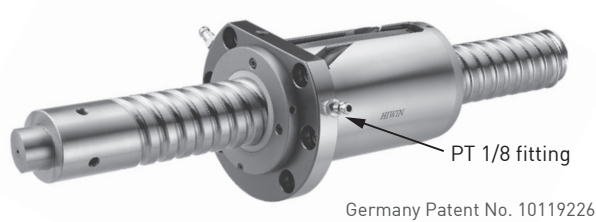


## 9.5 Cool Type

### 9.5.1 Extra High Dm-N Value Ballscrew - Cool Type I



#### • Cool type I:

- New era for high speed ballscrew - achieving extra high Dm-N value (up to 200,000) and high positioning accuracy.
- Cool type I and a hollow shaft design.
- High speed machine tools and machining center.

#### • Design Principle:

The cool type series feature using forced cooling fluid to pass through the nut, which minimize heat generation and thermal expansion during ballscrew operation.

##### • Cool type I as shown in the Figure 9.1:

Flowing fluids are circulated in passages that inside the nut, and exchanging heat with the cooler as shown in the Figure 9.2 In cooperation with hollow shaft design, it makes high quality of thermal control and maintains high accuracy. That combination is the most suitable for high-speed machine tools.

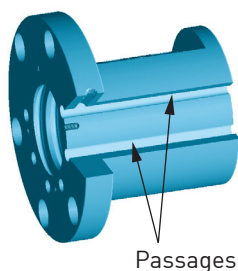


Fig. 9.1 Cool type I

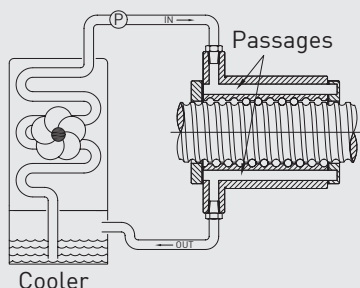


Fig. 9.2 Cool type I with cooler

#### • Specification:

1. We recommend shaft diameter above  $\varnothing 32\text{mm}$  to cool type design.
2. Nut type: FSV, FSW, PFDW, OFSW, DFSV, FSH, FSI, etc.
3. Please contact HIWIN with other specification you need.
4. The cool type I, compared with the standard specifications, will make a minor external dimension change of the nut, please contact HIWIN.

#### • Specification number:

Example: R50 - 30C1 - OFSWC1 - 1180 - 1539 - 0.008



C1: HIWIN cool type ballscrew for type I

#### • Performance Comparison:

For high-speed machine tools, hollow shaft design only is not enough against heat generation and thermal expansion, because nut itself is a heat source, as shown in Figure 9.3.

##### Test condition :

specification :  $\varnothing 50$ , lead 30 mm  
 speed : 2500 rpm ( 75 m/min),  
 back and forth feed continuously  
 acceleration :  $9.8 \text{ m/sec}^2$   
 stroke : 1180 mm  
 preload : 205 kgf  
 moving weight : 300 kgf  
 cooling rate : oil 2.5 liter/min  
 inlet temperature :  $16^\circ\text{C}$   
 room temperature :  $25^\circ\text{C}$

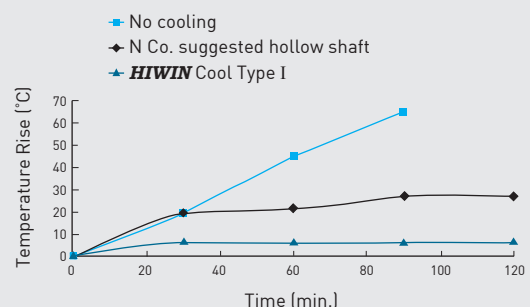


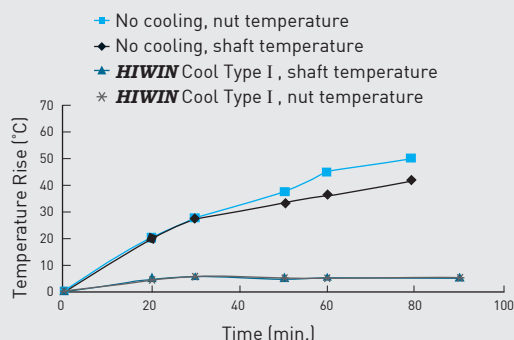
Fig. 9.3 Nut temperature rise

### Cool type I Performance (1)

Specification: Ø50, lead 30 mm

Dm-N value: 150,000

Acceleration: 9.8 m/sec<sup>2</sup>



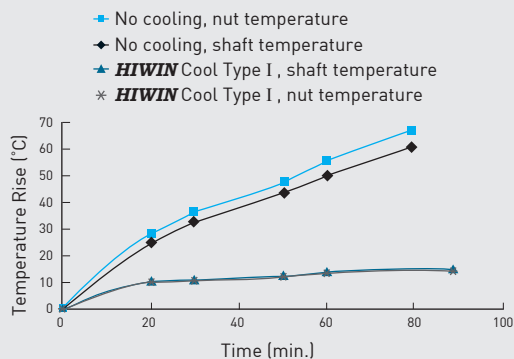
Cool type I : Temperature rise of ballscrew

