Feed the Chasers forward carefully against the Grinding Wheel by means provided on the Machine and at the same time rock the Chaser back and forth across the periphery of the Wheel, grinding very lightly to see that the chamfer clearance is correct. A Stop, or other suitable means, should be provided on the Machine so that all Chasers of the set will be ground an equal amount. The width of the Wheel at the periphery must be thin enough so that it is suitable for the radius on the Chaser.

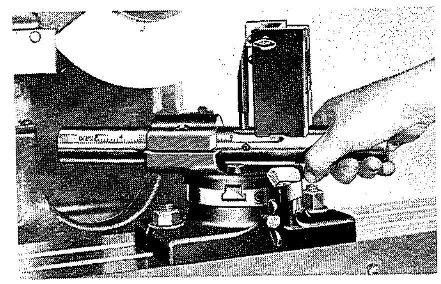


Figure 2

chamfering collapsing tap chasers

(1) Insert the Slide Bar with the Radius Scale marked "Taps" and Base Scale (B, Fig. 1) towards you and with the Slide Bar Locking Screw away from you. (See Fig. 3.)

(2) Clamp the suitable Chaser Holder in position as shown in Fig. 3, using the Inner Screw Hole in the Slide Bar with the head of Wing Screw in Holder away from you.

(3) The Chaser Stop is not used with Holders for "S" Chasers for 1" to 2" tap sizes inclusive, nor with Holder for ¾" "SL" Chasers. Set the Chasers firmly

against the Angle Plate in the Holder. The Angle Plate must be set so the threaded portion of the Chaser is vertical and to the left. When using these Chaser Holders the reading on the Radius Scale marked "Taps" (See C, Fig. 3) should always be set at ⅞". When this is done set the Slide Bar so that its center line is at zero and lock it tightly.

(4) For Chasers larger than 2" Tap size insert the Chaser Stop at the left of Holder (no Angle Plate in Holder being required). Insert the Chaser with the chamfer up in the Holder bringing the threaded end against the Chaser Stop and lock in position by means of the Wing Screw in Chaser Holders With these Chaser Holders the Slide Bar should be set so that the reading on it will equal as nearly as possible half of the major (outside) diameter of the thread. When this is done set the Slide Bar so that its center line is at zero and lock it tightly.

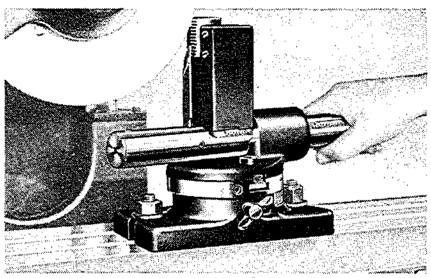


Figure 3

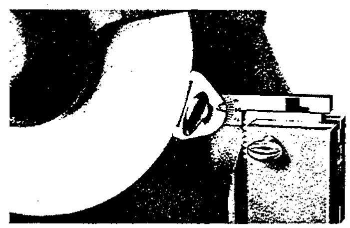
(5) To follow the original grind as to chamfer adjust the Machine until the contact between the periphery of the Grinding Wheel and chamfer will produce the desired angle. (See Fig. 3.)

(6) Loosen two Offset Plate Locking Screws (At B, Fig. 3) and adjust Offset Plate (use Scale—See D, Fig. 2) by means of Adjusting Screws (one shown at D, Fig. 3) so that original chamfer clearance may be maintained. With Slide Bar parallel to the Wheel as shown in Fig. 3 the direction of offset should be away from you for Right Hand Chasers and towards you for Left Hand Chasers. If figures are unavailable, judge amount of offset by original clearance on Chasers being reground. Once having obtained correct chamfer clearance, lock Offset Plate in place by means of Offset Plate Locking Screws (See B, Fig. 3).

(7) Feed the Chaser forward carefully against the Grinding Wheel by means provided on the Machine and at the same time rock the Chaser back and forth across the periphery of the Wheel, grinding very lightly to see that the chamfer clearance is correct. A Stop, or other suitable means, should be provided on the Machine so that all Chasers of the set will be ground an equal amount.

chamfer angle setting gage

A simple device used for setting the grinder to the desired angle of chamfer on any of the Chasers heretofore mentioned is a Setting Gage that can be obtained at a slight additional charge.
Set Gage to desired angle of chamfer. Clamp Chaser in Chaser Holder and place the Setting Gage on top of Chaser with the swivel end towards periphery of Grinding Wheel. Adjust the Machine until both points of swivel end of Setting Gage contact the wheel. Be sure Grinding Wheel is not in motion.



CUTTING FACE GRINDS

It is quicker and more convenient to grind a complete set of Chasers at a time on the cutting face, making use of a magnetic chuck tilted to the desired angle. The Style "E" Fixture, however, can be used for face grinding if desired, even though it is primarily only a Chamfer Grinding Fixture.

grinding the cutting face of die head chasers

Chasers used in Holders for ¾" size Die Head Chasers or smaller, are ground with the Holders mounted in a vertical position as shown in Fig. 4. Reverse the Key Plate (B, Fig. 4) in the Chaser Holder, if necessary, so that the Chaser can be clamped with the thread up as illustrated. Set the Slide Bar so that straight, snubbed or hooked cutting face can be ground as desired. Graduations are provided for this purpose. (See A, Fig. 4.) Feed the Chaser against the side of the wheel by means provided on the Machine, passing it back and forth as it is being ground.

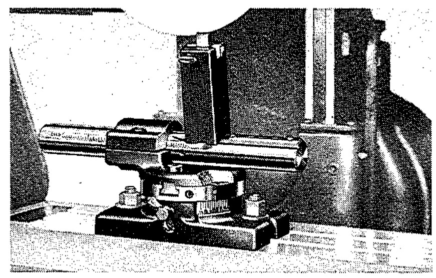


Figure 4

Chasers used in Holders for Die Head Chasers sizes larger than ¾" are ground with the Chaser Holders mounted in a horizontal position as shown in Fig. 5. It is necessary to use the Key in these Holders for "D" Chasers, but it must be removed for "K" Chasers. Fasten Stop Plate (B, Fig. 5) to Holders to suit Right or Left Hand Chasers. Set the Slide Bar so that straight, snubbed or hooked cutting face can be ground as desired. Graduations are provided for this purpose. (See A, Fig. 5.) Insert the Chasers in the Holder bringing the threaded end against the Stop Plate. Feed the Chaser against

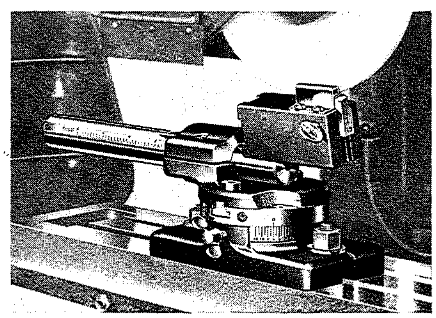
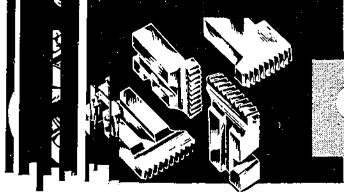


Figure 5



the side of the Wheel by means provided on the Machine, passing it back and forth as it is being ground. A Stop, or other suitable means, should be provided on the Machine so that all Chasers of a set will be ground an equal amount.

Milled, Ground and Supermetric Chasers should be ground principally on the chamfer, but can be touched very lightly on the cutting face occasionally.

grinding the cutting face of collapsing tap chasers

Chasers used in Holders up to and including 2″ Tap size are ground with the Chaser Holders mounted in a vertical position as shown in Fig. 6. Set the Angle Plate in the Chaser Holder so that the Chaser can be clamped with the threads horizontal as illustrated. Set the Slide Bar so that straight, snubbed or hooked cutting face can be ground as desired. Graduations are provided for this (See A, Fig. 6.) Feed the Chaser against the side of the Wheel by means provided on the Machine, passing it back and forth as it is being ground. A Stop, or other suitable means, should be provided on the Machine so that all Chasers of the set will be ground an equal amount.

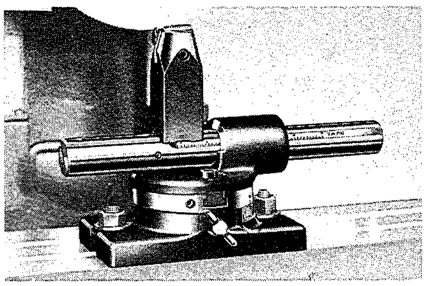


Figure 6

Chasers used in Holders larger than 2″ Tap size are ground with the Chaser Holders mounted in a horizontal position as shown in Fig. 7. Fasten the Stop Plate (See B, Fig. 5) to Chaser Holder to suit Right or Left Hand Chasers. Set the Slide Bar so that straight, snubbed or hooked cutting face can be ground as desired. Graduations are provided for this purpose. (See A, Fig. 7.) Insert the Chaser in the Holder, bringing the threaded end against the Stop Plate. Feed the Chaser against the side of the Wheel by means provided on the Machine, passing it back and forth as it is being ground. A Stop, or other suitable means, should be provided on the Machine so that all Chasers of the set will be ground an equal amount.

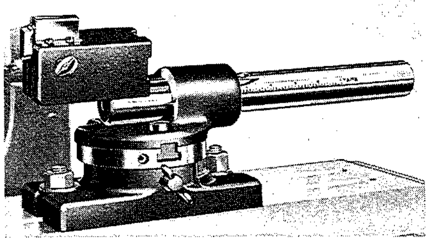
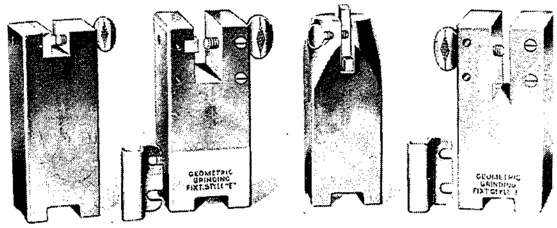


Figure 7

specifications

The Geometric Universal Chaser Grinding Fixture is furnished complete, together with only one Chaser Holder, at list price. In placing orders be sure to specify the Chaser Holder you require, as well as any additional Holders which may be necessary and which are furnished at additional cost.

CHASER HOLDERS



A separate Chaser Holder is required for each different size of chaser blank. Avoid mistakes by ordering by Chaser Holder number (see list below). The illustration above shows the four general types of Holders.
Holders for 5/16″ to 3/4″ Die Head Chasers inclusive. Note Removable Plate with Key.
Holders for 1″ and larger Die Head Chasers. Note Removable Key.
Holders for 3/4″ to 2″ Tap Chasers inclusive. Note Adjustable Angle Plate.
Holders for 2½″ and larger Tap Chasers.

At the left of the second and fourth Holders is shown the Stop Plate for face grinding not used in chamfering.

Specify Chaser Holders by number and avoid mistakes.
(*Regarding Special Short Holders see page 39)

Holder Number	Used With	Holder Number	Used With
2	5/16″ DS and 5/16″ K	9	3″, 3½″ and 4½″ D
3	9/16″ D and 9/16″ K	10	1″ S
4	3/4″ D	11	1¼″ S
5	1″ D and 1″ K	12	1½″ S
6	1¼″ D and 1¼″ K.	13	2″ S
	Use Holder No. 6 on all	14	2½″, 3″, 3½″ S
	K Chasers for Tools	15	4″ and 4½″ S
	1¼″ or larger	16	5″ and 6″ S
7	1½″ D	24	3/4″ SL
8	2″ and 2½″ D	25	3/16″ EJ5

The Style "E" Fixture is not suitable for Tangemetric and Circometric Chasers. The Style F fixture should be used.

recommended chamfers

A long chamfer should be used on all Chasers wherever it is possible to do so. While a 2-thread chamfer is usually satisfactory, on certain tough materials a 3-thread, or even longer chamfer, will give better results. A short, 1-thread chamfer, is usually used where the thread is cut close to a shoulder, but even under such circumstances it is often possible to use a 1½ thread chamfer. Remember that the longer the chamfer the less will be the stress thrown on the first full tooth of the Chasers.

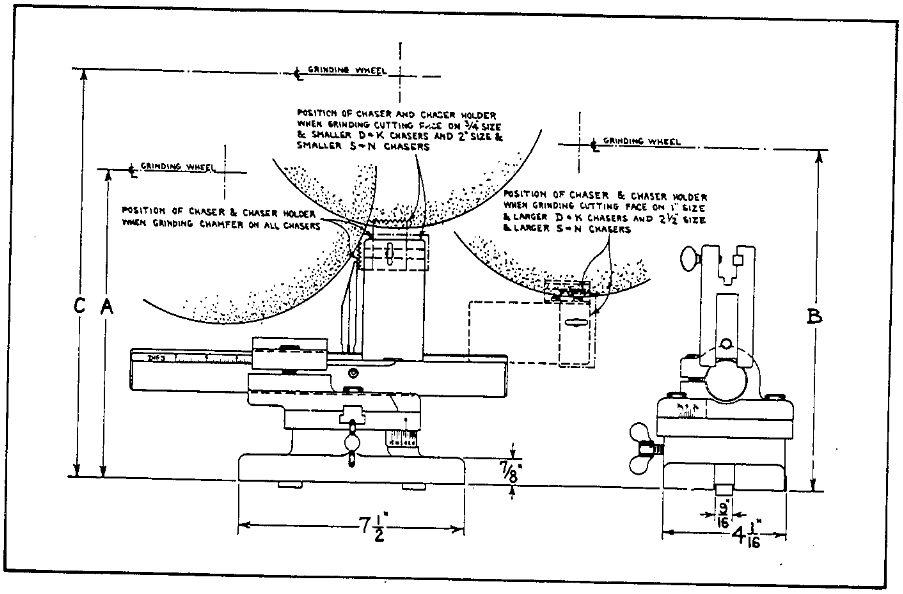
Approximate Angle of Chamfer in Relation to Threads

Number of Threads Chamfered	Angle of Chamfer	
	Amer. Nat'l (U.S.), V, Whitworth, Metric Thread Forms	Acme and Similar Thread Forms
1	45°	33°
1½	33°	22°
2	22°	15°
3	15°	

In designing the Style "E" Grinding Fixture, we had to keep in mind the necessity of re-sharpening all Geometric Chasers from the 3/16" EJ5 to the 3½" D, from the ¾" SL to the 6" S. Thus the Fixture had to be large enough and high enough to give proper clearances for re-sharpening all these types of Chasers.

*SPECIAL SHORT HOLDERS—When clearances on machine will not permit the regular Holders to be used, contact us regarding possibility of using shorter Holders.

PRINCIPAL SPECIFICATIONS OF STYLE "E" FIXTURE



To determine if the Style "E" Fixture can be adapted to a Grinding Machine, consult the following tables, which give the clearance needed for the type of Chasers being sharpened, and the angle of chamfer desired.

WHEEL POSITION FOR GRINDING CHAMFER — DIMENSION "A"*

Size and Type Chasers	15° Chamfer			22° Chamfer			33° Chamfer			45° Chamfer		
	Wheel Diam.			Wheel Diam.			Wheel Diam.			Wheel Diam.		
	6"	8"	10"	6"	8"	10"	6"	8"	10"	6"	8"	10"
3/16" EJ5	8⅝"	8⅞"	Wheel Interferes with Fixture	9"	9⅜"	9¾"	9½"	10"	10½"	10"	10⅝"	11⅜"
5/16" to 1½"-K; 5/16"-DS & 9/16" to 1½"-D; 1" to 2"-S	9"	9¼"	Wheel Interferes with Fixture	9⅜"	9¾"	10⅛"	9⅞"	10⅜"	11"	10⅜"	11"	11¾"
2" and 2½"-D; 2½" to 3½"-S	9¼"	9½"	Wheel Interferes with Fixture	9⅝"	10"	10⅜"	10⅛"	10⅝"	11¼"	10⅝"	11¼"	12"
¾"-SL	9½"	9¾"	10"	9⅞"	10¼"	10⅝"	10⅜"	10⅞"	11½"	10⅞"	11½"	12¼"
4" to 6"-S	9¾"	10"	10¼"	10⅛"	10½"	10⅞"	10⅝"	11¼"	11¾"	11⅛"	11⅞"	12½"
3" and 3½"-D	10⅛"	10⅜"	10⅝"	10½"	10⅞"	11¼"	11"	11½"	12⅛"	11½"	12¼"	12⅞"

WHEEL POSITION FOR GRINDING CUTTING FACE

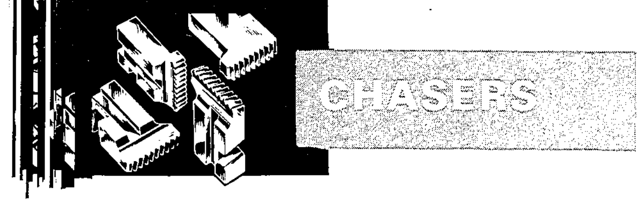
DIMENSION "B"

Size and Type Chasers	6" Wheel	8" Wheel	10" Wheel
1" & Larger-D & K; 2½" & Larger-S	9¼"	10¼"	11¼"

DIMENSION "C"

Size and Type Chasers	6" Wheel	8" Wheel	10" Wheel
3/16" EJ5	11¼"	12¼"	13¼"
5/16"-DS and K; 1" to 2"-S	11½"	12½"	13½"
9/16" and ¾"-D; 9/16"-K	11¾"	12¾"	13¾"

*Dimensions given are for Regular Chasers. For Projection or Overhanging Chasers Add Amount of Projection or Overhang to Dimension "A"



INCORRECT BEARING

If chasers have too heavy bearing they will rub too hard producing taper or rough threads or causing chaser breakage. Milled form chasers may be corrected by grinding the cutting face by .002'' to .003'' increments.

When there is not enough bearing, the chasers should be lapped to provide more.

For lapping a mixture of fine emery and oil is applied before engaging the teeth. Note in Fig. 1 below that the teeth at chamfer ends are fully engaged. Rear teeth do no cutting so no harm is done if not lapped.

Referring to Fig. 2, tip chaser ''B'' slightly, and lap cutting edge of both chasers, as in Fig. 3, taking care not to twist chaser ''B''. Take only about eight strokes, then test for results. Further lapping may be necessary, however too much can ruin thread form or cause other troubles.

Tapped chasers are almost always lapped in a die head. Milled chasers may also be lapped in a die head but usually by hand.

Chasers are lapped in a die head by running lap in reverse direction. It is recommended that the lap used be a good sample. If necessary to make a lap be sure to obtain a good thread.

Fine emery and oil are also used for a lapping compound, tension is applied by closing the die head slightly on the lap.

Very few turns of the lap are required and be careful not to lap too much.

Clean chasers and die head thoroughly after lapping and before using to cut a thread.

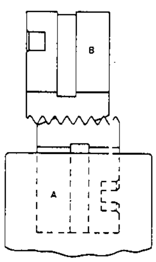


Fig. 1

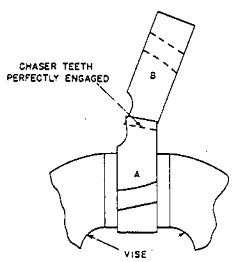


Fig.2

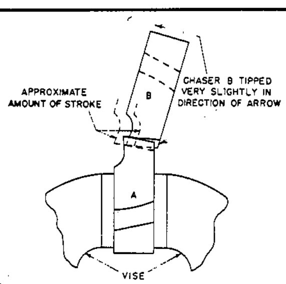
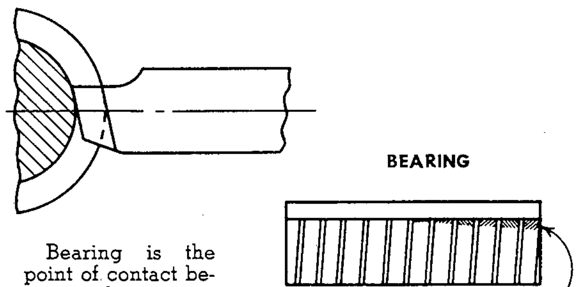
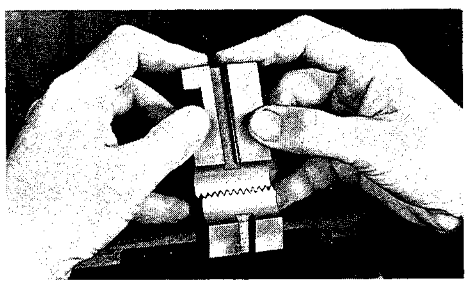


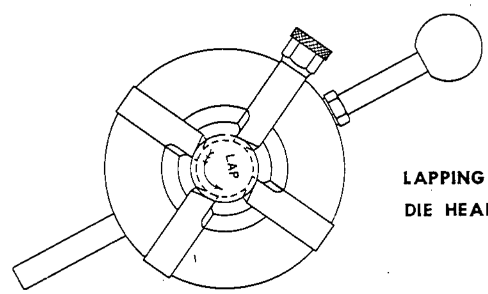
Fig. 3



Bearing is the point of contact between the cutting point and the work piece just back of the cutting edge.

HAND LAPPING CHASERS





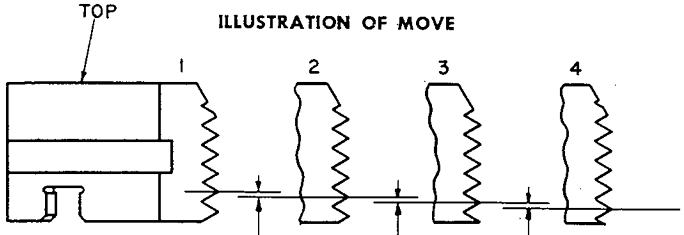
LAPPING IN DIE HEAD

CHASERS TOO KEEN

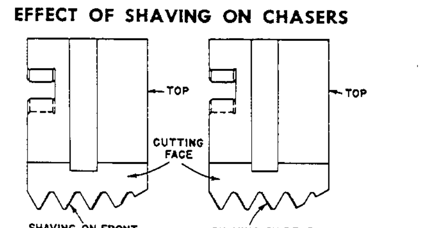
One of the causes for stripped threads not covered elsewhere is that the chasers may be too keen. In this case dull the chaser teeth at the chamfer. This is usually done by stoning lightly. It is most often necessary to do this when threading brass and zinc.

