Gear Manufacturing

Gear Manufacturing

Gear Engineering

Gear Construction

Blank Preparation

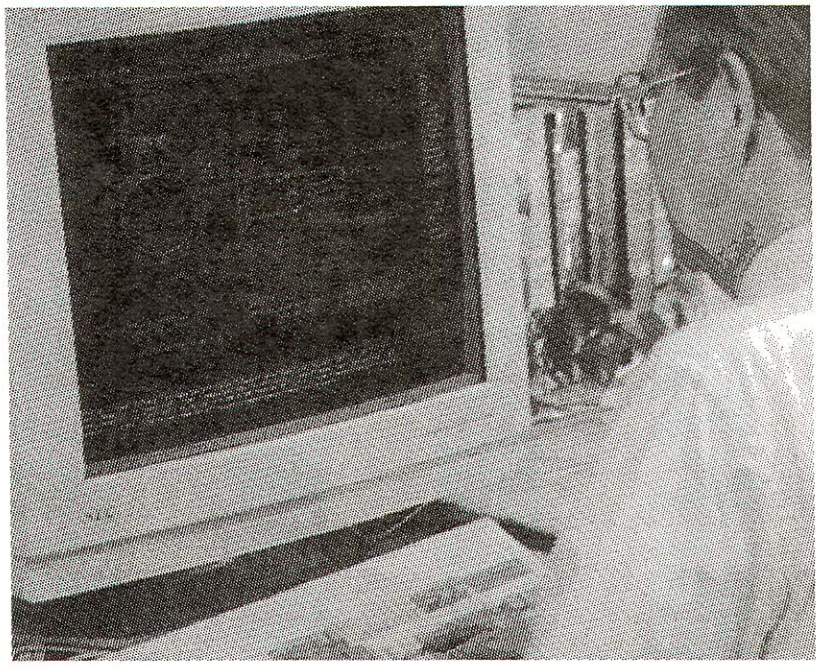
Gear Cutting

Gear Hardening

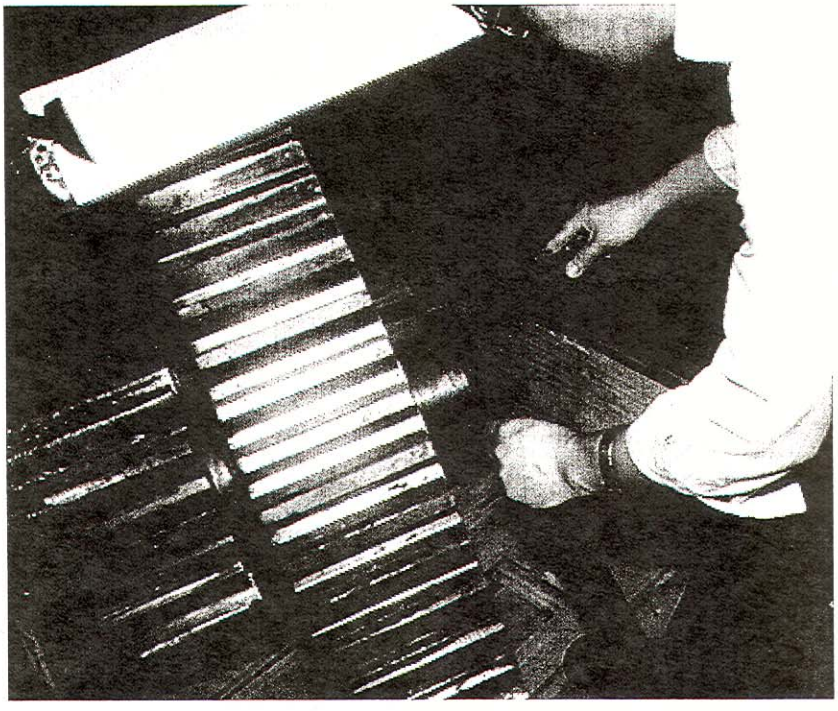
Gear Finishing

Checking

Engineering

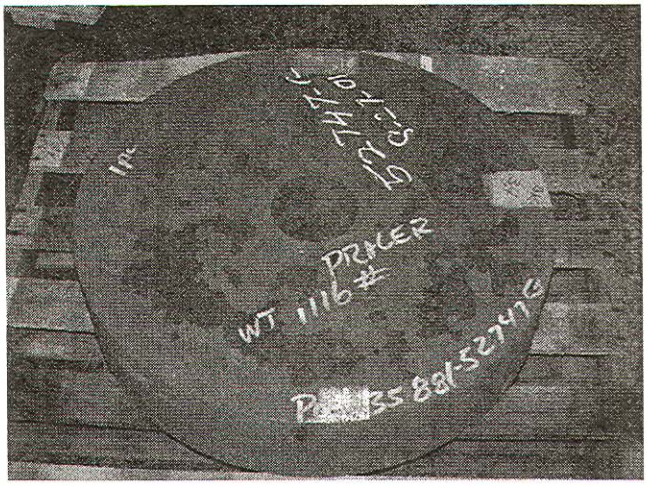


Primary Engineering



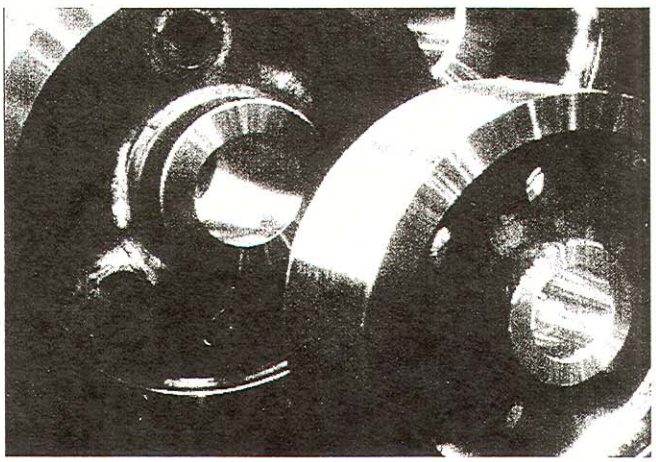
Reverse Engineering

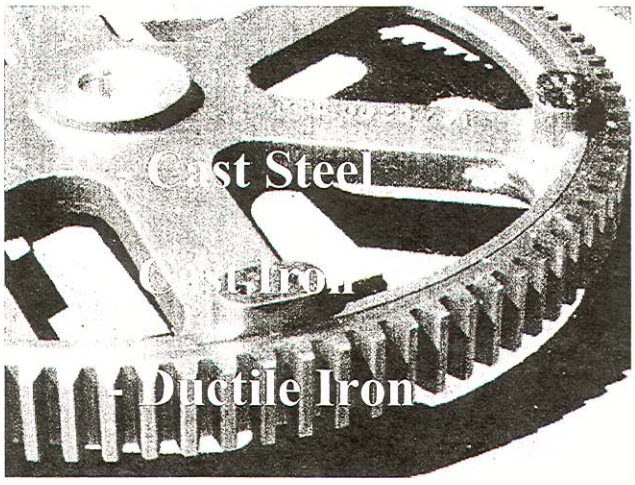
Gear Construction



Forging

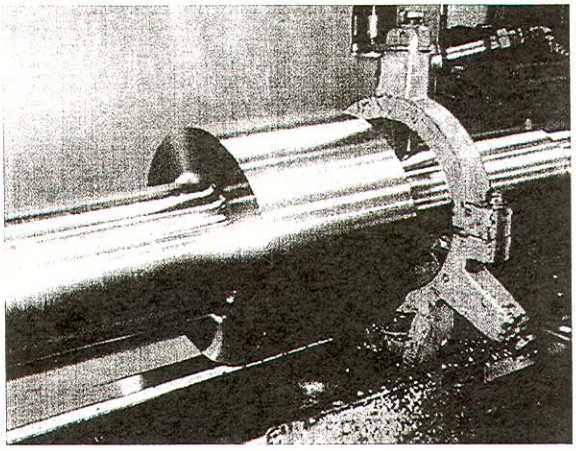
Fabrication

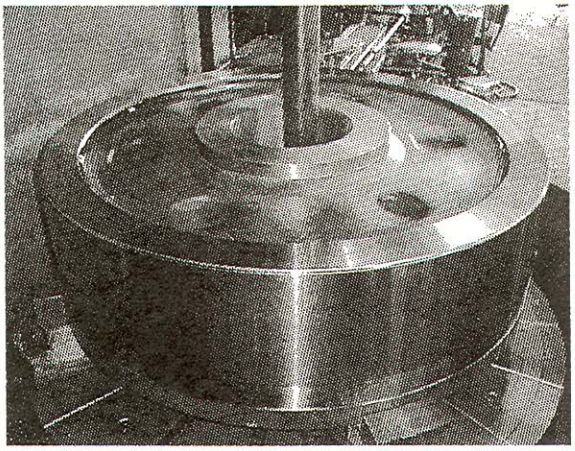


