

Think **power**, Think **HSS**

GEAR CUTTING

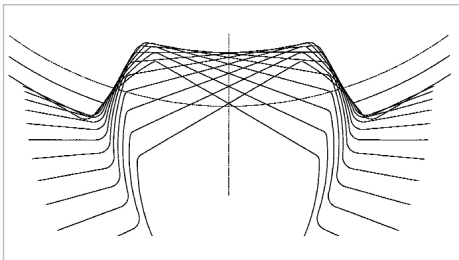
BASICS AND GEAR SHAPING

- 2 The basics of gear cutting
- 3 Types of gears
- 4 Types of gears
- 5 Which HSS for maximum efficiency?
- 6 Coatings for the best performance
- 7 The basics of shaper cutting
- 8 Shaper cutter - Vocabulary
- 9 Types of shaper cutters
- 10 Types of shaper cutters and work shapes

BROACHING PROCESS

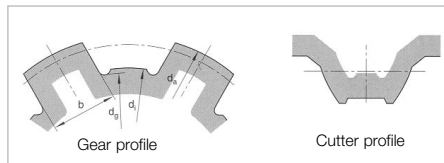
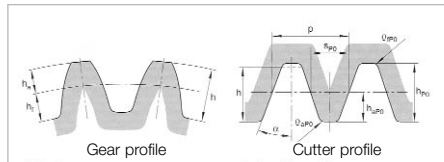
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Generation of a gear profile by the enveloping cuts of a hob



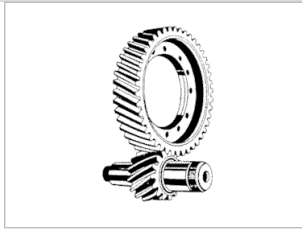
- Used in gear boxes, transmission systems, etc, gears are essential components in the mechanical industry. They can be found in all vehicles such as cars, trucks, tractors, construction equipment but also in marine drives, rolling mills, generating stations, etc.
- Most gears are cut by a hob or a shaper cutter. Hobbing is a generating process, wherein the metal is progressively removed to produce gear teeth.

Examples of profiles of cutter teeth vs. profile of gear teeth

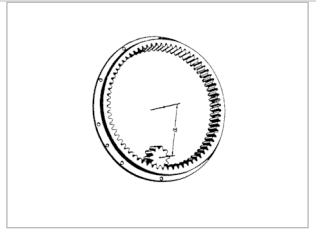




Straight spur gears

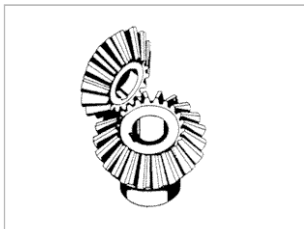


Helical gears



Internal gears





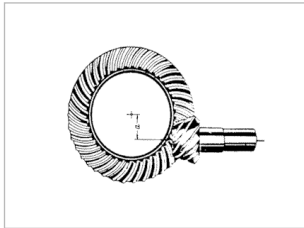
Straight bevel gears



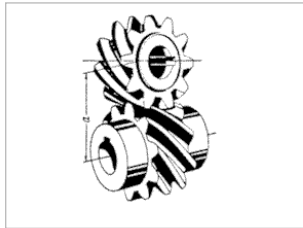
Conical bevel gears



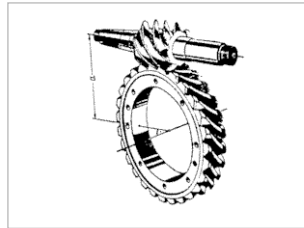
Spiral bevel gears



Hypoid gears



Helical gears



Worm gears

TOOL MAKER'S TIP

Reach the highest performance with HSS-PM

HSS

- Used for hobs and for shaving cutters

HSS-E

5%-8% cobalt

- Used for hobs and shaper cutters

HSS-PM

(powder metallurgy)

- Mainly used for shaving cutters

HSS-E-PM

with cobalt
(powder metallurgy)

- High performance
- High cutting speeds
- Longer tool life
- Suitable for dry machining
- Used for hobs and for shaper cutters

Steel
20MoCrS4

SUCCESS STORY

Operation

- High speed dry hobbing of planet gears, module 1.25, flank angle 20°, 21 teeth, face width 24 mm

Solution

- HSS-PM hob with multilayer TiAlN coating

Cutting data

- v_c 220 m/min, f_a 2.5 mm/rev, t_h 12.4 sec.

