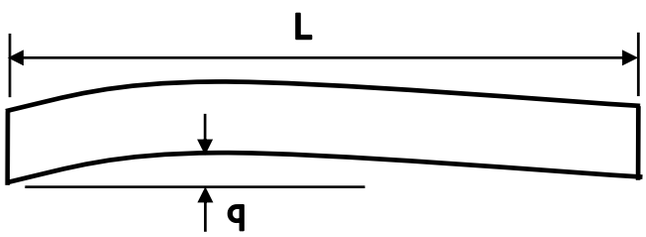
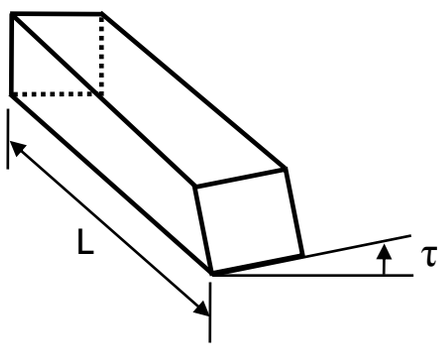
Requirement of High-Precision Rack

Requirement and Reason	Technology needed
Good Straightness, Less Torsion • Influence the accuracy of pressure angle, helical angle and pitch error, hence Influence the gear coupling with pinion. • To avoid re-straightening work after long-term stock due to slowly out-let of internal tension	➢ Heat-treatment ➢ Straightening ➢ Machining on all sides ➢ Teeth milling and grinding ➢ Teeth induction hardening





Requirement and Reason	Technology needed
Accurate Pressure Angle α and Helical Angle β • Optimizing gear-coupling with pinion • Optimizing transmission of torque or feed force • For high speed, low noise, less wearing, longer life-time	➢ Heat-treatment ➢ Straightening ➢ Machining on all sides ➢ Teeth milling and grinding ➢ Teeth induction hardening

Standard

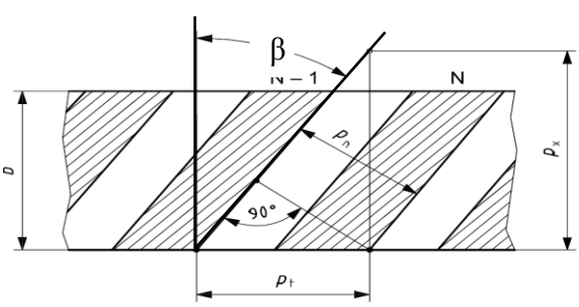
Left-Hand Helical

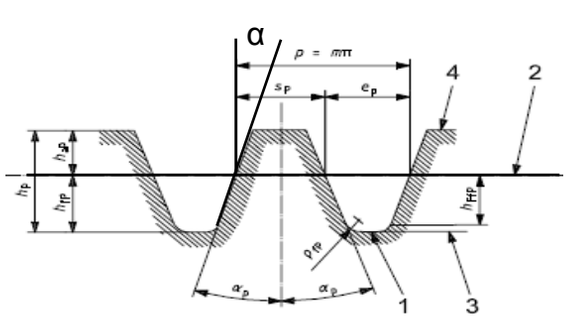
Right-Hand Helical

$\alpha = 20^\circ$

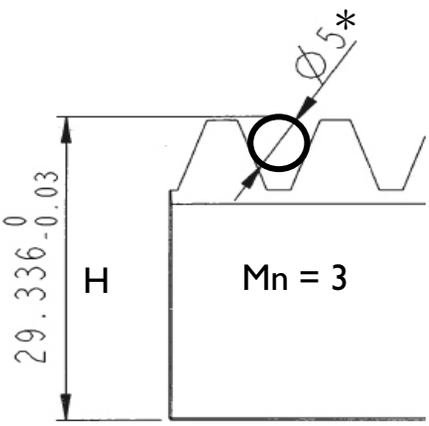
$\beta = 19^\circ 31' 42''$ (19.5283°)

or 0° by Straight Teeth





Requirement and Reason	Technology needed
Accurate Over Pin Height H • A measure of accuracy of teeth profile • Optimizing gear-coupling with pinion • Influence on backlash between rack and pinion	➢ Heat-treatment ➢ Straightening ➢ Machining on all sides ➢ Teeth milling and grinding ➢ Teeth induction hardening

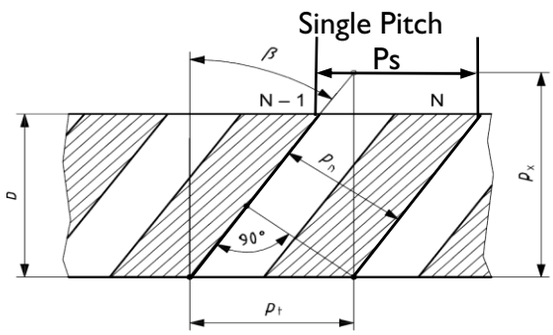


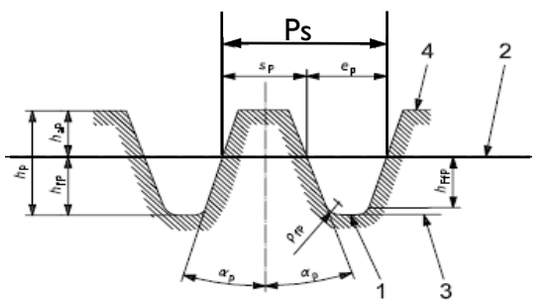
* Pin Diameter depending on Mn.