SHAVING

A set of chasers consists of four or more cutters which together produce the full thread (helical groove) on the work place. To accomplish this, the chasers have to have "move" or advance of the teeth from one chaser to the next. "Shaving" means that not all the chasers are "tracking" properly or following exactly in the groove cut by the preceding chaser or chasers. While the thread form on each chaser might be good, the thread they cut, combined, could be too thin or of incorrect form.



The distance is the same from one chaser to the next in a set.
The move can be measured starting from any thread as long as the corresponding thread is followed through on each succeeding chaser.
This description applies to single threads only.



The chaser or chasers that are shaving can be detected by noting the frosting on the cutting face along the front or back edges of the teeth. This frosting appears as a narrow band and indicates that these cutting edges have been taking a light shaving cut.

Chasers may be corrected for shaving by lapping as described on the opposite page. Only the chasers that are shaving are to be lapped. In some cases only one chaser has to be corrected and when rubbing, care should be taken not to pass it across the cutting face of the mating chaser or this chaser may be forced out of trackage.

With milled chasers take the chaser that is shaving, hold it in the fingers and force sidewise or twist slightly in such a manner as to lap the sides of the teeth that show frosting. To correct shaving, the lapping will not be carried across the full width of the land, but only along the cutting edge of chaser.

After lapping remove the frosting from the cutting face by stoning lightly with an oil stone and cut a sample or two. If the frosting again appears, the chasers must be lapped an additional amount.

Tapped form chasers are usually lapped in a die head as described on opposite page. They may also be lapped on a sample held in a vise.

Frequently, machine operators stone chasers for shaving. We recommend lapping; but stoning, if expertly done, will correct the condition and may be accomplished much more quickly. Only the sides of teeth showing frosting should be stoned. Stoning should be done lightly and at the sides of teeth along the cutting edge. Use a diamond shaped or knife-edge stone.

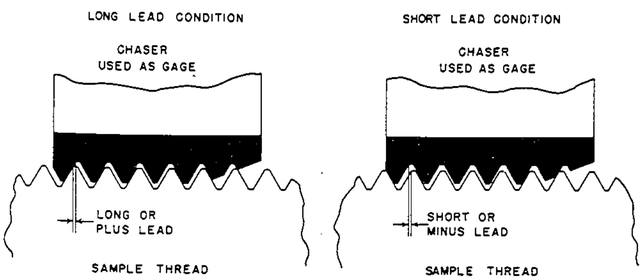
LEAD ERROR

Lead error is usually detected when a finished piece will not pass the gage and a check with a thread comparator or lead indicator shows lead error.

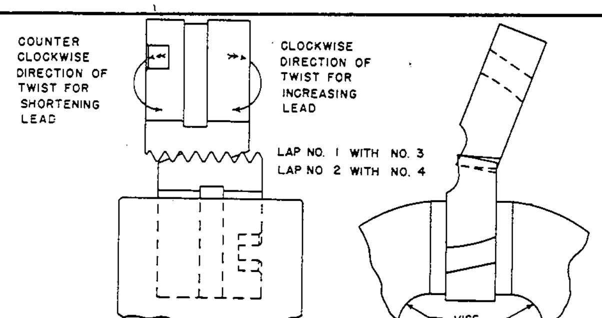
The correction of lead errors depends upon the cause. The procedures are either self evident or have been discussed elsewhere.

However, should it be necessary to correct chasers for lead, it is possible to lap them so that they will produce threads within closer lead limits.

In lapping chasers for lead, follow the same general instructions as rubbing chasers for bearing.



A simple way to detect lead error without instruments is to place one chaser in the sample thread.



Chasers are twisted in respect to each other when lapping for lead.

CHASERS Servicing

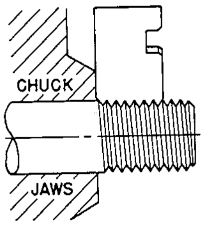
BREAKAGE

The most frequent threading accident is chaser breakage. Usually we find that the chasers have run into something — we call it "Running into a shoulder."

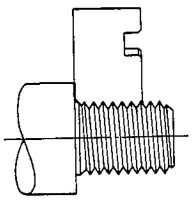
It may not actually be a shoulder, it may be any of the conditions shown on this page.

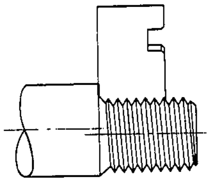
The remedy for actually running into a shoulder is to stop far enough away from the shoulder or chuck, or to recess the work piece in front of the shoulder.

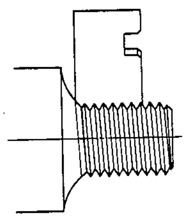
Projection chasers can frequently be used to advantage on shoulder threading. A 5° rake ground on top of the projection is recommended. This rake permits the chasers to cut into the shoulder and are less apt to break in event of accidentally striking against one.

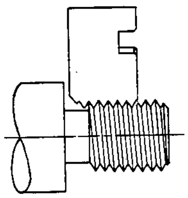


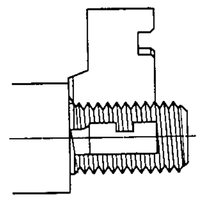
Running into chuck jaws or work holder.


Running into a shoulder.


Running into a shoulder caused by out of round condition.

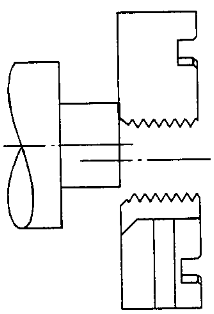

Running into a fillet.


Recess next to shoulder of work piece prevents chaser breakage.

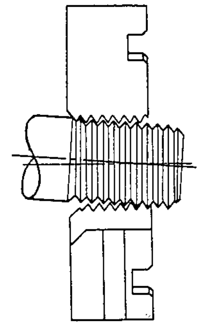

Rake on projection chasers permits single point of contact with shoulder

Misalignment, heavy bearing, improper face grinds, improper chamfers, attempting to thread stock not turned to size prior to threading, improper adjustment of chasers to size and conditions peculiar to the work piece may also cause chaser breakage. Some of these conditions are illustrated below.

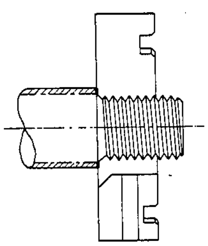
Excessive misalignment presenting possibility of chaser breakage.



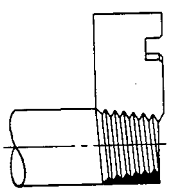
Showing why misalignment may cause chaser breakage. Note that the axis of the die head is at an angle to the axis of the work.



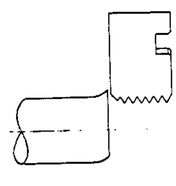
Attempting to remove too much material with chasers.



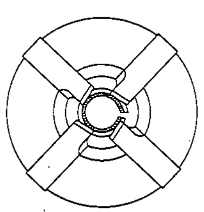
Stock should be turned to correct taper before threading.



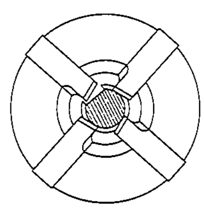
Stock improperly cut off presenting possibility of chaser breakage.



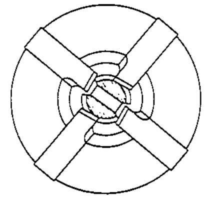
Possibility of chaser breakage due to seam opening up when cutting pipe or tubing.



Likelihood of chasers breaking when cutting across keyway.

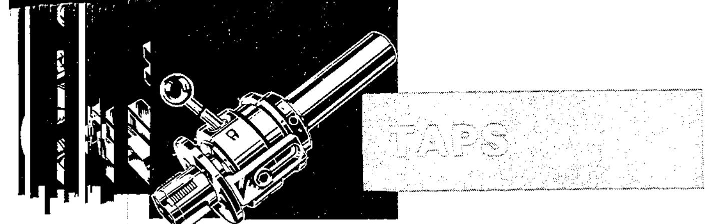


Possibility of chasers breaking when cutting across cotter pin hole.



TAPS

taps



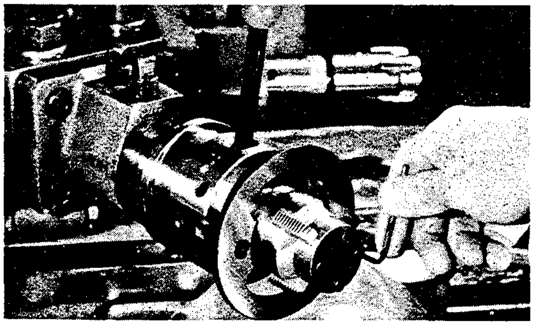
COLLAPSING

The principle of a Geometric collapsing tap is to collapse the chasers at the end of the cut, releasing the chasers from the work, thus permitting the return of the tap without reversing the spindle or following the lead of the thread. The proper care and operating conditions for these tools are so similar to those described for self opening Die Heads, that we recommend a thorough reading of the section on "General Instructions" pages 6-7.

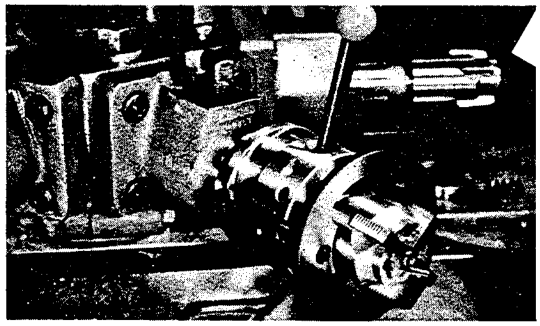
Setting up for Operation

1. INSERTING CHASERS

Before you can insert the chasers the cap must be removed from the nose of the tool by removing cap screws and the tap should be set into cutting position. Then insert the chasers in the proper slots: The No. 1 chaser in the slot stamped No. 1, the No. 2 chaser in the slot stamped No. 2, and so on. Be sure chasers are fitted on ribs on plunger.



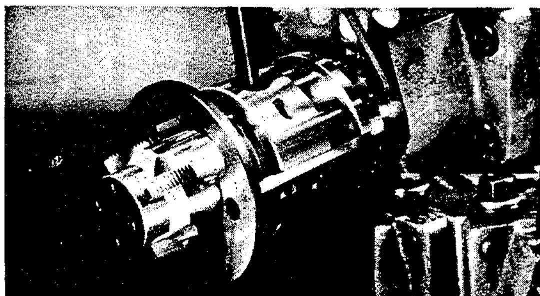
(Shown with chasers in position) Remove cap screws with the hex key. Lift off cap.



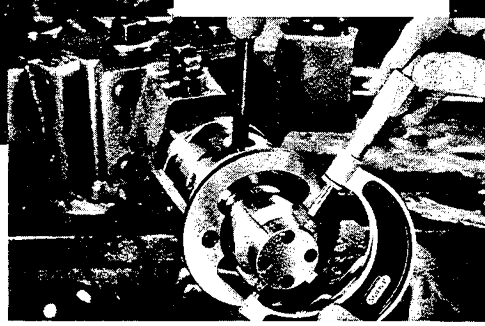
Be sure tap is in cutting position by pulling forward on closing handle until tap locks.

2. ADJUSTING CHASERS TO SIZE

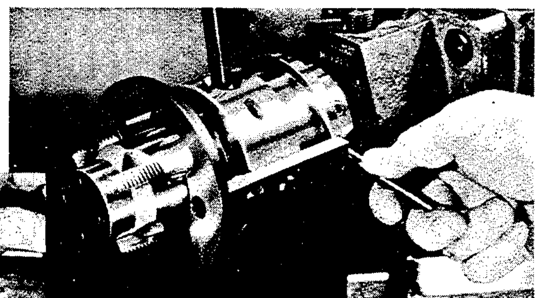
The cap should of course be put back on the nose of the tool and cap screws inserted. Then you are in a position to adjust the chasers to proper size. Micrometers can be used to set the chasers to size, the adjustment to proper diameter being accomplished as shown.



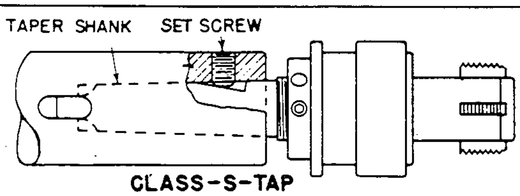
Loosen the adjusting ring binding screw, using the hex key provided.



Using Micrometer to Obtain Desired Thread Size



With a pin inserted in hole of adjusting ring, turn until desired thread size is obtained. Tighten adjusting ring binding screw.



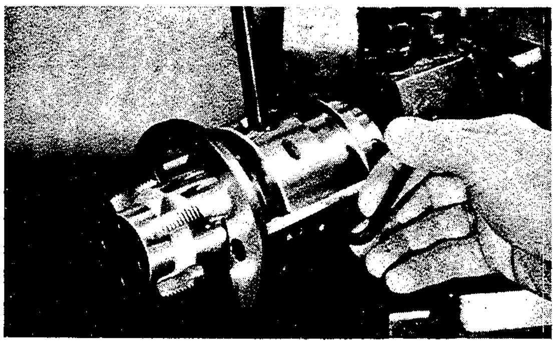
When using a tool with a Morse Taper shank don't attempt to drive with the tang alone. Drill and tap a hole in the machine spindle, using a set screw to locate the tool securely in the spindle.

3. SETTING OPERATING STOP

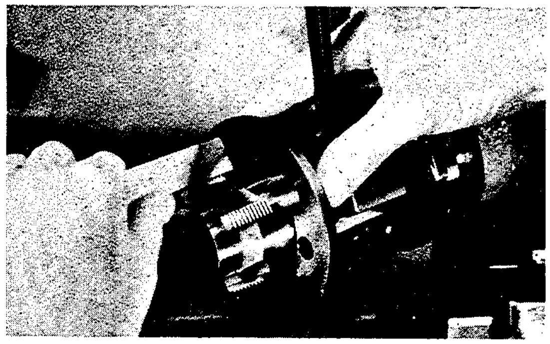
The tap must also be set so as to cut the proper length of thread. On a turret lathe and with some rotating tools this usually means the setting of the trip plate so as to contact the work or the work-holding fixture at the proper moment. On some automatic machines a yoke or fork is employed.

In setting up a collapsing tap allow at least 3/16″ for the collapsing action of the tool. In other words, set the trip plate (if used) so that the distance from the front of chasers to trip plate measures at least 3/16″ less than the depth desired. In case of a yoke trip allow a like amount. This is extremely important if tapping to a shoulder or blind bottom. Minor adjustments can be made after the first thread is cut.

It is good practice before cutting a thread to reset and trip the tap once or twice by hand to be sure the tool is functioning properly.

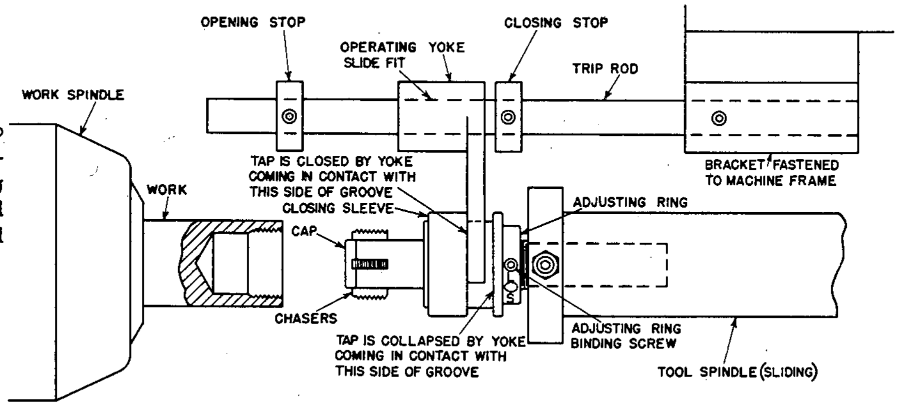


Loosen the trip bar binding screws with the hex key provided.



Move the plate to stop position. Tighten the trip bar binding screw securely.

Typical example of how a collapsing tap is operated on a multiple spindle automatic screw machine. The collapsing and resetting of the tap are controlled by adjusting the stops on the trip rod as shown.



5. PROPER SPEED This subject is covered fully in Self-Opening Die section. See pages 8–9.

6. PROPER LUBRICANT This subject is covered fully in Self-Opening Die section. See page 10.

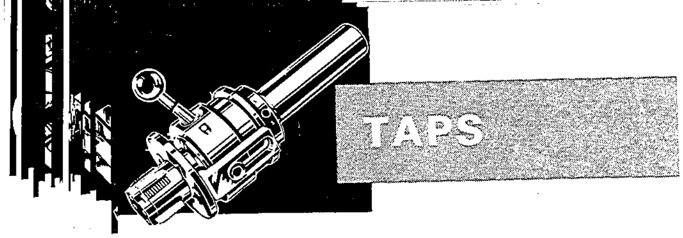
Disassembly

Take off the cap by removing cap screws. Remove the trip plate complete with trip bars by removing the two trip bar screws. Remove the closing handle by driving out the handle pin.

This pin can most easily be driven out from the left when facing front of tap. Next, back out the plunger screw which will release the plunger spring and washer. If the tap has a Morse Taper shank, the tang must first be removed. The tang is threaded into the end of the shank and cross pinned. Then loosen the adjusting ring binding screw and unscrew the adjusting ring and slide it over the tap shank. If the tap is arranged with a shank bushing or flanged shank, it must be taken off to permit removal of parts.

Next remove the closing sleeve trip screw and slide the closing sleeve off the skeleton ring and take it off over the tap shank. When sliding the closing sleeve off the skeleton ring be sure to hold the pawl under tension until the closing sleeve is removed, after which the pawl and pawl springs can be released. Note that the

(continued on next page)



COLLAPSING

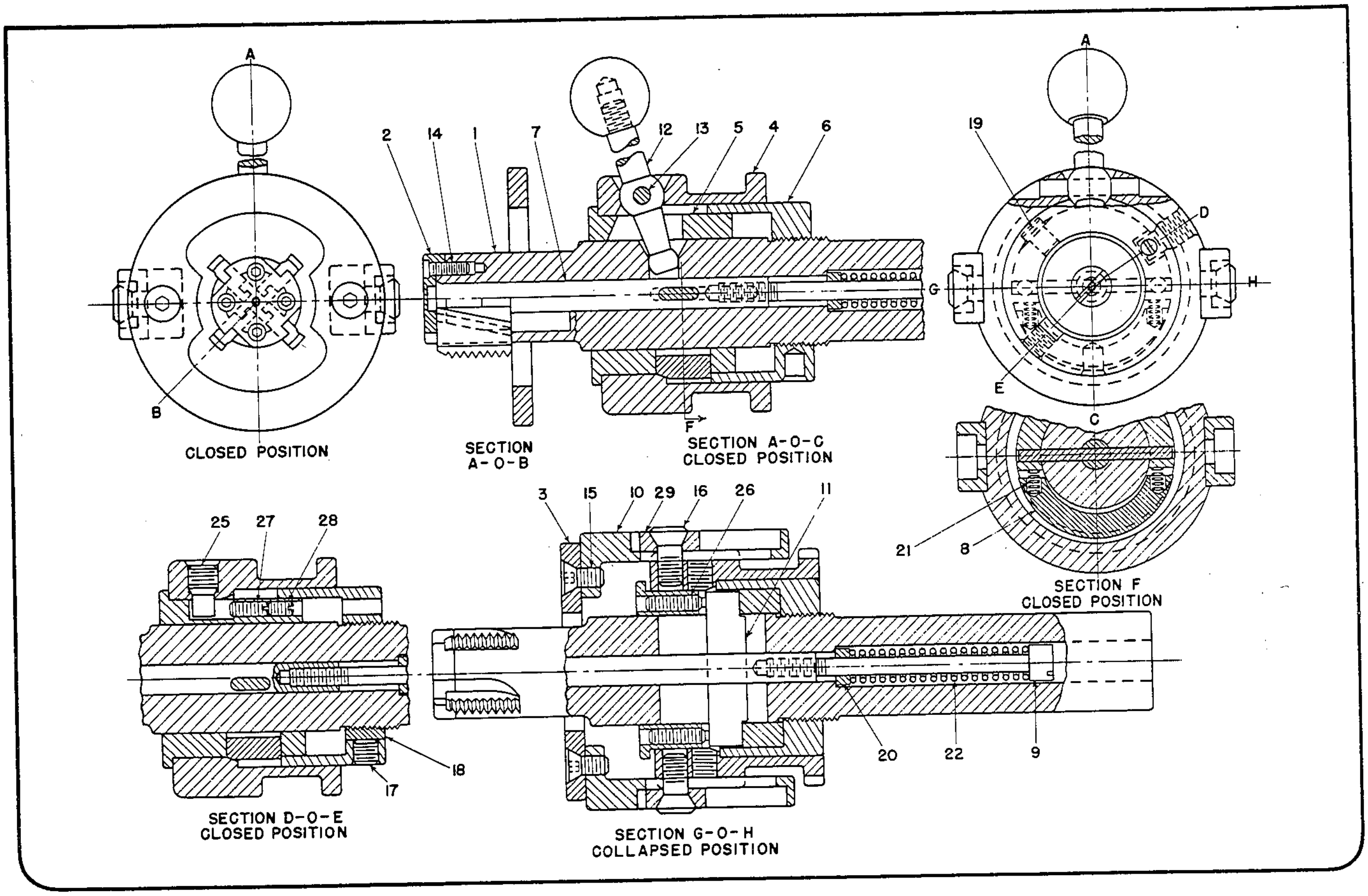
(Continued from preceding page)

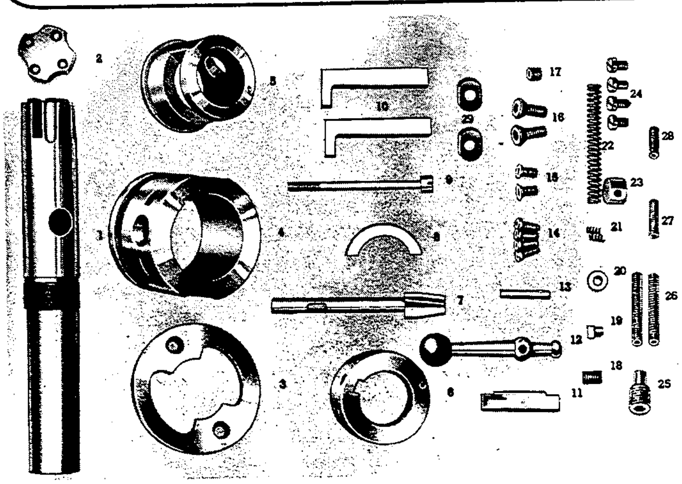
pawl has the beveled edge toward the front of the tap. Now back off the two plunger key screws about ¼" from the front face of the skeleton ring. **Do not** disturb the abutment screw and abutment lock screw located in the back face of the skeleton ring, inasmuch as these control the positive action of the tap and have been properly set at the factory. The plunger key can now be taken out by pushing it across the tap and this will disengage the skeleton ring which can now be taken off over the tap shank. The plunger can be removed by pushing it out through the front of the tap.

