Ball Splines

BIBUS®
SUPPORTING YOUR SUCCESS

www.bibus.de

THOMSON®
Linear Motion. Optimized.™

www.thomsonlinear.com

Ball Splines

A Thomson Precision ball spline consists of mating inner and outer races containing concave axial races and a complement of bearing balls. The balls provide the only physical contact between the inner and outer races. Unlimited rolling travel is achieved by diverting the path of the balls at the extremes of the outer race into the end cap return circuit. This provides a closed loop through which the balls recirculate when the races are displaced axially relative to each other. The bearing balls resist radial displacement resulting from torque loads.

- Efficiency — coefficient of friction 0.007 maximum
- Hardness — minimum of RC 56 in ball race
- Lash — 0.005 inch maximum standard play perpendicular to rotational axis

Precision Rolled Ball Splines

0.625 in to 4.000 in Diameter

Inner and Outer Spline Races

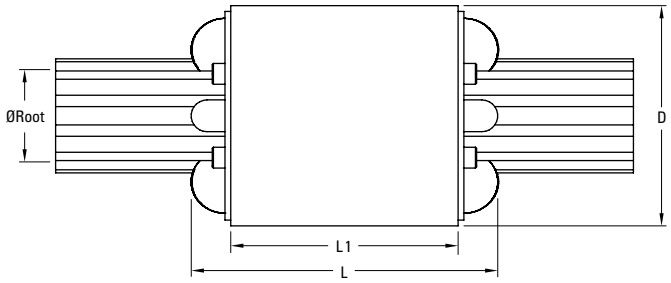
- Offers high speed, anti-friction linear motion under high torsional loads
- All units available with and without keyway
- **All sizes stocked for quick delivery**

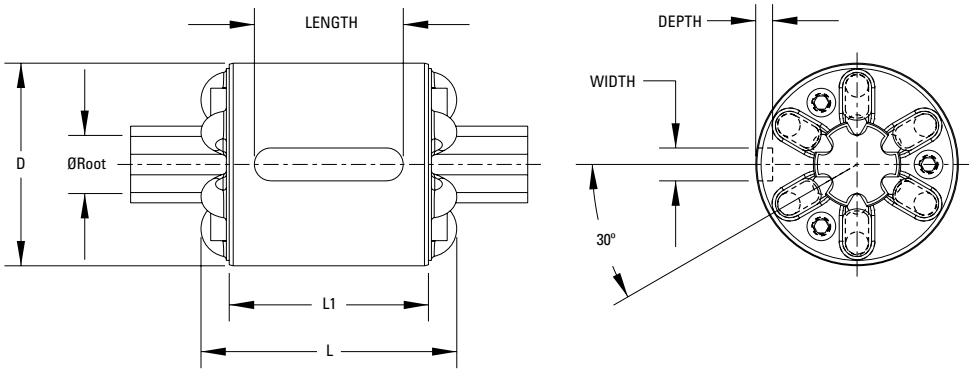
Nominal Diameter	Active Races[1][2]	Inner Race P/N	Outer Race P/N (w/o keyway)	Outer Race P/N (w/ keyway)	Performance Data				Inner Race Specifications		
					Dynamic Load Capacity (C_{am})	Static Torque Capacity (C_o)	Max. Diametral Backlash	Max. Angular Backlash	Root Diameter	Standard Length	Inner Weight
(in.)					(in-lb)	(in-lb)	(in.)	(radians)	(in.)	(in.)	(lb/in)
0.625	3	**5707548**	**5707445**	**7828128**	585	1,770	0.005	0.0160	0.425	48	0.06
0.625	6	**5707548**	**5708943**	**7828129**	1,170	3,540	0.005	0.0160	0.425	48	0.06
1.000	3	**5706084**	**5707472**	**7828130**	1,300	3,900	0.005	0.0100	0.800	74	0.17
1.000	6	**5706084**	**5708944**	**7828131**	2,600	7,800	0.005	0.0100	0.800	74	0.17
1.500	3	**5706388**	**5707528**	**7828132**	4,200	11,588	0.005	0.0067	1.230	74	0.4
1.500	6	**5706388**	**5708945**	**7828133**	8,400	23,176	0.005	0.0067	1.230	74	0.4
2.000	3	**5706436**	**5707530**	**7828134**	8,000	20,138	0.005	0.0050	1.670	74	0.75
2.000	6	**5706436**	**5708946**	**7828135**	16,000	40,276	0.005	0.0050	1.670	74	0.75
2.500	3	**5706484**	**5707532**	**7828136**	13,500	36,625	0.005	0.0040	2.100	74	1.17
2.500	6	**5706484**	**5708947**	**7828137**	27,000	62,250	0.005	0.0040	2.100	74	1.17
4.062	6	**5702204**	**5708330**	**7828138**	57,000	140,000	0.005	0.0025	3.660	74	3.13

(1) Dimensional information on bearing supports and standard end machining is available on page 118 - 137.