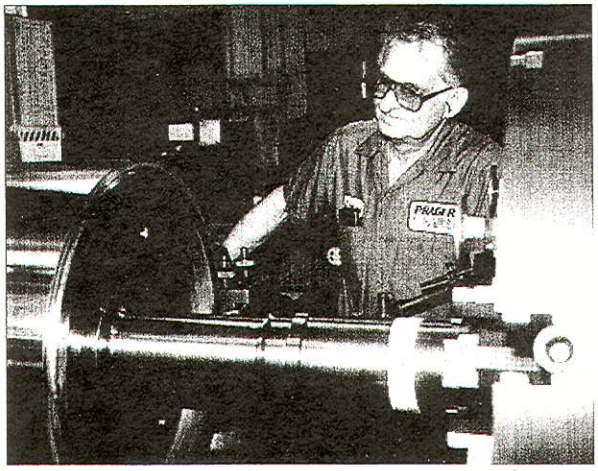


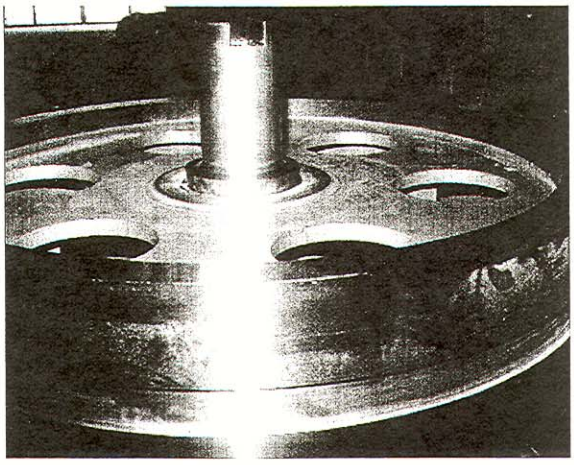
Castings

Gear Blank Preparation

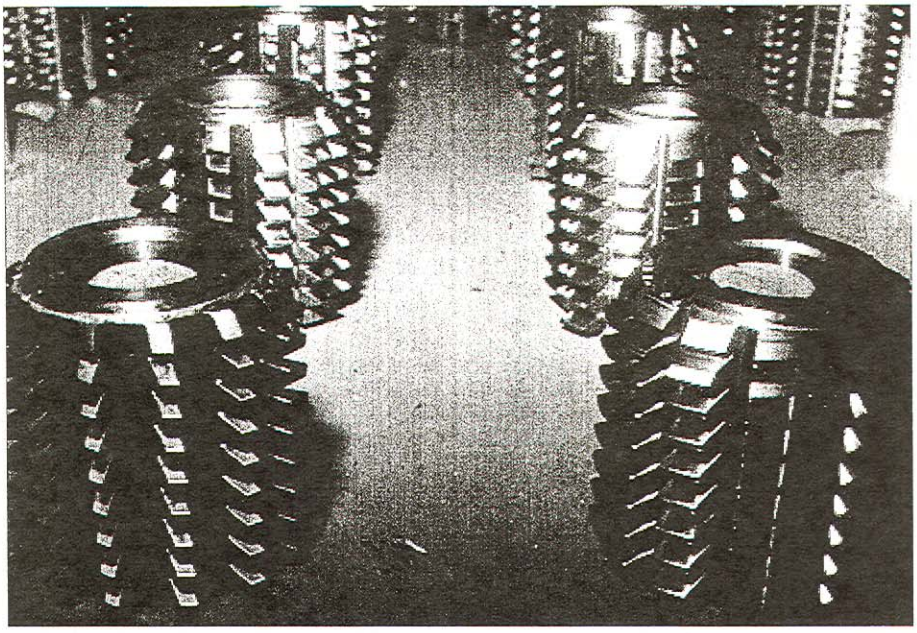








Gear Cutting
Hobbing



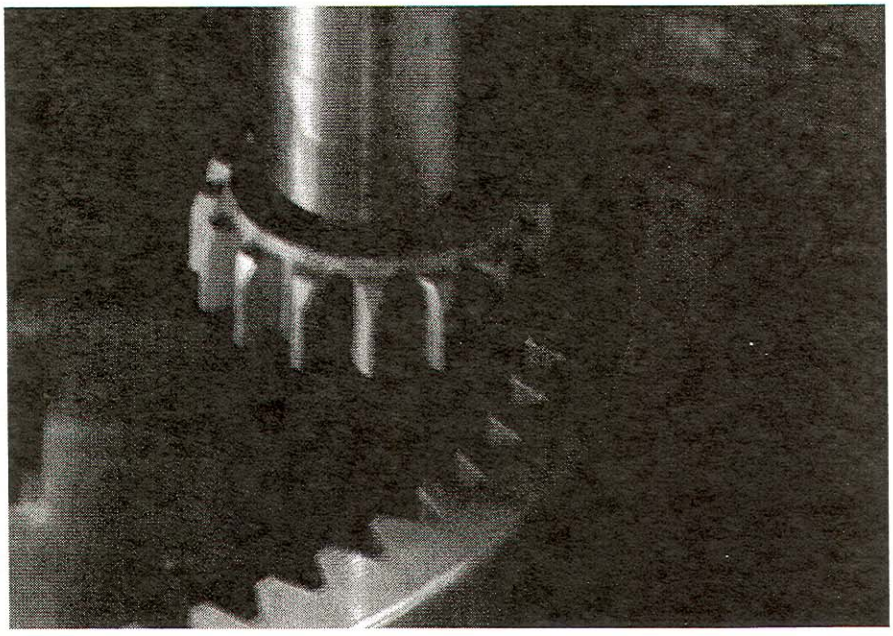
Hobbing produces good tooth spacing and accurate lead. It cannot economically achieve a surface finish better than 40 microinches. The hobbing machine generates gear teeth by a continuous indexing process in which both the cutting tool and the workpiece rotate in a constant relationship while the hob is fed into the work.

