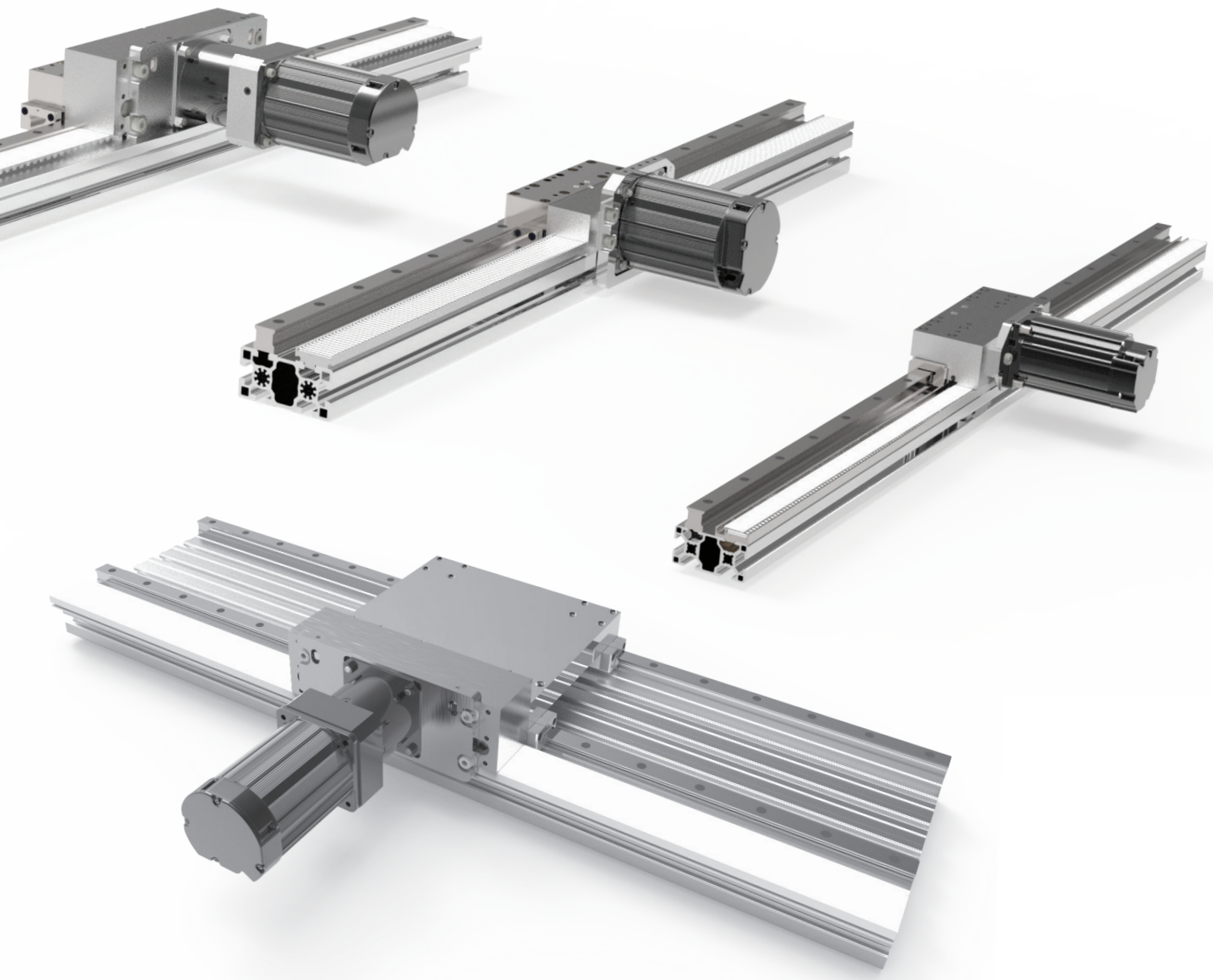
# Bell Everman



## ServoBelt™ Linear

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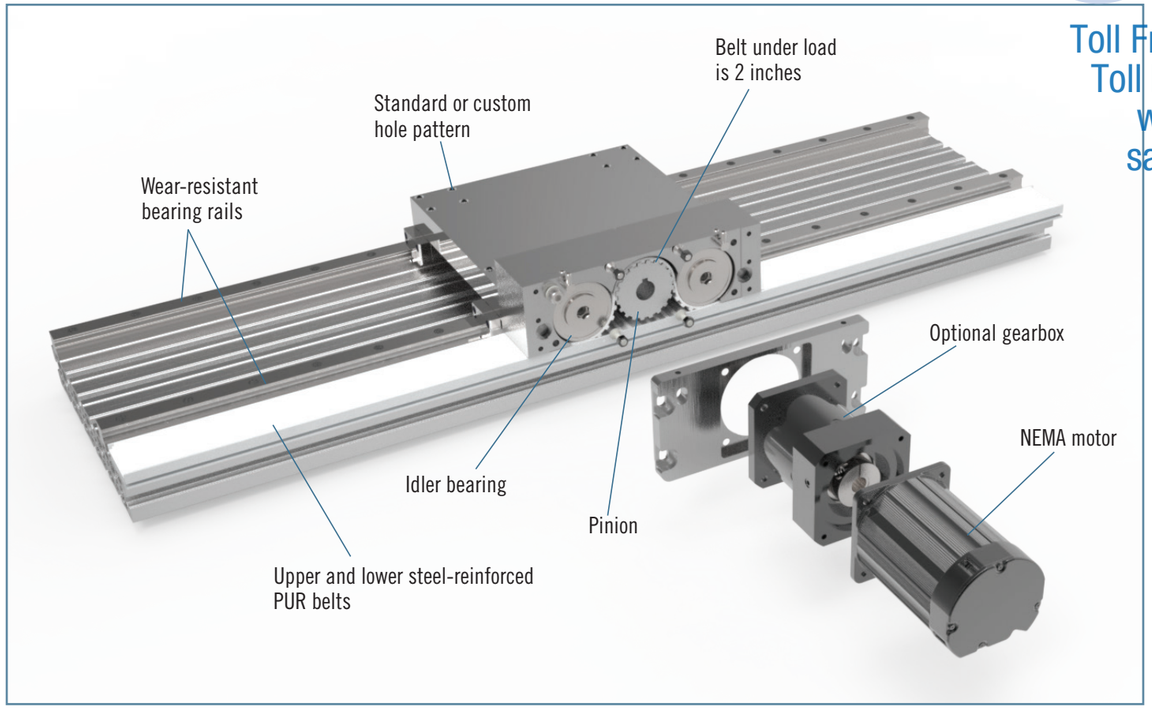


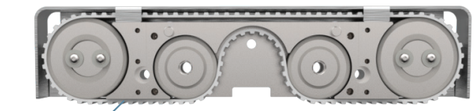

- **High Performance, Low Cost.** With speeds up to 4 m/s and repeatability up to ± 4 µm per meter, ServoBelt Linear compares favorably to high-end linear motor drives costing thousands more.
- **Limitless Scalability.** With a modular chassis based on standard Bosch-Rexroth T-slot extrusions, ServoBelt Linear offers virtually limitless travel distances, making it easy to create large-format motion systems.
- **Multiple Carriages and Axes.** A single ServoBelt Linear axis will support multiple carriages with independent motion. Multi-axis configurations include Cartesian motion systems and gantry robots.

