LMECA2840 - Project in mechanical design

# Technical Report iV : Tolerance


Brevi Matteo 7708-16-00
Creelle Robbe 3693-17-00
Diriken Axel 3382-17-00
Ibrahim Muhammad 1444-20-00
Marchal Youri 6170-17-00
Peres Hugo 4454-16-00
Philipin Aurélien 4622-17-00


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# 1 Introduction

Here bellow are the justifications of the tolerances we have putted for the manufacturing of the two keys, the gear and the main shaft of our rack and pinion. If there is no specific justification for a tolerance (a dimensional or a geometrical one), it means that this tolerance is a current one, often used in this kind of application. Furthermore this tolerance comes from the Ricordeau.

# 2 Key

All the dimensional tolerances have been chosen with respect to a free keying.

## 2.1 Lateral surface A

- Geometrical tolerances
  - We putted a flatness' tolerance of 0.05 microns on the reference A because it's a functional surface.

## 2.2 Upper surface B

- Geometrical tolerances
  - The parallelisms tolerance is less strict that the flatness one because the main stress will be located perpendicularly to A. However, the key must be flat enough to be correctly inserted in the groove.

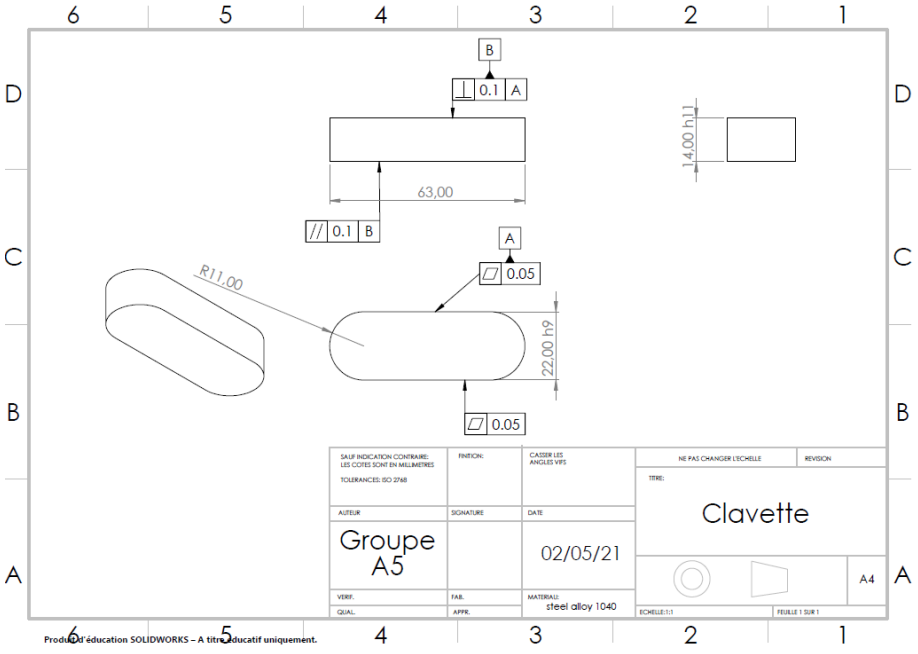


Figure 1: Solidworks technical plan key

# 3 Gear

The dimensional tolerances have been chosen with respect to the Ricordeau for a hub.

## 3.1 Hub

- Geometrical tolerances
  - The cylindricity on the reference surface A is strict because this surface will be in contact with the main shaft and have to transmit the stresses. That's why there is a tolerance of 0.05 microns.
  - The groove of the key must be flat enough, indeed it's where the key will transmit the efforts to the gear.

### 3.2 Thickness

- Dimensional tolerance
  - The tolerance on the thickness of the gear is negative because the gear has to be placed in his groove without any problem.

### 3.3 Teeth

- Geometrical tolerances
  - The tolerance on the shape of the teeth is there in order to have a more strict tolerance than the default one.

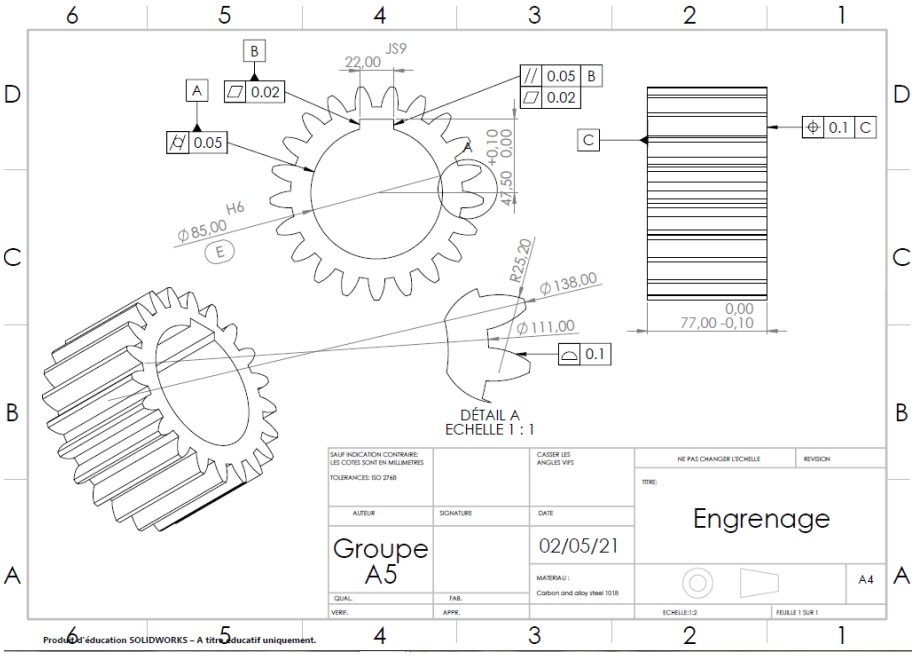


Figure 2: Solidworks technical plan gear

## 4 Shaft

### 4.1 Seats for bearings

- Dimensional tolerances
  - Tolerances have been chosen from the corresponding bearing catalogue (4)
- Geometrical tolerances
  - The tolerance on the cylindricity is strict for a proper effort transmission, that's why we fixed it at 0.05 microns.
  - The coaxiality has a tolerance of 0.1 microns in order to avoid oscillations and wear.

