



Hevi-Rail

CAM Roller Technology

Roller Bearings & Linear Guideways



HEVI-RAIL



Configure Online at
pbclinear.com

1-800-962-8979

Hevi-Rail®

	Combined Hevi-Rail Bearing		Rail		Flange Plate	Clamp Flange	Bearing with welded flange plate*		System MAX Static Load** kN		General Dimensions*** mm				
	Fixed	Adjustable	U-Channel	I-channel			fixed	adjustable	Radial	Axial	A	B	C	D	E
HVB-053	-		HVR-S	-	HVPS-1	-	HVB-053/HVPS	-	5.23	1.68	52.5	30	33.0	65.0	30.0
HVB-054	HVBEA-454		HVR-0	-	HVPO-1	HVC-0	HVB-054/HVPO	HVBEA-454/HVPO	10.30	3.20	62.0	30	37.5	86.5	36.0
HVB-055	HVBEA-455		HVR-1	HVRI-07	HVP1-1	HVC-1	HVB-055/HVP1	HVBEA-455/HVP1	12.40	3.87	70.1	35	44.0	103.2	40.0
HVB-056	HVBEA-456		HVR-2	-	HVP2-1	HVC-2	HVB-056/HVP2	HVBEA-456/HVP2	12.90	4.00	77.7	40	48.0	121.3	41.0
HVB-057	HVBEA-457		-	HVRI-08	HVP2-1	-	HVB-057/HVP2	HVBEA-457/HVP2	12.90	4.00	77.7	40	40.7	113.9	66.0
HVB-058	HVBEA-458		HVR-3	HVRI-09	HVP3-1	HVC-3	HVB-058/HVP3	HVBEA-458/HVP3	22.40	7.00	88.4	45	57.0	135.4	53.0
HVB-059	HVBEA-459		-	HVRI-10	-	-	-	-	22.00	7.00	101.2	50	46.0	140.3	69.9
HVB-060	HVBEA-460		-	HVRI-11	-	-	-	-	23.80	7.44	107.7	55	53.0	152.4	83.0
HVB-061	HVBEA-461		HVR-4	-	HVP4-1	HVC-4	HVB-061/HVP4	HVBEA-461/HVP4	23.80	7.44	107.7	60	69.0	157.2	61.2
HVB-062	HVBEA-462		HVR-5	-	HVP4-1	-	HVB-062/HVP4	HVBEA-462/HVP4	33.90	10.60	123.0	60	72.3	175.0	66.2
HVB-063	HVBEA-463		HVR-6	-	HVP6-1	-	HVB-063/HVP6	HVBEA-463/HVP6	59.20	18.50	149.0	60	78.5	201.5	71.2

*For flange plate oriented 90 degrees to either fixed or adjustable, add -90 to the end of the part number (ex. HVB-053/HVPS-90).

System MAX static loads are achievable when used with shown rails. *Detailed dimensions can be found on each product page.

FEATURES & BENEFITS

The economical Hevi-Rail® guide systems offer a lifetime of durability under continuous use. The easily interchangeable bearing components provide even dispersion of forces in the rails for longer system life and stability.

Linear Bearings

- Outer ring made of case-hardened steel
- Handles very high axial and radial loads
- Easily interchangeable components for less down-time
- Fixed and adjustable combined bearings available

Rails

- Standard length up to 6 meters
- Sand blasted or lightly oiled options available
- U-channel or I-channel available

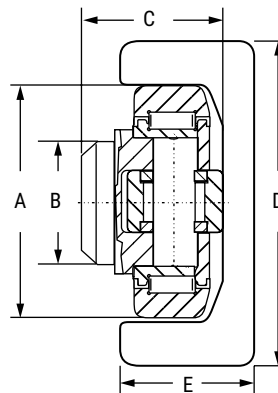
Clamp Flanges

- Eliminates need for welding and straightening
- Easily adjustable parallelism

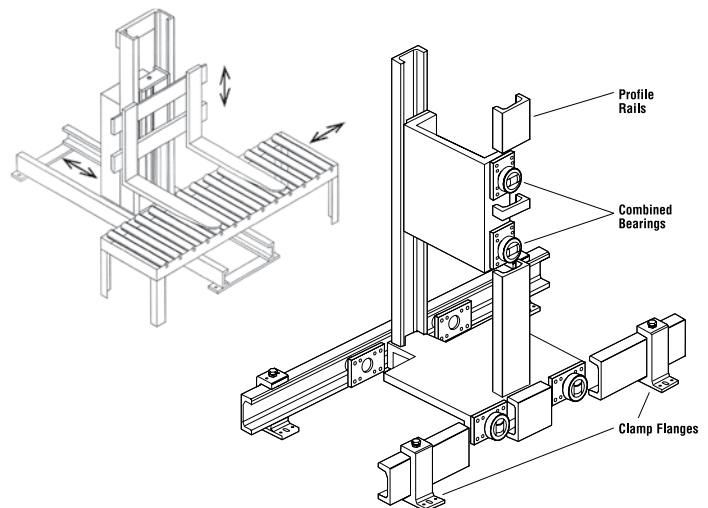
Flange Plates

- Simple mounting for bearings
- Can be ordered pre-welded to bearing

Ordering example: HVB-054/HVPO-1



Sample Hevi-Rail Configurations



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Hevi-Rail® HVB-053 • 0.58 US Ton-Force



Axial Bearing – Fixed HVB-053

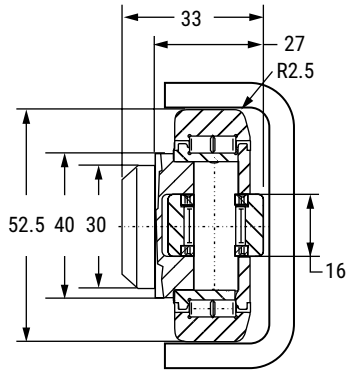
Weight = 0.36 kg

Maximum Bearing Loads:

