



# Ingranaggi in Plastica

Durata: 16 ore

## “Normative e Progettazione in KISSsoft”

### Small Cylindrical and Crossed Helical Worm Gears in Plastic or Sinter Material

The use of plastic and sinter gears is often considered because of their advantages over metal gears. As they also have disadvantages like lower strength and lower manufacturing tolerances, it is important to evaluate exactly the strength and geometry of the gears before going into production.

During the 2-day training, the specific differences compared to steel gears and their calculation methods will be explained. An overview of the material properties with advantages and limitations as well as the measuring techniques will be given. The choice of the material and the calculation of the tooth form specialties will be discussed. The basic issues involved in the theory of worm wheels and crossed helical gears are summarized. The differences between worm wheels with and without globoid form are illustrated.

In addition, participants will carry out several exercises to see the problems and possible solutions in practical cases, using a full KISSsoft version.

This training is for design engineers who had already participated in a cylindrical gear training and do know how to use the KISSsoft user interface and the sizing functions in the gear calculation module. A knowledge of geometry and strength calculation is essential for properly understanding the contents of this course.



### General Topics

- General properties of plastic and sinter materials
- Tribological properties of plastic and sinter materials
- Typical failure modes of cylindrical and crossed helical gears
- Overview of materials implemented in KISSsoft
- Sizing functions in KISSsoft: rough, fine sizing and sizing of modifications
- Overview of the VDI 2736 and old VDI 2545
- S-N curves (Wöhler lines) for plastics and sinters: their measurements and implementation into KISSsoft
- Safety factors: general recommendation, procedure to design plastic gears

### Cylindrical Gear Calculation

- Strength calculation: static strength and lifetime calculations, load spectrum calculation, evaluation of results and reports
- Temperature calculation: theoretical background, measurement possibilities
- Wear calculation: theoretical background, methods in KISSsoft
- Contact analysis: background, general overview, result evaluation
- Noise optimization: main sources of noise, possible optimization procedures

- Operating backlash optimization: general inputs, interpretation of the results
- Tooth form calculation: tolerances, special tooth form modifications for small gears

## Calculating the Injection Mold

The theoretical tooth form, which has been optimized as described above, is calculated using the mid-value of the tooth thickness deviations. The result is the required tooth form, which can be transferred to a CAD program via the DXF or IGES interface. In further calculations, you can also take into account the manufacturing processes:

- Modifying the injection mold to compensate for shrinkage/expansion
- Display the eroding wire / spark gap
- Monitoring the wire diameter during erosion process

## Crossed Helical Gear Calculation

- Basic geometry and forces
- Differences between globoidal and cylindrical worm wheel
- Efficiency calculations, self-locking gear pairs
- Strength calculation: static and lifetime calculations, differences between VDI 2545 and VDI 2736
- Wear calculation: method according to Pech
- Tooth thickness optimization
- Graphical contact analysis: visualization with 3D skin model

## Plastics Manager

- General overview
- How to measure gear fatigue data on a test rig
- Statistical evaluation of measured data

## Various

- Asymmetric gears: design possibilities, advantages and limitations
- Non-circular gears: design possibilities, advantages and limitations
- Importing tooth form as a .dxf