To assemble the tap, reverse the sequence of operations.

REPLACEMENT PARTS

Style S





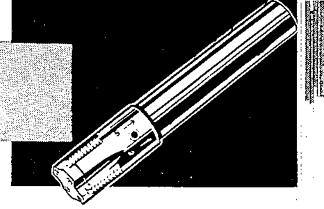
PARTS FOR COLLAPSIBLE TAP — STYLE S

When ordering repair parts give both number and name of part, also construction number and serial number of the tool.

1 Skeleton (Specify shank size when ordering).
*2 Cap.
3 Trip plate.
4 Closing sleeve.
5 Skeleton ring.
†6 Adjusting ring.
7 Plunger.
8 Pawl.
9 Plunger screw.
10 Trip bars.
11 Plunger key.
12 Closing handle.
13 Closing handle pin.
14 Cap screws.
15 Trip plate screws.
16 Trip bar screws.
17 Adjusting ring binding screw.
18 Adjusting ring binding shoe.
19 Skeleton ring key.
20 Plunger screw washer.
21 Pawl springs.
22 Plunger spring.
23 Closing sleeve plug.
24 Closing sleeve screws.
25 Closing sleeve trip screw.
26 Plunger key screws.
27 Abutment screw.
28 Abutment lock screw.
29—Trip Bar Binding Shoes

*Cap as shown is a regular cap for use with regular chasers. If tapping to a blind bottom or broad shoulder specify a bottoming cap for use with overhanging chasers.

†Furnished assembled with No. 17 and No. 18.



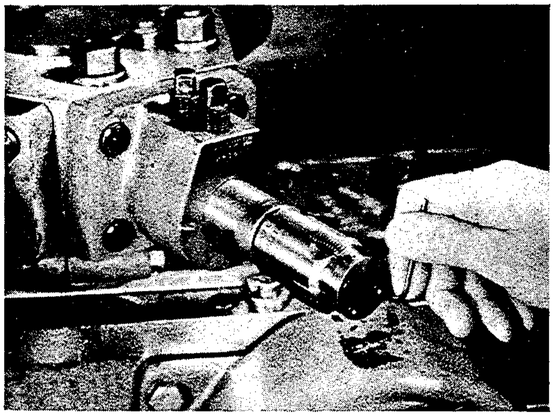
SOLID ADJUSTABLE

GENERAL INSTRUCTIONS

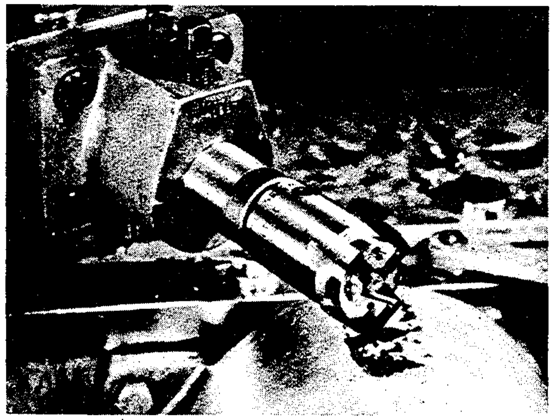
Solid Adjustable taps differ from Collapsible Taps in that, while adjustable, the chasers do not collapse in the tap. Like Solid one piece taps they must be backed off the work when in use.

The same type of chasers are employed in these taps as in Collapsible taps, in fact they are interchangeable size for size.

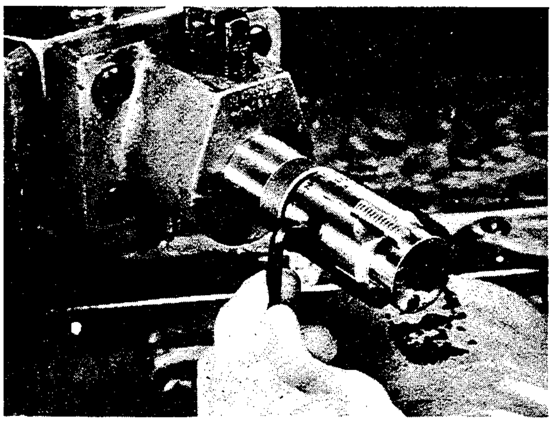
For threading bottoming holes a "bottoming" cap should be employed which permits the chasers to project or "overhang" slightly beyond the nose of the tap.



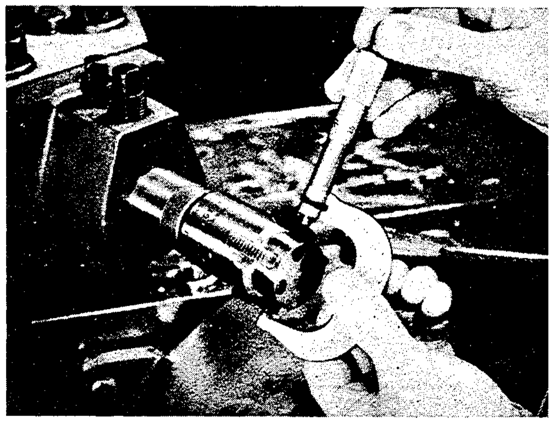
1. To insert or remove chasers, first remove cap screws and cap.



2. Insert chaser number 1 in slot number 1, chaser number 2 in slot 2, etc. Replace cap.

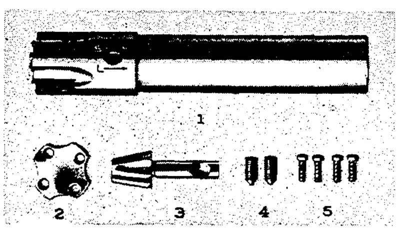


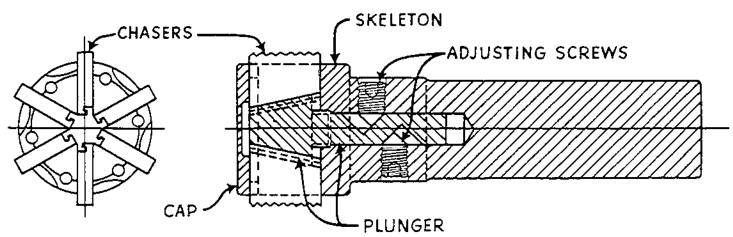
3. To adjust for size, loosen one adjusting screw and tighten the opposing screw. Be sure both screws are tight before starting to tap.



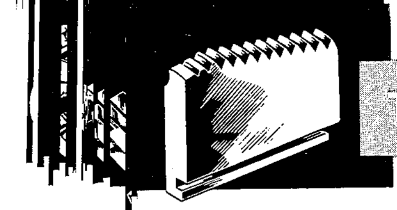
4. Chasers may be measured for size with a micrometer during and after adjustment.

REPLACEMENT PARTS — STYLE SJ





1. Skeleton (Specify shank size when ordering)
2. Cap (If used with overhanging chasers, specify overhanging cap)
3. Plunger
4. Adjusting Screws
5. Cap Screws



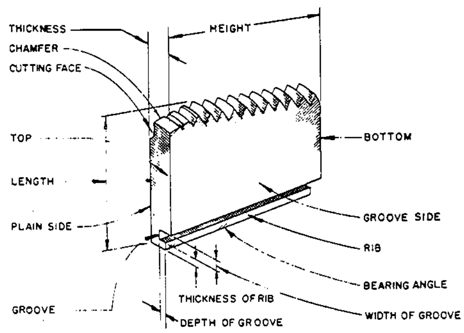
TAP CHASERS

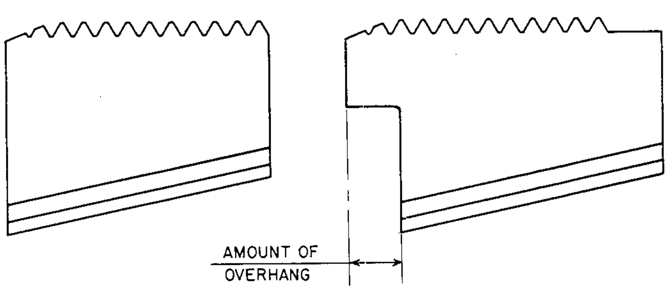
Geometric Class S Tap Chasers are interchangeable size for size in all types of Geometric Taps. They may be "regular" or "overhanging" chasers. For tapping to a blind bottom or to a shoulder, overhanging chasers and a bottoming cap are required.

While there are many differences in the problems involved in external and internal threading, many of the factors which govern the successful use of Die Head Chasers are also true of Tap Chasers. We therefore recommend reading the section on Die Head Chasers for the basic principles of their function, operation and care.

The information on this and the opposite page however refer specifically to tap chasers.

CHASERS FOR S AND SJ TAPS





SHARPENING CHASERS

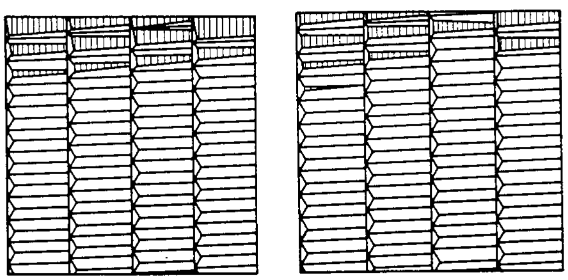
Nothing contributes more to the production of accurate threads, and low cost per thread, than accurate sharpening of chasers. Frequent light grinding or touching up will not only give better threads but will greatly extend the life of the chasers. Partial dullness leads to chipping as well as poor threads.

Therefore, to obtain the best results from any chasers they should be sharpened periodically and before they become dull. They should be resharpened by machine using an appropriate grinding fixture. They should not be resharpened free hand.

See pages 35 thru 39 for sharpening fixture.

Chamfer Grinding

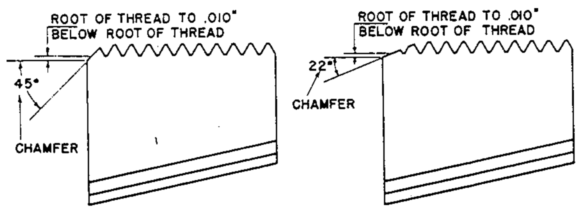
CORRECT AND INCORRECT CHAMFERS



Correctly Ground Set **Incorrectly Ground Set**

Note that chamfer is slightly different on each chaser of set. For explanation see illustration of "Move" on page 29.

DEPTH OF CHAMFER



The chamfer should start at root or .010" below the root of the chaser teeth. All chasers of a set should be ground at uniform angle and depth so that each chaser will start cutting at the same time.

Grinding Cutting Face

Never grind chasers free hand. Always use a grinding fixture or grind them on a surface grinder equipped with a suitable work holder. The usual procedure is to employ a magnetic chuck on a surface grinder which permits resharpening all chasers of a set at one set-up. This, of course, insures equal resharpening of all chasers.

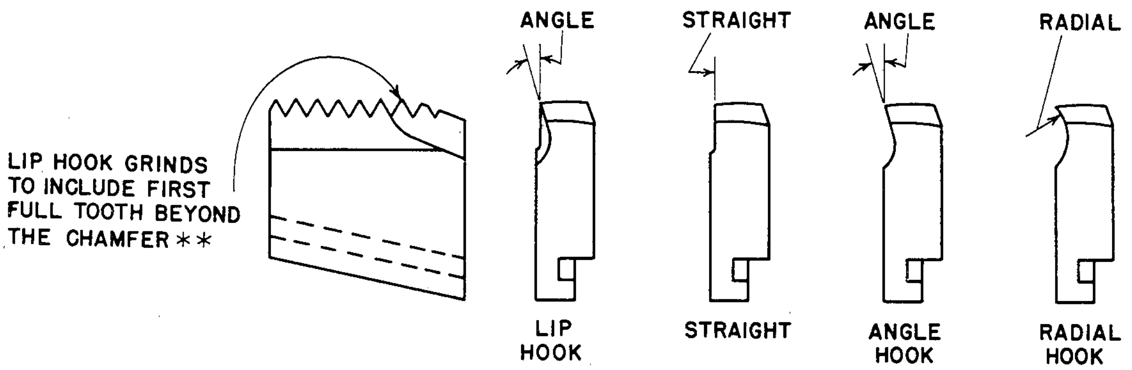
It is important that the width of the land or thickness of cutting edge should be uniform on all chasers of a set or the load of cutting will be thrown entirely upon the thicker chaser or chasers.

Before setting up, be sure you know what face grind should be employed. Use the chart below as a guide.

TAP CHASER GRINDING CHART FOR FACE GRINDING ONLY

The Cutting Face Grinds specified are approximate and due to conditions may have to be varied to obtain best results.

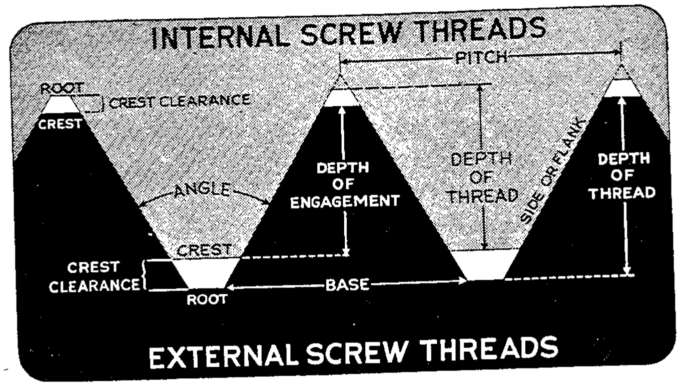
TAP CHASERS — S Use this Chart for both Right Hand and Left Hand Tap Chasers.

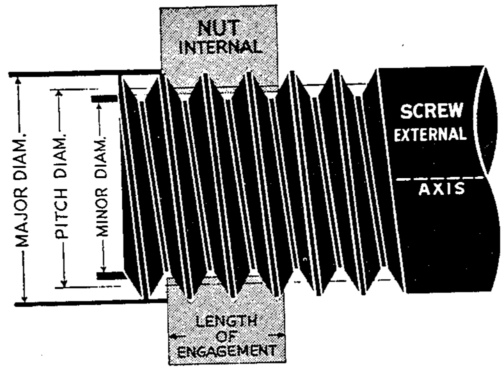


**Lip Hook Grinds not recommended for Shoulder or Bottoming Work, in this case use the same angle but omit the lip.

Material	Straight Thread	Taper Thread	Material	Straight Thread	Taper Thread
Aluminum – Cast	20° Radial Hook	20° Radial Hook	Magnesium	20° Radial Hook	20° Radial Hook
Aluminum – Die Cast	20° Radial Hook	20° Radial Hook	Monel Metal	10° Hook	10° Hook
Aluminum – Rod	20° Radial Hook	20° Radial Hook	Nickel	20° Lip Hook	15° Radial Hook
Aluminum – Stamping	20° Radial Hook	20° Radial Hook	Rubber	5° Hook	5° Hook
Bakelite	5° Hook	5° Hook	Silver – German	10° Hook	10° Hook
Brass – Bar	5° Hook	5° Hook	Steel – Bessmr. Scr. Stock	10° Hook	10° Hook
Brass – Cast	5° Hook	5° Hook	Steel – Cast	10° Hook	10° Hook
Brass – Forging	10° Hook	10° Hook	Steel – Carb. SAE 1010–1035	10° Hook	10° Hook
Brass – Stamping	10° Hook	10° Hook	Steel – Carb. SAE 1112–X1340	10° Hook	10° Hook
Brass – Tubing	10° Hook	10° Hook	Steel – Carb. SAE 1040–1095	20° Lip Hook	15° Radial Hook
Brass – Naval	10° Hook	10° Hook	Steel – Mang. SAE T1330–T1350	20° Lip Hook	15° Radial Hook
Bronze – Bar	10° Hook	10° Hook	Steel – Chrome SAE 5120–52100	20° Lip Hook	15° Radial Hook
Bronze – Cast	5° Hook	5° Hook	Steel – Chrome Van. SAE 6115–6195	20° Lip Hook	15° Radial Hook
Bronze – Cast Aluminum	10° Hook	10° Hook	Steel – Forging	20° Lip Hook	15° Radial Hook
Bronze – Manganese	10° Hook	10° Hook	Steel – Molybdenum SAE 4130–4820	20° Lip Hook	15° Radial Hook
Bronze – Naval	10° Hook	10° Hook	Steel – Nickel SAE 2015–2515	20° Lip Hook	15° Radial Hook
Bronze – Phosphor	10° Hook	10° Hook	Steel – Ni-Chrome SAE 3115–3450	20° Lip Hook	15° Radial Hook
Bronze – Tubing	10° Hook	10° Hook	Steel – Nitralloy	20° Lip Hook	15° Radial Hook
Celluloid	5° Hook	5° Hook	Steel – Stainless	20° Lip Hook	15° Radial Hook
Copper	20° Lip Hook	20° Radial Hook	Steel – Stamping	20° Lip Hook	15° Radial Hook
Everdur	10° Hook	10° Hook	Steel – Tool	20° Lip Hook	15° Radial Hook
Fibre	5° Hook	5° Hook	Steel – Tubing	20° Lip Hook	5° Hook
Iron – Cast	5° Hook	5° Hook	Steel – Semi-Casting	5° Hook	5° Hook
Iron – Malleable	10° Hook	10° Hook	Zinc – Die Casting	20° Radial Hook	20° Radial Hook
Iron – Wrought	10° Hook	10° Hook			

SCREW THREAD TERMS





Allowance. An intentional difference in the dimensions of mating parts. It is the minimum clearance or the maximum interference which is intended between mating parts.

Angle of Thread. The angle included between sides of thread, measured in an axial plane.

Axis of Screw. The longitudinal central line through the screw from which all corresponding parts are equally distant.

Base of Thread. The bottom section of a thread; the greatest section between the two adjacent roots.

Basic. The theoretical or nominal standard size from which all variations are made.

Crest. The top surface joining the two sides or flanks of a thread.

Crest Clearance. The space between the crest of a thread and the root of its component.

Depth of Thread. In profile, distance between crest and base measured normal to the axis.

Engagement, Depth of. The radial distance between crests of mating parts.

Engagement, Length of. The length of contact between two mating parts measured axially.

Helix Angle. The angle made by the helix of the thread at the pitch diameter with a plane perpendicular to the axis.

Lead. The distance a screw thread advances axially in one turn. (See Thread.)

Lead Error. The variation from basic lead.

Limits. The extreme dimensions which are prescribed to provide variation in fit and workmanship.

Major Diameter. On a straight screw thread the major diameter is the largest diameter of the screw or nut.

Minor Diameter. On a straight screw thread the smallest diameter of the screw or nut.

Neutral Zone. A positive allowance clearance. (See "Allowance.")

Number of Threads. The number of threads in one inch of length. Equals 1/pitch.

Pitch. The distance from a point on a screw thread to a corresponding point on the next thread measured parallel to the axis.

Pitch Diameter. On a straight screw thread the diameter of a cylinder where the width of the thread and the width of the space between threads is equal.

Root. The bottom surface joining the sides of two adjacent threads.

Screw Thread. A ridge of uniform section in the form of a helix on the external or internal surface of a cylinder, or as a conical spiral on the external or internal surface of a cone.

Side or Flank of Thread. The surface of the thread which connects the crest with root.

Taper Thread. A thread on which the pitch diameter is increased by some constant ratio as on the American Standard Taper Pipe Tap.

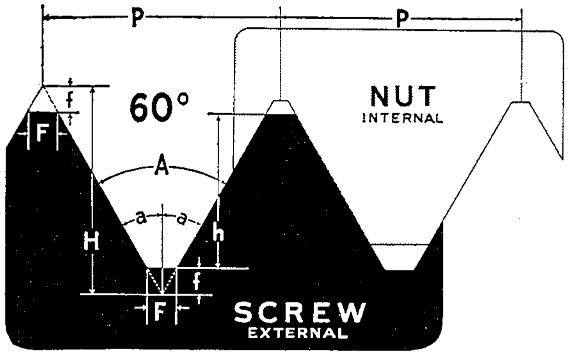
Thread, Single. A thread in which lead is equal to pitch.
- **Double.** A thread in which lead is equal to twice the pitch.
- **Triple.** A thread in which lead is equal to three times the pitch.
- **Quadruple.** A thread in which lead is equal to four times the pitch.

