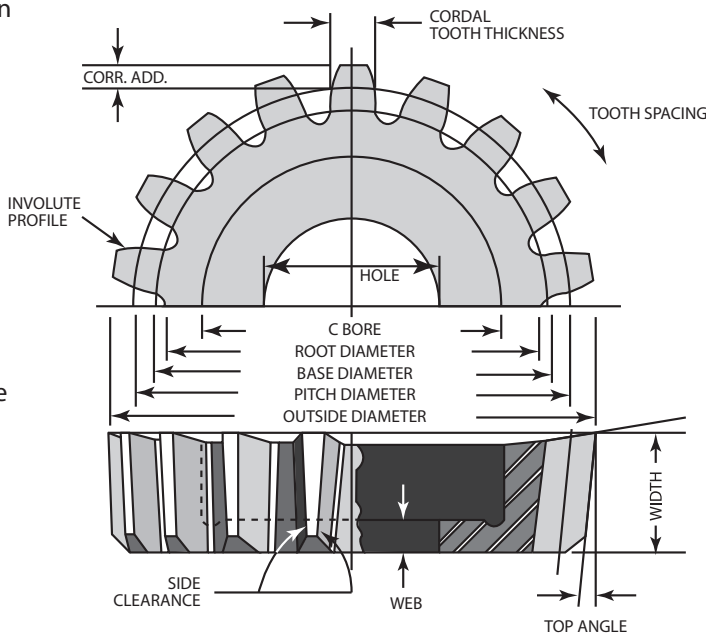
SHAPER CUTTERS GUIDE

THE SHAPING PROCESS

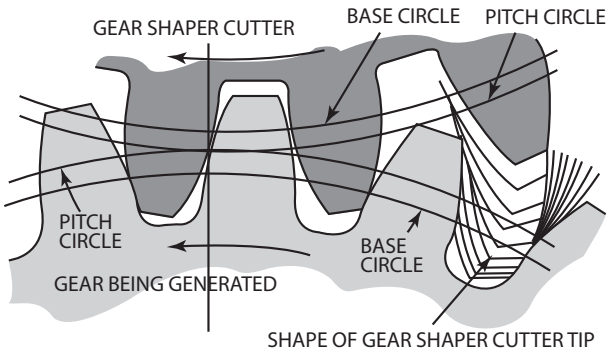
The gear shaper cutter is basically the same as a gear, except the teeth are relieved to provide clearance and the face is ground at a slight angle to provide the necessary cutting edges. Gear shaping itself is a generating process based upon the principle of the action of a cutter mounted on a cutter-spindle and a gear blank held on an arbor or fixture on the work-spindle. These spindles are driven by independent index worms and wheels which are connected by change gears or the proper relation between the cutter and the work. Synchronized as such, the cutter makes successive passes through the blank generating a series of closely spaced individual cuts. When the cutter reaches full depth the desired tooth form will have been produced.

The Shaper Cutter is a full generating tool just as much as a hob, but it has an involute of finite base circle radius. The base circle is constant throughout cutter life, the base pitch also remains constant. On spur gear Shaper Cutters the same diameter of base circle is used to generate both sides of the cutter tooth. However, the actual size of the base circle for the cutter is not the same as the base circle of a gear of the same sizes. There must be an adjustment in base circle diameter for the cutter to correct the face sharpening angle and side relief angles. When a Pitch Diameter is given for a Shaper Cutter, it is considered a Nominal Pitch Diameter. When new, the shaper cutter is made with a slightly oversize operating diameter; when sharpened back, the operating diameter gradually becomes undersized with regard to the nominal value.