### Cool type I Performance (2)

Specification: Ø50, lead 30 mm

Dm-N value: 200,000

Acceleration: 9.8 m/sec<sup>2</sup>



Cool type I : Temperature rise of ballscrew

### • Features:

#### 1. Optimized design for high reliability:

Use of computer simulation and FEM analysis, the cool type ballscrew features well thermal protection and high reliability.

#### 2. Promote higher speed rotation and extra high Dm-N value (up to 200,000):

Cool type ballscrew will eliminate high-speed rotation aftereffect, i. e., thermal problem, and promote higher speed rotation.

#### 3. Prevent thermal distortion:

Optimized heat transfer design to minimize heat generation and prevent thermal distortion.

#### 4. Strengthen durability:

When operating repeatedly, friction between balls cause heat generation. That may be made balls oxidized or decarburized, and shortened the service life. Cool type ballscrew will strengthen durability under a cooling environment.

#### 5. Extended lubricant life cycle:

When using lubrication, minimum heat generation further inhibits deterioration in the quality of lubrication and extends the lubricant life cycle.

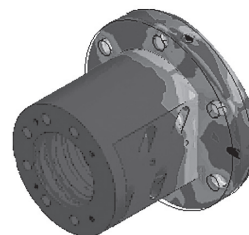
#### 6. Keep temperature uniform and reduce warm-up time:

When high-speed operation, nut and shaft cooling effect indeed keep feed-system temperature constant and reduce warm-up time.

#### 7. Higher feeding accuracy:

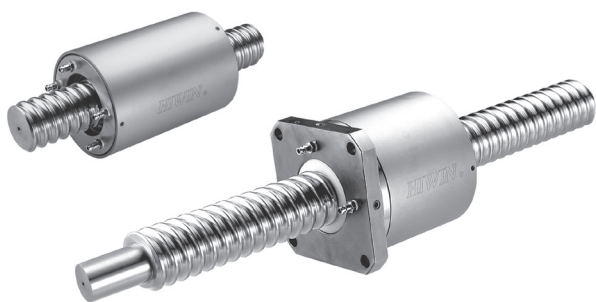
Cooling effect of cool type ballscrew will stabilize against thermal expansion and equalize feeding accuracy.

X 1e7  
(Pa)  
0.001  
0.180  
0.260  
0.540  
0.719  
0.999  
1.079  
1.258  
1.438  
1.618



FEM analysis for cool type ballscrew

## 9.5.2 High Load Ballscrew - Cool Type II



Germany Patent No. 20119457.0  
Taiwan Patent No. 193878

### • Cool type II:

- New era for ballscrew applied in electric - driven injection machine, presses, power units, and other replaceable hydraulic drives.
- Electric-driven injection machine, presses, power units and other replaceable hydraulic drives.

### • Design Principle:

The cool type series feature using forced cooling fluid to pass through the nut, which minimize heat generation and thermal expansion during ballscrew operation.

#### • Cool type II as shown in the Figure 9.4:

Flowing fluids are circulated through a space, which inside the nut, and exchanging heat with the cooler as shown in the Figure 9.5. It is the most suitable for electric-driven injection machine, presses, and power units. The cool type II, compared with the standard specifications, will make a minor external dimension change of the nut. Please contact HIWIN .

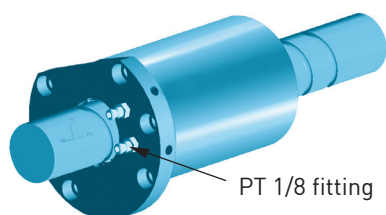


Fig. 9.4 Cool type II

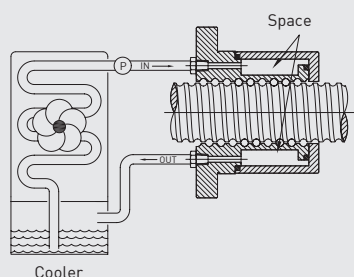


Fig. 9.5 Cool type II with cooler

### • Specification:

1. We recommend shaft diameter above  $\varnothing 32\text{mm}$  to cool type design.
2. Nut type: FSV, FSW, PFDW, OFSW, DFSV, FSH, FSI, etc.
3. Please contact HIWIN with other specification you need.
4. The cool type II, compared with the standard specifications, will make a minor external dimension change of the nut, please contact HIWIN.