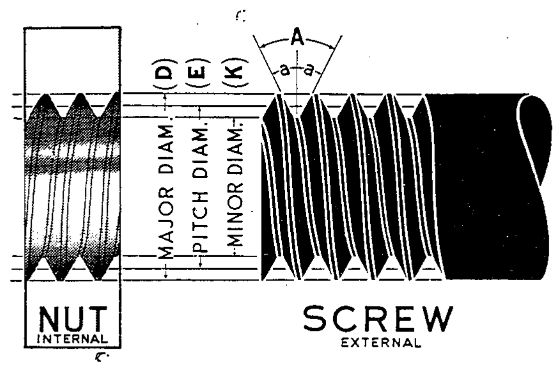
Straight Thread. A thread on which the pitch diameter is the same from one end to the other.

Thread, V. A theoretical form of thread having 60° angle and sharp top and bottom. Useful only as a basis for laying out other thread forms.

Tolerance. The amount of variation permitted in the size of a part. A tolerance may be expressed as plus or minus, or both.

THREAD DIMENSIONS • AMERICAN NATIONAL FORM





Adopted by the National Screw Thread Commission and formerly known as "United States Standard" this form of thread is the most common in the United States and one of the most widely used thread forms in the world. There are two standard series in commercial use — NC (National Coarse) and NF (National Fine). Threads of this form not included in the NC and NF series are designated as NS (National Special).

A = 60° = Angle of thread
a = 30° = ½ Angle of thread
F = 0.125000p, or ⅛p = Width of flat at crest and root
f = 0.108253p, or ⅛H, or 1/6h = Depth of truncation
H = 0.866025p = Depth Theoretical V 60° thread
h = 0.649519p, or 6/8H = Depth American National form thread
n = Number threads per inch
p = 1/n, = Pitch

n	h	F	p	n	h	F	p
4	.1624	.0313	.2500	18	.0361	.0069	.0556
4½	.1443	.0278	.2222	20	.0325	.0063	.0500
5	.1299	.0250	.2000	24	.0271	.0052	.0417
6	.1083	.0208	.1667	28	.0232	.0045	.0357
7	.0928	.0179	.1429	32	.0203	.0039	.0313
8	.0812	.0156	.1250	36	.0180	.0035	.0278
9	.0722	.0139	.1111	40	.0162	.0031	.0250
10	.0650	.0125	.1000	44	.0148	.0028	.0227
11	.0590	.0114	.0909	48	.0135	.0026	.0208
12	.0541	.0104	.0833	56	.0116	.0022	.0179
13	.0500	.0096	.0769	64	.0101	.0020	.0156
14	.0464	.0089	.0714	72	.0090	.0017	.0139
16	.0406	.0078	.0625	80	.0081	.0016	.0125

UNIFIED THREADS Inasmuch as the Unified Thread is essentially the same as the American National Thread (differing only in product limits), Geometric tools are capable of producing either standard as there are adjustment facilities in all Geometric Tools whereby the pitch diameter of all threads produced can be controlled . . . Our handbook "SCREW THREADS" which covers classes of threads in both Unified and American National standards, is available on request.

HELIX ANGLES (BASED ON PITCH DIAMETER)

Thread Size	Helix	Thread Size	Helix	Thread Size	Helix	Thread Size	Helix	Thread Size	Helix
# 0—80	4° 23′	# 8—32	3° 58′	7/16—20	2° 15′	1⅛— 7	2° 31′	2½— 4	1° 57′
# 1—64	4° 31′	# 8—36	3° 28′	½—13	3° 7′	1⅛—12	1° 25′	2½— 8	0° 57′
# 1—72	3° 57′	#10—24	4° 39′	½—20	1° 57′	1¼— 7	2° 15′	2¾— 4	1° 46′
# 2—56	4° 22′	#10—32	3° 21′	9/16—12	2° 59′	1¼—12	1° 16′	2¾— 8	0° 51′
# 2—64	3° 45′	#12—24	4° 1′	9/16—18	1° 55′	1⅜— 6	2° 24′	3 — 4	1° 36′
# 3—48	4° 26′	#12—28	3° 22′	⅝—11	2° 56′	1⅜—12	1° 9′	3 — 8	0° 47′
# 3—56	3° 43′	¼—20	4° 11′	⅝—18	1° 43′	1½— 6	2° 11′	3¼— 4	1° 29′
# 4—40	4° 45′	¼—28	2° 52′	¾—10	2° 40′	1½—12	1° 3′	3½— 4	1° 22′
# 4—48	3° 51′	5/16—18	3° 40′	¾—16	1° 36′	1¾— 5	2° 15′	3¾— 4	1° 16′
# 5—40	4° 11′	5/16—24	2° 40′	⅞— 9	2° 31′	1¾—10	1° 5′	4 — 4	1° 11′
# 5—44	3° 45′	⅜—16	3° 24′	⅞—14	1° 34′	2 — 4½	2° 11′		
# 6—32	4° 50′	⅜—24	2° 11′	1 — 8	2° 29′	2¼— 4½	1° 55′		
# 6—40	3° 44′	7/16—14	3° 20′	1 —14	1° 22′	2¼— 8	1° 3′		

AMERICAN NATIONAL AND UNIFIED STANDARD SIZES

Diam.	Basic Major Diam.	Thread Series						
		NC & UNC	NF & UNF	NEF	8 N	12 N & UN	16 N & UN	27 N
0	.0600		80					
1	.0730	64	72					
2	.0860	56	64					
3	.0990	48	56					
4	.1120	40	48					
5	.1250	40	44					
6	.1380	32	40					
8	.1640	32	36					
10	.1900	24	32					
12	.2160	24	28					
1/4	.2500	**20**	**28**	32				27
5/16	.3125	**18**	**24**	32				27
3/8	.3750	**16**	**24**	32				27
7/16	.4375	**14**	**20**	**28**				27
1/2	.5000	**13**	**20**	**28**		**12**		27
9/16	.5625	**12**	**18**	24		**12**		27
5/8	.6250	**11**	**18**	24		12		27
11/16	.6875			24		12		
3/4	.7500	**10**	**16**	**20**		12	**16**	27
13/16	.8125			**20**		12	**16**	
7/8	.8750	**9**	**14**	**20**		12	**16**	27
15/16	.9375			**20**		**12**	**16**	
1	1.0000	**8**	**12**	**20**	8	**12**	**16**	27
1 1/16	1.0625			18		**12**	**16**	
1 1/8	1.1250	**7**	**12**	18	8	**12**	**16**	
1 3/16	1.1875			18		**12**	**16**	
1 1/4	1.2500	**7**	**12**	18	8	**12**	**16**	
1 5/16	1.3125			18		**12**	**16**	
1 3/8	1.3750	**6**	**12**	18	8	**12**	**16**	
1 7/16	1.4375			18		**12**	**16**	
1 1/2	1.5000	**6**	**12**	18	8	**12**	**16**	
1 9/16	1.5625			18			16	
1 5/8	1.6250			18	8	12	16	
1 11/16	1.6875			18			16	
1 3/4	1.7500	**5**		**16**	8	**12**	**16**	
1 13/16	1.8125						16	
1 7/8	1.8750				8	12	16	
2	2.0000	**4½**		**16**	8	**12**	**16**	
2 1/16	2.0625						16	
2 1/8	2.1250				8	12	16	
2 3/16	2.1875						16	
2 1/4	2.2500	**4½**			8	**12**	**16**	
2 5/16	2.3125						16	
2 3/8	2.3750					12	16	
2 7/16	2.4375						16	
2 1/2	2.5000	**4**			8	**12**	**16**	
2 5/8	2.6250					12	16	
2 3/4	2.7500	**4**			8	**12**	**16**	
2 7/8	2.8750					12	16	
3	3.0000	**4**			8	**12**	**16**	
3 1/8	3.1250					12	16	
3 1/4	3.2500	**4**			8	**12**	**16**	
3 3/8	3.3750					12	16	
3 1/2	3.5000	**4**			8	**12**	**16**	
3 5/8	3.6250					12	16	
3 3/4	3.7500	**4**			8	**12**	**16**	
3 7/8	3.8750					12	16	
4	4.0000	**4**			8	**12**	**16**	
4 1/4	4.2500					**12**	**16**	
4 1/2	4.5000					**12**	**16**	
4 3/4	4.7500					**12**	**16**	
5	5.0000					**12**	**16**	
5 1/4	5.2500					**12**	**16**	
5 1/2	5.5000					**12**	**16**	
5 3/4	5.7500					**12**	**16**	
6	6.0000					**12**	**16**	

Bold type indicates Unified threads.

CLASSES 3A AND 3 EXTERNAL THREAD LIMITS

SIZE			CLASS 3A UNIFIED					CLASS 3 AMERICAN NATIONAL				
Nominal	Threads Per Inch		Major Diameter		Pitch Diameter		Minor Diameter	Major Diameter		Pitch Diameter		Minor Diameter
	Coarse	Fine	Max.	Min.	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.
0	..	80	.0600	.0568	.0519	.0506	.0447	.0600	.0566	.0519	.0506	.0447
1	64	..	.0730	.0692	.0629	.0614	.0538	.0730	.0692	.0629	.0615	.0538
1	..	72	.0730	.0695	.0640	.0626	.0560	.0730	.0694	.0640	.0627	.0560
2	56	..	.0860	.0819	.0744	.0728	.0641	.0860	.0820	.0744	.0729	.0641
2	..	64	.0860	.0822	.0759	.0744	.0668	.0860	.0822	.0759	.0745	.0668
3	48	..	.0990	.0945	.0855	.0838	.0734	.0990	.0946	.0855	.0839	.0734
3	..	56	.0990	.0949	.0874	.0858	.0771	.0990	.0950	.0874	.0859	.0771
4	40	..	.1120	.1069	.0958	.0939	.0813	.1120	.1072	.0958	.0941	.0813
4	..	48	.1120	.1075	.0985	.0967	.0864	.1120	.1076	.0985	.0969	.0864
5	40	..	.1250	.1199	.1088	.1068	.0943	.1250	.1202	.1088	.1071	.0943
5	..	44	.1250	.1202	.1102	.1083	.0971	.1250	.1204	.1102	.1086	.0971
6	32	..	.1380	.1320	.1177	.1156	.0997	.1380	.1326	.1177	.1158	.0997
6	..	40	.1380	.1329	.1218	.1198	.1073	.1380	.1332	.1218	.1201	.1073
8	32	..	.1640	.1580	.1437	.1415	.1257	.1640	.1586	.1437	.1418	.1257
8	..	36	.1640	.1585	.1460	.1439	.1299	.1640	.1590	.1460	.1442	.1299
10	24	..	.1900	.1828	.1629	.1604	.1389	.1900	.1834	.1629	.1605	.1389
10	..	32	.1900	.1840	.1697	.1674	.1517	.1900	.1846	.1697	.1678	.1517
12	24	..	.2160	.2088	.1889	.1863	.1649	.2160	.2094	.1889	.1865	.1649
12	..	28	.2160	.2095	.1928	.1904	.1722	.2160	.2098	.1928	.1906	.1722
1/4	20	..	.2500	.2419	.2175	2147	.1887	.2500	.2428	.2175	.2149	.1887
1/4	..	28	.2500	.2435	.2268	.2243	.2062	.2500	.2438	.2268	.2246	.2062
5/16	18	..	.3125	.3038	.2764	.2734	.2443	.3125	.3043	.2764	.2734	.2443
5/16	..	24	.3125	.3053	.2854	.2827	.2614	.3125	.3059	.2854	.2830	.2614
3/8	16	..	.3750	.3656	.3344	.3311	.2983	.3750	.3660	.3344	.3312	.2983
3/8	..	24	.3750	.3678	.3479	.3450	.3239	.3750	.3684	.3479	.3455	.3239
7/16	14	..	.4375	.4272	.3911	.3876	.3499	.4375	.4277	.3911	.3875	.3499
7/16	..	20	.4375	.4294	.4050	.4019	.3762	.4375	.4303	.4050	.4024	.3762
1/2	13	..	.5000	.4891	.4500	.4463	.4056	.5000	.4896	.4500	.4463	.4056
1/2	..	20	.5000	.4919	.4675	.4643	.4387	.5000	.4028	.4675	.4649	.4387
9/16	12	..	.5625	.5511	.5084	.5045	.4603	.5625	.5513	.5084	.5044	.4603
9/16	..	18	.5625	.5538	.5264	.5230	.4943	.5625	.5543	.5264	.5234	.4943
5/8	11	..	.6250	.6129	.5660	.5619	.5135	.6250	.6132	.5660	.5618	.5135
5/8	..	18	.6250	.6163	.5889	.5854	.5568	.6250	.6168	.5889	.5859	.5568
3/4	10	..	.7500	.7371	.6850	.6806	.6273	.7500	.7372	.6850	.6805	.6273
3/4	..	16	.7500	.7406	.7094	.7056	.6733	.7500	.7410	.7094	.7062	.6733
7/8	9	..	.8750	.8611	.8028	.7981	.7387	.8750	.8610	.8028	.7979	.7387
7/8	..	14	.8750	.8647	.8286	.8245	.7874	.8750	.8652	.8286	.8250	.7874
1	8	..	1.0000	.9850	.9188	.9137	.8466	1.0000	.9848	.9188	.9134	.8466
1	..	12	1.0000	.9886	.9459	.9415	.8978	1.0000	.9888	.9459	.9419	.8978
1 1/8	7	..	1.1250	1.1086	1.0322	1.0268	.9497	1.1250	1.1080	1.0322	1.0263	.9497
1 1/8	..	12	1.1250	1.1136	1.0709	1.0664	1.0228	1.1250	1.1138	1.0709	1.0669	1.0228
1 1/4	7	..	1.2500	1.2336	1.1572	1.1517	1.0747	1.2500	1.2330	1.1572	1.1513	1.0747
1 1/4	..	12	1.2500	1.2386	1.1959	1.1913	1.1478	1.2500	1.2388	1.1959	1.1919	1.1478
1 3/8	6	..	1.3750	1.3568	1.2667	1.2607	1.1705	1.3750	1.3548	1.2667	1.2596	1.1705
1 3/8	..	12	1.3750	1.3636	1.3209	1.3162	1.2728	1.3750	1.3638	1.3209	1.3169	1.2728
1 1/2	6	..	1.5000	1.4818	1.3917	1.3856	1.2955	1.5000	1.4798	1.3917	1.3846	1.2955
1 1/2	..	12	1.5000	1.4886	1.4459	1.4411	1.3978	1.5000	1.4888	1.4459	1.4419	1.3978
1 3/4	5	..	1.7500	1.7295	1.6201	1.6134	1.5046	1.7500	1.7268	1.6201	1.6119	1.5046
2	4 1/2	..	2.0000	1.9780	1.8557	1.8486	1.7274	2.0000	1.9746	1.8557	1.8468	1.7274
2 1/4	4 1/2	..	2.2500	2.2280	2.1057	2.0984	1.9774	2.2500	2.2246	2.1057	2.0968	1.9774
2 1/2	4	..	2.5000	2.4762	2.3376	2.3298	2.1933	2.5000	2.4720	2.3376	2.3279	2.1933
2 3/4	4	..	2.7500	2.7262	2.5876	2.5797	2.4433	2.7500	2.7220	2.5876	2.5779	2.4433
3	4	..	3.0000	2.9762	2.8376	2.8296	2.6933	3.0000	2.9720	2.8376	2.8279	2.6933
3 1/4	4	..	3.2500	3.2262	3.0876	3.0794	2.9433	3.2500	3.2220	3.0876	3.0779	2.9433
3 1/2	4	..	3.5000	3.4762	3.3376	3.3293	3.1933	3.5000	3.4720	3.3376	3.3279	3.1933
3 3/4	4	..	3.7500	3.7262	3.5876	3.5792	3.4433	3.7500	3.7220	3.5876	3.5779	3.4433
4	4	..	4.0000	3.9762	3.8376	3.8291	3.6933	4.0000	3.9720	3.8376	3.8279	3.6933

PITCH DIAMETER TOLERANCES FOR EXTERNAL THREADS OF SPECIAL DIAMETERS, PITCHES AND LENGTHS OF ENGAGEMENT, CLASS 3A (UNS and NS Threads)

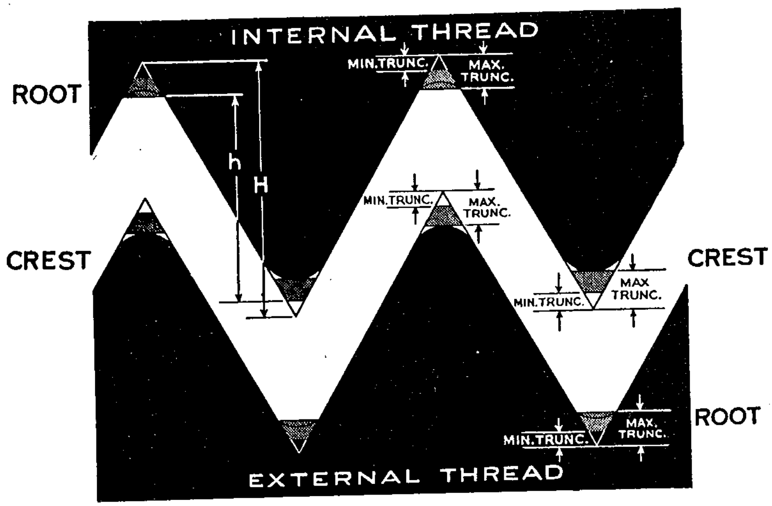
Threads per Inch	Lengths of Engagement: Number of Pitches	Lengths of Engagement: Inches	Pitch Diameter Tolerances: 1/16 0.0600 to 0.0781	3/32 0.0782 to 0.1094	1/8 0.1095 to 0.1563	3/16 0.1564 to 0.2188	1/4 0.2189 to 0.3125	3/8 0.3126 to 0.4375	1/2 0.4376 to 0.5625	5/8 0.5626 to 0.6875	3/4 0.6876 to 0.8750	1 0.8751 to 1.1250	1 1/4 1.1251 to 1.3750	1 1/2 1.3751 to 1.6250	1 3/4 1.6251 to 1.8750	2 1.8751 to 2.2500	2 1/2 2.2501 to 2.7500	3 2.7501 to 3.2500	3 1/2 3.2501 to 3 7500	4 3.7501 to 4.5000	5 4.5001 to 5.5000	6 5.5001 to 7.0000
80	5 to 15	0.06 to 0.19	0.0014	0.0015	0.0015	0.0016	0.0017	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.191 to 0.38	0.0016	0.0017	0.0017	0.0018	0.0019	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
72	5 to 15	0.07 to 0.21	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.211 to 0.42	......	0.0018	0.0018	0.0019	0.0020	0.0021	......	......	......	......	......	......	......	......	......	......	......	......	......	......
64	5 to 15	0.08 to 0.23	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	0.0020	......	......	......	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.231 to 0.46	......	0.0018	0.0019	0.0020	0.0020	0.0021	0.0022	......	......	......	......	......	......	......	......	......	......	......	......	......
56	5 to 15	0.09 to 0.27	......	0.0017	0.0018	0.0019	0.0019	0.0020	0.0021	0.0022	0.0022	......	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.271 to 0.54	......	0.0020	0.0020	0.0021	0.0021	0.0023	0.0023	0.0024	0.0025	......	......	......	......	......	......	......	......	......	......	......
48	5 to 15	0.10 to 0.31	......	0.0019	0.0019	0.0020	0.0020	0.0022	0.0022	0.0023	0.0024	......	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.311 to 0.62	......	......	0.0021	0.0022	0.0023	0.0024	0.0025	0.0025	0.0026	......	......	......	......	......	......	......	......	......	......	......
40	5 to 15	0.12 to 0.38	......	......	0.0021	0.0021	0.0022	0.0023	0.0024	0.0025	0.0025	0.0026	......	......	......	......	......	......	......	......	......	......
	16 to 30	0.381 to 0.76	......	......	0.0023	0.0024	0.0025	0.0026	0.0027	0.0027	0.0028	0.0029	......	......	......	......	......	......	......	......	......	......
36	5 to 15	0.14 to 0.42	......	......	0.0022	0.0022	0.0023	0.0024	0.0025	0.0026	0.0026	0.0027	0.0028	0.0029	......	......	......	......	......	......	......	......
	16 to 30	0.421 to 0.84	......	......	......	0.0025	0.0026	0.0027	0.0028	0.0028	0.0029	0.0030	0.0031	0.0032	......	......	......	......	......	......	......	......
32	5 to 15	0.16 to 0.47	......	......	0.0023	0.0024	0.0024	0.0025	0.0026	0.0027	0.0027	0.0028	0.0029	0.0030	0.0031	0.0031	0.0032	0.0033	......	......	......	......
	16 to 30	0.471 to 0.94	......	......	......	0.0026	0.0027	0.0028	0.0029	0.0030	0.0030	0.0031	0.0032	0.0033	0.0034	0.0034	0.0035	0.0036	......	......	......	......
28	5 to 15	0.18 to 0.54	......	......	......	0.0025	0.0026	0.0027	0.0028	0.0028	0.0029	0.0030	0.0031	0.0031	0.0032	0.0033	0.0034	0.0035	0.0036	0.0036	......	......
	16 to 30	0.541 to 1.08	......	......	......	0.0028	0.0029	0.0030	0.0031	0.0031	0.0032	0.0033	0.0034	0.0035	0.0035	0.0036	0.0037	0.0038	0.0039	0.0040	......	......
24	5 to 15	0.21 to 0.62	......	......	......	0.0027	0.0028	0.0029	0.0029	0.0030	0.0031	0.0032	0.0033	0.0033	0.0034	0.0035	0.0036	0.0037	0.0037	0.0038	0.0040	0.0041
	16 to 30	0.621 to 1.24	......	......	......	......	0.0031	0.0032	0.0033	0.0033	0.0034	0.0035	0.0036	0.0037	0.0037	0.0038	0.0039	0.0040	0.0041	0.0042	0.0043	0.0044
20	5 to 15	0.25 to 0.75	......	......	......	......	0.0030	0.0031	0.0032	0.0032	0.0033	0.0034	0.0035	0.0036	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0042	0.0043
	16 to 30	0.751 to 1.50	......	......	......	......	0.0034	0.0035	0.0035	0.0036	0.0037	0.0038	0.0039	0.0039	0.0040	0.0041	0.0042	0.0043	0.0044	0.0044	0.0046	0.0047
18	5 to 15	0.28 to 0.83	......	......	......	......	......	0.0032	0.0033	0.0034	0.0035	0.0036	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0041	0.0042	0.0044	0.0045
	16 to 30	0.831 to 1.66	......	......	......	......	......	0.0036	0.0037	0.0038	0.0038	0.0039	0.0040	0.0041	0.0042	0.0042	0.0044	0.0044	0.0045	0.0046	0.0047	0.0049
16	5 to 15	0.31 to 0.94	......	......	......	......	......	0.0034	0.0035	0.0036	0.0036	0.0037	0.0038	0.0039	0.0040	0.0040	0.0041	0.0042	0.0043	0.0044	0.0045	0.0047
	16 to 30	0.941 to 1.88	......	......	......	......	......	0.0038	0.0039	0.0039	0.0040	0.0041	0.0042	0.0043	0.0043	0.0044	0.0045	0.0046	0.0047	0.0048	0.0049	0.0050
14	5 to 15	0.36 to 1.07	......	......	......	......	......	......	0.0037	0.0038	0.0039	0.0040	0.0041	0.0041	0.0042	0.0043	0.0044	0.0045	0.0045	0.0046	0.0048	0.0049
	16 to 30	1.071 to 2.14	......	......	......	......	......	......	0.0042	0.0042	0.0043	0.0044	0.0045	0.0046	0.0046	0.0047	0.0048	0.0049	0.0050	0.0051	0.0052	0.0053
12	5 to 15	0.42 to 1.25	......	......	......	......	......	......	0.0040	0.0041	0.0041	0.0042	0.0043	0.0044	0.0045	0.0045	0.0046	0.0047	0.0048	0.0049	0.0050	0.0052
	16 to 30	1.251 to 2.50	......	......	......	......	......	......	0.0045	0.0046	0.0046	0.0047	0.0048	0.0049	0.0050	0.0050	0.0051	0.0052	0.0053	0.0054	0.0055	0.0056
10	5 to 15	0.50 to 1.50	......	......	......	......	......	......	......	......	0.0045	0.0046	0.0047	0.0048	0.0048	0.0049	0.0050	0.0051	0.0052	0.0053	0.0054	0.0055
	16 to 30	1.501 to 3.00	......	......	......	......	......	......	......	......	0.0050	0.0051	0.0052	0.0053	0.0054	0.0054	0.0055	0.0056	0.0057	0.0058	0.0059	0.0061
8	5 to 15	0.62 to 1.88	......	......	......	......	......	......	......	......	......	0.0051	0.0052	0.0053	0.0054	0.0054	0.0055	0.0056	0.0057	0.0058	0.0059	0.0061
	16 to 30	1.881 to 3.76	......	......	......	......	......	......	......	......	......	0.0057	0.0058	0.0059	0.0059	0.0060	0.0061	0.0062	0.0063	0.0064	0.0065	0.0066
6	5 to 15	0.83 to 2.50	......	......	......	......	......	......	......	......	......	......	......	0.0061	0.0061	0.0062	0.0063	0.0064	0.0065	0.0066	0.0067	0.0068
	16 to 30	2.501 to 5.00	......	......	......	......	......	......	......	......	......	......	......	0.0067	0.0068	0.0069	0.0070	0.0071	0.0072	0.0072	0.0074	0.0075
4	5 to 15	1.25 to 3.75	......	......	......	......	......	......	......	......	......	......	......	......	......	0.0076	0.0077	0.0078	0.0079	0.0079	0.0081	0.0082
	16 to 30	3.751 to 7.50	......	......	......	......	......	......	......	......	......	......	......	......	......	0.0084	0.0085	0.0086	0.0087	0.0088	0.0089	0.0090