Radial: Dynamic = 24.50 kN; Static = 32.50 kN

Axial: Dynamic = 7.50 kN; Static = 7.50 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

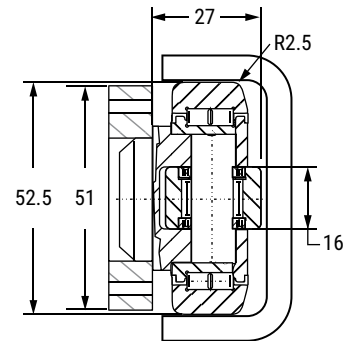
Radial: 5.23 kN/0.58 US Ton-Force

Axial: 1.68 kN/0.18 US Ton-Force

Note: Above loads are achievable when used with shown rails.



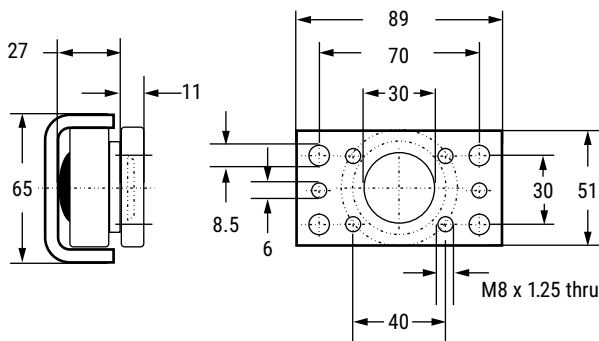
Axial Bearing – Fixed HVB-053/HVPS with welded Flange plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Flange Plate HVPS-1

For ordering separate flange plate only



Rail – U Channel HVR-S

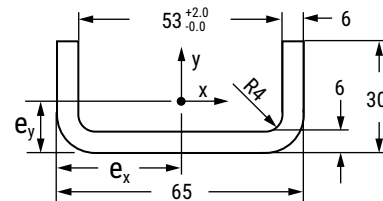
Weight = 5.3 kg/m

Moment of Inertia: $I_x = 5.2 \text{ cm}^4$; $I_y = 38.8 \text{ cm}^4$

Moment of Resistance: $W_x = 2.50 \text{ cm}^3$; $W_y = 11.90 \text{ cm}^3$

Radius of Inertia: $i_x = 0.80 \text{ cm}$; $i_y = 2.40 \text{ cm}$

Distance to Center of Gravity: $e_y = 0.94 \text{ cm}$; $e_x = 32.50 \text{ cm}$



Units of Measurement mm



Email an Application Engineer



Link to video "Hevi-Rail Top 5 Design Tips"

Ordering Information

Part NO.	Description
HVB-053	Fixed axial bearing
HVB-053/HVPS	Fixed axial bearing with welded flange plate
HVPS-1	Flange plate
HVR-S	U-channel profile rail for -53 bearings

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Hevi-Rail® HVB-054 • 1.15 US Ton-Force



Axial Bearing – Fixed HVB-054

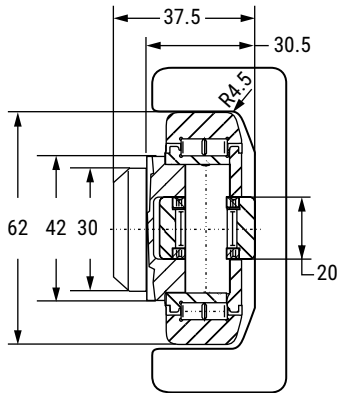
Weight = 0.53 kg

Maximum Bearing Loads:

Radial: Dynamic = 31 kN; Static = 35.5 kN

Axial: Dynamic = 11.50 kN; Static = 11.50 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

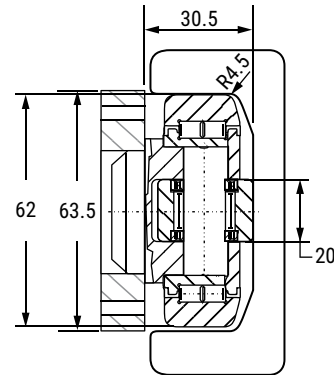
Radial: 10.3 kN/1.15 US Ton-Force

Axial: 3.2 kN/0.35 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-054/HVP0 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-454

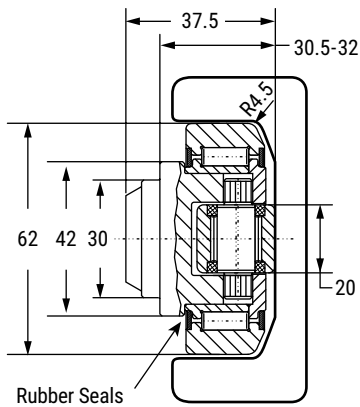
Weight = 0.53 Kg

Maximum Bearing Loads:

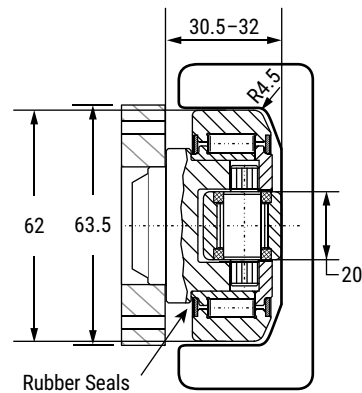
Radial: Dynamic = 31 kN; Static = 35.5 kN

Axial: Dynamic = 11 kN; Static = 11 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-454/HVP0 with welded Flange plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