Requirement and Reason	Technology needed
Low Single Pitch Error Es / Low Total Pitch Error Et • Optimizing gear-coupling with pinion • Low noise, less wearing, longer life-time • High positioning accuracy • Influence on backlash	➢ Heat-treatment ➢ Straightening ➢ Machining on all sides ➢ Teeth milling and grinding ➢ Teeth induction hardening

➢ Pitch = π x Module No.

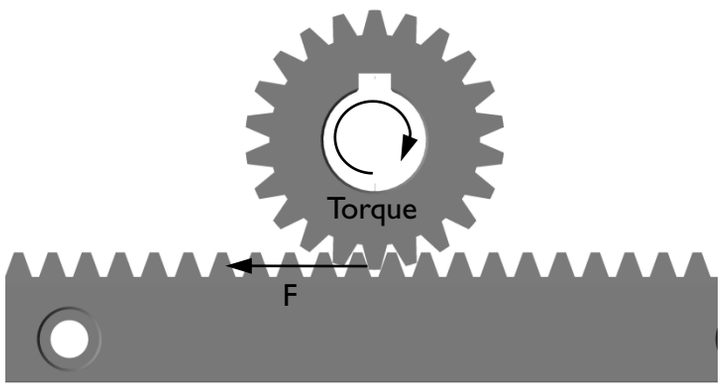
➢ Total Pitch Error Et is to be measured between the first and the last tooth of a rack.





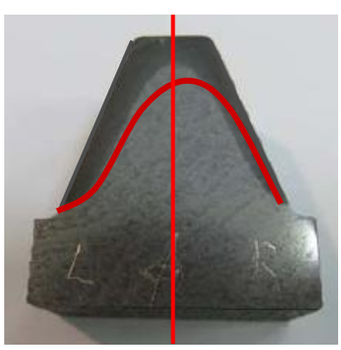
Requirement of High-Precision Rack

Requirement and Reason	Technology needed
Rigidity / Material Hardness • No deformation during gear coupling with Pinion • High strength of rack / High strength of teeth • Transmission of high torque or high feed force • High speed, less wearing, long life-time	➢ Heat-treatment ➢ Teeth induction hardening



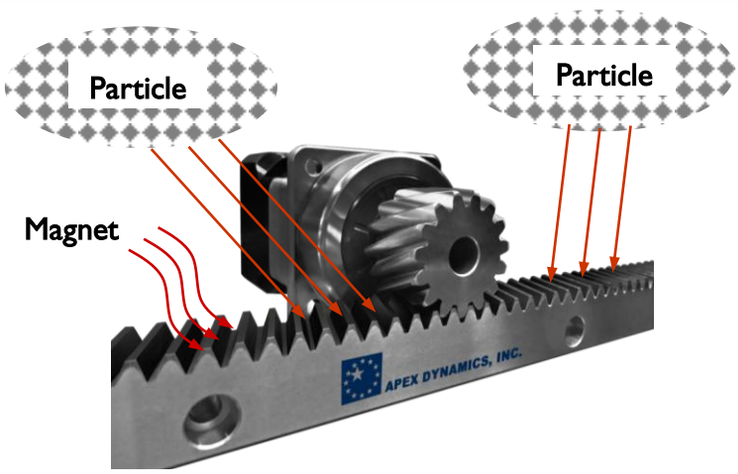
Requirement and Reason	Technology needed
High Surface Hardness • High strength of rack / High strength of teeth • Transmission of high torque or high feed force • High wearing resistance	➢ Heat-treatment ➢ Induction hardening ➢ Teeth grinding
Thickness of Hardened-Layer • Preserve accuracy and long lift-time	
Symmetry of Hardened-Layer on teeth profiles • Preserve accuracy and long lift-time in both moving directions on the rack	

Qualified induction hardening and teeth grinding



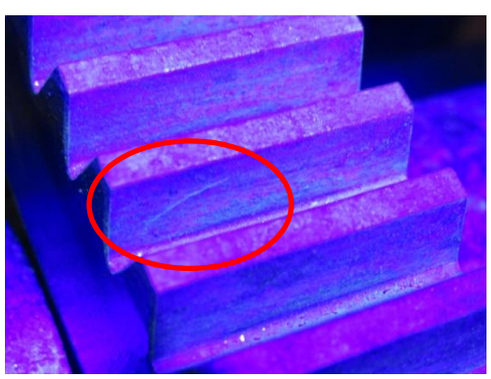
Bad induction hardening and / or bad teeth grinding

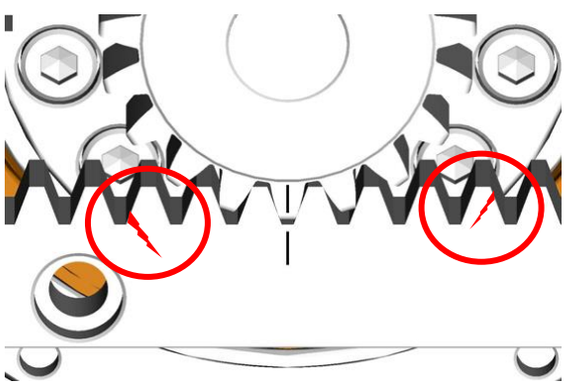
Requirement and Reason	Technology needed
Low Remaining Magnet • Prevent adhesion of particles between the rack and pinion which leads to pitting and damage the teeth profile. • Smooth running • Preserve accuracy and long lift-time	➢ Degauss device



APEX rack has been degaussed until 10 ± 3 Gauss!

Requirement and Reason	Technology needed
Magnetic Crack Inspection • Preserve accuracy • Guarantee of long life-time	➢ Magnetic crack inspection device





APEX rack has been checked by Magnetic Crack Inspection Device!