*Custom Gantry*

*Lab Automation System*

## ServoBelt Carriage Styles

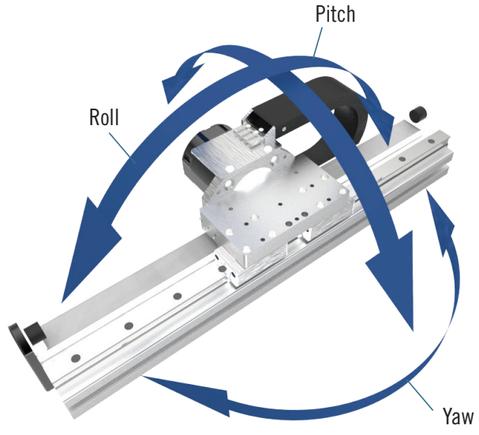
LoopTrack

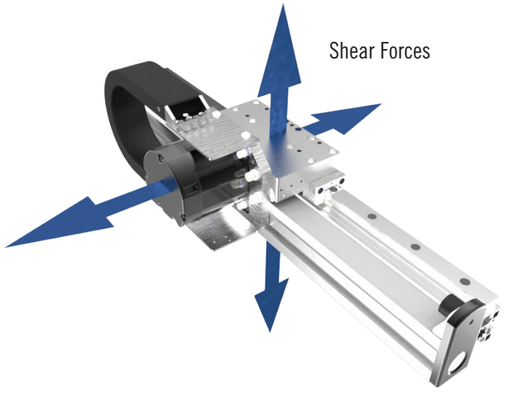



Standard


ServoBelt Linear comes in two different carriage styles. The **Standard** carriage is more compact and uses our dual-belt drive technology. This carriage style is suitable for most applications. The **LoopTrack** carriage is a design in which the upper drive belt loops continuously within the carriage itself. It prevents the possibility of belt sag in inverted or cantilevered applications. Both carriages have a new "shoe" feature that doubles the pullout strength of the belt teeth compared to early ServoBelt designs.

## Moments and Forces





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# How Do I Size ServoBelt Linear?