Hevi-Rail® HVB-054 • 1.15 US Ton-Force

Rail – U Channel HVR-0

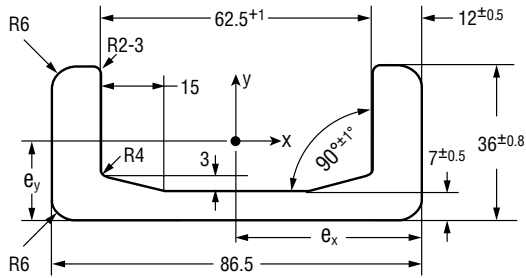
Weight = 10.5 kg/m

Moment of Inertia: $I_x = 15.35 \text{ cm}^4$; $I_y = 137.05 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 6.64 \text{ cm}^3$;
 $W_{x\max} = 11.93 \text{ cm}^3$; $W_y = 31.69 \text{ cm}^3$

Radius of Inertia: $i_x = 1.07 \text{ cm}$; $i_y = 3.20 \text{ cm}$

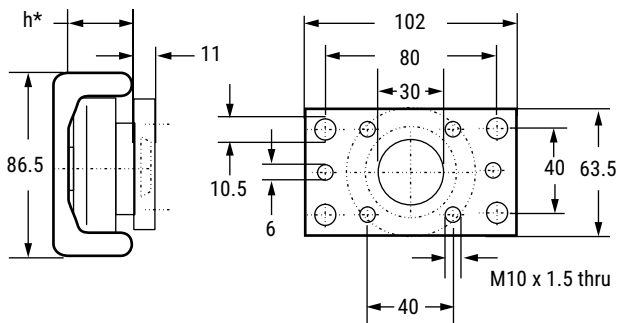
Distance to Center of Gravity: $e_y = 1.29 \text{ cm}$; $e_x = 4.33 \text{ cm}$



● **Hevi-Rail Bearings**
 Can be ordered with pre-welded flange plate

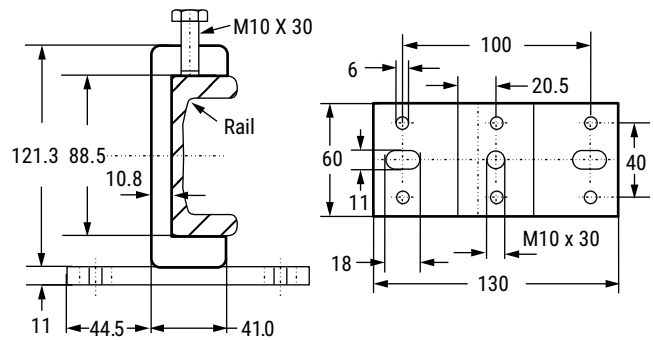
Flange Plate HVP0-1

For ordering separate flange plate only



***Note:** "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-054) or eccentric adjustable bearing (HVBEA-454).

Clamp Flange HVC-0



Ordering Information

Part NO.	Description
HVB-054	Fixed axial bearing
HVB-054/HVP0	Fixed axial bearing with welded flange plate
HVBEA-454	Eccentric adjustable axial bearing
HVBEA-454/HVP0	Eccentric adjustable axial bearing with welded flange plate
HVP0-1	Flange plate
HVR-0	U-channel rail for -54 bearings
HVC-0	Clamp flange

Units of Measurement mm

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Hevi-Rail® HVB-055 • 1.39 US Ton-Force



Axial Bearing Fixed – HVB-055

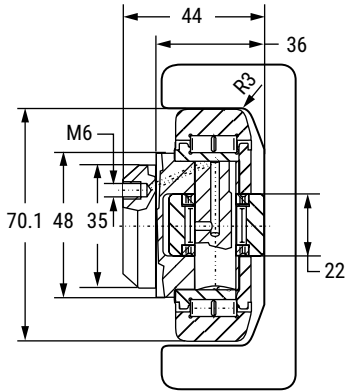
Weight = 0.80 kg

Maximum Bearing Loads:

Radial: Dynamic = 56 kN; Static = 93 kN

Axial: Dynamic = 17 kN; Static = 25 kN

Note: Above loads achievable when used with a hardened rail HRC 58-62 minimum 2.54 mm deep.



System Maximum Static Loads:

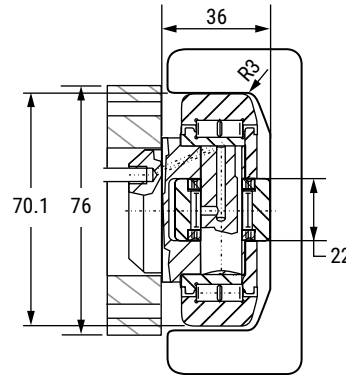
Radial: 12.4 kN/1.39 US Ton-Force

Axial: 3.87 kN/0.43 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-055/HVP1 with welded Flange plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-455

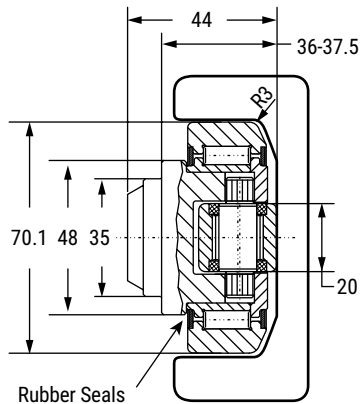
Weight = 0.80 kg

Maximum Bearing Loads:

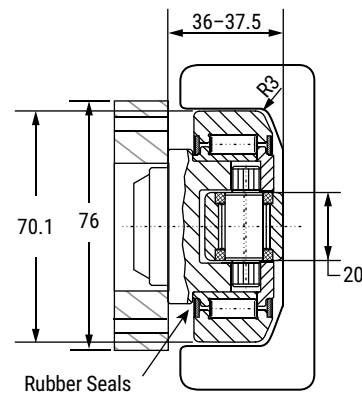
Radial: Dynamic = 45.5 kN; Static = 51 kN