The hob (cutting tool) is basically a worm which has been fluted and has form-relieved teeth. These flutes provide the cutting edges and can be sharpened and retain the orginal tooth profile. As the workpiece meshes with the hob, the teeth are formed by a series of cuts which is the generating process. To cut the helix angle, the rotation of the work is slightly retarded or advanced in relationship to the hob rotation and the feed is held in a definite relationship with the work and hob.

Hobbing machines can produce very accurate gears and are available to hob gears from 0.5 to 300 diameteral pitch with pitch diameters over 200 inches.

Gear Cutting

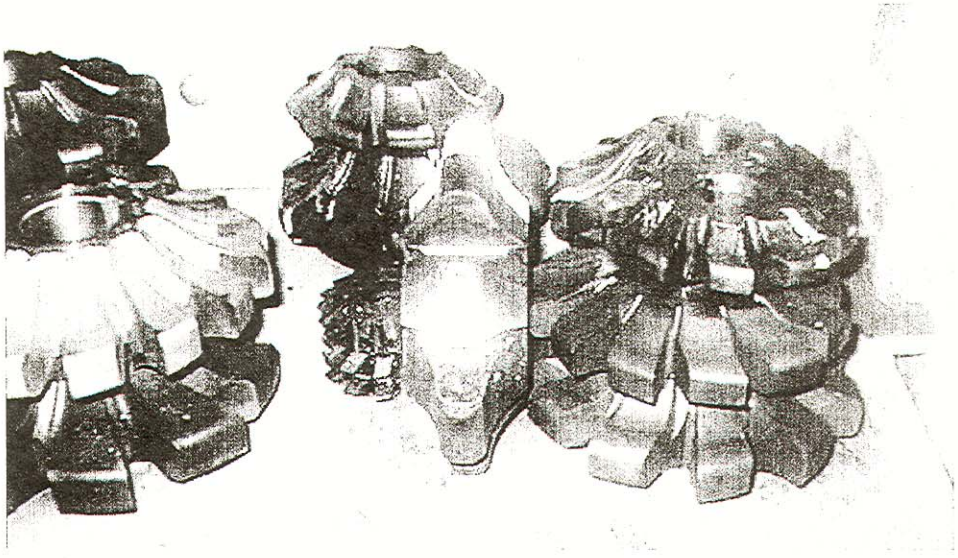
Shaping



The shaper cutter is the shaft of a pinion and reciprocates back and forth accross the face of the gear cutting the teeth while meshing with the workpiece. This process makes possible the continuous tooth herringbone type gear and internal gears. When shaper cut gear are lapped, the finish can be improved the same as a hobbed gear.