### Estimate Required Linear Force

- Convert your desired acceleration to g's.
- Determine moving weight in pounds by adding payload, carriage, motor and gearhead weights.
- Calculate linear force as weight × g's.

### Select a ServoBelt Class

- Refer to **Maximum Force Table** and verify your application forces are under the recommended value.
- Refer to **Lifecycle Expectations Table** for the approximate life of the upper belt based on your application's force as percentage of Maximum Recommended.

### Calculate Length

ServoBelt's overall length (OAI) will be the sum of your carriage length from the Carriage Table, hardstop dead length from the Hardstop Table and travel in 10-mm increments.

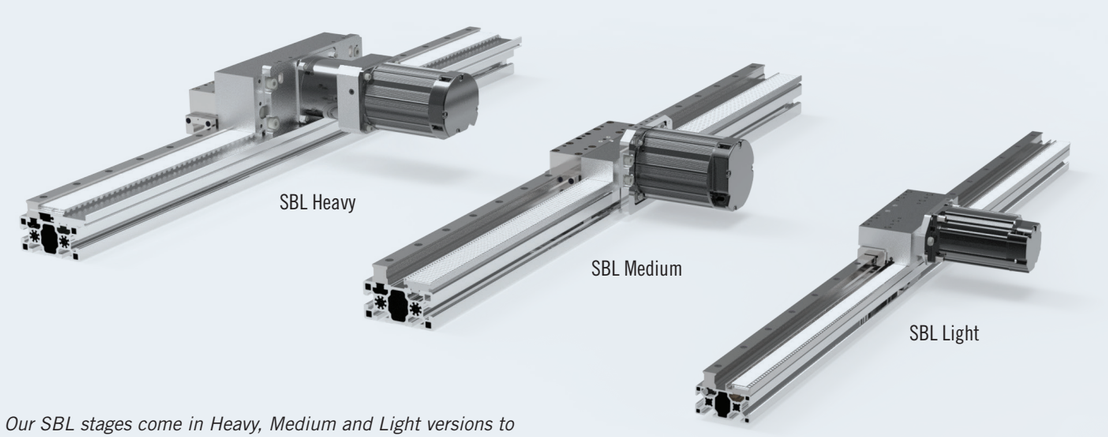
### Think Rack-and-Pinion

ServoBelt Linear can also be analyzed in a number of motor sizing programs as a rack-and-pinion system. Use 23.87 as the pitch diameter for the Light and Medium models and 63.66 mm as the pitch diameter for the Heavy Model.

### Carriage Table

| | Carriage Weight (lb) less motor | Length (in) | Minimum Multi Carriage Spacing (in) |
|---|---|---|---|
| SBL-L SHORT | 2.39 | 4.33 | n/a |
| SBL-L LONG | 2.87 | 6.29 | n/a |
| SBL-M-90 | 6.01 | 6.29 | 7.24 |
| SBL-M-LT-90 | 6.76 | 6.29 | 8.66 |
| SBL-M-180 | 10.07 | 6.29 | 7.24 |
| SBL-M-LT-180 | 10.47 | 6.29 | 8.66 |
| SBL-M-270 | 11.96 | 6.29 | 7.24 |
| SBL-M-LT-270 | 13.48 | 6.29 | 8.66 |
| SBL-H-90 | 11 | 9.84 | 10.75 |
| SBL-H-LT-90 | 18.48 | 9.84 | 16.81 |
| SBL-H-180 | 17 | 9.84 | 10.75 |
| SBL-H-LT-180 | 23.27 | 9.84 | 16.81 |
| SBL-H-270 | 21.4 | 9.84 | 10.75 |
| SBL-H-LT-270 | 29 | 9.84 | 16.81 |

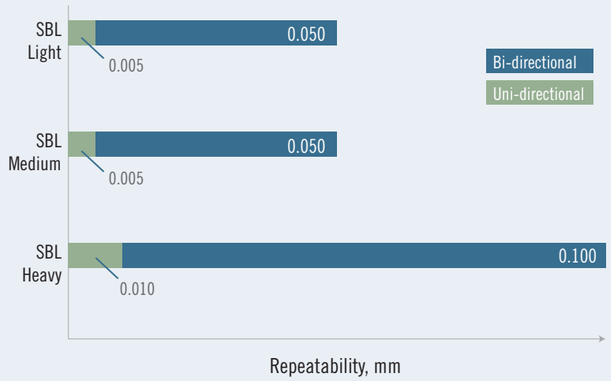
Notes:
1. -90 implies a single rail with two 4-hole 20 mm bearing blocks, -180 and -270 are dual rail.
2. ServoBelt Light not available with multi-carriage other than as a special.
3. ServoBelt Heavy always gets a gearhead because of its large pinion diameter. We have belt reducers available to allow a linear encoder loop closure.
4. Linear encoder requires use of long carriage.




