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# High Torque Type Ball Spline

Models LBS, LBST, LBF, LBR and LBH

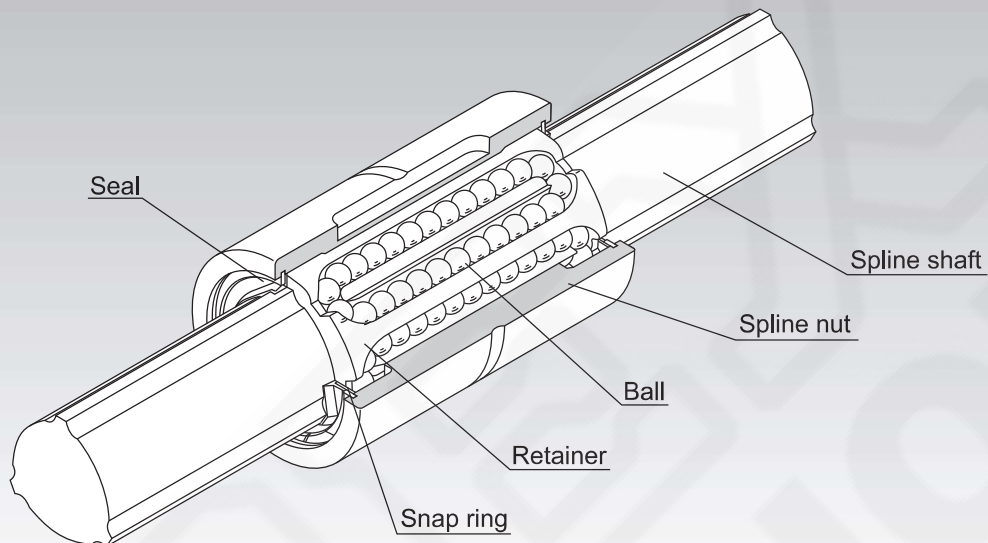


Fig.1 Structure of High Torque Type Ball Spline Model LBS

|  |               |
|--|---------------|
| <b>Point of Selection</b>                                  | <b>A3-6</b>   |
| <b>Point of Design</b>                                     | <b>A3-117</b> |
| <b>Options</b>   | <b>A3-120</b> |
| <b>Model No.</b>   | <b>A3-122</b> |
| <b>Precautions on Use</b>                                  | <b>A3-123</b> |
| <b>Accessories for Lubrication</b>                         | <b>A24-1</b>  |
| <b>Mounting Procedure and Maintenance</b>                  | <b>B3-31</b>  |
| <b>Cross-sectional Characteristics of the Spline Shaft</b> | <b>A3-17</b>  |
| <b>Equivalent factor</b>                                   | <b>A3-27</b>  |
| <b>Clearance in the Rotation Direction</b>                 | <b>A3-30</b>  |
| <b>Accuracy Standards</b>                                  | <b>A3-34</b>  |
| <b>Maximum Manufacturing Length by Accuracy</b>            | <b>A3-115</b> |

## Structure and Features

With the high torque type Ball Spline, the spline shaft has three crests positioned equidistantly at 120°, and along both sides of each crest, two rows of balls (six rows in total) are arranged so as to hold the crest, as shown in Fig.1.

The raceways are precision ground into R-shaped grooves whose diameters are approximate to the ball diameter. When a torque is generated from the spline shaft or the spline nut, the three rows of balls on the load-bearing side evenly receive the torque, and the center of rotation is automatically determined. When the rotation reverses, the remaining three rows of balls on the unloaded side receive the torque.

The rows of balls are held in a retainer incorporated in the spline nut so that they smoothly roll and circulate. With this design, balls will not fall even if the spline shaft is removed from the nut.

### [No Angular Backlash]

With the high torque type Ball Spline, a single spline nut provides a preload to eliminate angular backlash and increase the rigidity.

Unlike conventional ball splines with circular-arc groove or Gothic-arch groove, the high torque type Ball Spline eliminates the need for twisting two spline nuts to provide a preload, thus allowing compact design to be achieved easily.

### [High Rigidity and Accurate Positioning]

Since this model has a large contact angle and provides a preload from a single spline nut, the initial displacement is minimal and high rigidity and high positioning accuracy are achieved.

### [High-speed Motion, High-speed Rotation]

Adoption of a structure with high grease retention and a rigid retainer enables the ball spline to operate over a long period with grease lubrication even in high-speed straight motion. Since the distance in the radius direction is almost uniform between the loaded balls and the unloaded balls, the balls are little affected by the centrifugal force and smooth straight motion is achieved even during high-speed rotation.