Benefits

- **Cutting time reduced by 51%** and **38% more pieces** (6444 pieces before resharpening)



TOOL MAKER'S TIP

For maximum coating efficiency, prefer a HSS-PM substrate

TiN
Gold

- Conventional, general purpose coating
- Reduces friction
- Good abrasion-wear resistance at low cutting speed

TiCN
Grey-violet

- High abrasion-wear resistance at low cutting speed and with plain-oil lubrication

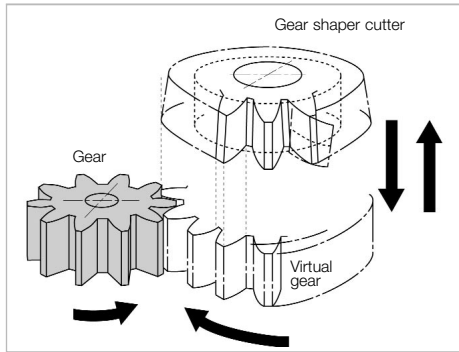
TiAlN
or **TiAlCN**
Black-violet

- High performance coating ($v_c \geq 120$ m/min)
- Prevents the tool from overheating
- Suitable for dry hobbing and dry shaping
- High abrasion-wear resistance at high temperature

MoS₂
or **WC-C**
Grey-black

- Reduces friction
- Limited temperature resistance
- For dry machining





A gear shaper cutter is basically a gear with teeth relieved to provide suitable cutting edges and clearances. The stroking, together with the related rotation of the cutter and the workpiece results in a molding-generation process.

Shaper cutters are used to produce gears and also racks, cams, latches, ratchets, clutches, etc.

This technology is used when hobbing is not possible due to accessibility problems.

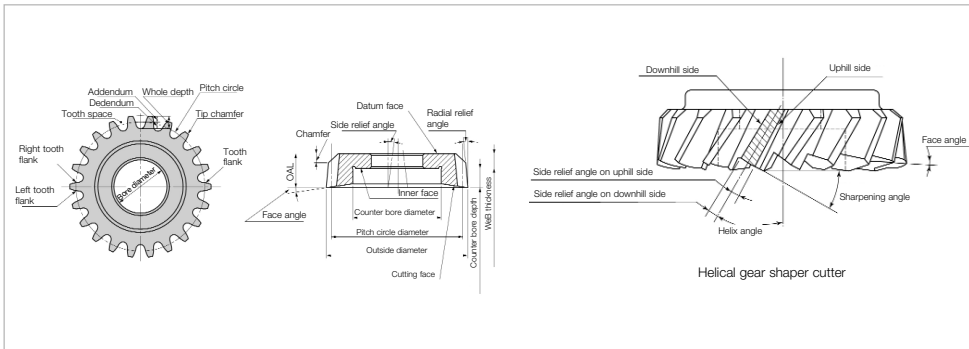
**A SHAPER CUTTER
AROUND THE WORLD**

*French: un outil
pignon*

*German: ein
Hobelwerkzeug*

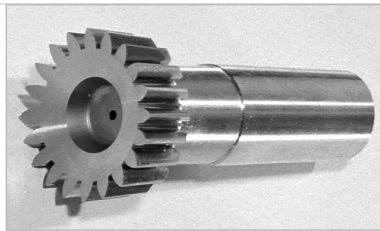
Italian: stozzatore

*Spanish: una
herramienta
para cepillar*





Disk type shaper cutter



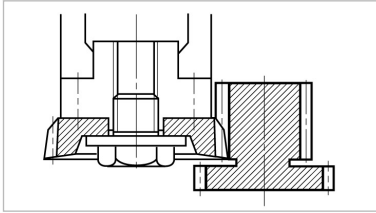
Shank type shaper cutter



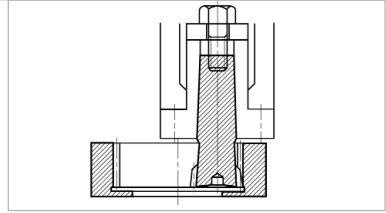
Disk type helical shaper cutter



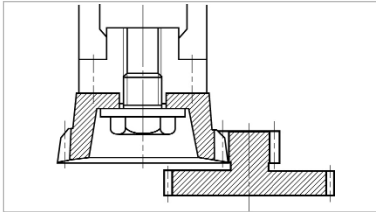
Deep counterbore type shaper cutter



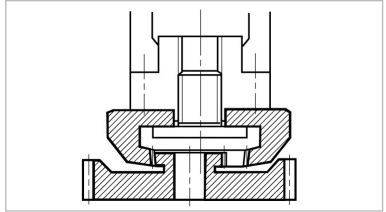
Disk shaper cutter for shoulder gears



Shank shaper cutter for small diameter internal gears



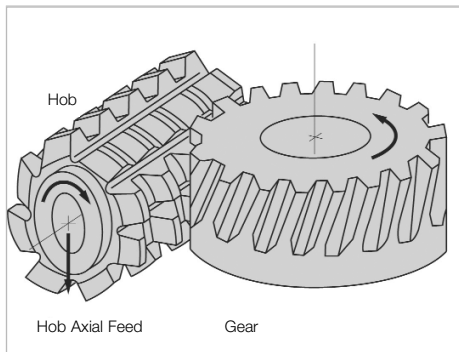
Deep counterbore shaper cutter with recessed nut



Pot shaper cutter for external gears

DID YOU KNOW?