PITCH DIAMETER TOLERANCES FOR THREADS OF SPECIAL DIAMETERS, PITCHES AND LENGTHS OF ENGAGEMENT, CLASS 3

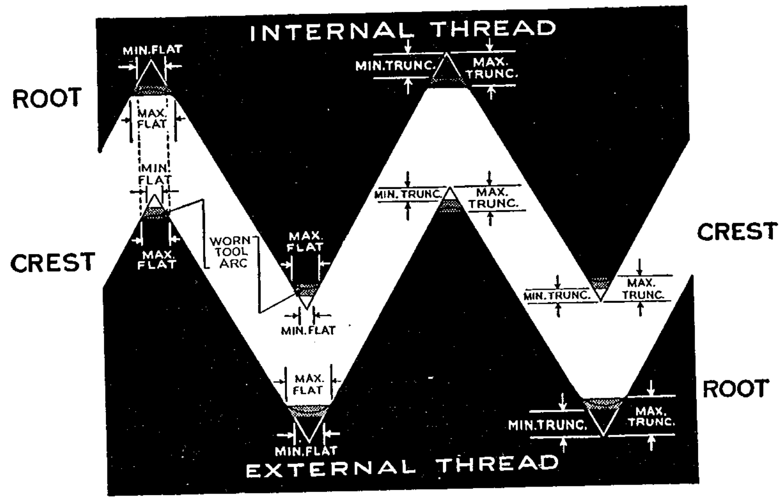
Threads per Inch	Lengths of Engagement: Number of Pitches	Lengths of Engagement: Inches	PITCH DIAMETER TOLERANCES: 1/16 0.0600 to 0.0781	3/32 0.0782 to 0.1094	1/8 0.1095 to 0.1563	3/16 0.1564 to 0.2188	1/4 0.2189 to 0.3125	3/8 0.3126 to 0.4375	1/2 0.4376 to 0.5625	5/8 0.5626 to 0.6875	3/4 0.6876 to 0.8750	1 0.8751 to 1.1250	1 1/4 1.1251 to 1.3750	1 1/2 1.3751 to 1.6250	1 3/4 1.6251 to 1.8750	2 1.8751 to 2.2500	2 1/2 2.2501 to 2.7500	3 2.7501 to 3.2500	3 1/2 3.2501 to 3.7500	4 3.7501 to 4.5000	5 4.5001 to 5.5000	6 5.5001 to 7.0000
80	5 to 15 16 to 30	0.06 to 0.19 0.191 to 0.38	0.0012 0.0014	0.0013 0.0014	0.0014 0.0015	0.0015 0.0016	0.0016 0.0017	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
72	5 to 15 16 to 30	0.07 to 0.21 0.211 to 0.42	0.0013 0.0014	0.0014 0.0015	0.0014 0.0016	0.0015 0.0017	0.0016 0.0018	0.0018 0.0019	......	......	......	......	......	......	......	......	......	......	......	......	......	......
64	5 to 15 16 to 30	0.08 to 0.23 0.231 to 0.46	0.0014 0.0015	0.0014 0.0016	0.0015 0.0017	0.0016 0.0018	0.0017 0.0019	0.0019 0.0020	0.0020 0.0022	......	......	......	......	......	......	......	......	......	......	......	......	......
56	5 to 15 16 to 30	0.09 to 0.27 0.271 to 0.54	0.0014 0.0016	0.0015 0.0017	0.0016 0.0018	0.0017 0.0019	0.0018 0.0020	0.0019 0.0021	0.0021 0.0023	0.0022 0.0024	0.0023 0.0025	......	......	......	......	......	......	......	......	......	......	......
48	5 to 15 16 to 30	0.10 to 0.31 0.311 to 0.62	......	0.0016 0.0018	0.0017 0.0019	0.0018 0.0020	0.0019 0.0021	0.0020 0.0023	0.0022 0.0024	0.0023 0.0025	0.0024 0.0026	......	......	......	......	......	......	......	......	......	......	......
40	5 to 15 16 to 30	0.12 to 0.38 0.381 to 0.76	......	......	0.0018 0.0021	0.0019 0.0022	0.0020 0.0023	0.0022 0.0024	0.0023 0.0026	0.0024 0.0027	0.0025 0.0028	0.0027 0.0030	......	......	......	......	......	......	......	......	......	......
36	5 to 15 16 to 30	0.14 to 0.42 0.421 to 0.84	......	......	0.0019 0.0022	0.0020 0.0023	0.0021 0.0024	0.0023 0.0025	0.0024 0.0027	0.0025 0.0028	0.0026 0.0029	0.0028 0.0031	0.0030 0.0032	0.0031 0.0034	......	......	......	......	......	......	......	......
32	5 to 15 16 to 30	0.16 to 0.47 0.471 to 0.94	......	......	0.0020 0.0023	0.0021 0.0024	0.0022 0.0025	0.0024 0.0027	0.0025 0.0028	0.0026 0.0029	0.0027 0.0030	0.0029 0.0032	0.0031 0.0034	0.0032 0.0035	0.0034 0.0037	0.0035 0.0038	0.0037 0.0040	0.0039 0.0042	......	......	......	......
28	5 to 15 16 to 30	0.18 to 0.54 0.541 to 1.08	......	......	......	0.0022 0.0026	0.0023 0.0027	0.0025 0.0028	0.0026 0.0030	0.0027 0.0031	0.0028 0.0032	0.0030 0.0034	0.0032 0.0036	0.0033 0.0037	0.0035 0.0038	0.0036 0.0040	0.0038 0.0042	0.0040 0.0044	0.0042 0.0046	0.0044 0.0048	......	......
24	5 to 15 16 to 30	0.21 to 0.62 0.621 to 1.24	......	......	......	0.0024 0.0028	0.0025 0.0029	0.0026 0.0031	0.0028 0.0032	0.0029 0.0033	0.0030 0.0034	0.0032 0.0036	0.0033 0.0038	0.0035 0.0039	0.0036 0.0041	0.0038 0.0042	0.0040 0.0044	0.0042 0.0046	0.0044 0.0048	0.0046 0.0050	0.0049 0.0053	0.0052 0.0056
20	5 to 15 16 to 30	0.25 to 0.75 0.751 to 1.50	......	......	......	......	0.0027 0.0032	0.0028 0.0034	0.0030 0.0035	0.0031 0.0036	0.0032 0.0037	0.0034 0.0039	0.0035 0.0041	0.0037 0.0042	0.0038 0.0043	0.0040 0.0045	0.0042 0.0047	0.0044 0.0049	0.0046 0.0051	0.0048 0.0053	0.0051 0.0056	0.0054 0.0059
18	5 to 15 16 to 30	0.28 to 0.83 0.831 to 1.66	......	......	......	......	......	0.0030 0.0035	0.0031 0.0037	0.0032 0.0038	0.0033 0.0039	0.0035 0.0041	0.0037 0.0042	0.0038 0.0044	0.0040 0.0045	0.0041 0.0047	0.0043 0.0049	0.0045 0.0051	0.0047 0.0053	0.0049 0.0055	0.0052 0.0058	0.0055 0.0061
16	5 to 15 16 to 30	0.31 to 0.94 0.941 to 1.88	......	......	......	......	......	0.0031 0.0038	0.0033 0.0039	0.0034 0.0040	0.0035 0.0041	0.0037 0.0043	0.0038 0.0045	0.0040 0.0046	0.0041 0.0048	0.0043 0.0049	0.0045 0.0051	0.0047 0.0053	0.0049 0.0055	0.0051 0.0057	0.0054 0.0060	0.0057 0.0063
14	5 to 15 16 to 30	0.36 to 1.07 1.071 to 2.14	......	......	......	......	......	......	0.0035 0.0042	0.0036 0.0043	0.0037 0.0044	0.0039 0.0046	0.0040 0.0048	0.0042 0.0049	0.0043 0.0051	0.0044 0.0052	0.0047 0.0054	0.0049 0.0056	0.0051 0.0058	0.0053 0.0060	0.0056 0.0063	0.0059 0.0066
12	5 to 15 16 to 30	0.42 to 1.25 1.251 to 2.50	......	......	......	......	......	......	0.0037 0.0046	0.0038 0.0047	0.0039 0.0048	0.0041 0.0050	0.0043 0.0051	0.0044 0.0053	0.0046 0.0054	0.0047 0.0056	0.0049 0.0058	0.0051 0.0060	0.0053 0.0062	0.0055 0.0064	0.0058 0.0067	0.0061 0.0070
10	5 to 15 16 to 30	0.50 to 1.50 1.501 to 3.00	......	......	......	......	......	......	......	......	0.0043 0.0053	0.0045 0.0055	0.0046 0.0056	0.0048 0.0058	0.0049 0.0059	0.0050 0.0061	0.0053 0.0063	0.0055 0.0065	0.0057 0.0067	0.0059 0.0069	0.0062 0.0072	0.0065 0.0075
8	5 to 15 16 to 30	0.62 to 1.88 1.881 to 3.76	......	......	......	......	......	......	......	......	......	0.0049 0.0062	0.0051 0.0064	0.0052 0.0065	0.0054 0.0067	0.0055 0.0068	0.0057 0.0070	0.0059 0.0072	0.0061 0.0074	0.0063 0.0076	0.0067 0.0079	0.0070 0.0082
6	5 to 15 16 to 30	0.83 to 2.50 2.501 to 5.00	......	......	......	......	......	......	......	......	......	......	......	0.0060 0.0077	0.0061 0.0078	0.0062 0.0079	0.0065 0.0082	0.0067 0.0084	0.0069 0.0086	0.0071 0.0088	0.0074 0.0091	0.0077 0.0094
4	5 to 15 16 to 30	1.25 to 3.75 3.751 to 7.50	......	......	......	......	......	......	......	......	......	......	......	......	......	0.0076 0.0101	0.0078 0.0104	0.0080 0.0106	0.0082 0.0108	0.0084 0.0110	0.0087 0.0113	0.0090 0.0116

AMERICAN STANDARD AND DRYSEAL PIPE THREADS

American Standard Pipe Threads — NPT



American Standard Dryseal Pipe Threads — NPTF



Limits on Crest and Root of External and Internal Pipe Threads — Inches

THREADS Per Inch		DEPTH SHARP V THREAD H	STANDARD TAPER PIPE THREAD					DRYSEAL PIPE THREAD				
			Depth Taper Pipe Thread "Max" h	Truncation		Equivalent Width of Flat		Truncation		Equivalent Width of Flat		
				Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
27	Crest	.03208	.02963	.0012	.0036	.0014	.0041	.0017	.0035	.0020	.0040	Note: The major diameter of standard taper pipe plug gages and the minor diameter of standard taper pipe ring gages used for gaging dry-seal threads will be truncated .20p minimum or .25p maximum for all pitches.
	Root			.0012	.0036	.0014	.0041	.0035	.0052	.0040	.0060	
18	Crest	.04811	.04444	.0018	.0049	.0021	.0057	.0026	.0043	.0030	.0050	
	Root			.0018	.0049	.0021	.0057	.0043	.0061	.0050	.0070	
14	Crest	.06186	.05714	.0024	.0056	.0027	.0064	.0026	.0043	.0030	.0050	
	Root			.0024	.0056	.0027	.0064	.0043	.0061	.0050	.0070	
11 ½	Crest	.07531	.06957	.0029	.0063	.0033	.0073	.0035	.0052	.0040	.0060	
	Root			.0029	.0063	.0033	.0073	.0052	.0078	.0060	.0090	
8	Crest	.10825	.10000	.0041	.0078	.0048	.0090	.0052	.0069	.0060	.0080	
	Root			.0041	.0078	.0048	.0090	.0069	.0095	.0080	.0110	

The limits specified above are intended to serve as a guide for establishing limits of the thread elements of taps, dies and thread chasers. These limits may be required on the product.

The Army-Navy Aeronautical Specifications AN-P-363 agrees with all values given in this table.

For complete specifications see latest edition of American Standards Association Pamphlet B.2-1.

THREAD DIMENSIONS • PIPE

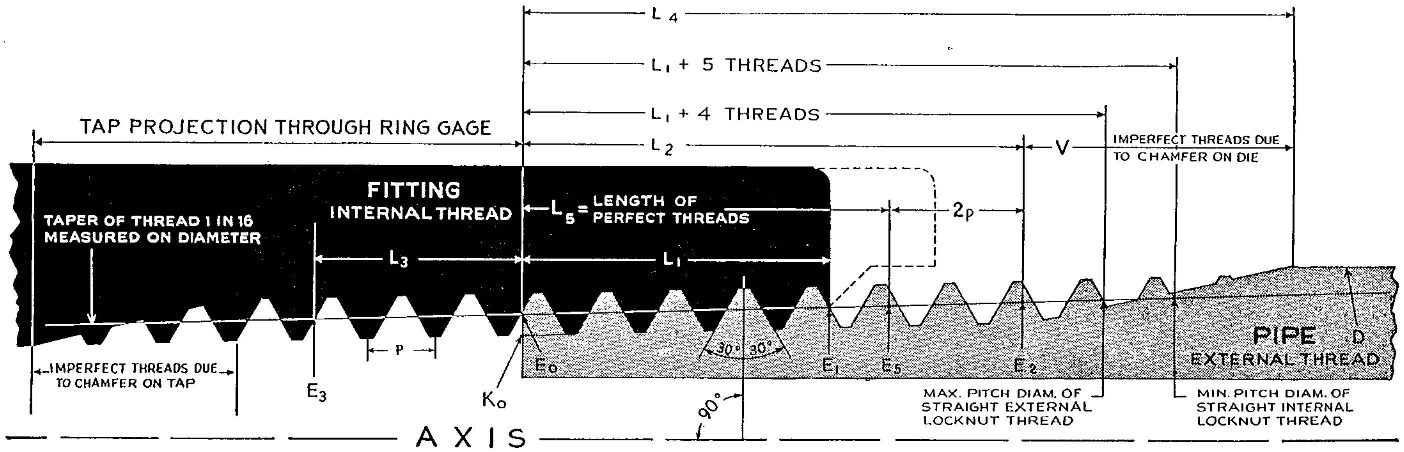
Maximum depth of pipe thread $= \frac{.8}{n}$

Basic major diam. plug gage $= E_1$ plus $\frac{.666}{n}$

Basic minor diam. ring gage $= E_1$ minus $\frac{.666}{n}$

Minimum pitch diameter of straight internal locknut thread $= E_1$ plus $\frac{.3125}{n}$

Maximum pitch diameter of straight external locknut thread $= E_1$ plus $\frac{.250}{n}$

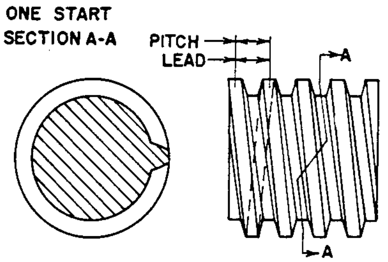


Basic Dimensions of Taper Pipe Threads — Inches

PIPE SIZE		PITCH		HAND TIGHT ENGAGEMENT		EFFECTIVE THREAD OR WRENCH MAKEUP				TOTAL LENGTH OF THREAD	PERFECT THREADS		SMALL END OF PIPE		INCREASE IN DIAMETER PER THREAD 0.0625/n	*TAP DRILL SIZES
						External		Internal								
Nominal	Outside Diameter	Threads per Inch	Length	Length, also Thickness of Thin Ring Gage and Distance from Gaging Notch to Small End of Plug Gage	Basic Pitch Diam., also Pitch Diam. at Gaging Notch, also Basic Pitch Diam. of Straight Pipe Thread	Length, also Length of Plug Gage	Pitch Diameter	Length Wrench Makeup	Pitch Diameter at Small End		Length	Pitch Diameter of Largest External	Pitch Diameter	Basic Minor Diameter		
..	D	n	p	L_1	E_1	L_2	E_2	L_3	E_3	L_4	L_5	E_5	E_0	K_0	..	..
1/16	.3125	27	.03704	.160	.28118	.2611	.28750	.1111	.26424	.3896	.1870	.28287	.27118	.2416	.00231	..
1/8	.405	27	.03704	.180	.37476	.2639	.38000	.1111	.35656	.3924	.1898	.37537	.36351	.3339	.00231	R
1/4	.540	18	.05556	.200	.48989	.4018	.50250	.1667	.46697	.5946	.2907	.49556	.47739	.4329	.00347	7/16
3/8	.675	18	.05556	.240	.62701	.4078	.63750	.1667	.60160	.6006	.2967	.63056	.61201	.5676	.00347	37/64
1/2	.840	14	.07143	.320	.77843	.5337	.79179	.2143	.74504	.7815	.3909	.78286	.75843	.7013	.00446	23/32
3/4	1.050	14	.07143	.339	.98887	.5457	1.00179	.2143	.95429	.7935	.4029	.99286	.96768	.9105	.00446	59/64
1	1.315	11 1/2	.08696	.400	1.23863	.6828	1.25630	.2609	1.19733	.9845	.5088	1.24543	1.21363	1.1441	.00543	1 5/32
1 1/4	1.660	11 1/2	.08696	.420	1.58338	.7068	1.60130	.2609	1.54083	1.0085	.5329	1.59043	1.55713	1.4876	.00543	1 1/2
1 1/2	1.900	11 1/2	.08696	.420	1.82234	.7235	1.84130	.2609	1.77978	1.0252	.5496	1.83043	1.79609	1.7265	.00543	1 47/64
2	2.375	11 1/2	.08696	.436	2.29627	.7565	2.31630	.2609	2.25272	1.0582	.5826	2.30543	2.26902	2.1995	.00543	2 7/32
2 1/2	2.875	8	.12500	.682	2.76216	1.1375	2.79062	.250	2.70391	1.5713	.8875	2.77500	2.71953	2.6195	.00781	2 5/8
3	3.500	8	.12500	.766	3.38850	1.2000	3.41562	.250	3.32500	1.6337	.9500	3.40000	3.34062	3.2406	.00781	3 1/4
3 1/2	4.000	8	.12500	.821	3.88881	1.2500	3.91562	.250	3.82188	1.6837	1.0000	3.90000	3.83750	3.7375	.00781	3 3/4
4	4.500	8	.12500	.844	4.38712	1.3000	4.41562	.250	4.31875	1.7337	1.0500	4.40000	4.33438	4.2344	.00781	4 1/4
5	5.563	8	.12500	.937	5.44929	1.4063	5.47862	.250	5.37511	1.8407	1.1563	5.46300	5.39073	5.2907	.00781	..
6	6.625	8	.12500	.958	6.50597	1.5125	6.54062	.250	6.43047	1.9467	1.2625	6.52500	6.44609	6.3461	.00781	..
8	8.625	8	.12500	1.063	8.50003	1.7125	8.54062	.250	8.41797	2.1467	1.4625	8.52500	8.43359	8.3336	.00781	..
10	10.750	8	.12500	1.210	10.62094	1.9250	10.66562	.250	10.52969	2.3587	1.6750	10.65000	10.54531	10.4453	.00781	..
12	12.750	8	.12500	1.360	12.61781	2.1250	12.66562	.250	12.51719	2.5587	1.8750	12.65000	12.53281	12.4328	.00781	..

