

B-3-3.1 HMD Type for High-Speed Machine Tools

This product is being applied for a patent. The newly developed ball recirculation components, the end-deflector and middle-deflector, have greatly contributed for the substantial improvements in the maximum rotational speed and noise level compared to the HMC type.

1. Features

- High speed
The permissible rotational speed (d·n value) has greatly increased to 160 000 compared with 135 000 of the HMC type.
- Low noise
Noise reduced by 5 dB or more compared with the HMC type ball screws for high-speed machine tools.
- Nut mounting dimensions
The ball nut diameters are the same as those of the HMC type.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the middle-deflector recirculation system of the HMD type.

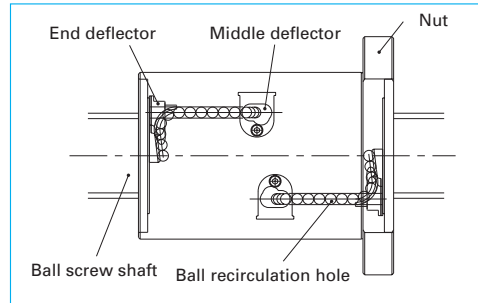


Fig. 1 Structure of middle-deflector recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

| | |
|----------------|------------------|
| Accuracy grade | C3, C5 |
| Axial play | 0 mm (preloaded) |

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value: 160 000 or less
Criterion of maximum rotational speed : 4 000 min⁻¹

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

- For twin-drive systems (See page B543.)
Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.
- Hollow shaft ball screw (See page B544.)
- Nut cooling ball screw (See page B549.)

The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMD type.

(5) Seal

Compact, thin plastic seal is available. Nut outside diameter is compact compare with the return tube recirculation system.

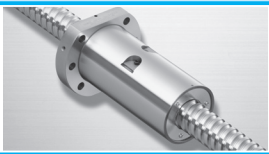
3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Product categories

The HMD type has a model as follows.

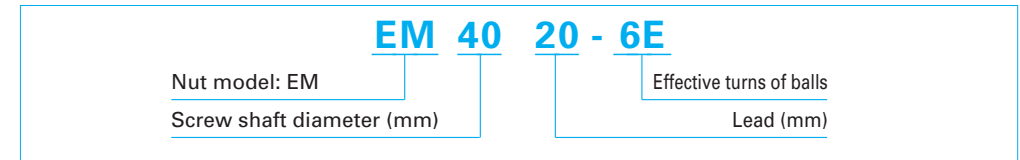
Table 2 HMD type product categories

| Nut model | Shape | Flange shape | Nut shape | Preload system |
|-----------|---|---------------------|-----------|----------------------------|
| EM |  | Flanged Circular II | Circular | Z-Preload (medium preload) |

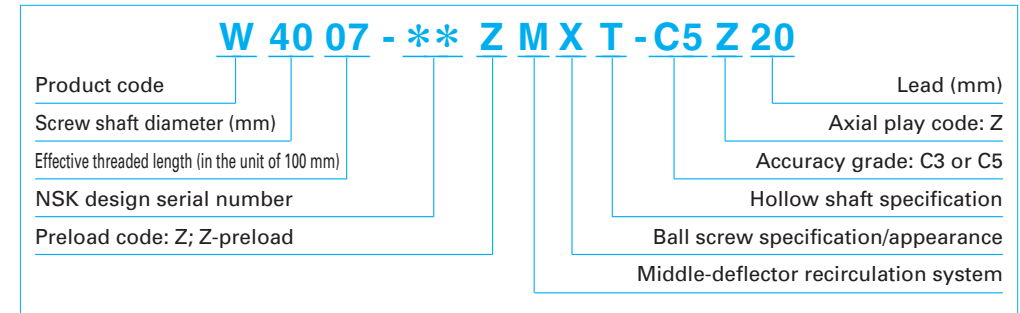
5. Structure of model number and reference number