Axial: Dynamic = 13 kN; Static = 14 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-455/HVP1 with welded Flange plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

Hevi-Rail® HVB-055 · 1.39 US Ton-Force

Rail – U Channel HVR-1

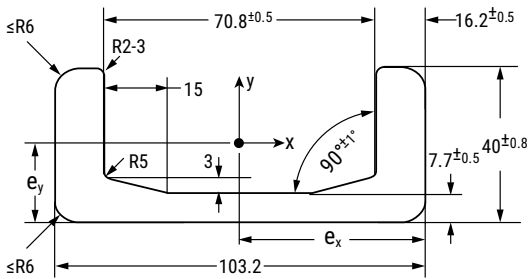
Weight = 14.8 kg/m

Moment of Inertia: $I_x = 27.29 \text{ cm}^4$; $I_y = 273.50 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 10.91 \text{ cm}^3$;
 $W_{x\max} = 18.20 \text{ cm}^3$; $W_y = 53.00 \text{ cm}^3$

Radius of Inertia: $i_x = 1.20 \text{ cm}$; $i_y = 3.81 \text{ cm}$

Distance to Center of Gravity: $e_y = 1.50 \text{ cm}$; $e_x = 5.16 \text{ cm}$



Rail – I Channel HVRI-07

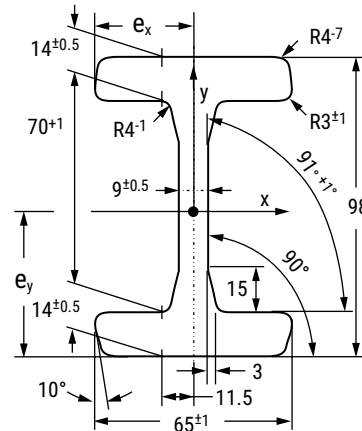
Weight = 19.4 kg/m

Moment of Inertia: $I_x = 344.29 \text{ cm}^4$; $I_y = 57.63 \text{ cm}^4$

Moment of Resistance: $W_x = 70.26 \text{ cm}^3$; $W_y = 17.73 \text{ cm}^3$

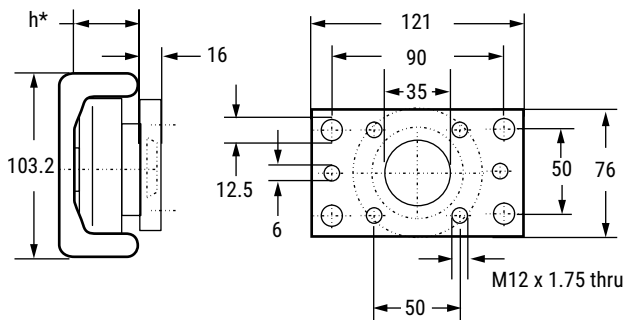
Radius of Inertia: $i_x = 3.73 \text{ cm}$; $i_y = 1.52 \text{ cm}$

Distance to Center of Gravity: $e_y = 4.90 \text{ cm}$; $e_x = 3.25 \text{ cm}$



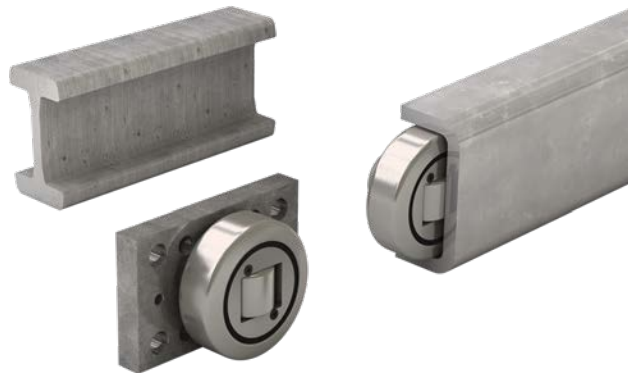
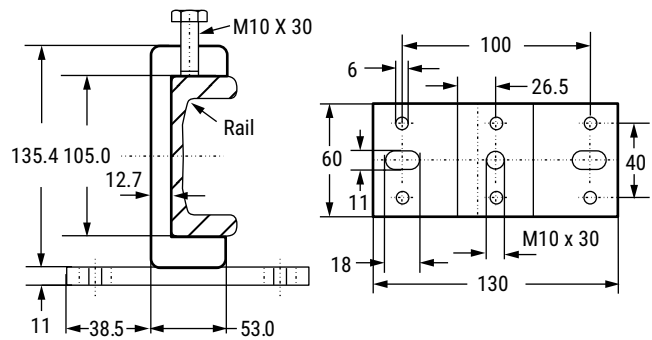
Flange Plate HVP1-1

For ordering separate flange plate only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-055) or eccentric adjustable bearing (HVBEA-455).