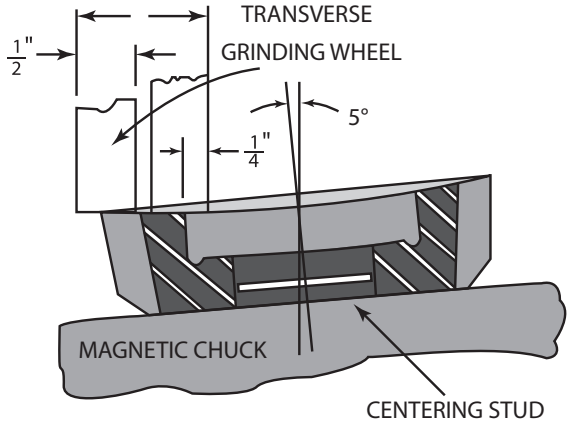


BASIC TYPES & FEATURES

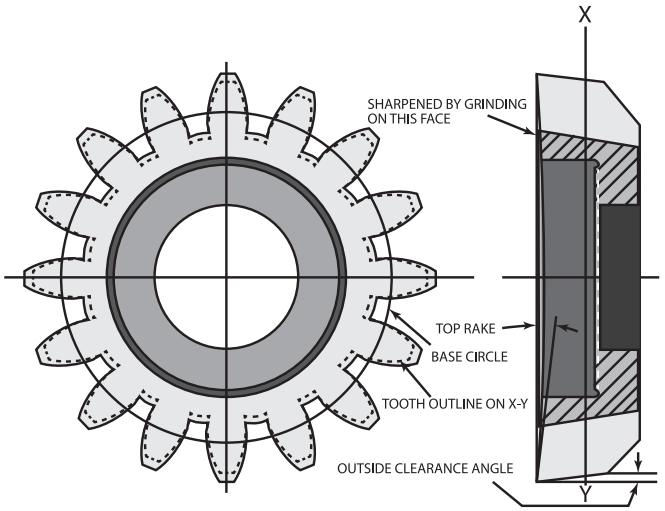
There are basically three types of Shaper Cutters commonly in use; the disc type, hub type and shank type.
The disc type is by far the most common and generally used for external parts. When conditions warrant, the disc type can be manufactured with an extended hub which will form a deeper recess in the counter bore thus termed a deep counter bore cutter. Another variation of the disc shaper cutter is called a Button Cutter & generally has a 1/2 or 3/4 bore. The button Cutter is primarily used for internal work and can be adapted for any length of stroke.
The Hub type shaper has a threaded I. D. and will screw right on to the spindle. Truly a special application cutter not as popular now partially due to the introduction of the button cutter.
The shank type shaper cutter can be ordered in a variety of configurations, varying the stroke and number of teeth to fit the part. This cutter is used for internal work. Special features can be incorporated in the tooth form of the shaper cutter such as, chamfering, topping, protuberance, full radius etc. These features will be dictated directly by the configuration of the part desired.



SHARPENING & SPUR GEAR SHAPER CUTTERS



POSITION OF GRINDING WHEEL ON SPUR CUTTERS



FORM REMAINS CONSTANT AS SHARPENED BACK

As shown in the drawing, the wheel should not leave the cutter when grinding. The inner edge is Transversed to the root diameter of the cutter, and the vertical feed made when the wheel is in the position indicated by the dotted lines.

After the final vertical feed of cutter to wheel, the wheel is left in contact and traversed until sparking stops.

In order to maintain quality of production parts and to obtain maximum cutter life, cutters must be sharpened regularly and frequently. The number of gears generated before sharpening should be so regulated that no more than 0.015 inch of stock need by removed from the cutter at each sharpening. With small fine pitch shaper cutters, no more than 0.010 inch should be removed at each sharpening. The tooth surfaces and cutting edges must have a smooth finish and be free of any burning or heat checks. In this connection there are these controlling factors:

1. Use a soft wheel with medium grain.
Keep wheel clean as a glazed wheel may crack cutter teeth.

2. Grinding too much metal at a time may cause heat-checks in the cutter teeth.

3. Never grind a cutter except on its face. Touching up sides or ends will alter the tooth form and spoil the cutter.

4. Be sure the cutting face is true with the bore. If not, cutting action will be irregular and tooth form changed.

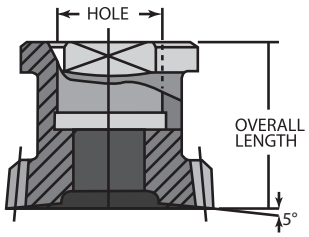
5. Always grind the correct face angle 5° (unless special).

If the original face angle (ie 5°) is decreased, the PA will be changed and cutting efficiency decreased. If the angle is increased, the cutting efficiency may be increased but the PA will be incorrect.

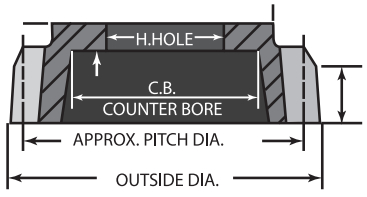
Also be sure that the mounting of the shaper cutter on the sharpening machine is concentric. Rotary surface grinders are used to sharpen disc and hub cutters.
Shank cutters may be sharpened by placing them in a cutter spindle adapter. For rough sharpening of gear shaper cutter, a vitrified grinding wheel 12 - 14 inches in diameter, 1 inch face width, 60-grit, grade H is employed. Recommended operation is a surface speed of 5400 to 6000 feet per minute. About 45 strokes a minute, each taking a cut of 0.001 inch is recommended; 0.0002 to 0.004 inches should be left for finish sharpening and wet grinding with either plain water or a compound.

For finish sharpening disc and hub type cutters use special fine grain, soft bound grinding wheels, 12 inches in diameter with a 1/2 inch face width. When new, the wheel should be operated at a speed of 5400 to 6000 surface feet per minute. The work is rotated at a speed of 160 RPM, and a cut of 0.00025 is taken at each traverse at a feed of 20 inches per minute.