Gear Cutting

Form Cutting



Spur and helical gears can be produced using an indexing mechanism and a milling or hobbing machine. The cutter is the same shape as the tooth space and are different for different numbers of teeth. Generally, these gears are of low accuracy and applied for low speeds.

Gear Manufacturing

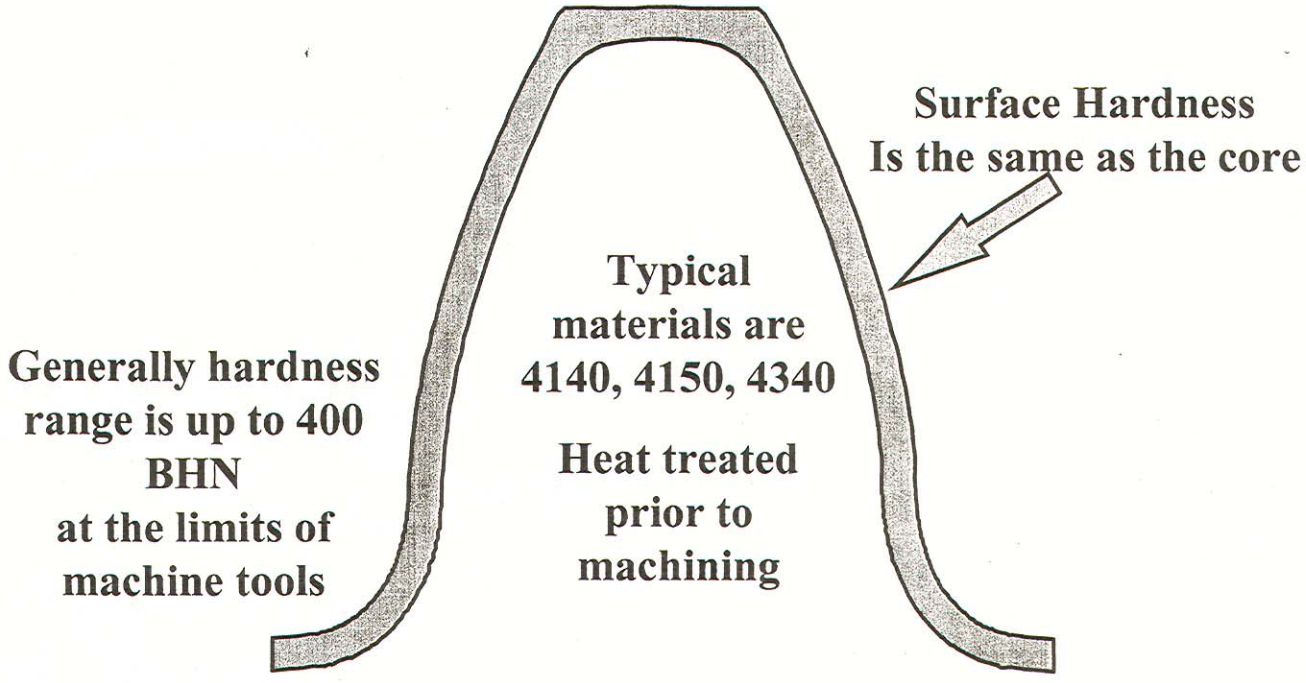
Gear/Steel Hardening

Heating to upper tranformation temperature
Quenching steel or cooling rapidly
Quenched in a polymer or oil
Tempered to specifications