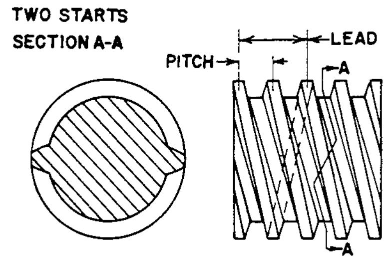
*Methods of inspection vary. Care should be taken to use a tap drill or taper reamer which can meet thread specifications. Sizes given permit direct tapping without reaming the hole, but only give a full thread for the first two or three threads. See columns K_0 and L_3.

MULTIPLE THREADS



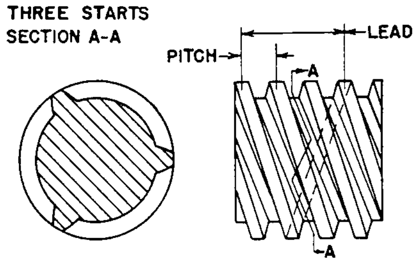
SINGLE THREAD

A thread in which the lead and pitch are equal.



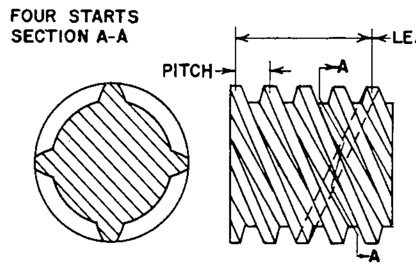
DOUBLE THREAD

A thread in which the lead is equal to two times the pitch.



TRIPLE THREAD

A thread in which the lead is equal to three times the pitch.

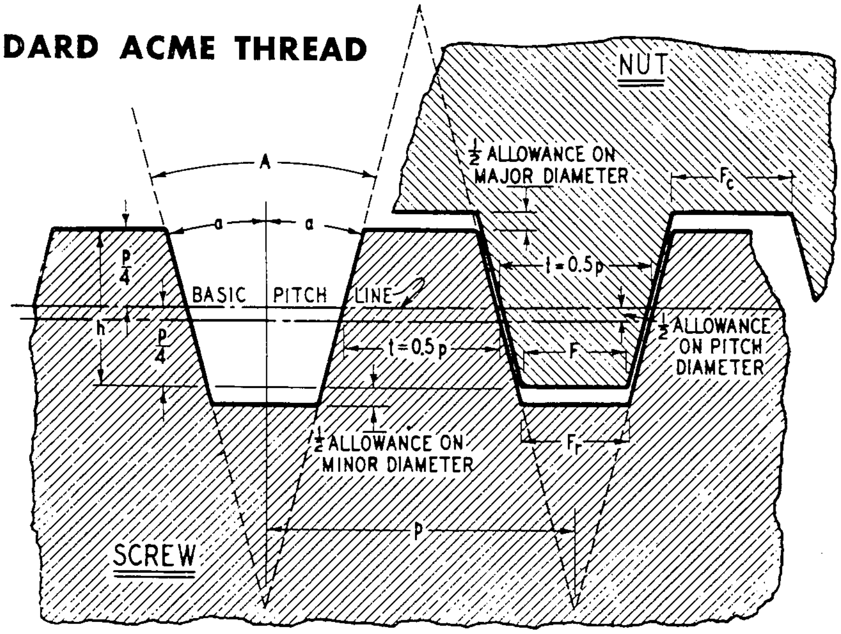


QUADRUPLE THREAD

A thread in which the lead is equal to four times the pitch.

T.P.I.	Lead (given in inches)									
	Single	Double	Triple	Quadruple	Quintuple	Sextuple	Septuple	Octuple	Nonuple	Decuple
3	1/3	2/3	1	1 1/3	1 2/3	2	2 1/3	2 2/3	3	3 1/3
4	1/4	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2
4 1/2	2/9	4/9	2/3	8/9	1 1/9	1 1/3	1 5/9	1 7/9	2	2 2/9
5	1/5	2/5	3/5	4/5	1	1 1/5	1 2/5	1 3/5	1 4/5	2
6	1/6	1/3	1/2	2/3	5/6	1	1 1/6	1 1/3	1 1/2	1 2/3
7	1/7	2/7	3/7	4/7	5/7	6/7	1	1 1/7	1 2/7	1 3/7
8	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
9	1/9	2/9	1/3	4/9	5/9	2/3	7/9	8/9	1	1 1/9
10	1/10	1/5	3/10	2/5	1/2	3/5	7/10	4/5	9/10	1
11	1/11	2/11	3/11	4/11	5/11	6/11	7/11	8/11	9/11	10/11
12	1/12	1/6	1/4	1/3	5/12	1/2	7/12	2/3	3/4	5/6
13	1/13	2/13	3/13	4/13	5/13	6/13	7/13	8/13	9/13	10/13
14	1/14	1/7	3/14	2/7	5/14	3/7	1/2	4/7	9/14	5/7
15	1/15	2/15	1/5	4/15	1/3	2/5	7/15	8/15	3/5	2/3
16	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
18	1/18	1/9	1/6	2/9	5/18	1/3	7/18	4/9	1/2	5/9
20	1/20	1/10	3/20	1/5	1/4	3/10	7/20	2/5	9/20	1/2
22	1/22	1/11	3/22	2/11	5/22	3/11	7/22	4/11	9/22	5/11
24	1/24	1/12	1/8	1/6	5/24	1/4	7/24	1/3	3/8	5/12
28	1/28	1/14	3/28	1/7	5/28	3/14	1/4	2/7	9/28	5/14
32	1/32	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
36	1/36	1/18	1/12	1/9	5/36	1/6	7/36	2/9	1/4	5/18
40	1/40	1/20	3/40	1/10	1/8	3/20	7/40	1/5	9/40	1/4
44	1/44	1/22	3/44	1/11	5/44	3/22	7/44	2/11	9/44	5/22
48	1/48	1/24	1/16	1/12	5/48	1/8	7/48	1/6	3/16	5/24
56	1/56	1/28	3/56	1/14	5/56	3/28	1/8	1/7	9/56	5/28
60	1/60	1/30	1/20	1/15	1/12	1/10	7/60	2/15	3/20	1/6

STANDARD ACME THREAD

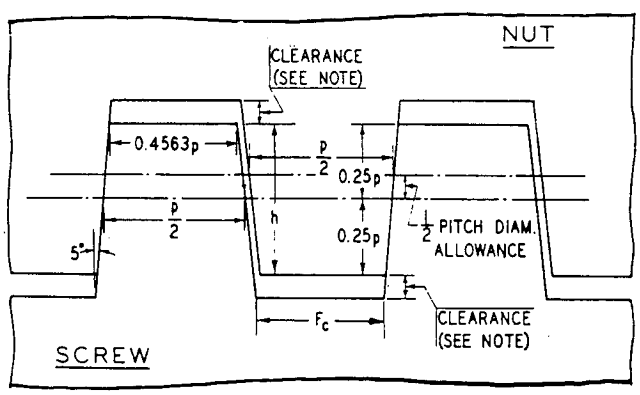


NOTATION

A = 29°00′
a = 14°30′
p = pitch
n = number of threads per inch
N = number of turns per inch
h = 0.5p, basic depth of thread
t = thickness of thread
F = 0.3707p = basic width of flat
F_c = 0.3707p − 0.259 × major diameter allowance
F_r = 0.3707p − 0.259 × (minor diameter allowance on screw-pitch diameter allowance).

TPI(n)	h + allow.	F	F_r	p	TPI(n)	h + allow.	F	F_r	p
1	.5100	.3707	.3655	1.0000	5½	.1009	.0674	.0622	.1818
1⅓	.3850	.2780	.2728	.7500	6	.0933	.0618	.0566	.1667
1½	.3433	.2471	.2419	.6667	7	.0814	.0530	.0478	.1429
2	.2600	.1854	.1802	.5000	8	.0725	.0463	.0411	.1250
2½	.2100	.1483	.1431	.4000	9	.0656	.0412	.0360	.1111
3	.1767	.1236	.1184	.3333	10	.0600	.0371	.0319	.1000
3½	.1529	.1059	.1007	.2857	12	.0467	.0309	.0283	.0833
4	.1350	.0927	.0875	.2500	14	.0407	.0265	.0239	.0714
4½	.1211	.0824	.0772	.2222	16	.0363	.0232	.0206	.0625
5	.1100	.0741	.0689	.2000					

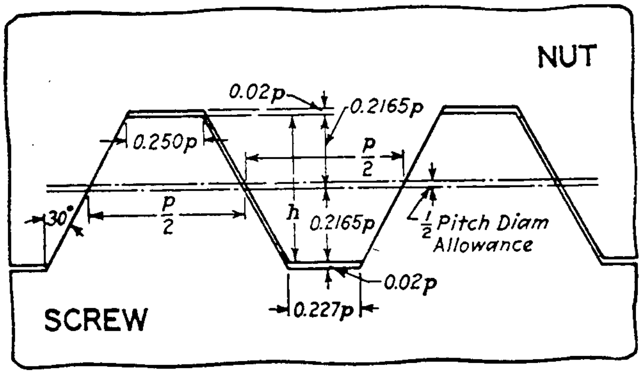
MODIFIED SQUARE THREAD



p = pitch in inches
h (basic depth of thread) = 0.5p
H (total depth of thread) = 0.5p + clearance
t (thickness of thread) = 0.5p
F_c (flat at root of screw thread) = 0.4563p − (0.17 × clearance)
F (basic width of flat at crest of screw thread) = 0.4563p

NOTE.—A clearance should be added to "h" to produce extra depth, thus avoiding interference with threads of mating parts at minor or major diameters. The amount of this clearance must be determined from the application of the thread assembly.

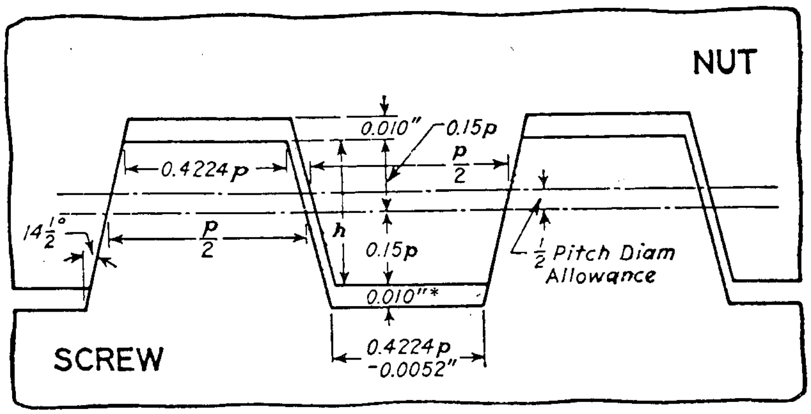
TPI (n)	h+ allow.	F	F_c	p
1	.5100	.4563	.4545	1.0000
1⅓	.3850	.3422	.3404	.7500
1½	.3433	.3041	.3024	.6666
1¾	.2957	.2607	.2591	.5714
2	.2600	.2281	.2264	.5000
2½	.2100	.1825	.1806	.4000
3	.1767	.1521	.1503	.3333
3½	.1528	.1304	.1286	.2857
4	.1350	.1141	.1123	.2500
4½	.1211	.1014	.0996	.2222
5	.1100	.0913	.0895	.2000
6	.0933	.0761	.0743	.1667
7	.0814	.0652	.0634	.1429
8	.0725	.0570	.0553	.1250
9	.0656	.0507	.0489	.1111
10	.0600	.0456	.0439	.1000
11	.0504	.0415	.0406	.0909
12	.0467	.0380	.0372	.0833
13	.0435	.0351	.0342	.0769
14	.0407	.0326	.0317	.0714
15	.0384	.0304	.0296	.0667
16	.0363	.0285	.0276	.0625



60° STUB THREAD

p = pitch in inches
h = basic depth of thread = 0.433p
h+ = total depth of thread = h+.02p
t = thread thickness = .5p
F = width of flat at crest = .250p
Fc = width of flat at root = .227p
n = threads per inch

TPI(n)	h	h +	F	Fc	p	TPI(n)	h	h +	F	Fc	p
4	.1083	.1133	.0625	.0567	.2500	9	.0481	.0503	.0278	.0252	.1111
5	.0866	.0906	.0500	.0454	.2000	10	.0433	.0453	.0250	.0227	.1000
6	.0722	.0755	.0417	.0378	.1667	12	.0361	.0378	.0208	.0189	.0833
7	.0619	.0647	.0357	.0324	.1429	14	.0309	.0324	.0179	.0162	.0714
8	.0541	.0566	.0313	.0284	.1250	16	.0271	.0283	.0156	.0142	.0625



29° STUB ACME THREAD

p = pitch in inches
h = basic depth of thread = .3p
h+ = total depth of thread = h+*
t = thread thickness = .5p
F = width of flat at crest = .4224p
Fc = width of flat at root = .4224p-(.52 × clearance)
n = threads per inch

TPI(n)	h	h +	F	Fc	p	TPI(n)	h	h +	F	Fc	p
2	.1500	.1600	.2112	.2060	.5000	7	.0429	.0529	.0603	.0551	.1429
2½	.1200	.1300	.1690	.1638	.4000	8	.0375	.0475	.0528	.0476	.1250
3	.1000	.1100	.1408	.1356	.3333	9	.0333	.0433	.0469	.0417	.1111
3½	.0857	.0957	.1207	.1155	.2857	10	.0300	.0400	.0422	.0370	.1000
4	.0750	.0850	.1056	.1004	.2500	12	.0250	.0300	.0352	.0326	.0833
5	.0600	.0700	.0845	.0793	.2000	14	.0214	.0264	.0302	.0276	.0714
6	.0500	.0600	.0704	.0652	.1667	16	.0188	.0238	.0264	.0238	.0625

* A clearance of at least 0.010 in. is added to "h" on threads of 10-pitch and coarser, and 0.005 in. on finer pitches, to produce extra depth, thus avoiding interference with threads of mating part at minor or major diameters. It is recognized that there are conditions where a greater or lesser clearance may be desirable.

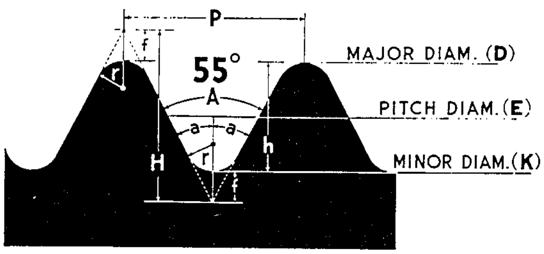
WHITWORTH FORM THREADS STANDARD SIZES COMMONLY USED

Diam.	Basic Major Diam.	Threads per Inch (British) Whit. St'd	B.S.F.	Conduit	Admiralty Fine	26* Series	Diam.	Basic Major Diam.	Threads per Inch (British) Whit. St'd	B.S.F.	Conduit	Admiralty Fine	26* Series
1/8	.1250	40					1½	1.5000	6	8	14	12	26
5/32	.1562	32					1⅝	1.6250	5	8		12	
3/16	.1875	24			24	26	1¾	1.7500	5	7		12	
7/32	.2187	24	28		24		1⅞	1.8750	4½			12	
1/4	.2500	20	26		24	26	2	2.0000	4½	7	14	8	
9/32	.2812		26		24		2⅛	2.1250	4½			8	
5/16	.3125	18	22		24	26	2¼	2.2500	4	6		8	
3/8	.3750	16	20		24	26	2⅜	2.3750	4			8	
7/16	.4375	14	18		24	26	2½	2.5000	4	6	14	8	
1/2	.5000	12	16	18	20	26	2⅝	2.6250	4			8	
9/16	.5625	12	16		20	26	2¾	2.7500	3½	6		8	
5/8	.6250	11	14	18	20	26	2⅞	2.8750	3½			8	
11/16	.6875	11	14		20	26	3	3.0000	3½	5		8	
3/4	.7500	10	12	16	14	26	3⅛	3.1250	3½			8	
13/16	.8125	10	12		14	26	3¼	3.2500	3¼			8	
7/8	.8750	9	11		14	26	3⅜	3.3750	3¼			8	
15/16	.9375	9			14	26	3½	3.5000	3¼			8	
1	1.0000	8	10	16	12	26	3⅝	3.6250	3¼			8	
1⅛	1.1250	7	9		12	26	3¾	3.7500	3			8	
1¼	1.2500	7	9	16	12	26	3⅞	3.8750	3			8	
1⅜	1.3750	6	8		12	26	4	4.0000	3			6	

*British Standard Brass Thread.

THREAD DIMENSIONS BRITISH STANDARD (WHITWORTH FORM)

This form of thread is used almost exclusively in Great Britain and extensively in the British Dominions, Asia and South America. There are two standard series, the British Standard Whitworth which is a coarse thread series and the British Standard Fine. Threads of this form not included in the BSW and BSF series are designated simply Whitworth.



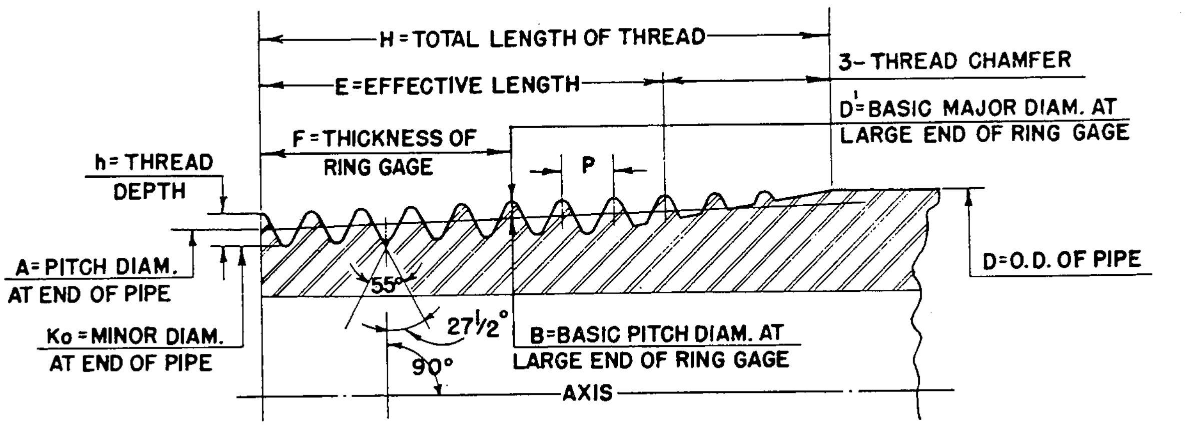
A = 55° = Angle of thread
a = 27½° = ½ Angle of thread
f = 1/6H = Depth of truncation
H = 0.960491p = Depth Theoretical V 55° thread
h = 0.640327p, or 4/6H = Depth Whitworth form thread
n = Number threads per inch
p = 1/n = Pitch
r = 0.137329p = Radius of crest and root

n	h	r	p	n	h	r	p	n	h	r	p
2¼	.2846	.0610	.4444	9	.0711	.0153	.1111	34	.0188	.0040	.0294
2⅜	.2696	.0578	.4210	10	.0640	.0137	.1000	36	.0178	.0038	.0278
2½	.2561	.0549	.4000	11	.0582	.0125	.0909	38	.0169	.0036	.0263
2⅝	.2439	.0523	.3810	12	.0534	.0114	.0833	40	.0160	.0034	.0250
2¾	.2328	.0499	.3636	13	.0493	.0106	.0769	42	.0152	.0033	.0238
2⅞	.2227	.0478	.3478	14	.0457	.0098	.0714	44	.0146	.0031	.0227
3	.2134	.0458	.3333	15	.0427	.0092	.0667	46	.0139	.0030	.0217
3¼	.1970	.0422	.3077	16	.0400	.0086	.0625	48	.0133	.0029	.0208
3½	.1830	.0392	.2857	18	.0356	.0076	.0556	50	.0128	.0027	.0200
4	.1601	.0343	.2500	20	.0320	.0069	.0500	52	.0123	.0026	.0192
4¼	.1423	.0305	.2222	22	.0291	.0062	.0455	56	.0114	.0025	.0179
5	.1281	.0275	.2000	24	.0267	.0057	.0417	60	.0107	.0023	.0167
5½	.1164	.0250	.1818	26	.0246	.0053	.0385	64	.0100	.0021	.0156
6	.1067	.0229	.1667	28	.0229	.0049	.0357	68	.0094	.0020	.0147
7	.0915	.0196	.1429	30	.0213	.0046	.0333	72	.0089	.0019	.0139
8	.0800	.0172	.1250	32	.0200	.0043	.0313	80	.0080	.0017	.0125