*Our SBL stages come in Heavy, Medium and Light versions to meet a variety of force requirments.*

### Repeatability Range

Repeatability depends on the application's acceleration profile. Here's a range for all three models.




Bi-Directional repeatability can be greatly enhanced by experimentation with deceleration values. Ask us about this.

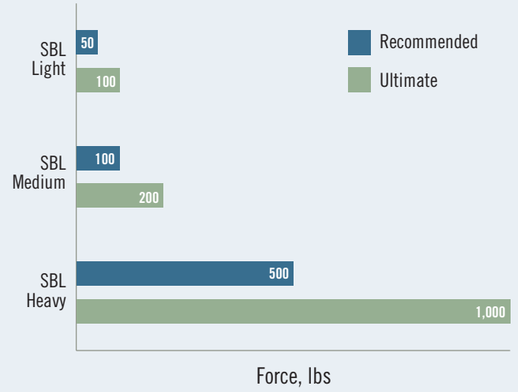
### Hardstop Table

| Type | Dead Length, standard (in) | Dead length, heavy style (in) |
|---|---|---|
| SBL-L | 140 mm | 190 mm |
| SBL-M | 190 mm | 240 mm |
| SBL-H | 190 mm | 240 mm |

Notes:
1. Stops are hard rubber. Consult engineering for shock absorbers.

### Maximum Linear Forces

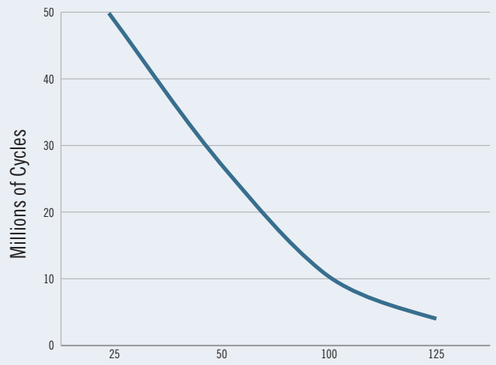
SBL models differ primarily in the amount of linear force they can deliver.




Ultimate Force Capacity is the load at which the belt will skip around the drive pinion. It is a non-destructive event but not intended as a repetitive overload protection.

### Lifecycle Expectations

As a function of recommended operating forces.




Notes:
1. Life curve extrapolated from test data.
2. At end of life, failure mode is detachment of a tooth from its reinforcement.
3. Replacement of the upper belt is all that would be required.
4. Life assumes a light, one time coat of mesh with food grade mineral oil.
5. Life numbers generated without retensioning or relubrication.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| OVERVIEW | ServoBelt Linear | | |
|---|---|---|---|
| | SBL-L<br>ServoBelt Linear, Light Duty | SBL-M<br>ServoBelt Linear, Medium Duty | SBL-H<br>ServoBelt Linear, Heavy Duty |
| Type | Rotary Drive Linear,<br>NEMA 23 or user motor | Rotary Drive Linear,<br>NEMA 23, 34 or user motor | Rotary Drive Linear,<br>NEMA 34 or user motor |
| Maximum Linear Force (lbs)<br>Recommended \| Ultimate | 50 \| 100 | 100 \| 200 | 500 \| 1000 |
| Linear travel<br>Per pinion revolution (mm) \| Pitch Diameter | 75 \| 0.940 | | 200 \| 2.506 |
| Bearing type | Preloaded 4-row recirculating ball, standard or corrosion resistant | | |
| Maximum length | 5.5 m with single-piece chassis<br>Virtually limitless travel distances with chassis splices | | |
| Motor type | 3-phase brushless servo or user supplied of any type | | |
| Accuracy (µm)<br>Linear accuracy at stage centerline | Linear optical encoder: ±4 / meter<br>Rotary encoder: ±135 / full travel | | |
| Uni-directional repeatability (µm)<br>Achievable under ideal conditions | ±10 | | ±15 |
| Bi-directional repeatability (µm) | ±25 to ±125 depending on deceleration profile | | ±80 to ±130 depending on deceleration profile |
| Angular deviation (±arc-sec)<br>Yaw angle maximum in the plane of the base. Most chassis are flexible enough that this value is generally the achievable number when the unit is straightened on user surface. | ±20 | | |
| Encoder type and resolutions:<br>rotary (CPR), linear (µm) | 16 KCPR (NEMA 23) rotary motor encoder; 1 µm magnetic linear; 1 µm, 0.5 µm, 0.2 µm, 0.1 µm optical linear | 16 KCPR (NEMA 23), 16 KCPR (NEMA 34) rotary motor encoder; 1 µm magnetic linear; 1 µm, 0.5 µm, 0.2 µm, 0.1 µm optical linear | 16 KCPR (NEMA 34) rotary motor encoder; 1 µm magnetic linear; 1 µm, 0.5 µm, 0.2 µm, 0.1 µm optical linear |
| Speed (m/sec) | 4 | | |
| Max shear for $10^6$ m @ 2 m/sec (N) | 840 | 2028 (single rail)<br>4057 (double rail) | |
| Max pitch and yaw moment for<br>$10^6$ m @ 2 m/sec (N-m) | 5.6 | 110 (single rail)<br>220 (double rail) | |
| Max roll moment for $10^6$m @ 2m/sec (N-m) | 5.6 | 25 (single rail)<br>183, 365, 232<br>(-180, -270, -90S) | 25 (single rail)<br>183, 365 (-180, -270) |
| Ultimate dynamic belt life<br>Out-and-back cycles to belt failure at load in Newtons | 50 M cycles @ 13 lb<br>25 M cycles @ 25 lb<br>18 M cycles @ 38 lb<br>9 M cycles @ 50 lb | 50 M cycles @ 25 lb<br>25 M cycles @ 50 lb<br>18 M cycles @ 75 lb<br>9 M cycles @ 100 lb | 25 M cycles @ 300 lb |