Through Hardened
Case Hardened

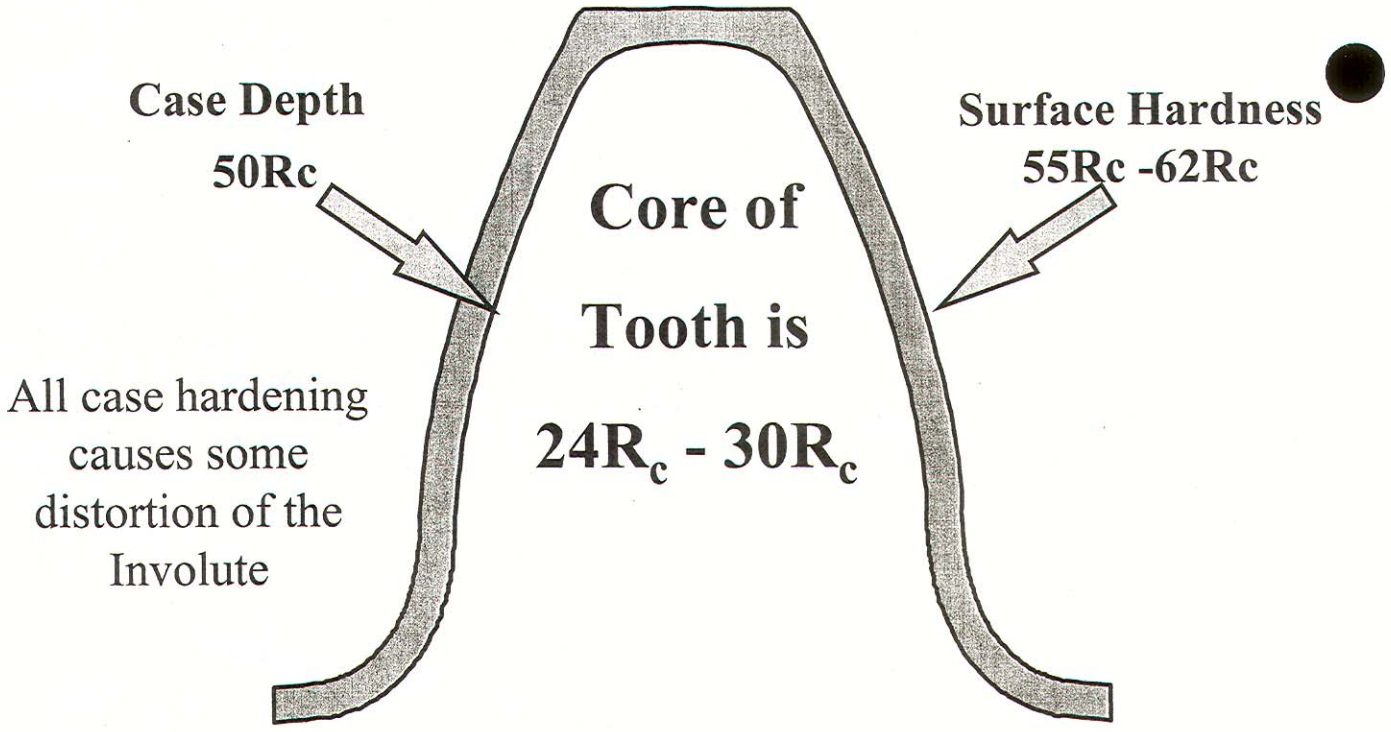
Through Hardened Gears

Typical materials - 4140, 4150,4330
Heat treating is done before machining
Generally heat treatment range to 400 BHN
(43Rc)



Case Hardened Gear

The surface is much harder than the core
How deep is called the case depth
The softer core allows the tooth to flex
Case hardening is performed after cutting
Since it involves heat it creates distortion
A finish process is required to reconstruct the involute



Case Hardening

Nitriding

Common materials - 4140, 4340, Nitralloy
900 - 1100 Degrees F in a nitrogen rich atmosphere
Relative shallow case depth - .025 inches
Low distorion
Lose 0 to 1 point AGMA quality

Induction

Common materials - 4140, 4150,4340
Normalized, quenched and tempered to 300 BHN (32Rc) before hardending to achieve desired core strength
Tooth to tooth process with inductor
Surface hardness is 55 - 58 Rc
Lose 0 to 1 point AGMA quality

Carburizing

Common materials - 4320, 8620,9310, 17CrNiMo6
Gear is placedin furnace at 1600-1700 Degrees F
Furnace atmosphere is carbon enriched
Depth is dependent on time and temperature
After quenching, case is hardened to 58-62 Rc
Distortion is considerable, grinding required