Clamp Flange HVC-1



Units of Measurement mm

Ordering Information

Part NO.	Description
HVB-055	Fixed axial bearing
HVB-055/HVP1	Fixed axial bearing with welded flange plate
HVBEA-455	Eccentric adjustable axial bearing
HVBEA-455/HVP1	Eccentric adjustable axial bearing with welded flange plate
HVP1-1	Flange plate
HVR-1	U-channel rail for -55 bearings
HVRI-07	I-channel rail for -55 bearings
HVC-1	Clamp flange

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Hevi-Rail® HVB-056 · 1.45 US Ton-Force



Axial Bearing – Fixed HVB-056

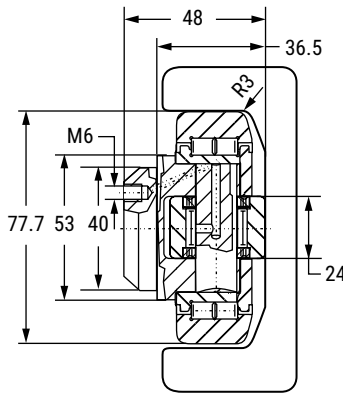
Weight = 1.00 kg

Maximum Bearing Loads:

Radial: Dynamic = 48 kN; Static = 60.8 kN

Axial: Dynamic = 16 kN; Static = 18 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

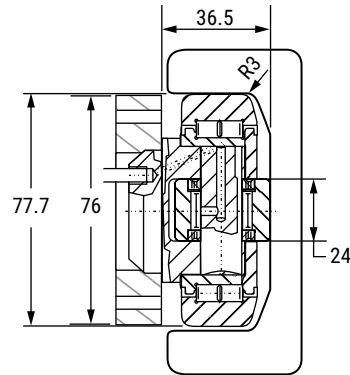
Radial: 12.9 kN/1.45 US Ton-Force

Axial: 4.0 kN/0.44 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-056/HVP2 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-456

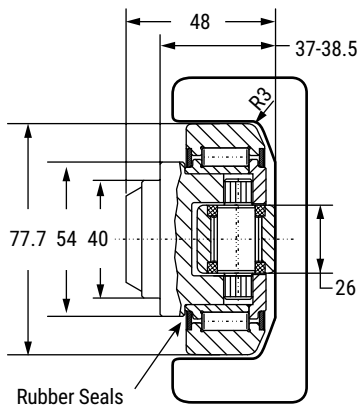
Weight = 1.00 kg

Maximum Bearing Loads:

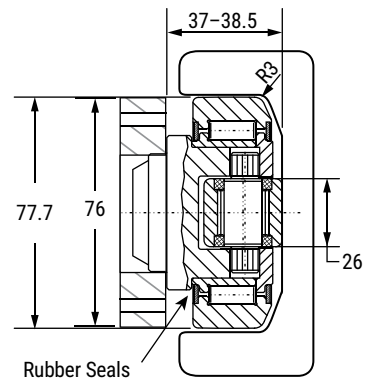
Radial: Dynamic = 48 kN; Static = 56.8 kN

Axial: Dynamic = 18 kN; Static = 18 kN

Note: Above loads achievable when used with a Hardened Rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-456/HVP2 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

Hevi-Rail® HVB-056 • 1.45 US Ton-Force

Rail – U Channel HVR-2

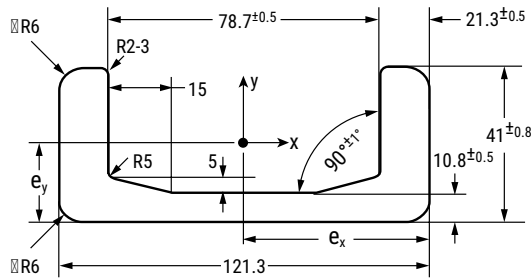
Weight = 20.9 kg/m

Moment of Inertia: $I_x = 37.92 \text{ cm}^4$; $I_y = 493.58 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 14.83 \text{ cm}^3$;
 $W_{x\max} = 24.58 \text{ cm}^3$; $W_y = 81.38 \text{ cm}^3$

Radius of Inertia: $i_x = 1.19 \text{ cm}$; $i_y = 4.30 \text{ cm}$

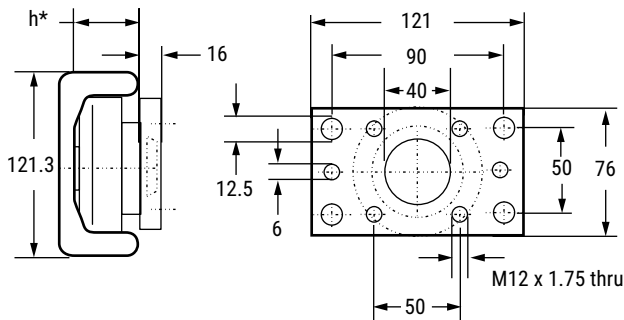
Distance to Center of Gravity: $e_y = 1.54 \text{ cm}$; $e_x = 6.07 \text{ cm}$



● Hevi-Rail Bearings
 Can be ordered with pre-welded flange plate

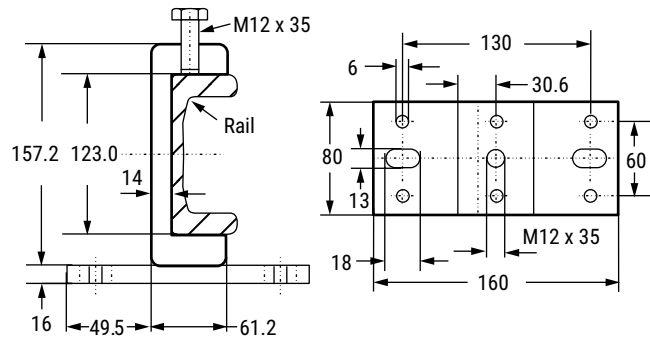
Flange Plate HVP2-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-056) or eccentric adjustable bearing (HVBEA-456).