(2) Information on required lubrication is on page 177.

Precision Rolled Ball Splines





Nominal Diameter	Active Races	Outer Race Specifications					
		D (max.)	L	L1	Keyway Dimensions (Optional) (Width x Depth x Length)	Outer Weight	Ball Diameter
(in.)		(in.)	(in.)	(in.)	(in.)	(lb)	(in.)
0.625	3	1.531	2.035	1.505	0.250 x 0.125 x 1.125	0.37	0.187
0.625	6	1.531	2.035	1.505	0.250 x 0.125 x 1.125	0.37	0.187
1.000	3	1.906	2.598	2.068	0.250 x 0.125 x 1.625	0.92	0.187
1.000	6	1.906	2.598	2.068	0.250 x 0.125 x 1.625	0.92	0.187
1.500	3	2.693	3.719	3.005	0.250 x 0.125 x 2.000	3.33	0.250
1.500	6	2.693	3.719	3.005	0.375 x 0.187 x 2.000	3.33	0.250
2.000	3	3.427	4.022	3.130	0.250 x 0.125 x 2.500	5.42	0.312
2.000	6	3.427	4.022	3.130	0.500 x 0.219 x 2.500	5.42	0.312
2.500	3	4.170	4.426	3.380	0.250 x 0.125 x 3.000	7.50	0.375
2.500	6	4.170	4.426	3.380	0.500 x 0.250 x 3.000	7.50	0.375
4.062	6	5.6245	5.495	4.500	1.000 x 0.500 x 3.500	14.50	0.375

Engineering Guidelines for Ball Splines

Selection Procedures

Applications Analysis — Follow this step-by-step procedure to determine the ball spline best suited for your application. It is suggested you analyze the requirements of your application using a work pad for easy reference.

Maximum Static Load — Determine the maximum static torque loads encountered in the application. This must include shock loads. Using the table on page 116, note the ball spline sizes and race combinations which have capacities in excess of the application requirements.

Rated Load — In many ball spline applications, freedom of axial movement is essential while actual travel is negligible. For example, a spline used on a jet engine accessory gear box drive moves less than 1/10 inch. This axial freedom is essential to eliminate damaging stress forces to the engine and gear box housings, but total daily travel may be less than 2 inches. Select the size and race combination with a rated load that will meet your application requirement from the table.

Life Expectancy — On occasion, it is important to plan for a specific life expectancy. These applications usually are designed to use the smallest practical ball spline at the maximum possible torque or where considerable translation occurs. For these applications, use the Life Expectancy chart on page 165. Contact Thomson if light weight and small size are considerations.

Determine the following:

- life expectancy — total inches of travel desired during the life of the application
- application load — the normal operating load for the application in inch-pounds (Newton-millimeters) of torque

Speed vs. Length — Determine the following:

- Speed — determine the maximum revolutions per minute (rpm) required
- Maximum length — determine the maximum unsupported length
- End fixity — determine the type of configuration (refer to the Bearing Support reference drawings on page 146). Quick Mount bearing support blocks can be used on diameters 5/8 inch through 2-1/2 inch. Using the example at the bottom of the Speed vs. Length chart on page 161, plot the point for your specific application.

Design Formulas

Life Ratings

$$L_{10}\,[\text{in.}] = \left[\frac{C_{am}}{T}\right]^3 \times 10^6$$

Parameters:

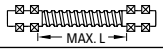
T = dynamic equivalent torque (A constant torque under the influence of which a ball spline assembly would have the same life as it will attain under the actual applied torque condition.)

C_{am} = dynamic load rating [lbs.] (based on 1.0 million inches)