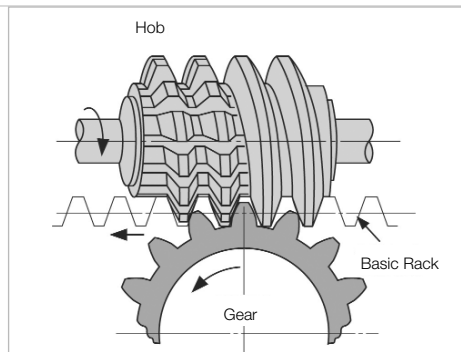
The hob profile is the mating profile of the gear teeth



Hob cutting

Throughout the hobbing process, the gear blank and the hob rotate in continuous coordinated movement. A linear feed is also applied.

The hob resembles a worm with cutting teeth located where the flutes intersect the worm.



Hob cutting action



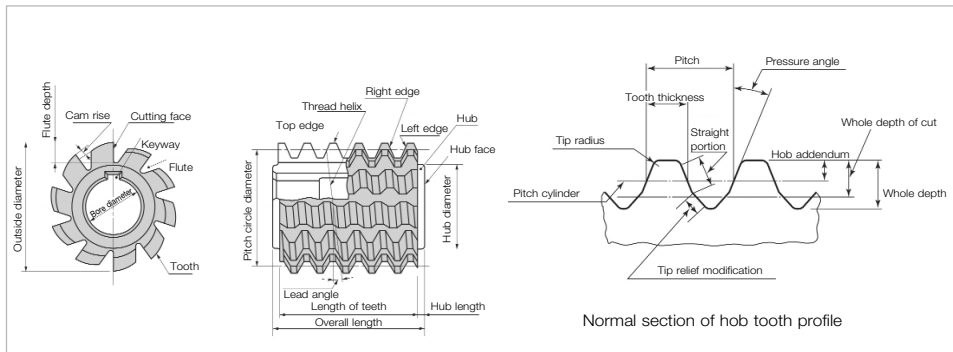
**A HOB AROUND
THE WORLD**

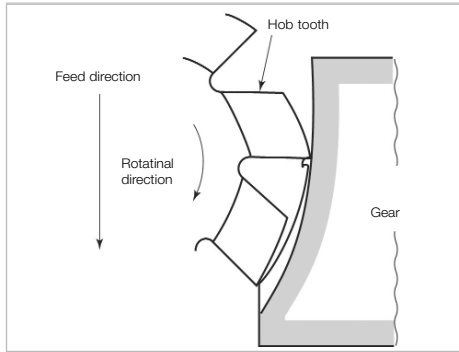
*French: une fraise-
mère*

*German: ein
Walzfräser*

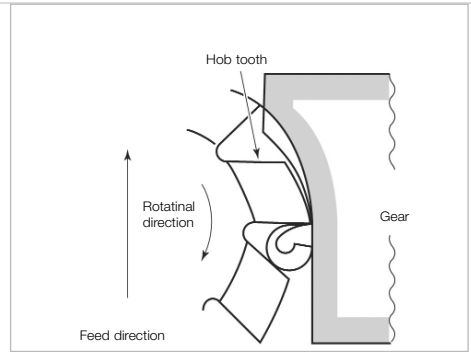
*Italian:
un creatore*

*Spanish: una fresa
madre*





Conventional cut (or up-hobbing)



Climb cut (or down-hobbing)