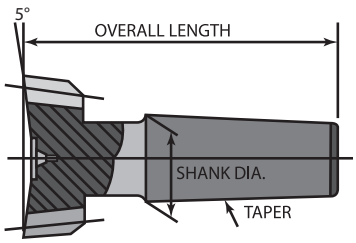
For disc type cutters smaller than 1-3/4 inches in diameter, and also for shank cutters, the wheel specifications are the same as above, but the wheel diameter should not exceed 5 with a face width of 1/2 inch.



HUB TYPE



DISK TYPE



SHANK TYPE

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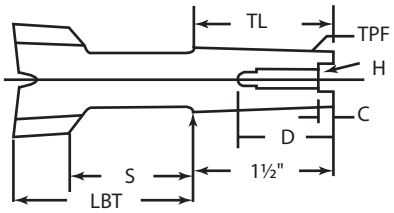
Shank Shaper Cutters

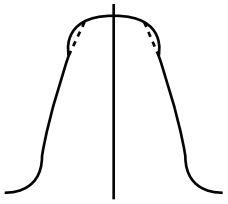
Shank Size	Taper Diam. (TD)	Taper Length (TL)	Taper Per Foot (TPF)	Thread Size (H)	Tapped Whole Depth (D)	Counter Bore Depth (C)	General Application
Long Fellows	1.062	2-1/4	0.6255	1/2-13 UNC	1	1/8	Heavy duty & coarse pitch
Short Fellows	1.062	1-1/2	0.6255	1/4-20 UNC or 1/2-13 UNC	13/16	1/4	Medium Duty & medium coarse pitch
# 2 Morse	0.700	1-1/2	0.600	1/4-20 UNC	5/8	1/8	Medium Duty & Fine pitch
# 1 Morse	0.475	1	0.599	#10-32 UNF	1/2	1/16	Very light duty & very fine pitch
# 2 Jarno	0.250	3/4	0.600	#5-40 UNC	5/16	1/16	Extra light duty & extremely fine pitch



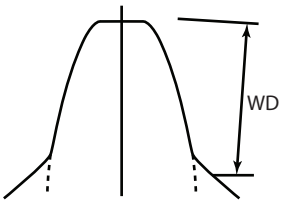
NO. 2 TAPER

Sizes and dimensions of ground finishing taper shank gear shaper cutters for cutting spur and helical teeth.

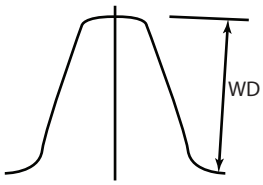
VARIOUS TYPES Of TOOTH ModIFICATIONS COMMON ON SHAPER CUTTERS



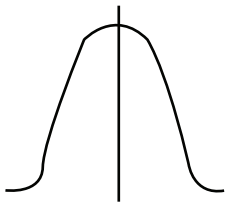
PROTUBERANCE TIP
Cutter tooth profile is built up on the tip to provide and undercut near the root of the gear being generated providing relief for subsequent finishing operations.



CHAMFERING OR SEMITOPPING
Root of cutter is filled in to generate a sharp corner break or chamfer on the tips of the gear.

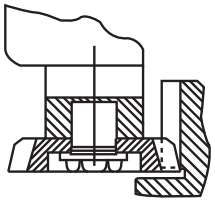


TOPPING
Cutter tooth depth os ground equal to the whole depth (WD) of the gear tooth.
The outside diameter of the gear is topped to size when the teeth are cut. Frequently used for fine pitch gearing.

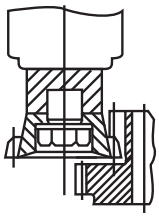


FULL FILLET RADIUS
Will produce a round bottom root on the gear being generated. This adds strength to the gear and will improve cutter life.

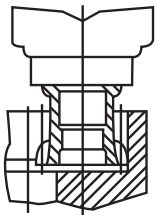
DIFFERENT METHODS Of MOUNTING GEAR SHAPER CUTTERS



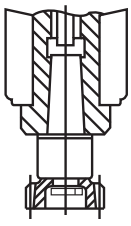
Typical Disk Cutter set up for cutting either external or internal gears.



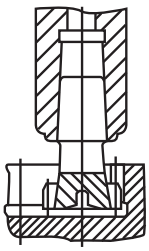
Typical Deep Counterbore type cutter set-up. This is necessary when the clamping nut cannot protrude beyond the cutting face at any time throughout the life of the cutter.



Typical Hub Type cutter set-up for an internal gear.



Internal gear being cut with a disc type cutter on an adapter. The adapter is mounted in a cutter-spindle having a tapered hole.



Taper Shank Cutter mounted in a cutter-spindle having a tapered hole. For cutting gears.

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