### [Compact Design]

Unlike conventional ball splines, unloaded balls do not circulate on the outer surface of the spline nut with this model. As a result, the outer diameter of the spline nut is reduced and a space-saving and compact design is achieved.

### [Ball Retaining Type]

Use of a retainer prevents the balls from falling even if the spline shaft is pulled out of the spline nut.

### [Can be Used as a Linear Bushing for Heavy Loads]

Since the raceways are machined into R grooves whose diameter is almost equal to the ball diameter, the contact area of the ball is large and the load capacity is large also in the radial direction.

### [Double, Parallel Shafts can be Replaced with a Single Shaft]

Since a single shaft is capable of receiving a load in the torque direction and the radial direction, double shafts in parallel configuration can be replaced with a single-shaft configuration. This allows easy installation and achieves space-saving design.

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## Applications

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The high torque type Ball Spline is a reliable straight motion system used in a wide array of applications such as the columns and arms of industrial robot, automatic loader, transfer machine, automatic conveyance system, tire forming machine, spindle of spot welding machine, guide shaft of high-speed automatic coating machine, riveting machine, wire winder, work head of electric discharge machine, spindle drive shaft of grinding machine, speed gears and precision indexing shaft.

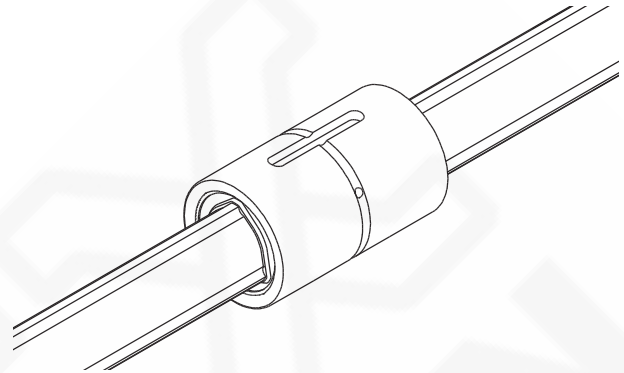
## Types and Features

### [Types of Spline Nuts]

#### Cylindrical Type Ball Spline Model LBS (Medium Load Type)

Specification Table⇒ **A3-56**

The most compact type with a straight cylindrical spline nut. When transmitting a torque, a key is driven into the body. The outer surface of the spline nut is provided with anti-carbonation treatment.

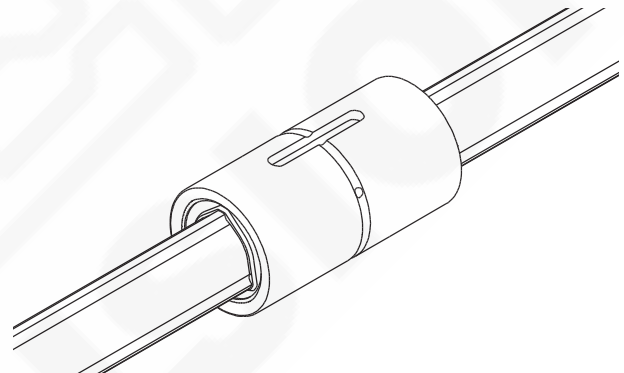


Ball Spline

#### Cylindrical Type Ball Spline Model LBST (Heavy Load Type)

Specification Table⇒ **A3-60**

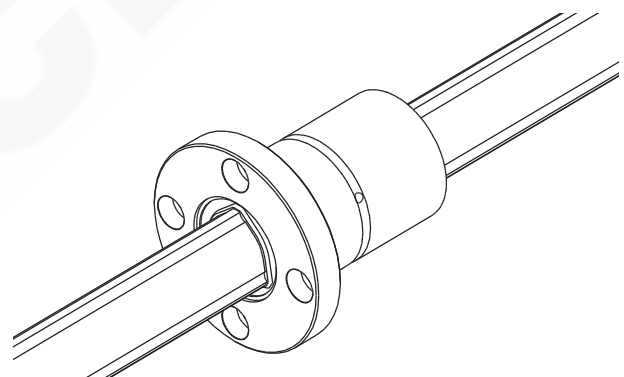
A heavy load type that has the same spline nut diameter as model LBS, but has a longer spline nut length. It is optimal for locations where the space is small, a large torque is applied, and an overhang load or moment load is applied.