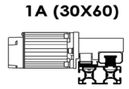
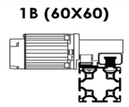
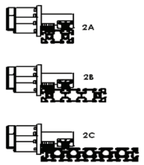
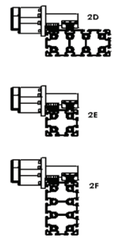
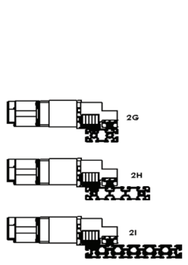
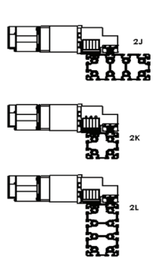
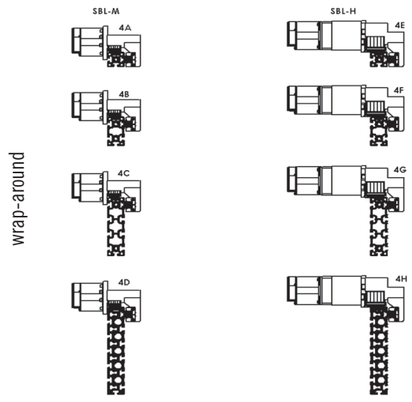


## Available Motors

The following chart lists specifications for the motors we supply. ServoBelt also supports equivalent motors chosen or supplied by our customers. ServoBelt quotes assume that we will modify an adapter plate if necessary, though your motor may already be in our large database of adapter plates. Customer furnished motors are installed after stage burn-in. If using non-motors, refer to this table for a motor's maximum speed at a particular bus voltage. Note that Teknic Motors with integrated Clearpath drives do not exceed 75 vdc, or 4,500 RPM.