$$n_c = C_s \times 4.76 \times 10^6 \times \frac{d_r}{l^2}$$

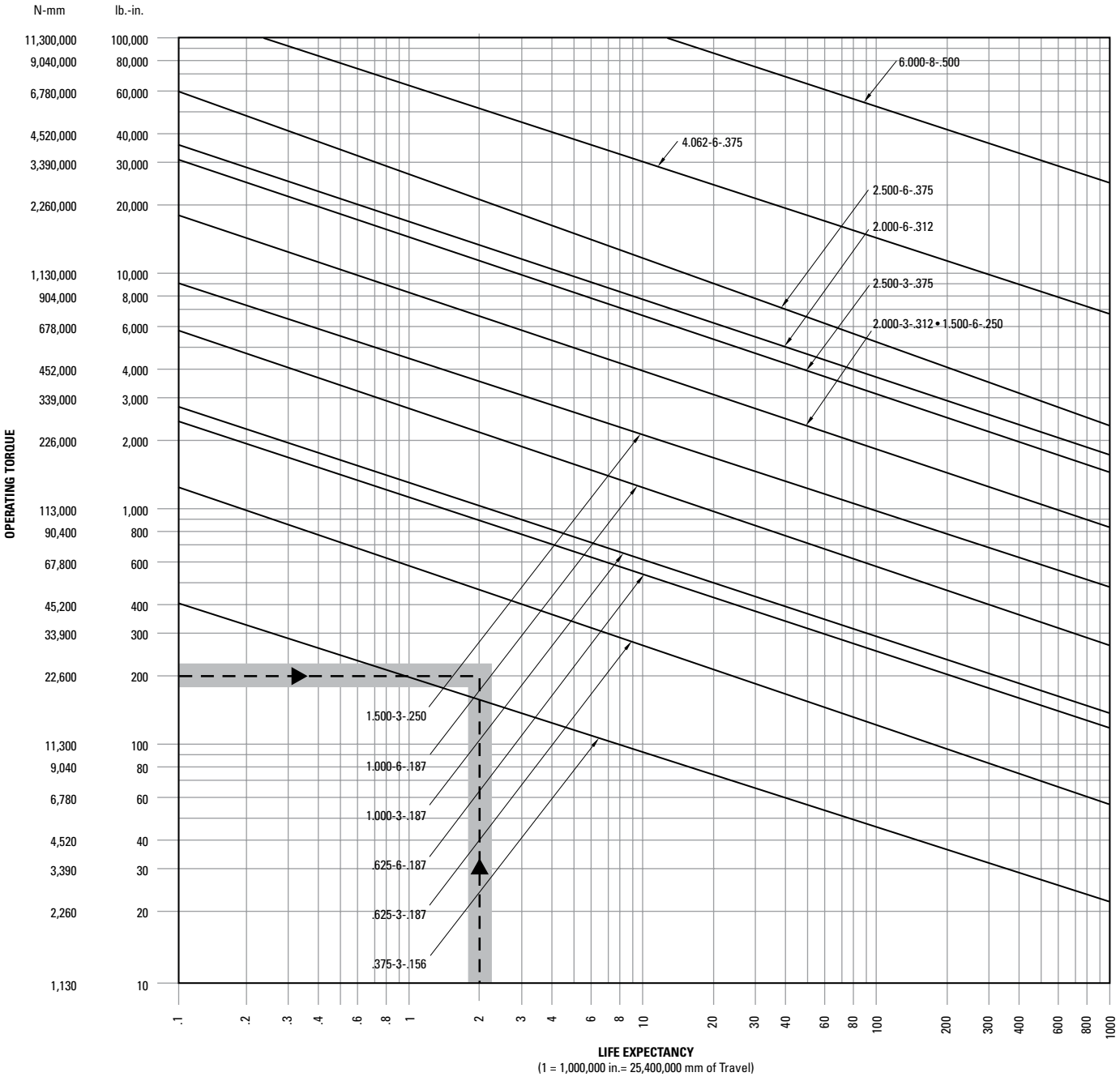
$$n_s = n_c \times S$$

n_c = Critical Speed (rpm)
n_s = Safe Drive Speed
d_r = Root Diameter (in.)
l = Length between Bearing Supports (in.)
S = Safety Factor (0.8 maximum)
C_s = End Fixity Factor

End Fixity Factor		
End Supports		C_s
A 	One end fixed, one end free	0.36
B 	Both ends supported	1.00
C 	One end fixed, one end supported	1.47
D 	Both ends fixed	2.23