#### Flanged Type Ball Spline Model LBF

Specification Table⇒ **A3-62**

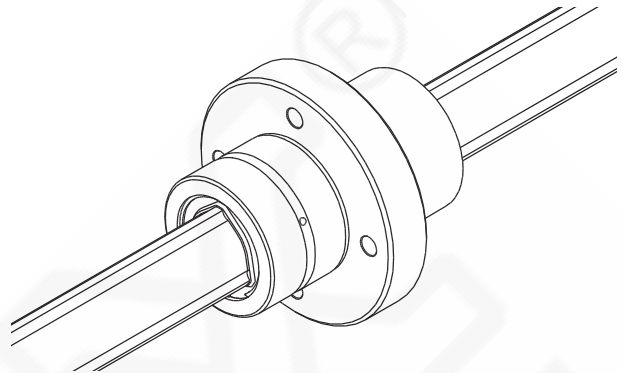
The spline nut can be attached to the housing via the flange, making assembly simple. It is optimal for locations where the housing may be deformed if a keyway is machined on its surface, and where the housing width is small.



## Flanged Type Ball Spline Model LBR

Specification Table⇒ **A3-64**

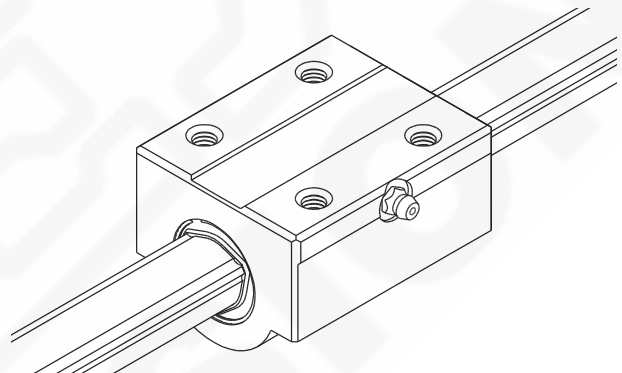
Based on the heavy load type model LBST, this model has a flange in the central area, making itself optimal for locations under a moment load such as arms of industrial robots.



## Rectangular Type Ball Spline Model LBH

Specification Table⇒ **A3-66**

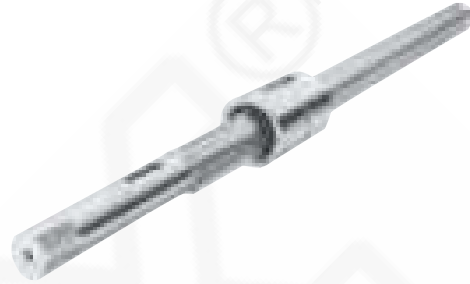
Its rigid rectangular spline nut does not require a housing and can be directly mounted on the machine body. Thus, a compact, highly rigid linear guide system is achieved.



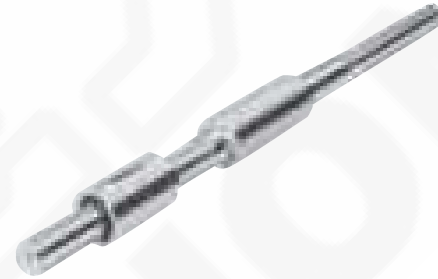
## [Types of Spline Shafts]

**Precision Solid Spline Shaft (Standard Type)**

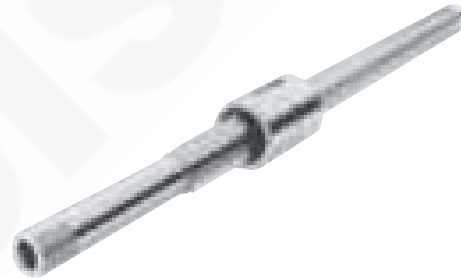
The spline shaft is cold-drawn and its raceway is precision ground. It is used in combination with a spline nut.

**Special Spline Shaft**

THK manufactures a spline shaft with thicker ends or thicker middle area through special processing at your request.

**Hollow Spline Shaft (Type K)**

A drawn, hollow spline shaft is available for requirements such as piping, wiring, air-vent and weight reduction.



Ball Spline

**Housing Inner-diameter Tolerance**

When fitting the spline nut to the housing, transition fit is normally recommended. If the accuracy of the Ball Spline does not need to be very high, clearance fitting is also acceptable.

Table1 Housing Inner-diameter Tolerance

|                                  |                                  |    |
|----------------------------------|----------------------------------|----|
| Housing Inner-diameter Tolerance | General conditions               | H7 |
|                                  | When clearance needs to be small | J6 |