| MOTOR | MOTOR TYPE | # OF POLES | Cont. Stall Torque or Force | | KV | VMAX 24VDC | VMAX 48VDC | VMAX 75VDC | VMAX 150VDC | VMAX 300VDC | CONT OUPUT | TMAX@VMAX | | MOTOR WEIGHT | INERTIA | | | INDUCTANCE | RESISTANCE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number of poles | Oz-in | IN-LB | V/kRPM | Max RPM at stated DC bus voltage | | | | | Watts | OZ-IN | IN-LB | LB | oz-in-sec$^2$ | LB-IN$^2$ | kg-m$^2$ | mH | ohm |
| ---Our Rotary Motors--- | | | | | | | | | | | | | | | | | | | |
| Teknic 2311S | 3-PH BLDC | 8 | 60 | 3.75 | 12.38 | 700 | 2500 | 4500 | 6000 | 6000 | 228 | 51.0 | 3.2 | 1.38 | 0.0011 | 0.026543 | 0.0000077665 | 2.932 | 2.760 |
| Teknic 2311P | 3-PH BLDC | 8 | 60 | 3.75 | 6.19 | 2900 | 6000 | 6000 | 6000 | 6000 | 228 | 51.0 | 3.2 | 1.38 | 0.0011 | 0.026543 | 0.0000077665 | 0.733 | 0.690 |
| Teknic 2321S | 3-PH BLDC | 8 | 114 | 7.125 | 21 | 410 | 1500 | 2700 | 6000 | 6000 | 399 | 90.0 | 5.6 | 2.05 | 0.0023 | 0.055499 | 0.0000162390 | 3.662 | 2.464 |
| Teknic 2321P | 3-PH BLDC | 8 | 114 | 7.125 | 10.5 | 1750 | 3900 | 6000 | 6000 | 6000 | 399 | 90.0 | 5.6 | 2.05 | 0.0023 | 0.055499 | 0.0000162390 | 0.915 | 0.616 |
| Teknic 2331S | 3-PH BLDC | 8 | 153 | 9.5625 | 26.5 | 330 | 1150 | 2150 | 4900 | 6000 | 525 | 118.0 | 7.4 | 2.41 | 0.0035 | 0.084455 | 0.0000247115 | 3.545 | 2.418 |
| Teknic 2331P | 3-PH BLDC | 8 | 153 | 9.5625 | 13.25 | 1500 | 3200 | 5200 | 6000 | 6000 | 525 | 118.0 | 7.4 | 2.41 | 0.0035 | 0.084455 | 0.0000247115 | 0.886 | 0.605 |
| Teknic 2341S | 3-PH BLDC | 8 | 183 | 11.4375 | 35.36 | 230 | 900 | 1550 | 3750 | 6000 | 458 | 102.0 | 6.4 | 2.76 | 0.0049 | 0.118237 | 0.0000345961 | 4.585 | 2.980 |
| Teknic 2341P | 3-PH BLDC | 8 | 183 | 11.4375 | 17.68 | 1050 | 2350 | 3800 | 6000 | 6000 | 458 | 102.0 | 6.4 | 2.76 | 0.0049 | 0.118237 | 0.0000345961 | 0.745 | 1.146 |
| Teknic 3411S | 3-PH BLDC | 8 | 150 | 9.375 | 28.36 | 230 | 1000 | 2000 | 4600 | 6000 | 471 | 106.0 | 6.6 | 3.1 | 0.01 | 0.2413 | 0.0000706044 | 3.900 | 3.000 |
| Teknic 3411P | 3-PH BLDC | 8 | 150 | 9.375 | 14.18 | 1000 | 2650 | 4500 | 6000 | 6000 | 471 | 106.0 | 6.6 | 3.1 | 0.01 | 0.2413 | 0.0000706044 | 0.975 | 0.750 |
| Teknic 3421S | 3-PH BLDC | 8 | 288 | 18 | 46.76 | 230 | 700 | 1200 | 2750 | 6000 | 665 | 142.0 | 8.9 | 4.6 | 0.0206 | 0.497078 | 0.0001454450 | 4.791 | 2.496 |
| Teknic 3421C | 3-PH BLDC | 8 | 288 | 18 | 23.38 | 700 | 1650 | 2750 | 6000 | 6000 | 665 | 142.0 | 8.9 | 4.6 | 0.0206 | 0.497078 | 0.0001454450 | 1.198 | 0.624 |
| Teknic 3431S | 3-PH BLDC | 8 | 400 | 25 | 49.08 | 230 | 700 | 1200 | 2700 | 5000 | 656 | 119.0 | 7.4 | 6.2 | 0.0295 | 0.711835 | 0.0002082829 | 3.452 | 1.420 |
| Teknic 3431C | 3-PH BLDC | 8 | 400 | 25 | 24.54 | 740 | 1650 | 2750 | 5000 | 5000 | 656 | 119.0 | 7.4 | 6.2 | 0.0295 | 0.711835 | 0.0002082829 | 0.863 | 0.355 |
| Teknic 3441S | 3-PH BLDC | 8 | 478 | 29.875 | 78.78 | 80 | 350 | 720 | 1650 | 3600 | 657 | 223.0 | 13.9 | 7.88 | 0.0401 | 0.967613 | 0.0002831236 | 6.640 | 2.637 |
| Teknic 3441P | 3-PH BLDC | 8 | 461 | 28.8125 | 39.39 | 350 | 930 | 1622 | 3550 | 4200 | 657 | 108.0 | 6.8 | 7.88 | 0.0401 | 0.967613 | 0.0002831236 | 1.660 | 0.659 |