Engineering Guidelines for Ball Splines

Life Expectancy for Precision Ball Splines

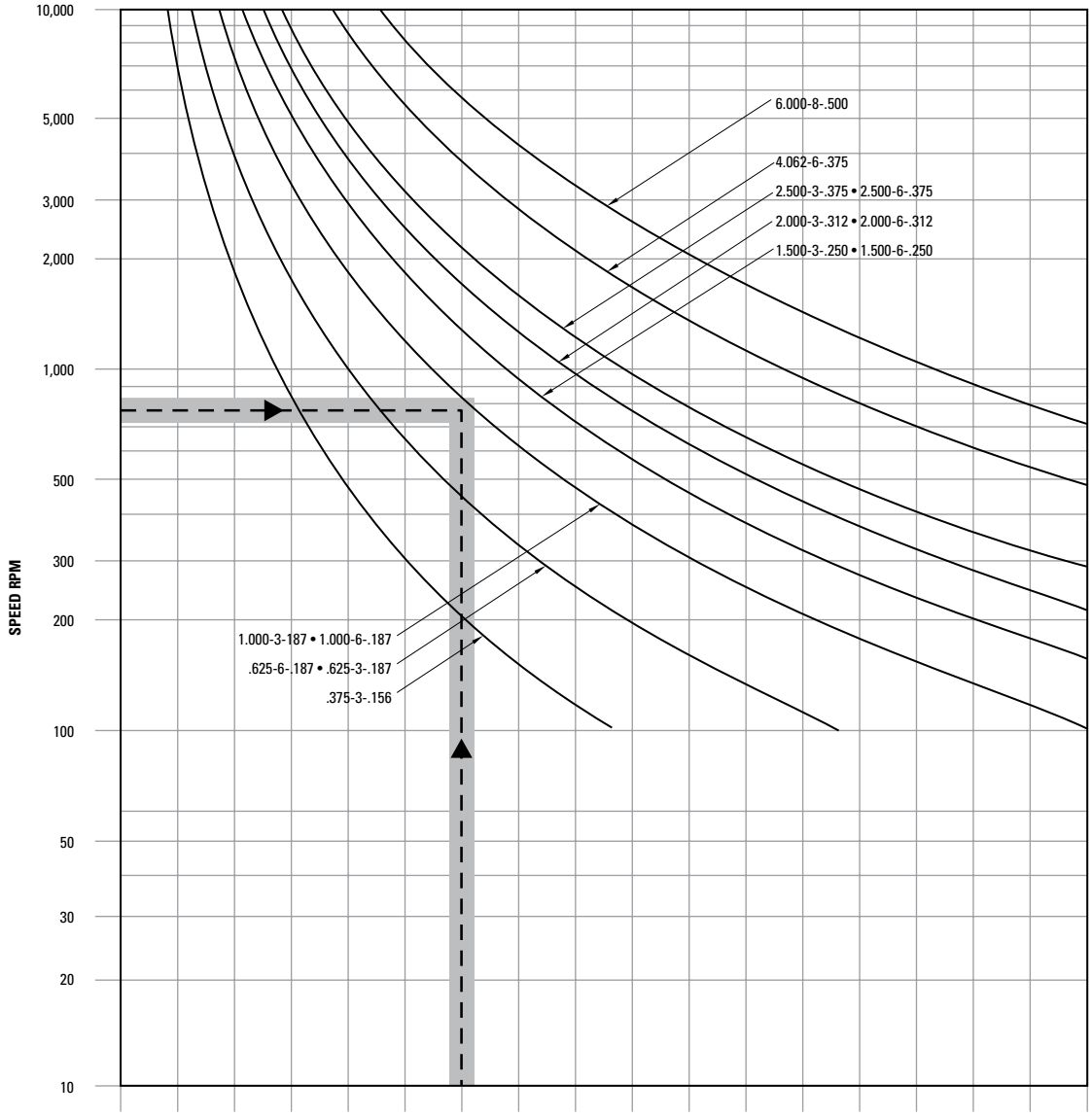


Example: Desired life of 2 million in.
(50.8 million mm).
Operating torque is 200 lb-in.
(22.6 N · mm)

All splines with curves which pass through or are above and to the right of the plotted point are suitable for the example.

Engineering Guidelines for Ball Splines

Speed vs. Length for Precision Ball Splines



END SUPPORT TYPE

A One end fixed, other end free (MAX. L)	Inches	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102
	mm	152	304	457	609	762	914	1056	1219	1371	1524	1676	1828	1981	2133	2286	2438	2590
B Both ends supported (MAX. L)	Inches	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
	mm	254	508	762	1016	1270	1524	1778	2032	2286	2743	2794	3048	3302	3556	3810	4064	4318
C One end fixed, other end supported (MAX. L)	Inches	12	24	36	48	61	73	85	97	109	121	133	145	158	170	182	194	206
	mm	304	609	914	1219	1549	1854	2159	2463	2768	3073	3378	3683	4013	4318	4622	4927	5232
D Both ends fixed (MAX. L)	Inches	15	30	45	60	75	90	105	119	134	149	164	179	194	209	224	239	254
	mm	381	762	1143	1524	1905	2286	2667	3022	3403	3784	4165	4546	4927	5308	5689	6070	6451

Example: Maximum shaft speed is 800 rpm.
Unsupported length is 60 in. (1524mm).
End fixity is both ends supported.