Caburization Case Depth

A typical carburizing process

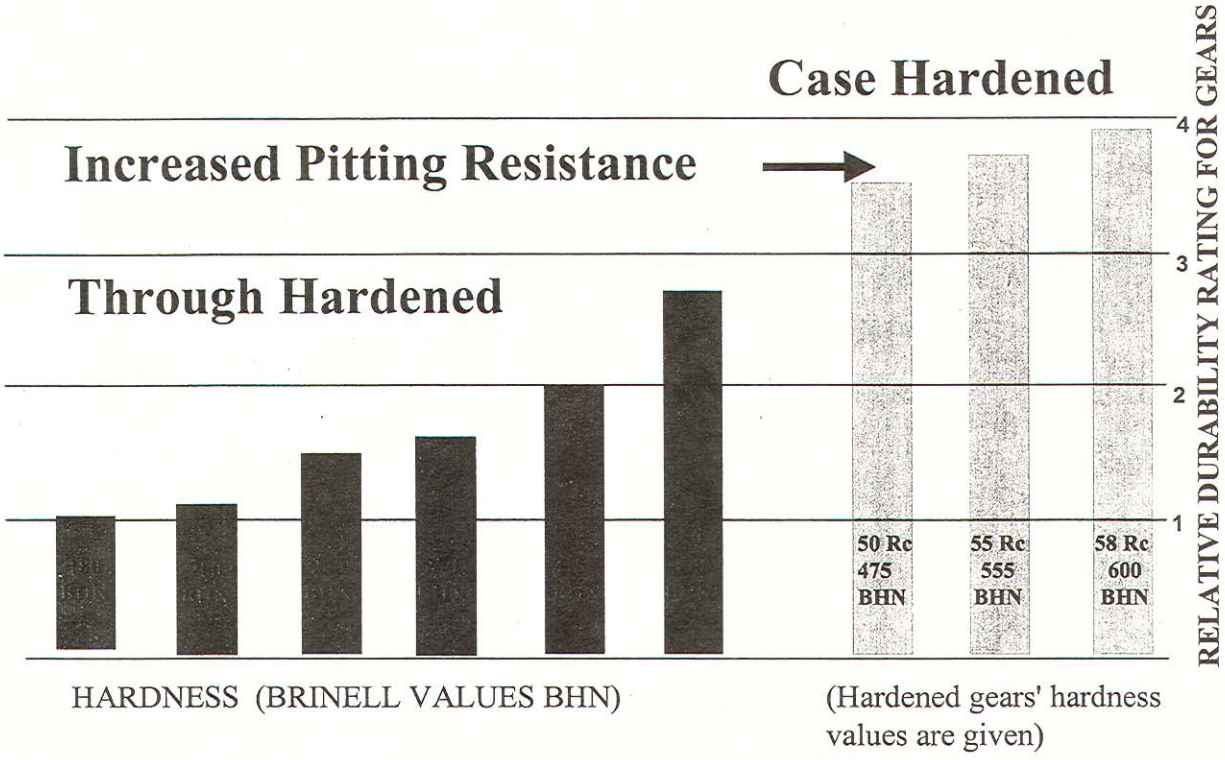
4 hrs - .050 Inches Total Case Depth

8 hrs - .071 Inches Total Case Depth

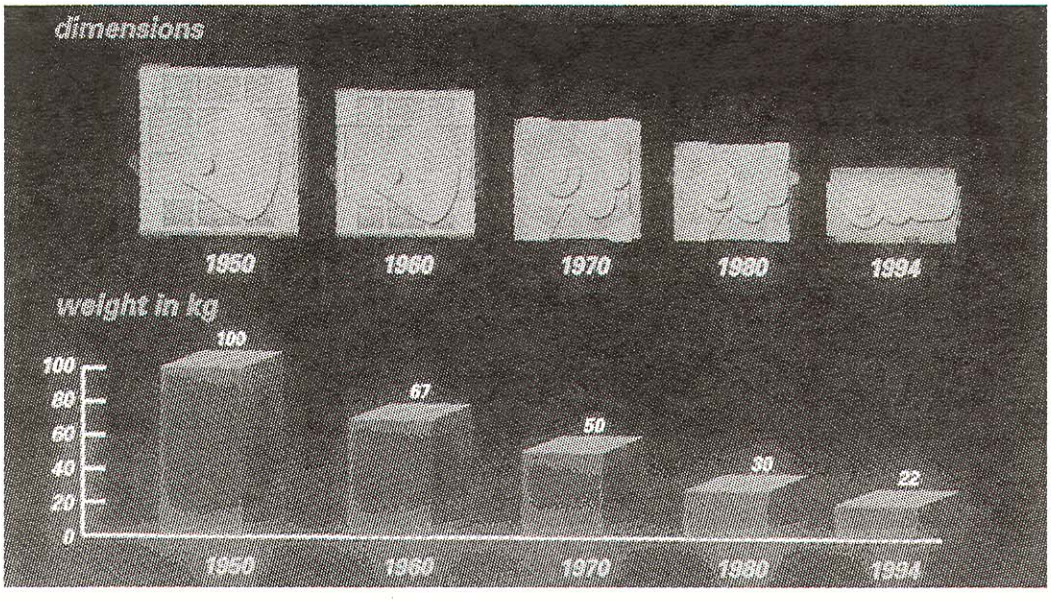
12 hrs - 0.87 Inches Total Case Depth

20 hrs - .112 Inches Total Case Depth.

Gear Durability Rating



Evolution of the Gearbox



Gear Finishing

Hobbing

125 RMS Finish
Quality Level 10 is obtainable with good quality & sharpened Hob

Lapping

64 RMS Finish
Does not improve quality

Grinding