## Single Rail Configurations

| Duty Class | Chassis X-Section (mm x mm) h x w | Description | Figure | Maximum Axial Force (lb) | | | | Chassis Stiffness (million lb/in²) | | Chassis Weight (lb/in) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Stall | 0.5 m/s | 2 m/s | 4 m/s | vertical direction | horizontal direction | |
| **SBL-L**ight Single Rail | 30x60 | short carriage (no linear encoder)   | 1A | 35 | 27 | 21 | 18 | 4 | 6 | 0.20 |
| | 60x60 | | 1B | | | | | 19 | 11 | 0.26 |
| | 30x60 | linear encoder-capable carriage   | 1A | | | | | 4 | 6 | 0.20 |
| | 60x60 | | 1B | | | | | 19 | 11 | 0.26 |
| **SBL-M**edium Single Rail | 45x90 | horizontal larger extrusion   vertical larger extrusion   | 2A | 104 | 80 | 62 | 53 | 18 | 36 | 0.44 |
| | 45x180 | | 2B | | | | | 26 | 191 | 0.53 |
| | 45x270 | | 2C | | | | | 42 | 1009 | 1.14 |
| | 90x180 | | 2D | | | | | 135 | 339 | 0.86 |
| | 90x90 | | 2E | | | | | 85 | 57 | 0.51 |
| | 180x90 | | 2F | | | | | 462 | 104 | 0.86 |
| **SBL-H**eavy Single Rail | 45x90 |     | 2G | 313 | 230 | 200 | 182 | 18 | 36 | 0.49 |
| | 45x180 | | 2H | | | | | 26 | 191 | 0.58 |
| | 45x270 | | 2I | | | | | 42 | 1009 | 1.19 |
| | 90x180 | | 2J | | | | | 135 | 339 | 0.90 |
| | 90x90 | | 2K | | | | | 85 | 57 | 0.56 |
| | 180x90 | | 2L | | | | | 462 | 104 | 0.90 |
| **SBL-M**edium Single Rail | 45x45 | wrap-around   | 4A | 104 | 80 | 62 | 53 | 4 | 12 | 0.32 |
| | 90x45 | | 4B | | | | | 36 | 11 | 0.44 |
| | 180x45 | | 4C | | | | | 242 | 17 | 0.53 |
| | 270x45 | | 4D | | | | | 1111 | 32 | 1.14 |
| **SBL-H**eavy Single Rail | 45x45 | | 4E | 313 | 230 | 200 | 182 | 4 | 12 | 0.37 |
| | 90x45 | | 4F | | | | | 36 | 11 | 0.49 |
| | 180x45 | | 4G | | | | | 242 | 17 | 0.58 |
| | 270x45 | | 4H | | | | | 1111 | 32 | 1.19 |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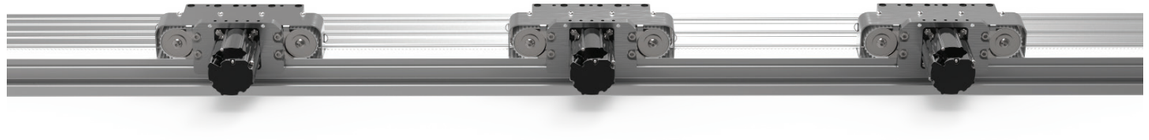
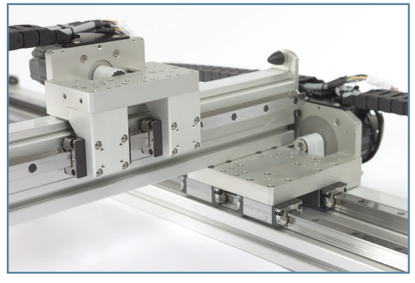
**Dual Rail Configurations**

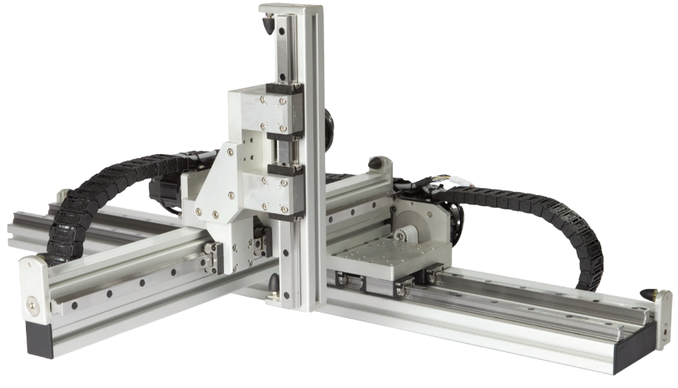
| Duty Class | Chassis X-Section (mm x mm) h x w | Description | Figure | Maximum Linear Force (lb) At Speed | | | | Chassis Stiffness (million lb/in²) | | Chassis Weight (lb/in) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Stall | 0.5 m/s | 2 m/s | 4 m/s | vertical direction | horizontal direction | |
| **SBL-M**edium Dual Rail | 45x180 | horizontal larger extrusion | 3A | 104 | 80 | 62 | 53 | 33 | 259 | 0.69 |
| | 45x270 | | 3B | | | | | 53 | 1218 | 1.29 |
| | 90x180 | | 3C | | | | | 164 | 408 | 1.01 |
| | 90x90 | vertical larger extrusion | 3D | | | | | 116 | 62 | 0.66 |
| | 180x90 | | 3E | | | | | 589 | 109 | 1.01 |
| **SBL-H**eavy Dual Rail | 45x180 | horizontal larger extrusion | 3F | 313 | 230 | 200 | 182 | 33 | 259 | 0.74 |
| | 45x270 | | 3G | | | | | 53 | 1218 | 1.34 |
| | 90x180 | | 3H | | | | | 164 | 408 | 1.06 |
| | 90x90 | vertical larger extrusion | 3I | | | | | 116 | 62 | 0.71 |
| | 180x90 | | 3J | | | | | 589 | 109 | 1.06 |
| **SBL-M**edium Dual Rail | 45x180 | wrap-around | 5A | 104 | 80 | 62 | 53 | 328 | 20 | 0.69 |
| | 45x270 | | 5B | | | | | 1351 | 35 | 1.14 |
| **SBL-H**eavy Dual Rail | 45x180 | | 5C | 313 | 230 | 200 | 182 | 328 | 20 | 0.74 |
| | 45x270 | | 5D | | | | | 1351 | 35 | 1.34 |