Clamp Flange HVC-2



Ordering Information

Part NO.	Description
HVB-056	Fixed axial bearing
HVB-056/HVP2	Fixed axial bearing with welded flange plate
HVBEA-456	Eccentric adjustable axial bearing
HVBEA-456/HVP2	Eccentric adjustable axial bearing with welded flange plate
HVP2-1	Flange plate
HVR-2	U-channel rail for -56 bearings
HVC-2	Clamp flange

Units of Measurement mm

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Hevi-Rail® HVB-057 · 1.45 US Ton-Force



Axial Bearing – Fixed HVB-057

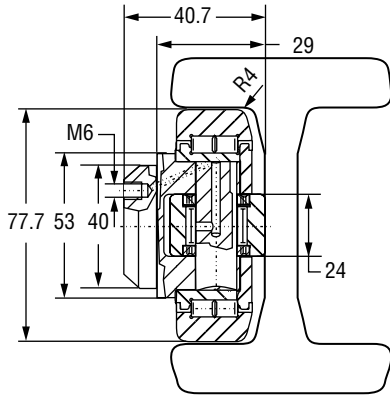
Weight = 0.90 kg

Maximum Bearing Loads:

Radial: Dynamic = 58 kN; Static = 102 kN

Axial: Dynamic = 21 kN; Static = 32 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

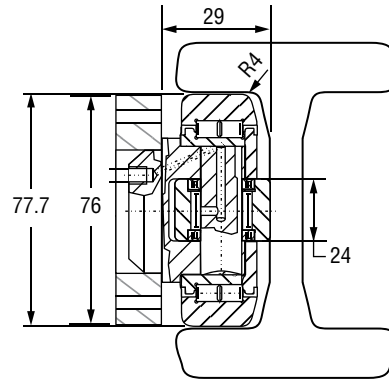
Radial: 12.9 kN/1.45 US Ton-Force

Axial: 4.0 kN/0.44 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-057/HVP2 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-457

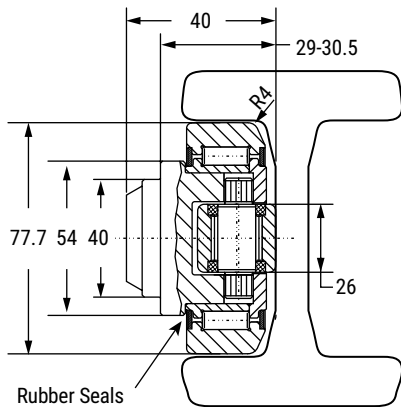
Weight = 0.87 kg

Maximum Bearing Loads:

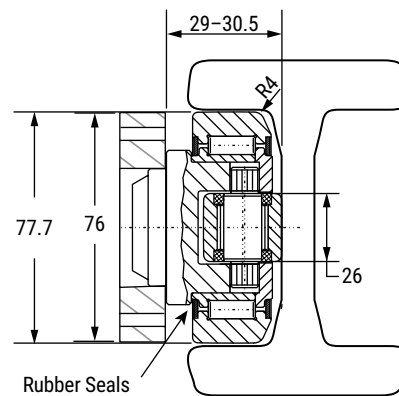
Radial: Dynamic = 48 kN; Static = 56.8 kN

Axial: Dynamic = 18 kN; Static = 18 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-457/HVP2 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

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Rail – I Channel HVRI-08

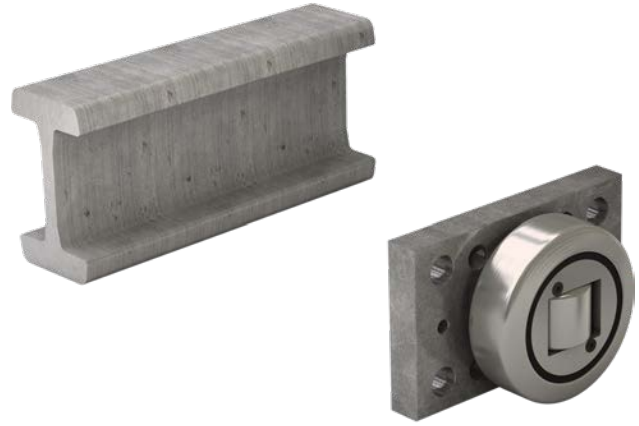
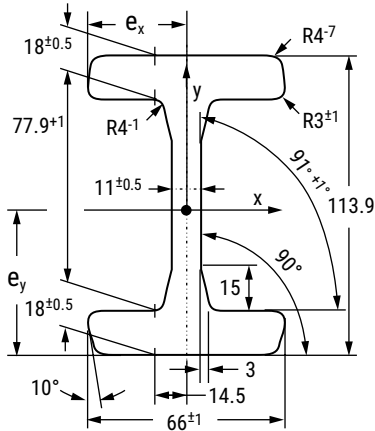
Weight = 25.3 kg/m

Moment of Inertia: $I_x = 597.54 \text{ cm}^4$; $I_y = 76.79 \text{ cm}^4$

Moment of Resistance: $W_x = 104.92 \text{ cm}^3$; $W_y = 23.27 \text{ cm}^3$

Radius of Inertia: $i_x = 4.24 \text{ cm}$; $i_y = 1.54 \text{ cm}$

Distance to Center of Gravity: $e_y = 5.70 \text{ cm}$; $e_x = 3.30 \text{ cm}$

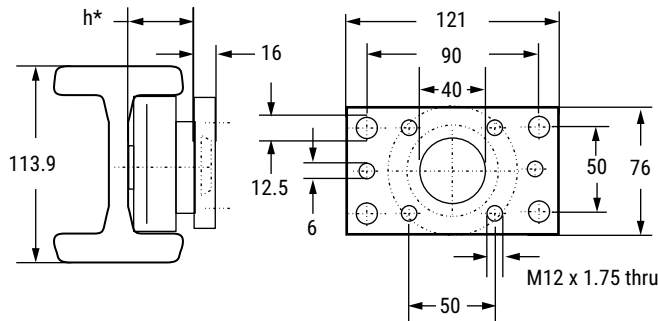


Hevi-Rail Bearings

Can be ordered with pre-welded flange plate

Flange Plate HVP2-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-057) or eccentric adjustable bearing (HVBEA-457).