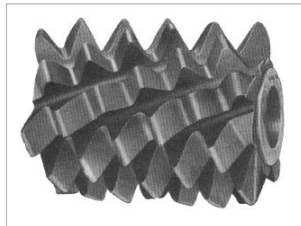
Solid hob



Hob for roller chain sprockets



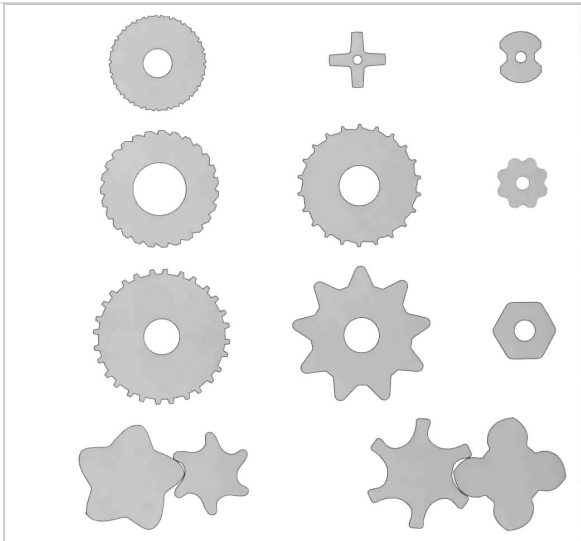
Segmented hob

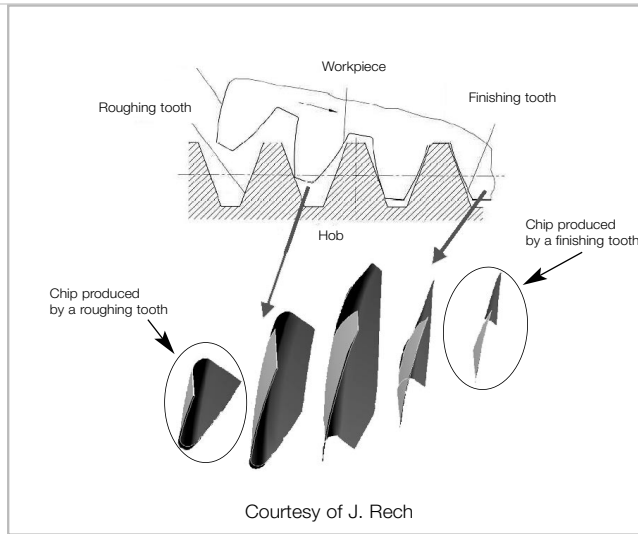


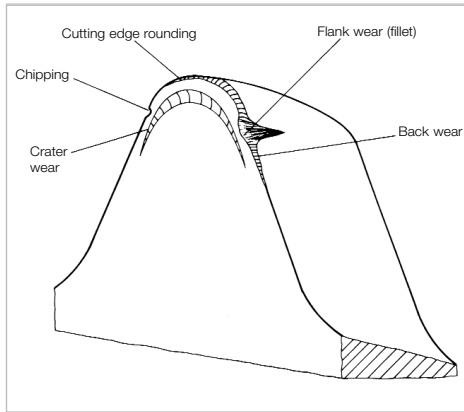
Hob for worm wheels



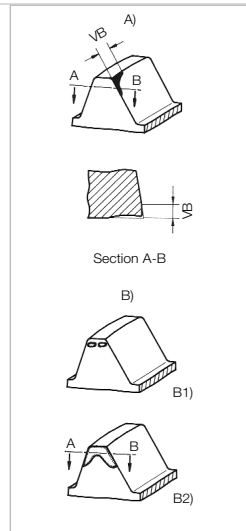
Hob for ratchet wheels







Types of wear on a hob tooth



Wear development on a hob

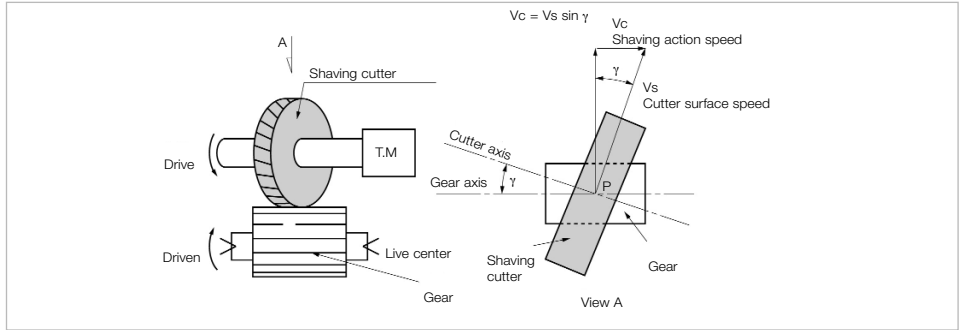
A) Flank wear mark width VB on an uncoated hob

B) Crater wear development on a coated hob

B1) Crater wear in the tooth tip corners

B2) Fully formed crater wear





Gear shaving is a finishing operation, taking place after roughing with a hob or a shaper cutter.

Shaving consists in removing small amounts of metal from the working surface of gear teeth and produces fine hair-like chips.

The process also improves tooth surface finish and eliminates, by means of crown tooth forms, the danger of tooth end load concentrations. Shaving modifies the tooth profile to reduce gear noise and to increase gear's load capacity, safety and service life.

The cutter has the form of helical gear with serrations in the flanks of the teeth acting as the cutting edges.

**A SHAVING CUTTER
AROUND THE WORLD**

*French: un outil de
rasage*

*German: ein
Schaberad*

Italian: sbarbatore

*Spanish: una
herramienta
de afeitado*