## Multiple Carriage LoopTrack



*ServoBelt LoopTrack supports multiple, independently moving carriages.*





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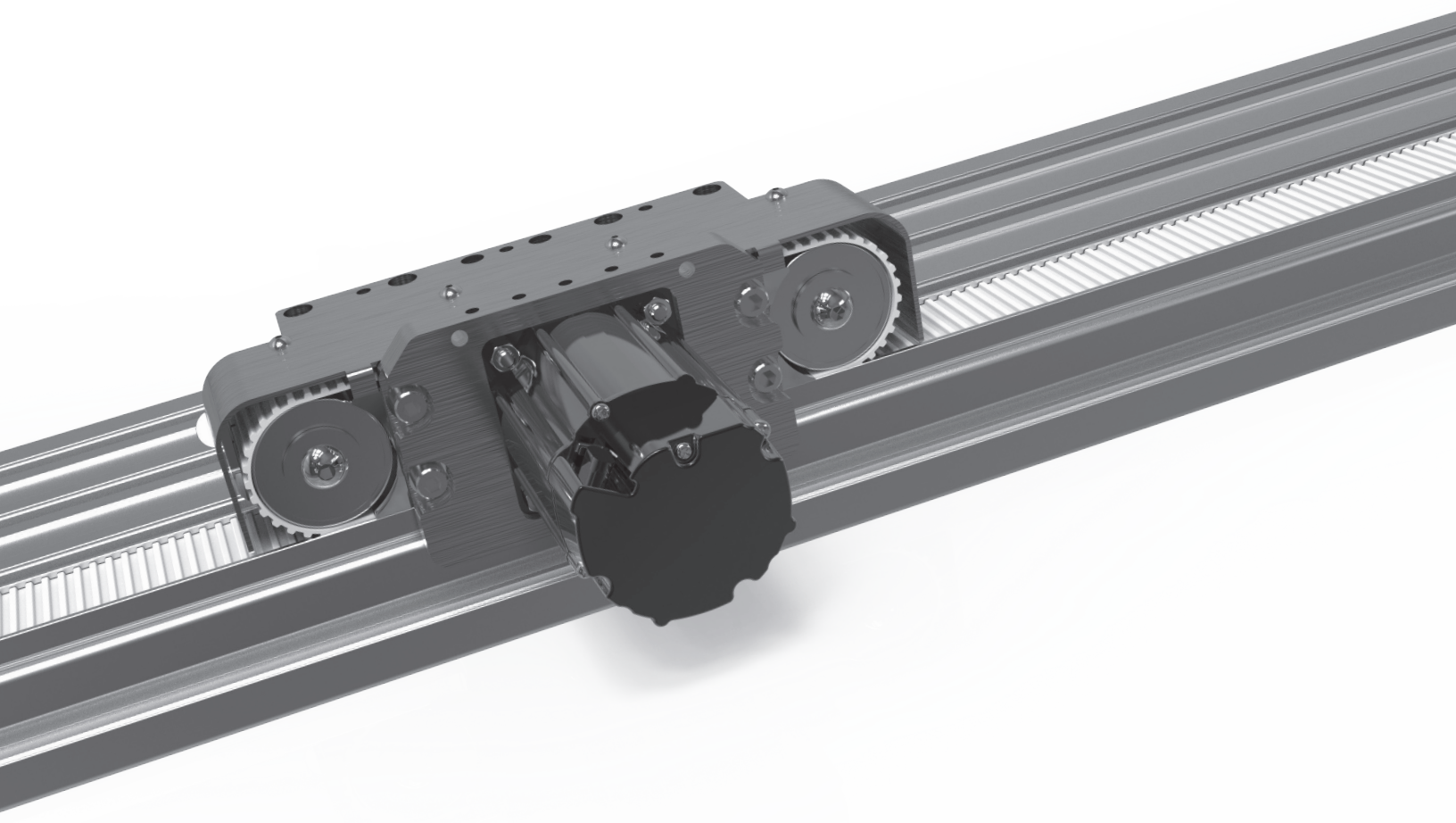



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