BRITISH STANDARD PIPE THREADS

WHITWORTH FORM

NOTE: "BSPP" — BRITISH STANDARD PIPE PARALLEL (STRAIGHT)
"BSP" — BRITISH STANDARD TAPER PIPE



FORMULA —
N = NUMBER OF THREADS PER INCH
3/4" TAPER PER FOOT ON DIAM.
P = PITCH
DEPTH OF PIPE THREAD = .0640327P

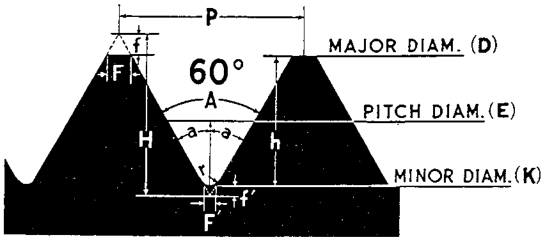
NOTE — A CHANGE IN LENGTH OF CHAMFER CHANGES "H"

BASIC THREAD DIMENSIONS BRITISH STANDARD PIPE THREAD

Pipe Size Nominal—Inches	Threads per Inch	Outside Diameter of Pipe (Mean)—Inches	Pitch Inches	Depth of Thread .064032 P—Inches	Basic Major Diam. at Large End of Ring Gage—Inches	Basic Pitch Diam. at Large End of Ring Gage—Inches	Pitch Diam. at End of Pipe—Inches	Minor Diam. at End of Pipe—Inches	Thickness of Ring Gage = Normal Engagement by Hand—Inches	Effective Length of Thread (Basic)—Inches	Total Length of Thread—Inches	Plus or Minus Tolerance on Length of Engagement		Tap Drill Sizes—Inches
												External Thread—Inches	Internal Thread—Inches	
	N	D	P	h	D1	B	A	Ko	F	E	H			
1/8	28	.400	.03571	.0229	.383	.3601	.3503	.3274	.1563	.2545	.362	.0357	.0446	21/64
1/4	19	.538	.05263	.0337	.518	.4843	.4695	.4358	.2367	.3814	.539	.0526	.0658	29/64
3/8	19	.676	.05263	.0337	.656	.6223	.6067	.5730	.2500	.3947	.553	.0526	.0658	37/64
1/2	14	.847	.07143	.0457	.825	.7793	.7592	.7135	.3214	.5178	.732	.0714	.0893	23/32
3/4	14	1.063	.07143	.0457	1.041	.9953	.9719	.9262	.3750	.5714	.786	.0714	.0893	59/64
1	11	1.336	.09091	.0582	1.309	1.2508	1.2253	1.1671	.4091	.6591	.932	.0909	.1136	1 11/64
1 1/4	11	1.677	.09091	.0582	1.650	1.5918	1.5605	1.5023	.5000	.7500	1.023	.0909	.1136	1 1/2
1 1/2	11	1.909	.09091	.0582	1.882	1.8238	1.7925	1.7343	.5000	.7500	1.023	.0909	.1136	1 3/4
2	11	2.381	.09091	.0582	2.347	2.2888	2.2497	2.1915	.6250	.9204	1.193	.0909	.1136	2 7/32
2 1/2	11	2.996	.09091	.0582	2.960	2.9018	2.8588	2.8006	.6875	1.0511	1.324	.1364	.1364	2 13/16
3	11	3.499	.09091	.0582	3.460	3.4018	3.3510	3.2928	.8125	1.1761	1.449	.1364	.1364	3 5/16
3 1/2	11	3.991	.09091	.0582	3.950	3.8918	3.8371	3.7789	.8750	1.2386	1.511	.1364	.1364	3 13/16
4	11	4.494	.09091	.0582	4.450	4.3918	4.3293	4.2711	1.0000	1.4091	1.682	.1364	.1364	
5	11	5.498	.09091	.0582	5.450	5.3918	5.3215	5.2633	1.1250	1.5795	1.852	.1364	.1364	
6	11	6.501	.09091	.0582	6.450	6.3918	6.3215	6.2633	1.1250	1.5795	1.852	.1364	.1364	
7	10	7.519	.10000	.0640	7.450	7.3860	7.3001	7.2361	1.3750	1.9250	2.225	.2000	.2000	
8	10	8.524	.10000	.0640	8.450	8.3860	8.2922	8.2282	1.5000	2.0500	2.3500	.2000	.2000	
9	10	9.529	.10000	.0640	9.450	9.3860	9.2922	9.2282	1.5000	2.0500	2.3500	.2000	.2000	
10	10	10.534	.10000	.0640	10.450	10.3860	10.2844	10.2204	1.6250	2.1750	2.4750	.2000	.2000	
11	8	11.540	.12500	.0800	11.450	11.3700	11.2684	11.1884	1.6250	2.3125	2.688	.2500	.2500	
12	8	12.545	.12500	.0800	12.450	12.3700	12.2684	12.1884	1.6250	2.3125	2.688	.2500	.2500	

THREAD DIMENSIONS • METRIC

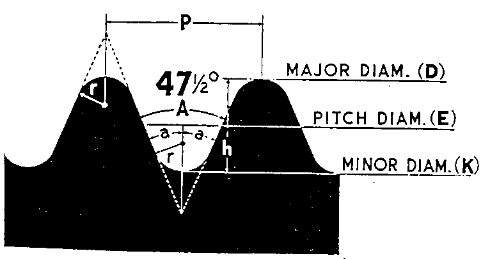
METRIC STANDARD



A = 60° = Angle of thread
a = 30° = ½ Angle of thread
F = ⅛p = Flat at crest
F' = $\frac{1}{16}$p = Flat at root
f = ⅛H = Depth of truncation at crest
f' = $\frac{1}{16}$H = Depth of truncation at root
H = 0.866025p = Depth of theoretical sharp V thread
h = 0.70365p, or $\frac{13}{16}$H = Depth Metric form thread
p = Pitch
r = Radius of root

p		h	F	r	p		h	F	r
MM	Inches				MM	Inches			
.35	.0138	.0096	.0017	.0008	1.8	.0709	.0496	.0089	.0041
.40	.0158	.0110	.0020	.0009	1.9	.0748	.0524	.0093	.0043
.45	.0177	.0124	.0022	.0010	2.0	.0787	.0551	.0098	.0046
.50	.0197	.0138	.0025	.0011	2.25	.0886	.0620	.0111	.0051
.55	.0217	.0152	.0027	.0013	2.5	.0984	.0689	.0123	.0057
.60	.0236	.0165	.0030	.0014	2.75	.1083	.0758	.0135	.0063
.65	.0256	.0179	.0032	.0015	3.0	.1181	.0827	.0148	.0068
.70	.0276	.0193	.0034	.0016	3.25	.1280	.0896	.0160	.0074
.75	.0295	.0207	.0037	.0017	3.5	.1378	.0964	.0172	.0080
.80	.0315	.0220	.0039	.0018	3.75	.1476	.1033	.0185	.0086
.85	.0335	.0234	.0042	.0019	4.0	.1575	.1102	.0197	.0092
.90	.0354	.0248	.0044	.0021	4.5	.1772	.1240	.0221	.0103
.95	.0374	.0262	.0047	.0022	5.0	.1969	.1378	.0246	.0114
1.0	.0394	.0276	.0049	.0023	5.5	.2165	.1516	.0271	.0126
1.1	.0433	.0303	.0054	.0025	6.0	.2362	.1654	.0295	.0137
1.2	.0472	.0331	.0059	.0027	6.5	.2559	.1791	.0320	.0148
1.25	.0492	.0344	.0061	.0029	7.0	.2756	.1929	.0344	.0160
1.3	.0512	.0359	.0064	.0030	7.5	.2953	.2067	.0369	.0171
1.4	.0551	.0386	.0069	.0032	8.0	.3150	.2205	.0394	.0183
1.5	.0591	.0413	.0074	.0034	8.5	.3346	.2342	.0418	.0194
1.6	.0630	.0441	.0079	.0037	9.0	.3543	.2480	.0443	.0206
1.7	.0669	.0468	.0084	.0039	9.5	.3740	.2618	.0467	.0217
1.75	.0689	.0482	.0086	.0040	10.0	.3937	.2756	.0492	.0228

BRITISH ASSOCIATION STANDARD



A = 47½° = Angle of thread
a = 23¾° = ½ Angle of thread
h = 0.600p = Depth British Association Thread
p = Pitch
r = 2/11p = Radius of crest and root

British Asso. No.	Diameter		Pitch		h	r
	MM	Inches	MM	Inches		
0	6.0	.236	1.0	.03937	.0236	.0072
1	5.3	.209	.9	.03543	.0213	.0064
2	4.7	.185	.81	.03189	.0191	.0058
3	4.1	.161	.73	.02874	.0172	.0052
4	3.6	.142	.66	.02598	.0156	.0047
5	3.2	.126	.59	.02323	.0139	.0042
6	2.8	.110	.53	.02087	.0125	.0038
7	2.5	.098	.48	.01890	.0113	.0034
8	2.2	.087	.43	.01693	.0102	.0031
9	1.9	.075	.39	.01535	.0092	.0028
10	1.7	.067	.35	.01378	.0083	.0025

DECIMAL EQUIVALENTS OF MILLIMETERS

FROM 1/10 TO 100 MM ADVANCING BY 1/10 MILLIMETERS

MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches
.1	.00394	7.6	.29921	15.1	.59488	22.6	.88976	30.1	1.18503	37.6	1.48031	45.1	1.77558
.2	.00787	7.7	.30314	15.2	.59842	22.7	.89369	30.2	1.18897	37.7	1.48424	45.2	1.77952
.3	.01181	7.8	.30708	15.3	.60236	22.8	.89763	30.3	1.19291	37.8	1.48818	45.3	1.78346
.4	.01575	7.9	.31102	15.4	.60629	22.9	.90157	30.4	1.19684	37.9	1.49212	45.4	1.78739
.5	.01968	8.0	.31496	15.5	.61023	23.0	.90551	30.5	1.20078	38.0	1.49606	45.5	1.79133
.6	.02362	8.1	.31889	15.6	.61417	23.1	.90944	30.6	1.20472	38.1	1.49999	45.6	1.79527
.7	.02756	8.2	.32283	15.7	.61810	23.2	.91338	30.7	1.20865	38.2	1.50393	45.7	1.79920
.8	.03149	8.3	.32677	15.8	.62204	23.3	.91732	30.8	1.21259	38.3	1.50787	45.8	1.80314
.9	.03543	8.4	.33070	15.9	.62598	23.4	.92125	30.9	1.21653	38.4	1.51180	45.9	1.80708
1.0	.03937	8.5	.33464	16.0	.62992	23.5	.92519	31.0	1.22047	38.5	1.51574	46.0	1.81102
1.1	.04330	8.6	.33858	16.1	.63385	23.6	.92913	31.1	1.22440	38.6	1.51968	46.1	1.81495
1.2	.04724	8.7	.34251	16.2	.63779	23.7	.93306	31.2	1.22834	38.7	1.52361	46.2	1.81889
1.3	.05118	8.8	.34645	16.3	.64173	23.8	.93700	31.3	1.23228	38.8	1.52755	46.3	1.82283
1.4	.05512	8.9	.35039	16.4	.64566	23.9	.94094	31.4	1.23621	38.9	1.53149	46.4	1.82676
1.5	.05905	9.0	.35433	16.5	.64960	24.0	.94488	31.5	1.24015	39.0	1.53543	46.5	1.83070
1.6	.06299	9.1	.35826	16.6	.65354	24.1	.94881	31.6	1.24409	39.1	1.53936	46.6	1.83464
1.7	.06692	9.2	.36220	16.7	.65747	24.2	.95275	31.7	1.24802	39.2	1.54330	46.7	1.83857
1.8	.07086	9.3	.36614	16.8	.66141	24.3	.95669	31.8	1.25196	39.3	1.54724	46.8	1.84251
1.9	.07480	9.4	.37007	16.9	.66535	24.4	.96062	31.9	1.25590	39.4	1.55117	46.9	1.84645
2.0	.07874	9.5	.37401	17.0	.66929	24.5	.96456	32.0	1.25984	39.5	1.55511	47.0	1.85039
2.1	.08267	9.6	.37795	17.1	.67322	24.6	.96850	32.1	1.26377	39.6	1.55905	47.1	1.85432
2.2	.08661	9.7	.38188	17.2	.67716	24.7	.97243	32.2	1.26771	39.7	1.56298	47.2	1.85826
2.3	.09055	9.8	.38582	17.3	.68110	24.8	.97637	32.3	1.27165	39.8	1.56692	47.3	1.86220
2.4	.09448	9.9	.38976	17.4	.68503	24.9	.98031	32.4	1.27558	39.9	1.57086	47.4	1.86613
2.5	.09842	10.0	.39370	17.5	.68897	25.0	.98425	32.5	1.27952	40.0	1.57480	47.5	1.87007
2.6	.10236	10.1	.39763	17.6	.69291	25.1	.98818	32.6	1.28346	40.1	1.57873	47.6	1.87401
2.7	.10629	10.2	.40157	17.7	.69684	25.2	.99212	32.7	1.28749	40.2	1.58267	47.7	1.87794
2.8	.11023	10.3	.40551	17.8	.70078	25.3	.99606	32.8	1.29133	40.3	1.58661	47.8	1.88188
2.9	.11417	10.4	.40944	17.9	.70472	25.4	.99999	32.9	1.29527	40.4	1.59054	47.9	1.88582
3.0	.11811	10.5	.41338	18.0	.70866	25.5	1.00393	33.0	1.29921	40.5	1.59448	48.0	1.88976
3.1	.12204	10.6	.41732	18.1	.71259	25.6	1.00787	33.1	1.30314	40.6	1.59842	48.1	1.89369
3.2	.12598	10.7	.42125	18.2	.71653	25.7	1.01180	33.2	1.30708	40.7	1.60235	48.2	1.89763
3.3	.12992	10.8	.42519	18.3	.72047	25.8	1.01574	33.3	1.31102	40.8	1.60629	48.3	1.90157
3.4	.13385	10.9	.42913	18.4	.72440	25.9	1.01968	33.4	1.31495	40.9	1.61023	48.4	1.90550
3.5	.13779	11.0	.43307	18.5	.72834	26.0	1.02362	33.5	1.31889	41.0	1.61417	48.5	1.90944
3.6	.14173	11.1	.43700	18.6	.73228	26.1	1.02755	33.6	1.32283	41.1	1.61810	48.6	1.91338
3.7	.14566	11.2	.44094	18.7	.73621	26.2	1.03149	33.7	1.32676	41.2	1.62204	48.7	1.91731
3.8	.14960	11.3	.44488	18.8	.74015	26.3	1.03543	33.8	1.33070	41.3	1.62598	48.8	1.92125
3.9	.15354	11.4	.44881	18.9	.74409	26.4	1.03936	33.9	1.33464	41.4	1.62991	48.9	1.92519
4.0	.15748	11.5	.45275	19.0	.74803	26.5	1.04330	34.0	1.33858	41.5	1.63385	49.0	1.92913
4.1	.16141	11.6	.45669	19.1	.75196	26.6	1.04724	34.1	1.34251	41.6	1.63779	49.1	1.93306
4.2	.16535	11.7	.46062	19.2	.75590	26.7	1.05117	34.2	1.34645	41.7	1.64172	49.2	1.93700
4.3	.16929	11.8	.46456	19.3	.75984	26.8	1.05511	34.3	1.35039	41.8	1.64566	49.3	1.94094
4.4	.17322	11.9	.46850	19.4	.76377	26.9	1.05905	34.4	1.35432	41.9	1.64960	49.4	1.94487
4.5	.17716	12.0	.47244	19.5	.76771	27.0	1.06299	34.5	1.35826	42.0	1.65354	49.5	1.94881
4.6	.18110	12.1	.47637	19.6	.77165	27.1	1.06692	34.6	1.36220	42.1	1.65747	49.6	1.95275
4.7	.18503	12.2	.48031	19.7	.77558	27.2	1.07086	34.7	1.36613	42.2	1.66141	49.7	1.95668
4.8	.18897	12.3	.48425	19.8	.77952	27.3	1.07480	34.8	1.37007	42.3	1.66535	49.8	1.96062
4.9	.19291	12.4	.48818	19.9	.78346	27.4	1.07873	34.9	1.37401	42.4	1.66928	49.9	1.96456
5.0	.19685	12.5	.49212	20.0	.78740	27.5	1.08267	35.0	1.37795	42.5	1.67322	50.0	1.96850
5.1	.20078	12.6	.49606	20.1	.79133	27.6	1.08661	35.1	1.38188	42.6	1.67716	50.1	1.97243
5.2	.20472	12.7	.49999	20.2	.79527	27.7	1.09054	35.2	1.38582	42.7	1.68109	50.2	1.97637
5.3	.20866	12.8	.50393	20.3	.79921	27.8	1.09448	35.3	1.38976	42.8	1.68503	50.3	1.98031
5.4	.21259	12.9	.50787	20.4	.80314	27.9	1.09842	35.4	1.39369	42.9	1.68897	50.4	1.98424
5.5	.21653	13.0	.51181	20.5	.80708	28.0	1.10236	35.5	1.39763	43.0	1.69291	50.5	1.98818
5.6	.22047	13.1	.51574	20.6	.81102	28.1	1.10629	35.6	1.40157	43.1	1.69684	50.6	1.99212
5.7	.22440	13.2	.51968	20.7	.81495	28.2	1.11023	35.7	1.40550	43.2	1.70078	50.7	1.99605
5.8	.22834	13.3	.52362	20.8	.81889	28.3	1.11417	35.8	1.40944	43.3	1.70472	50.8	1.99999
5.9	.23228	13.4	.52755	20.9	.82283	28.4	1.11810	35.9	1.41338	43.4	1.70865	50.9	2.00393
6.0	.23622	13.5	.53149	21.0	.82677	28.5	1.12204	36.0	1.41732	43.5	1.71259	51.0	2.00787
6.1	.24015	13.6	.53543	21.1	.83070	28.6	1.12598	36.1	1.42125	43.6	1.71653	51.1	2.01180
6.2	.24409	13.7	.53936	21.2	.83464	28.7	1.12991	36.2	1.42519	43.7	1.72046	51.2	2.01574
6.3	.24803	13.8	.54330	21.3	.83858	28.8	1.13385	36.3	1.42913	43.8	1.72440	51.3	2.01968
6.4	.25196	13.9	.54724	21.4	.84251	28.9	1.13779	36.4	1.43306	43.9	1.72834	51.4	2.02361
6.5	.25590	14.0	.55118	21.5	.84645	29.0	1.14173	36.5	1.43700	44.0	1.73228	51.5	2.02755
6.6	.25984	14.1	.55511	21.6	.85039	29.1	1.14566	36.6	1.44094	44.1	1.73621	51.6	2.03149
6.7	.26377	14.2	.55905	21.7	.85432	29.2	1.14960	36.7	1.44487	44.2	1.74015	51.7	2.03542
6.8	.26771	14.3	.56299	21.8	.85826	29.3	1.15354	36.8	1.44881	44.3	1.74409	51.8	2.03936
6.9	.27165	14.4	.56692	21.9	.86220	29.4	1.15747	36.9	1.45275	44.4	1.74802	51.9	2.04330
7.0	.27559	14.5	.57086	22.0	.86614	29.5	1.16141	37.0	1.45669	44.5	1.75196	52.0	2.04724
7.1	.27952	14.6	.57480	22.1	.87007	29.6	1.16535	37.1	1.46062	44.6	1.75590	52.1	2.05117
7.2	.28346	14.7	.57873	22.2	.87401	29.7	1.16928	37.2	1.46456	44.7	1.75983	52.2	2.05511
7.3	.28740	14.8	.58267	22.3	.87795	29.8	1.17322	37.3	1.46850	44.8	1.76337	52.3	2.05905
7.4	.29133	14.9	.58661	22.4	.88188	29.9	1.17716	37.4	1.47243	44.9	1.76771	52.4	2.06298
7.5	.29527	15.0	.59055	22.5	.88582	30.0	1.18110	37.5	1.47637	45.0	1.77165	52.5	2.06692

MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches
52.6	2.07086	60.5	2.38188	68.4	2.69290	76.3	3.00393	84.2	3.31495	92.1	3.62597
52.7	2.07479	60.6	2.38582	68.5	2.69684	76.4	3.00780	84.3	3.31889	92.2	3.62991
52.8	2.07873	60.7	2.38975	68.6	2.70078	76.5	3.01180	84.4	3.32282	92.3	3.63385
52.9	2.08267	60.8	2.39369	68.7	2.70471	76.6	3.01574	84.5	3.32676	92.4	3.63778
53.0	2.08661	60.9	2.39763	68.8	2.70865	76.7	3.01967	84.6	3.33070	92.5	3.64172
53.1	2.09054	61.0	2.40157	68.9	2.71259	76.8	3.02361	84.7	3.33463	92.6	3.64566
53.2	2.09448	61.1	2.40550	69.0	2.71653	76.9	3.02755	84.8	3.33857	92.7	3.64959
53.3	2.09842	61.2	2.40944	69.1	2.72046	77.0	3.03149	84.9	3.34251	92.8	3.65353
53.4	2.10235	61.3	2.41388	69.2	2.72440	77.1	3.03542	85.0	3.34645	92.9	3.65747
53.5	2.10629	61.4	2.41731	69.3	2.72834	77.2	3.03936	85.1	3.35038	93.0	3.66141
53.6	2.11023	61.5	2.42125	69.4	2.73227	77.3	3.04330	85.2	3.35432	93.1	3.66534
53.7	2.11416	61.6	2.42519	69.5	2.73621	77.4	3.04723	85.3	3.35826	93.2	3.66928
53.8	2.11810	61.7	2.42912	69.6	2.74015	77.5	3.05117	85.4	3.36219	93.3	3.67322
53.9	2.12204	61.8	2.43306	69.7	2.74408	77.6	3.05511	85.5	3.36613	93.4	3.67715
54.0	2.12598	61.9	2.43700	69.8	2.74802	77.7	3.05904	85.6	3.37007	93.5	3.68109
54.1	2.12991	62.0	2.44094	69.9	2.75196	77.8	3.06298	85.7	3.37400	93.6	3.68503
54.2	2.13385	62.1	2.44487	70.0	2.75590	77.9	3.06692	85.8	3.37794	93.7	3.68896
54.3	2.13779	62.2	2.44881	70.1	2.75983	78.0	3.07086	85.9	3.38188	93.8	3.69290
54.4	2.14172	62.3	2.45275	70.2	2.76377	78.1	3.07479	86.0	3.38582	93.9	3.69684
54.5	2.14566	62.4	2.45668	70.3	2.76771	78.2	3.07873	86.1	3.38975	94.0	3.70078
54.6	2.14960	62.5	2.46062	70.4	2.77164	78.3	3.08267	86.2	3.39369	94.1	3.70471
54.7	2.15353	62.6	2.46456	70.5	2.77558	78.4	3.08660	86.3	3.39736	94.2	3.70865
54.8	2.15747	62.7	2.46849	70.6	2.77952	78.5	3.09054	86.4	3.40156	94.3	3.71259
54.9	2.16141	62.8	2.47243	70.7	2.78345	78.6	3.09448	86.5	3.40550	94.4	3.71652
55.0	2.16535	62.9	2.47637	70.8	2.78739	78.7	3.09841	86.6	3.40944	94.5	3.72046
55.1	2.16928	63.0	2.48031	70.9	2.79133	78.8	3.10235	86.7	3.41337	94.6	3.72440
55.2	2.17322	63.1	2.48424	71.0	2.79527	78.9	3.10629	86.8	3.41731	94.7	3.72833
55.3	2.17716	63.2	2.48818	71.1	2.79920	79.0	3.11023	86.9	3.42125	94.8	3.73227
55.4	2.18109	63.3	2.49212	71.2	2.80314	79.1	3.11416	87.0	3.42519	94.9	3.73621
55.5	2.18503	63.4	2.49605	71.3	2.80708	79.2	3.11810	87.1	3.42912	95.0	3.74015
55.6	2.18897	63.5	2.49999	71.4	2.81101	79.3	3.12204	87.2	3.43306	95.1	3.74408
55.7	2.19290	63.6	2.50393	71.5	2.81495	79.4	3.12597	87.3	3.43700	95.2	3.74802
55.8	2.19684	63.7	2.50786	71.6	2.81889	79.5	3.12991	87.4	3.44093	95.3	3.75196
55.9	2.20078	63.8	2.51180	71.7	2.82282	79.6	3.13385	87.5	3.44487	95.4	3.75589
56.0	2.20472	63.9	2.51574	71.8	2.82676	79.7	3.13778	87.6	3.44881	95.5	3.75983
56.1	2.20865	64.0	2.51968	71.9	2.83070	79.8	3.14172	87.7	3.45274	95.6	3.76377
56.2	2.21259	64.1	2.52361	72.0	2.83464	79.9	3.14566	87.8	3.45668	95.7	3.76770
56.3	2.21653	64.2	2.52755	72.1	2.83857	80.0	3.14960	87.9	3.46062	95.8	3.77164
56.4	2.22096	64.3	2.53149	72.2	2.84251	80.1	3.15353	88.0	3.46456	95.9	3.77558
56.5	2.22440	64.4	2.53542	72.3	2.84645	80.2	3.15747	88.1	3.46849	96.0	3.77952
56.6	2.22834	64.5	2.53936	72.4	2.85038	80.3	3.16141	88.2	3.47243	96.1	3.78345
56.7	2.23227	64.6	2.54330	72.5	2.85432	80.4	3.16534	88.3	3.47637	96.2	3.78739
56.8	2.23621	64.7	2.54723	72.6	2.85826	80.5	3.16928	88.4	3.48030	96.3	3.79133
56.9	2.24015	64.8	2.55117	72.7	2.86219	80.6	3.17322	88.5	3.48424	96.4	3.79526
57.0	2.24409	64.9	2.55511	72.8	2.86613	80.7	3.17715	88.6	3.48818	96.5	3.79920
57.1	2.24802	65.0	2.55905	72.9	2.87007	80.8	3.18109	88.7	3.49211	96.6	3.80314
57.2	2.25196	65.1	2.56298	73.0	2.87401	80.9	3.18503	88.8	3.49605	96.7	3.80707
57.3	2.25590	65.2	2.56692	73.1	2.87794	81.0	3.18897	88.9	3.49999	96.8	3.81101
57.4	2.25983	65.3	2.57086	73.2	2.88188	81.1	3.19290	89.0	3.50393	96.9	3.81495
57.5	2.26377	65.4	2.57497	73.3	2.88582	81.2	3.19684	89.1	3.50786	97.0	3.81889
57.6	2.26771	65.5	2.57873	73.4	2.88975	81.3	3.20078	89.2	3.51180	97.1	3.82282
57.7	2.27164	65.6	2.58267	73.5	2.89369	81.4	3.20471	89.3	3.51574	97.2	3.82676
57.8	2.27558	65.7	2.58660	73.6	2.89763	81.5	3.20865	89.4	3.51967	97.3	3.83070
57.9	2.27952	65.8	2.59054	73.7	2.90156	81.6	3.21259	89.5	3.52361	97.4	3.83463
58.0	2.28346	65.9	2.59448	73.8	2.90550	81.7	3.21652	89.6	3.52755	97.5	3.83857
58.1	2.28739	66.0	2.59842	73.9	2.90944	81.8	3.22046	89.7	3.53148	97.6	3.84251
58.2	2.29133	66.1	2.60235	74.0	2.91338	81.9	3.22440	89.8	3.53542	97.7	3.84644
58.3	2.29527	66.2	2.60629	74.1	2.91731	82.0	3.22834	89.9	3.53936	97.8	3.85038
58.4	2.29920	66.3	2.61023	74.2	2.92125	82.1	3.23227	90.0	3.54330	97.9	3.85432
58.5	2.30314	66.4	2.61416	74.3	2.92519	82.2	3.23621	90.1	3.54723	98.0	3.85826
58.6	2.30708	66.5	2.61810	74.4	2.92912	82.3	3.24015	90.2	3.55113	98.1	3.86219
58.7	2.31101	66.6	2.62204	74.5	2.93300	82.4	3.24408	90.3	3.55611	98.2	3.86613
58.8	2.31495	66.7	2.62597	74.6	2.93700	82.5	3.24802	90.4	3.55904	98.3	3.87007
58.9	2.31889	66.8	2.62991	74.7	2.94093	82.6	3.25196	90.5	3.56298	98.4	3.87400
59.0	2.32283	66.9	2.63385	74.8	2.94487	82.7	3.25589	90.6	3.56692	98.5	3.87794
59.1	2.32676	67.0	2.63779	74.9	2.94881	82.8	3.25983	90.7	3.57085	98.6	3.88188
59.2	2.33070	67.1	2.64172	75.0	2.95275	82.9	3.26377	90.8	3.57479	98.7	3.88581
59.3	2.33464	67.2	2.64566	75.1	2.95668	83.0	3.26771	90.9	3.57873	98.8	3.88975
59.4	2.33857	67.3	2.64960	75.2	2.96062	83.1	3.27164	91.0	3.58267	98.9	3.89369
59.5	2.34251	67.4	2.65353	75.3	2.96456	83.2	3.27558	91.1	3.58660	99.0	3.89763
59.6	2.34645	67.5	2.65747	75.4	2.96849	83.3	3.27952	91.2	3.59054	99.1	3.90156
59.7	2.35038	67.6	2.66141	75.5	2.97243	83.4	3.28845	91.3	3.59448	99.2	3.90550
59.8	2.35432	67.7	2.66534	75.6	2.97637	83.5	3.28739	91.4	3.59841	99.3	3.90944
59.9	2.35826	67.8	2.66928	75.7	2.98030	83.6	3.29133	91.5	3.60235	99.4	3.91337
60.0	2.36220	67.9	2.67322	75.8	2.98424	83.7	3.29526	91.6	3.60629	99.5	3.91731
60.1	2.36613	68.0	2.67716	75.9	2.98818	83.8	3.29920	91.7	3.61022	99.6	3.92125
60.2	2.37007	68.1	2.68109	76.0	2.99212	83.9	3.30314	91.8	3.61416	99.7	3.92518
60.3	2.37401	68.2	2.68503	76.1	2.99605	84.0	3.30708	91.9	3.61810	99.8	3.92912
60.4	2.37794	68.3	2.68897	76.2	2.99999	84.1	3.31101	92.0	3.62204	99.9	3.93306
										100.0	3.93700

STEEL IDENTIFICATION OF COMPOSITION

The SAE (Society of Automotive Engineers) system of using numbers to designate steel composition is the most widely used and best understood. The AISI (American Iron and Steel Institute) system is also becoming widely used but it does not cause any confusion as both systems use the same numbers.

The systems use four numerals (five numerals are necessary when the carbon content is 1.00% or higher) each of which designate the basic type. The first digit designates the basic analysis group, the second digit signifies the amount of alloys, and the last two indicate the carbon content. (The last three when carbon is over 1.00%.) In the table below X is substituted for the proper digits.

Series Designation (1952)	Types and Classes
10XX	Carbon Steels — Not Resulphurized
*11XX	Carbon Steels — Resulphurized
12XX	Carbon Steels — Rephosphorized and Resulphurized
13XX	1.75% Manganese Steels
23XX	3.50% Nickel Steels
25XX	5.00% Nickel Steels
31XX	1.25% Nickel — .65 or .80% Chromium Steels
33XX	3.50% Nickel — 1.55% Chromium Steels
40XX	.25% Molybdenum Steels
41XX	.95% Chromium — .20% Molybdenum Steels
43XX	1.80% Nickel — .50 or .80% Chromium — .25% Molybdenum Steels
46XX	1.80% Nickel — .25% Molybdenum Steels
48XX	3.50% Nickel — .25% Molybdenum Steels
50XX	.30 or .60% Chromium Steels
51XX	.80 or .95% Chromium Steels
51XXX	1.00% Carbon — 1.00% Chromium Steels
52XXX	1.00% Carbon — 1.45% Chromium Steels
61XX	.80 or .95% Chromium — .10 or .15% Vanadium Steels
86XX	.55% Nickel — .50% Chromium — .20% Molybdenum Steels
87XX	.55% Nickel — .50% Chromium — .25% Molybdenum Steels
92XX	.85% Manganese — 2.00% Silicon Steels
94XX	1.00% Manganese — .45% Nickel — .40% Chromium — .20% Molybdenum Steels
97XX	.55% Nickel — .17% Chromium — .20% Molybdenum Steels
98XX	1.00% Nickel — .80% Chromium — .25% Molybdenum Steels

*The 11XX series includes B1112 and B1113 which are manufactured by the Bessemer Process and are rephosphorized and resulphurized. They are rapidly being replaced by the 1212 and 1213 which are the same composition made by the basic open hearth process. All other 11XX series are resulphurized basic open hearth steels.

The AISI system uses prefix letters to denote method of manufacture. If used the letters are applied as follows:

C — Denotes Basic Open Hearth Carbon Steel — (C1020)

E — Denotes Electric Furnace Carbon and Alloy Steel — (E4640)

B — Denotes Acid Bessemer Steel (B1112)

The AISI also uses a system for designating standard stainless and heat resisting steels. This system consists of three digits with the first digit either 3 or 4. The 3XX group are all basically Chromium nickel alloys and the 4XX group are straight chromium alloys. The 3XX group (Example 302, 303, etc.) are austenitic alloys, non-hardenable and are subject to cold work in any machining operation. The 4XX group vary in properties as some are hardenable (Example 416,440A) and others are not. (Example 430,446).

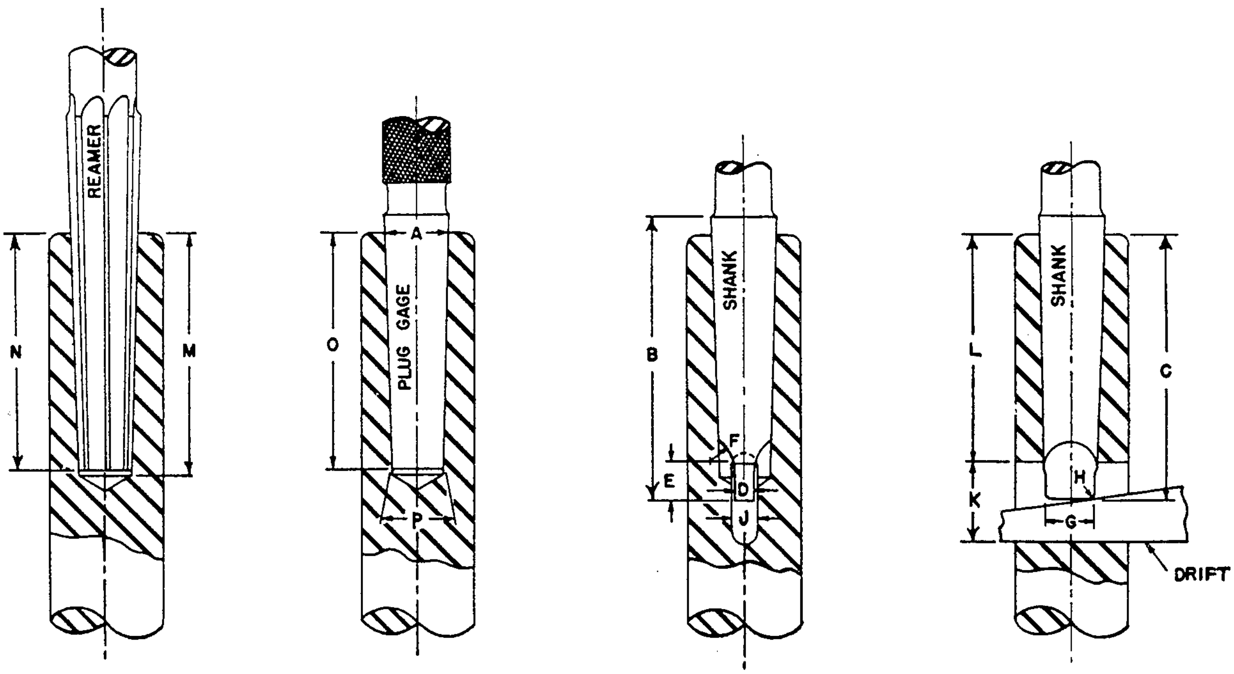
Material Hardness and Thread Chasing

It should be mentioned that the probable tool life column below indicates life relative to hardness only. When considering thread chaser life, all the possible variables relative to the specific application should be considered. Included in these would be the material, thread configuration, lubricant, speed, and general machine conditions under which the thread is to be generated.

Brinell	(C Scale) Rockwell	Approximate Tensile Strength In 1000 PSI	Probable Tool Life
388	42	195	Thread Chasing Impractical
375	40	182	
363	39	177	
353	38	171	
341	37	164	
331	36	162	Premium High Speed Chasers Can Be Supplied, But Tool Life Will Be Limited.
321	35	155	
311	34	153	
302	32.5	144	
293	31	140	
285	30	136	Tool Life In This Hardness Area Will Generally Be Fair To Good.
277	29	132	
269	28	128	
262	26	124	
255	25	121	
248	24	117	
241	23	115	Tool Life In This Hardness Area Will Generally Range From Good To Excellent.
235	21.7	111	
230	18	109	
223	16	108	
217	14	103	
212		101	
207		98	
201		96	

GEOMETRIC TOOL offers various surface treatments at a minimal cost to improve the overall performance of threading chasers for different materials and applications.

STANDARD MORSE TAPERS



Number of Taper	Diam. of Plug at Small End	Diam. at Gauge Line	SHANK		Depth of Drilled Hole	Depth of Reamed Hole	Standard Plug Depth	TANG					TANG SLOT		End of Socket to Tang Slot	Taper per Inch	Taper per Foot	Number of Drift
			Whole Length	Depth				Thickness	Length	Radius	Diameter	Radius	Width	Length				
	P	A	B	C	M	N	O	D	E	F	G	H	J	K	L			
*0	.252	.356	2 11/32	2 7/32	2 1/16	2 1/32	2	.156	1/4	5/32	15/64	3/64	.166	9/16	1 15/16	.052000	.62400	*0
1	.369	.475	2 9/16	2 7/16	2 3/16	2 5/32	2 1/8	.203	3/8	3/16	11/32	3/64	.213	3/4	2 1/16	.049882	.59858	1
2	.572	.700	3 1/8	2 15/16	2 21/32	2 39/64	2 9/16	.250	7/16	1/4	17/32	1/16	.260	7/8	2 1/2	.049951	.59941	2
3	.778	.938	3 7/8	3 11/16	3 5/16	3 1/4	3 3/16	.312	9/16	9/32	23/32	5/64	.322	1 3/16	3 1/16	.050196	.60235	3
4	1.020	1.231	4 7/8	4 5/8	4 3/16	4 1/8	4 1/16	.469	5/8	5/16	31/32	3/32	.479	1 1/4	3 7/8	.051938	.62326	4
5	1.475	1.748	6 1/8	5 7/8	5 5/16	5 1/4	5 3/16	.625	3/4	3/8	1 13/32	1/8	.635	1 1/2	4 15/16	.052626	.63151	5
6	2.116	2.494	8 9/16	8 1/4	7 13/32	7 21/64	7 1/4	.750	1 1/8	1/2	2	5/32	.760	1 3/4	7	.052137	.62565	6
7	2.750	3.270	11 5/8	11 1/4	10 5/32	10 5/64	10	1.125	1 3/8	3/4	2 5/8	3/16	1.135	2 5/8	9 1/2	.05200	.6240	7

* The Size "O" Taper is not listed in the American Standard on Machine Tapers.

The dimensions agree essentially with dimensions of the American Standard on Machine tapers.

The undercut shown on the tang having diameter G, and length E, may be eliminated at the option of the manufacturer provided the tang is heat-treated to a minimum Rockwell of C30 with 150Kg load.

TO DETERMINE MINOR DIAMETER OF THREAD

D=Major Diameter
D^1=Minor Diameter
C=Double Depth of Thread
D^1=D—C

TABLE SHOWING DOUBLE DEPTH OF THREADS

T.P.I.	Amer. Nat'l (U.S.)	Theoretical V Thread	Whit.	Acme	Metric	
					MM Pitch	Double Depth
3	.4330	.5773	.4269	.3533	.25	.0138
3½	.3712	.4948	.3659	.3057	.30	.0165
4	.3248	.4330	.3202	.2700	.35	.0193
4½	.2887	.3849	.2846	.2422	.40	.0221
5	.2598	.3464	.2561	.2200	.45	.0248
6	.2165	.2887	.2134	.1867	.50	.0276
7	.1856	.2474	.1830	.1629	.55	.0303
7½	.1732	.2309	.1708	.1533	.60	.0331
8	.1624	.2165	.1601	.1450	.65	.0358
9	.1443	.1924	.1423	.1311	.70	.0386
10	.1299	.1732	.1281	.1200	.75	.0413
11	.1181	.1575	.1164	.1009	.80	.0441
11½	.1130	.1506	.1114	.0970	.85	.0468
12	.1083	.1443	.1067	.0933	.90	.0496
13	.0999	.1332	.0985	.0869	.95	.0524
14	.0928	.1237	.0915	.0814	1.0	.0551
15	.0866	.1155	.0854	.0767	1.1	.0606
16	.0812	.1083	.0800	.0725	1.2	.0661
17	.0764	.1019	.0753	.0688	1.25	.0689
18	.0722	.0962	.0711	.0656	1.3	.0717
19	.0684	.0912	.0674	.0626	1.4	.0772
20	.0650	.0866	.0640	.0600	1.5	.0827
21	.0619	.0825	.0610		1.6	.0882
22	.0590	.0787	.0582		1.7	.0937
24	.0541	.0722	.0534		1.75	.0965
26	.0500	.0666	.0493		1.8	.0992
27	.0481	.0642	.0474		1.9	.1047
28	.0464	.0618	.0457		2.0	.1102
30	.0433	.0577	.0427		2.25	.1240
32	.0406	.0541	.0400		2.5	.1378
34	.0382	.0509	.0377		2.75	.1516
36	.0361	.0481	.0356		3.0	.1654
38	.0342	.0456	.0337		3.25	.1791
40	.0325	.0433	.0320		3.5	.1929
42	.0309	.0412	.0305		3.75	.2067
44	.0295	.0394	.0291		4.0	.2205
46	.0282	.0377	.0278		4.5	.2480
48	.0271	.0361	.0267		5.0	.2756
50	.0260	.0346	.0256		5.5	.3031
52	.0250	.0333	.0246		6.0	.3307
56	.0232	.0309	.0229		6.5	.3583
60	.0217	.0289	.0213		7.0	.3858
64	.0203	.0271	.0200		7.5	.4134
68	.0191	.0255	.0188		8.0	.4409
72	.0180	.0241	.0178		8.5	.4685
74	.0175	.0234	.0173		9.0	.4961
76	.0171	.0228	.0169		9.5	.5236
80	.0162	.0217	.0160		10.0	.5512

For use in determining minor diameter of Pipe Threads for the purposes of this Book, use V Thread figures.

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