16 - 24 RMS Finish
Quality Level 15

Rule of Thumb for Grinding - Speed

Hobbed Gears	<	4,000 FPM*
Lapped Gears	>	4,000 FPM
Ground Gears	>	7,000 FPM

All High Speed Gear Increaser
*FPM = Feet Per Minute Pitch Line Velocity

Pitch Line Velocity

Pitch Line Velocity = PD X .262 X RPM

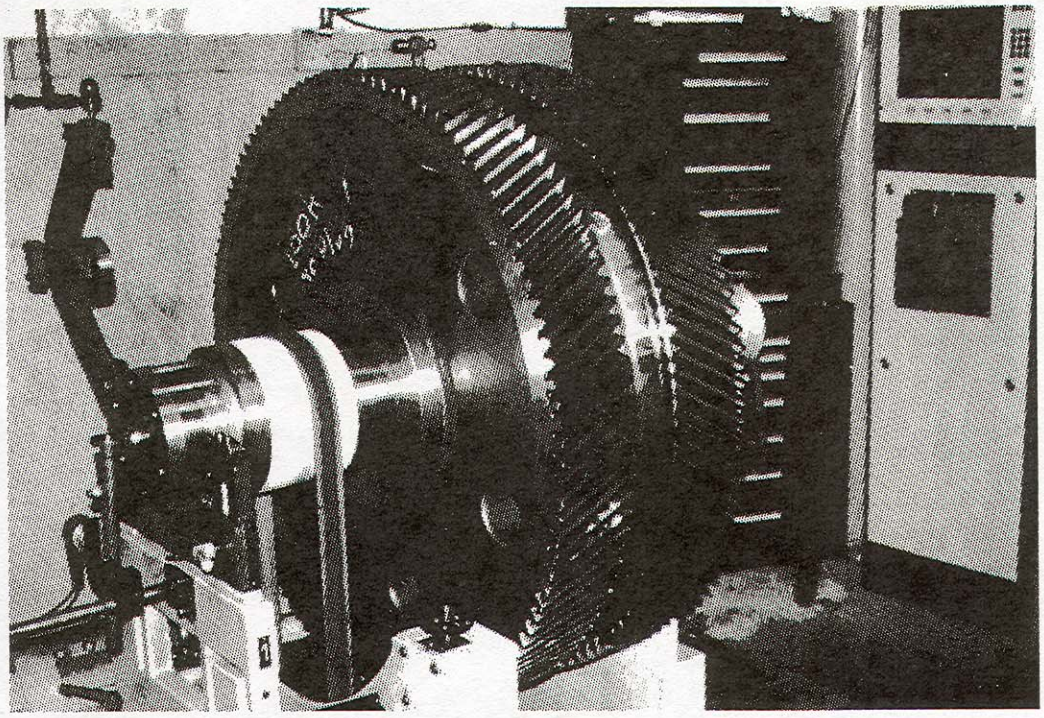
Example: Speed reducer with 5,000 RPM with Input with 8 inch pitch diameter pinion

PLV = 8 X .262 X 5,000 = 10,480 FPM

Do you grind for this application?

Yes

Balancing



Gear Checking