Ordering Information

Part NO.	Description
HVB-057	Fixed axial bearing
HVB-057/HVP2	Fixed axial bearing with welded flange plate
HVBEA-457	Eccentric adjustable axial bearing
HVBEA-457/HVP2	Eccentric adjustable axial bearing with welded flange plate
HVP2-1	Flange plate
HVRI-08	I-channel rail for -57 bearings

Units of Measurement mm

Hevi-Rail® HVB-058 • 2.51 US Ton-Force



Axial Bearing – Fixed HVB-058

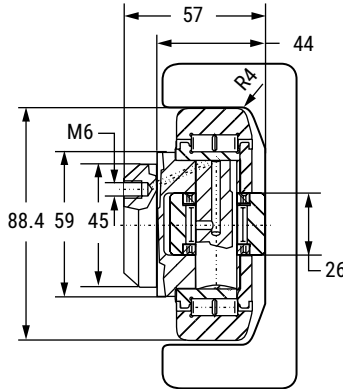
Weight = 1.62 kg

Maximum Bearing Loads:

Radial: Dynamic = 60 kN; Static = 72 kN

Axial: Dynamic = 23 kN; Static = 40 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

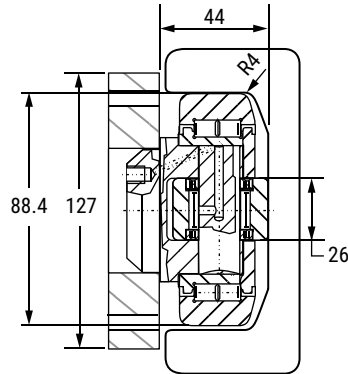
Radial: 22.4 kN/2.51 US Ton-Force

Axial: 7.0 kN/0.78 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-058/HVP3 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-458

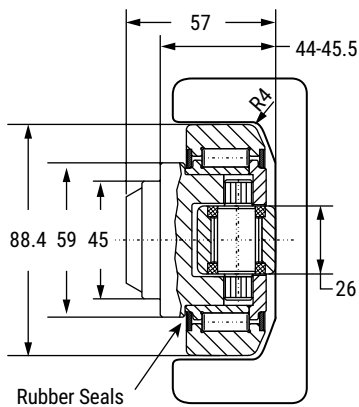
Weight = 1.62 kg

Maximum Bearing Loads:

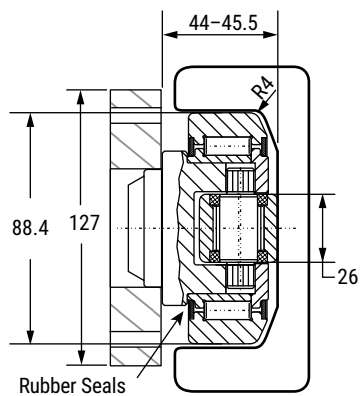
Radial: Dynamic = 68 kN; Static = 72 kN

Axial: Dynamic = 23 kN; Static = 23 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-458/HVP3 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

REDI-RAIL
COMMERCIAL RAIL
HARDENED CROWN ROLLER
FOLLOWER ROLLERS
V-GUIDE
HEVI-RAIL

Hevi-Rail® HVB-058 • 2.51 US Ton-Force

Rail – U Channel HVR-3

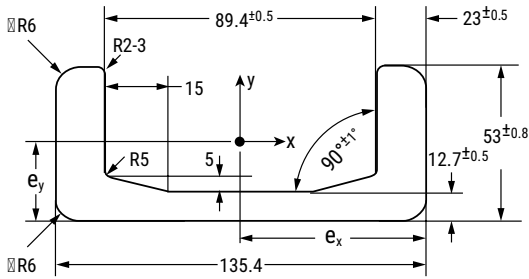
Weight = 28.6 kg/m

Moment of Inertia: $I_x = 89.47 \text{ cm}^4$; $I_y = 865.23 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 27.03 \text{ cm}^3$;
 $W_{x\max} = 44.96 \text{ cm}^3$; $W_y = 127.80 \text{ cm}^3$

Radius of Inertia: $i_x = 1.57 \text{ cm}$; $i_y = 4.87 \text{ cm}$

Distance to Center of Gravity: $e_y = 1.99 \text{ cm}$; $e_x = 6.77 \text{ cm}$



Rail – I Channel HVRI-09

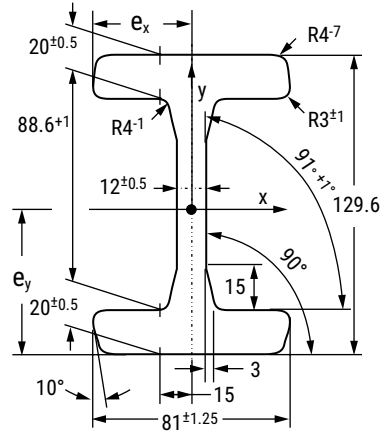
Weight = 34.1 kg/m

Moment of Inertia: $I_x = 1037.22 \text{ cm}^4$; $I_y = 161.89 \text{ cm}^4$

Moment of Resistance: $W_x = 160.07 \text{ cm}^3$; $W_y = 39.97 \text{ cm}^3$

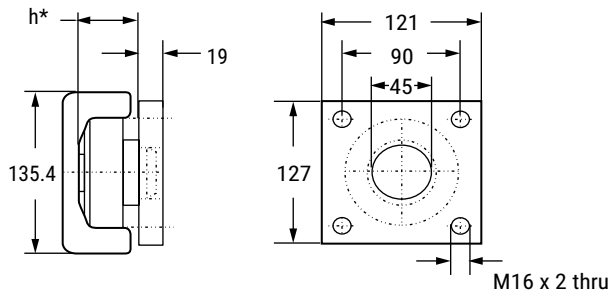
Radius of Inertia: $i_x = 4.89 \text{ cm}$; $i_y = 1.93 \text{ cm}$