The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number

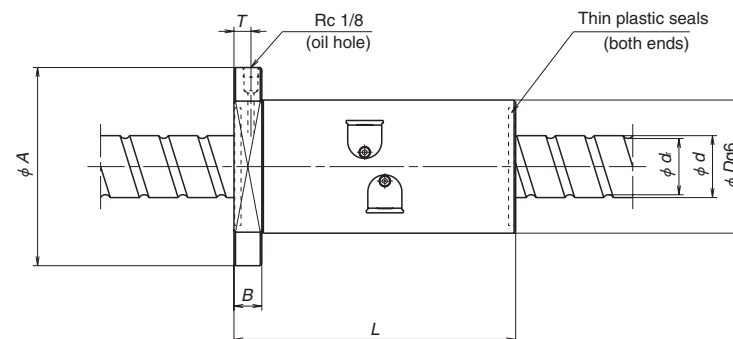
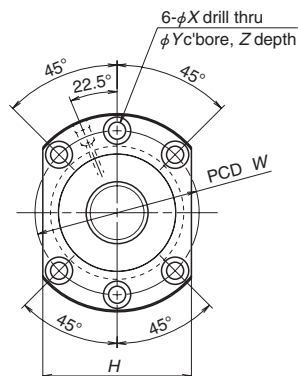


◇Reference number for ball screw



6. Handling Precautions

Maximum operating temperature: 80°C
If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (page B83).



| Model No. | Shaft dia. <i>d</i> | Lead <i>l</i> | Root dia. <i>d_r</i> | Basic load rating (N) | | Axial rigidity <i>K</i> (N/μm) |
|------------------|------------------------|------------------|-----------------------------------|---------------------------------|--------------------------------|--------------------------------------|
| | | | | Dynamic <i>C_d</i> | Static <i>C_s</i> | |
| EM4016-4E | 40 | 16 | 34.1 | 57 100 | 130 000 | 1 020 |
| EM4020-6E | | 20 | 34.4 | 66 900 | 165 000 | 1 340 |
| EM4025-6E | | 25 | 34.1 | 79 100 | 191 000 | 1 370 |
| EM4030-6E | | 30 | 34.1 | 79 100 | 191 000 | 1 350 |
| EM4516-4E | 45 | 16 | 39.1 | 59 600 | 145 000 | 1 060 |
| EM4520-6E | | 20 | 39.4 | 69 100 | 186 000 | 1 470 |
| EM4525-6E | | 25 | 39.1 | 82 500 | 213 000 | 1 510 |
| EM5016-4E | 50 | 16 | 44.1 | 61 800 | 160 000 | 1 150 |
| EM5020-6E | | 20 | 44.4 | 73 200 | 206 000 | 1 600 |
| EM5025-6E | | 25 | 44.1 | 85 600 | 235 000 | 1 620 |
| EM5030-6E | | 30 | 44.1 | 85 600 | 235 000 | 1 630 |
| EM6316-4E | 63 | 16 | 55.2 | 111 000 | 339 000 | 1 600 |

Notes: 1. The right turn screw is the standard. Please consult NSK for left turn screws.
2. Rigidity listed under the column K is the value when a 5% of basic dynamic load rating is applied as the preload.

| Ball nut dimensions | | | | | | | | | | Unit: mm | |
|------------------------|----------------------|-------------------------|--------------------------|-------------------------|----------------|----------|----------|---------------------------|-------------------------------|-------------------------------|--|
| Nut length <i>L</i> | Nut dia. <i>D</i> | Flange dia. <i>A</i> | Flange width <i>B</i> | Flange size <i>H</i> | Bolt hole size | | | Bolt hole PCD <i>W</i> | Oil hole position <i>T</i> | Max. feeding speed (m/min) | |
| | | | | | <i>X</i> | <i>Y</i> | <i>Z</i> | | | | |
| 160 | 86 | 128 | 18 | 96 | 11 | 17.5 | 11 | 106 | 11 | 64 | |
| 150 | | | | | | | | | | 80 | |
| 182 | | | | | | | | | | 100 | |
| 213 | | | | | | | | | | 120 | |
| 160 | 92 | 134 | 18 | 102 | 11 | 17.5 | 11 | 112 | 11 | 56 | |
| 150 | | | | | | | | | | 70 | |
| 182 | | | | | | | | | | 88 | |
| 160 | 98 | 140 | 18 | 107 | 11 | 17.5 | 11 | 118 | 11 | 51 | |
| 150 | | | | | | | | | | 64 | |
| 182 | | | | | | | | | | 80 | |
| 213 | | | | | | | | | | 96 | |
| 170 | 122 | 180 | 28 | 138 | 18 | 26 | 17.5 | 150 | 14 | 40 | |

B-3-3.2 HMS Type for High-Speed Machine Tools

1. Features

- High speed
The permissible rotational speed (d·n value) has greatly increased to 160 000 compared with 100 000 for tube type screws.
- Low noise
By adopting SRC recirculation system, noise reduced by 5 dB or more compared with tube type screws.
- Nut mounting dimensions
The ball nut diameters are the same as those of tube type screws.