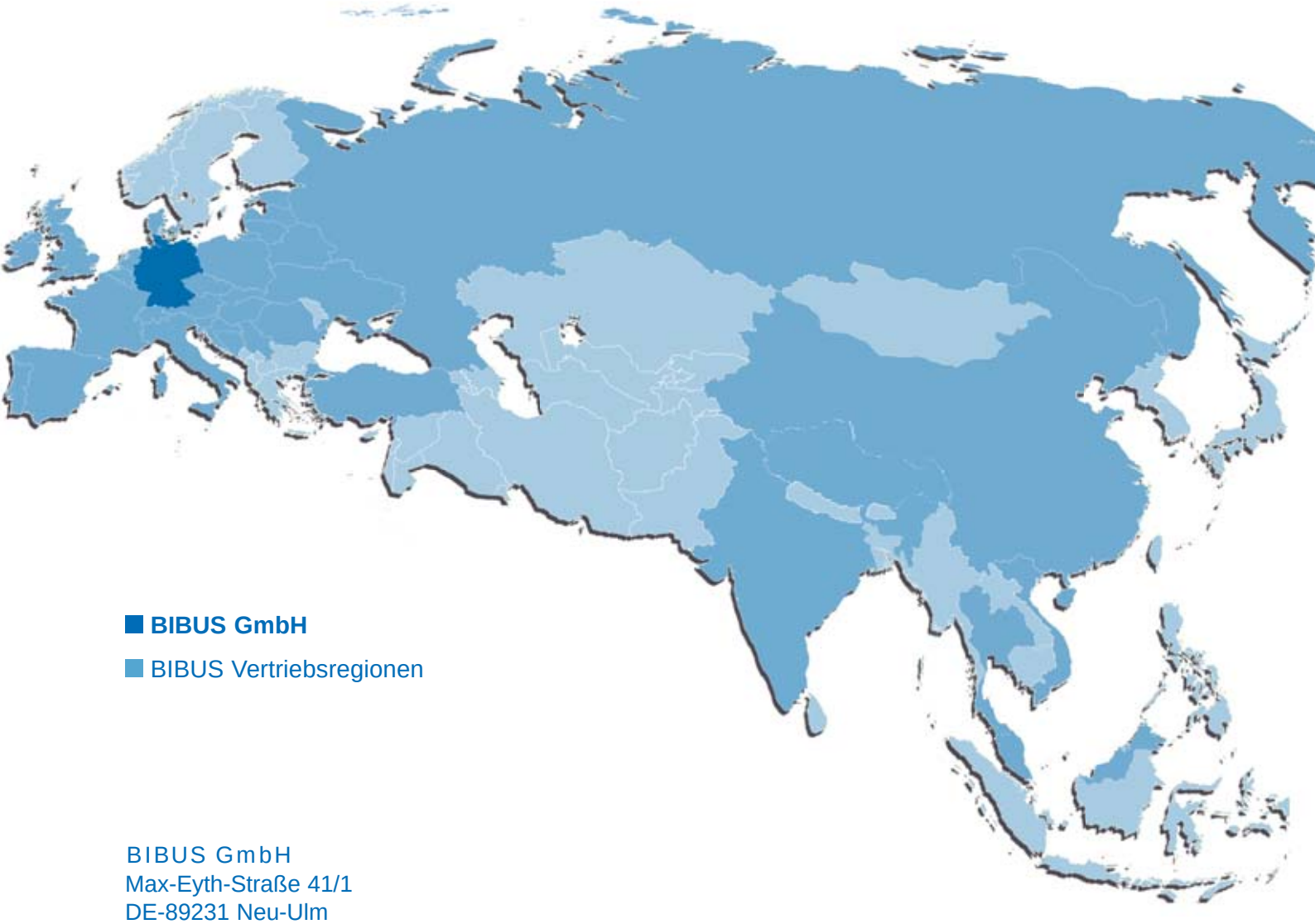
All splines with curves which pass through or are above and to the right of the plotted point are suitable for the example.

ENTWICKLUNG

LOGISTIK

SERVICE

BIBUS SUPPORTING YOUR SUCCESS



BIBUS GmbH

BIBUS Vertriebsregionen

BIBUS GmbH
Max-Eyth-Straße 41/1
DE-89231 Neu-Ulm

Telefon: +49 731 20769-0
Telefax: +49 731 20769-620

E-Mail: info@bibus.de
www.bibus.de

www.thomsonlinear.com

THOMSON

Linear Motion. Optimized.™

Worm_Gear_Screw_Jacks_CTDE-0007-02 | 20181023SK