### 4.2 Shoulder

- Geometrical tolerances
  - The perpendicularity's tolerance is here to ensure the alignment of the bearings.

### 4.3 Shaft keyway

- Dimensional tolerances
  - These dimensions are given for a normal keying from Ricordeau.

- Geometrical tolerances
  - The tolerance on the flatness is about 0.05 microns for an efficient effort transmission.

## 4.4 Seats for gears

- Dimensional tolerances
  - The tolerances are strict for an efficient effort transmission.
- Geometrical tolerances

  .The tolerance on the cylindricity is strict for a proper effort transmission, that's why we fixed it at 0.05 microns. The coaxiality has a tolerance of 0.1 microns in order to avoid oscillations and wear.

## 4.5 Circlip groove

- Geometrical tolerances
  - The position of the grooves must be very precise in order to have enough displacement for the circlips, and to allow a proper assembly.

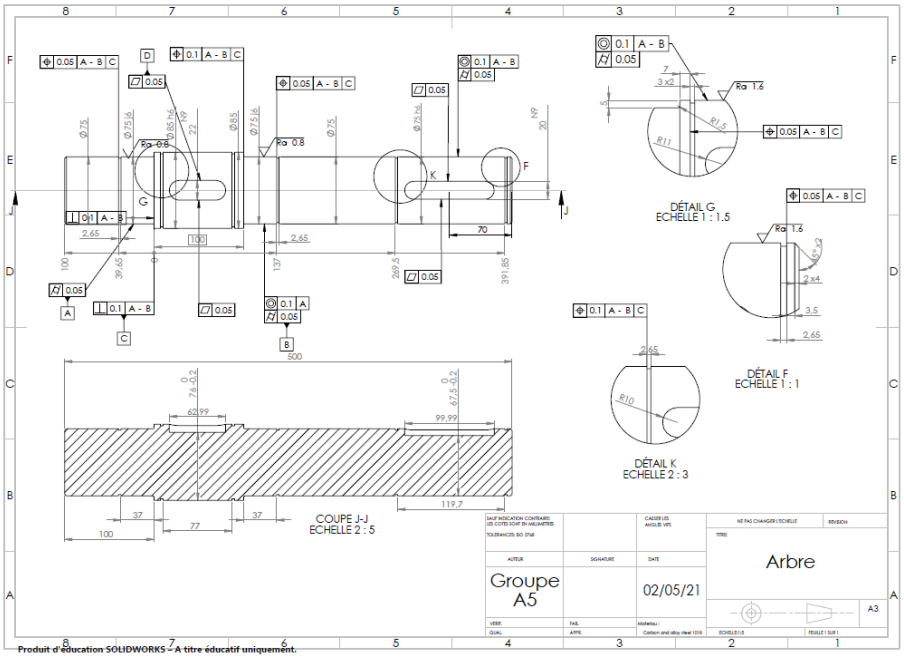


Figure 3: Solidworks technical plan shaft

# 5 Appendix

**table 1 - Tolerances for solid steel shafts - seats for radial ball bearings [1)]**

| Conditions | Shaft diameter | Dimensional tolerance[2)] | Total radial run-out tolerance[3)] | Total axial run-out tolerance[3)] | Ra |
|---|---|---|---|---|---|
| | mm | – | – | – | µm |
| **Rotating inner ring load or direction of load indeterminate** | | | | | |
| Light loads (P = 0,05 C) | = 17 | js5 | IT4/2 | IT4 | 0,4 |
| | > 17 to 100 | j6 | IT5/2 | IT5 | 0,8 |
| | > 100 to 140 | k6 | IT5/2 | IT5 | 1,6 |
| Normal to heavy loads (0,05 C < P = 0,1 C) | = 10 | js5 | IT4/2 | IT4 | 0,4 |
| | > 10 to 17 | j5 | IT4/2 | IT4 | 0,4 |
| | > 17 to 100 | k5 | IT4/2 | IT4 | 0,8 |
| | > 100 to 140 | m5 | IT4/2 | IT4 | 0,8 |
| | > 140 to 200 | m6 | IT5/2 | IT5 | 1,6 |
| | > 200 to 500 | n6 | IT5/2 | IT5 | 1,6 |
| | > 500 | p7 | IT6/2 | IT6 | 3,2 |
| **Stationary inner ring load** | | | | | |
| Easy axial displacement of inner ring on shaft desirable | | g6[4)] | IT5/2 | IT5 | 1,6 |
| Easy axial displacement of inner ring on shaft unnecessary | | h6 | IT5/2 | IT5 | 1,6 |
| **Axial loads only** | | j6 | IT5/2 | IT5 | 1,6 |

[1)] LinkedList

Figure 4: Bearing catalogue