2. Specifications

(1) Recirculation system

Fig.1 shows the structure of the SRC recirculation system of the HMS type.

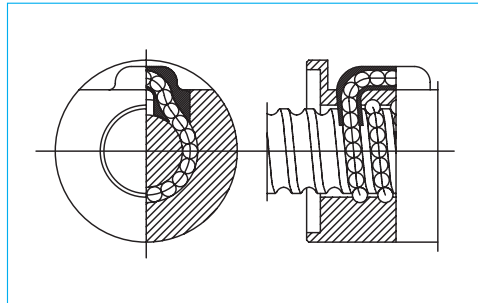


Fig. 1 Structure of SRC recirculation system

(2) Accuracy grade and axial play

The available standard accuracy grade and axial play are as follows. Please consult NSK for other grades.

Table 1 Accuracy grade and axial play

| | |
|----------------|------------------|
| Accuracy grade | C3, C5 |
| Axial play | 0 mm (preloaded) |

(3) Allowable d·n value and the criterion of maximum rotational speed

Allowable d·n value and the criterion of maximum rotational speed are shown below. Please consult NSK if the rotational speed exceeds the permissible range below.

Allowable d·n value: 160 000 or less
Criterion of maximum rotational speed : 5 000 min⁻¹

Note: Please also review the critical speed. See "Technical Description: Permissible Rotational Speed" (page B47) for details.

(4) Options

- For twin-drive systems (See page B543.)
Upon request, the variations in lead accuracy and preload torque between two ball screws of a pair of the TW series are controlled for the further improvement of the reliability.
- Hollow shaft ball screw (See page B544.)
- Nut cooling ball screw (See page B549.)

The temperature rise and measures against thermal expansion of ball screw driving mechanism are the most challenging for high-speed machine tools. We recommend using core forced cooling or nut cooling for the HMS type.

3. Design precautions

For general precautions regarding ball screws, refer to "Design Precautions" (page B83) and "Handling Precautions" (page B103).

4. Product categories

The HMS type has a model as follows.

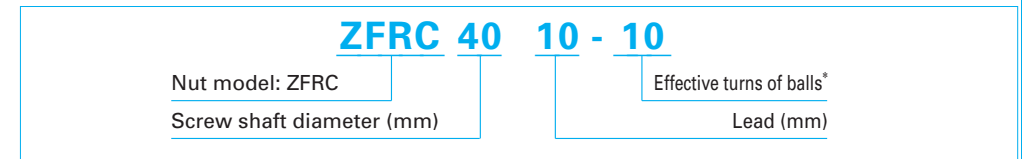
Table 2 HMS type product categories

| Nut model | Shape | Flange shape | Nut shape | Preload system |
|-----------|-------|---------------------|-----------|----------------------------|
| ZFRC | | Flanged Circular II | Circular | Z-Preload (medium preload) |

5. Structure of model number and reference number

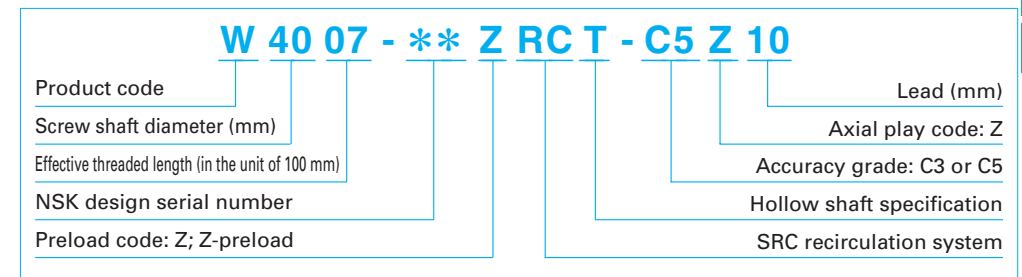
The followings describe the structure of "Model number" and "Reference number for ball screw".

◇Model number



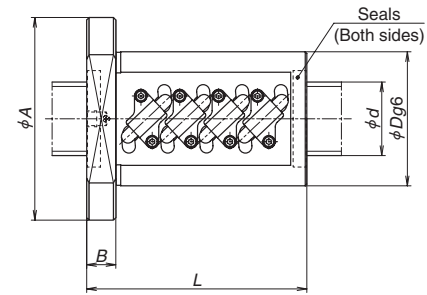
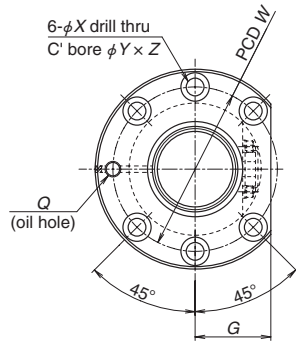
* In the case of Z-preload, the amount shown is twice the effective turn of balls.