### • Specification number:

Example: R63 - 16B3 - RSWC2 - 400 - 600- 0.05



C2 : HIWIN cool type ballscrew for type II

### • Performance Comparison:

#### Test condition :

specification :  $\varnothing 50$ , lead 30 mm  
speed : 1500 rpm ( 45 m/min),  
back and forth feed continuously  
acceleration :  $4.9 \text{ m/sec}^2$   
stroke : 300 mm  
preload : 205 kgf  
moving weight : 300 kgf  
cooling rate : oil 2.5 liter/min  
inlet temperature :  $16^\circ\text{C}$   
room temperature :  $25^\circ\text{C}$

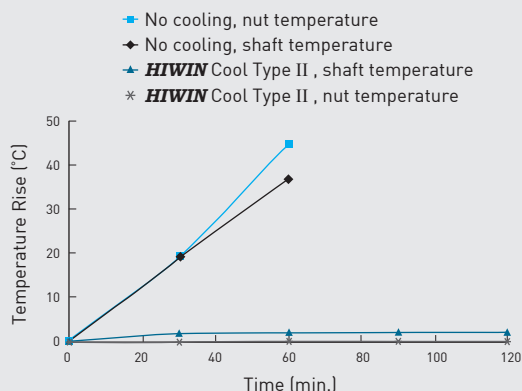


Fig. 9.6 Cool type II : Temperature rise of ballscrew

• **Features:**

**1. Optimized design for high reliability:**

Use of computer simulation and FEM analysis, the cool type ballscrew features well thermal protection and high reliability.

**2. Promote higher speed rotation and extra high Dm-N value (up to 200,000):**

Cool type ballscrew will eliminate high-speed rotation aftereffect, i. e., thermal problem, and promote higher speed rotation.

**3. Prevent thermal distortion:**

Optimized heat transfer design to minimize heat generation and prevent thermal distortion.

**4. Strengthen durability:**

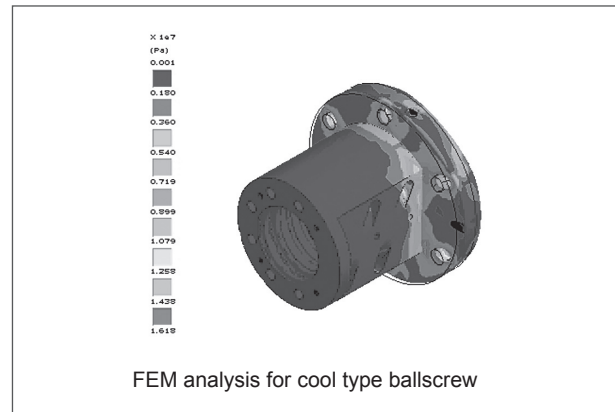
When operating repeatedly, friction between balls cause heat generation. That may be made balls oxidized or decarburized, and shortened the service life. Cool type ballscrew will strengthen durability under a cooling environment.

**5. Extended lubricant life cycle:**

When using lubrication, minimum heat generation further inhibits deterioration in the quality of lubrication and extends the lubricant life cycle.

**6. Higher feeding accuracy:**

Cooling effect of cool type ballscrew will stabilize against thermal expansion and equalize feeding accuracy.



## Average Life Cycle for Injection Machine Ballscrew

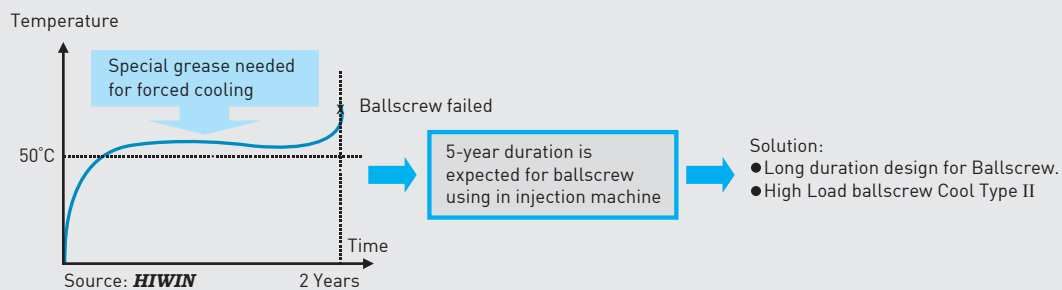


Fig 9.7 Life cycle for ballscrew using in general injection machine