◇Reference number for ball screw



6. Handling Precautions

Maximum operating temperature: 60°C
If using NSK K1, operating temperature should not exceed 50°C. Refer to "Designing Precautions" (page B83).



| Model No. | Shaft dia. <i>d</i> | Lead <i>l</i> | Root dia. <i>d_r</i> | Effective turns × rows | Basic load rating (N) | | Axial rigidity <i>K</i> (N/μm) |
|-------------|------------------------|------------------|-----------------------------------|------------------------------|---------------------------------|---------------------------------|--------------------------------------|
| | | | | | Dynamic <i>C_d</i> | Static <i>C_{st}</i> | |
| ZFRC3205-10 | 32 | 5 | 29.2 | 2.5×2 | 18 500 | 56 100 | 840 |
| ZFRC3210-10 | 32 | 10 | 26.4 | 2.5×2 | 46 300 | 108 000 | 920 |
| ZFRC4005-10 | 40 | 5 | 37.2 | 2.5×2 | 20 200 | 70 600 | 1 120 |
| ZFRC4010-10 | 40 | 10 | 34.4 | 2.5×2 | 52 000 | 137 000 | 1 090 |
| ZFRC4012-10 | 40 | 12 | 34.1 | 2.5×2 | 61 000 | 155 000 | 1 110 |
| ZFRC4508-10 | 45 | 8 | 40.5 | 2.5×2 | 37 300 | 118 000 | 1 160 |
| ZFRC4510-10 | 45 | 10 | 39.4 | 2.5×2 | 54 200 | 155 000 | 1 210 |
| ZFRC4512-10 | 45 | 12 | 39.1 | 2.5×2 | 64 200 | 177 000 | 1 230 |
| ZFRC5010-10 | 50 | 10 | 44.4 | 2.5×2 | 57 700 | 175 000 | 1 320 |
| ZFRC5012-10 | 50 | 12 | 43.2 | 2.5×2 | 77 600 | 214 000 | 1 360 |
| ZFRC6312-14 | 63 | 12 | 56.2 | 3.5×2 | 115 000 | 386 000 | 2 250 |

Notes: 1. The right turn screw is the standard. Please consult NSK for left turn screws.
2. Rigidity listed under the column K is the value when a 5% of basic dynamic load rating is applied as the preload.

Unit: mm

| Nut length <i>L</i> | Nut dia. <i>D</i> | Ball nut dimensions | | | Bolt hole size | | | Bolt hole PCD <i>W</i> | Oil hole position <i>Q</i> | Max. feeding speed (m/min) |
|------------------------|----------------------|-------------------------|--------------------------|-------------------------|----------------|----------|----------|---------------------------|-------------------------------|-------------------------------|
| | | Flange dia. <i>A</i> | Flange width <i>B</i> | Groove size <i>G</i> | <i>X</i> | <i>Y</i> | <i>Z</i> | | | |
| 89 | 58 | 85 | 12 | 32 | 6.6 | 11 | 6.5 | 71 | M6×1 | 25 |
| 163 | 74 | 108 | 15 | 41 | 9 | 14 | 8.5 | 90 | M6×1 | 50 |
| 92 | 67 | 101 | 15 | 39 | 9 | 14 | 8.5 | 83 | M6×1 | 25 |
| 166 | 82 | 124 | 18 | 47 | 11 | 17.5 | 11 | 102 | Rc1/8 | 40 |
| 192 | 86 | 128 | 18 | 48 | 11 | 17.5 | 11 | 106 | Rc1/8 | 48 |
| 136 | 82 | 124 | 18 | 47 | 11 | 17.5 | 11 | 102 | Rc1/8 | 28 |
| 166 | 88 | 132 | 18 | 50 | 11 | 17.5 | 11 | 110 | Rc1/8 | 35 |
| 192 | 90 | 132 | 18 | 50 | 11 | 17.5 | 11 | 110 | Rc1/8 | 42 |
| 166 | 93 | 135 | 18 | 51 | 11 | 17.5 | 11 | 113 | Rc1/8 | 32 |
| 198 | 100 | 146 | 22 | 55 | 14 | 20 | 13 | 122 | Rc1/8 | 38 |
| 244 | 115 | 161 | 22 | 61 | 14 | 20 | 13 | 137 | Rc1/8 | 30 |