Distance to Center of Gravity: $e_y = 6.48 \text{ cm}$; $e_x = 4.05 \text{ cm}$



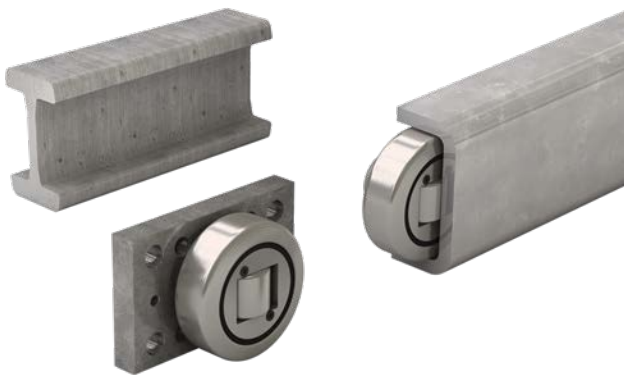
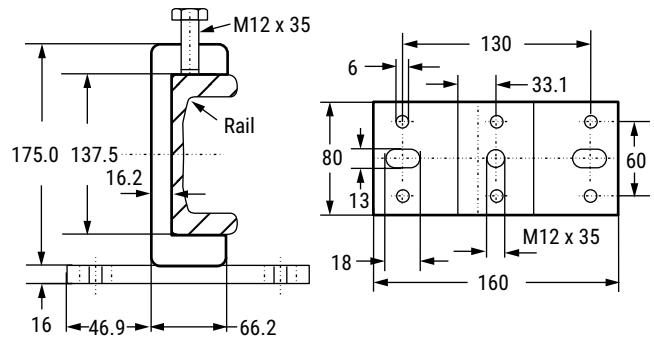
Flange Plate HVP3-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-058) or eccentric adjustable bearing (HVBEA-458).

Clamp Flange HVC-3



Units of Measurement mm

Ordering Information

Part NO.	Description
HVB-058	Fixed axial bearing
HVB-058/HVP3	Fixed axial bearing with welded flange plate
HVBEA-458	Eccentric adjustable axial bearing
HVBEA-458/HVP3	Eccentric adjustable axial bearing with welded flange plate
HVP3-1	Flange plate
HVR-3	U-channel rail for -58 bearings
HVRI-09	I-channel rail for -58 bearings
HVC-3	Clamp flange

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HARDENED CROWN ROLLER

FOLLOWER ROLLERS

V-GUIDE

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Hevi-Rail® HVB-059 • 2.47 US Ton-Force



Axial Bearing – Fixed HVB-059

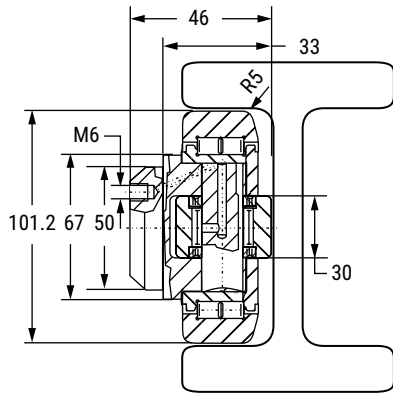
Weight = 1.80 kg

Maximum Bearing Loads:

Radial: Dynamic = 73 kN; Static = 82 kN

Axial: Dynamic = 25 kN; Static = 27 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

Radial: 22 kN/2.47 US Ton-Force

Axial: 7.0 kN/0.78 US Ton-Force

Note: Above loads are achievable when used with shown rails.

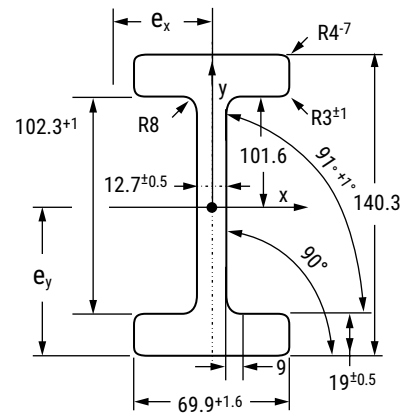
Rail – I Channel HVRI-10

Weight = 30.9 kg/m

Moment of Inertia: $I_x = 1078.01 \text{ cm}^4$; $I_y = 104.38 \text{ cm}^4$

Moment of Resistance: $W_x = 154.33 \text{ cm}^3$; $W_y = 29.89 \text{ cm}^3$

Distance to Center of Gravity: $e_y = 6.99 \text{ cm}$; $e_x = 3.49 \text{ cm}$



Eccentric Adjustable HVBEA-459

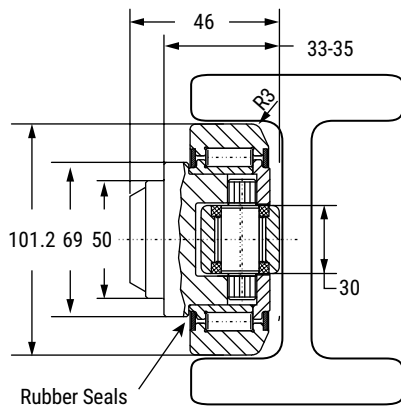
Weight = 1.74 kg

Maximum Bearing Loads:

Radial: Dynamic = 73 kN; Static = 82 kN

Axial: Dynamic = 25 kN; Static = 27 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Ordering Information

Part NO.	Description
HVB-059	Fixed axial bearing
HVBEA-459	Eccentric adjustable axial bearing
HVRI-10	I-channel profile rail

Units of Measurement mm

HVB-060 Hevi-Rail® • 2.67 US Ton-Force



Axial Bearing – Fixed HVB-060

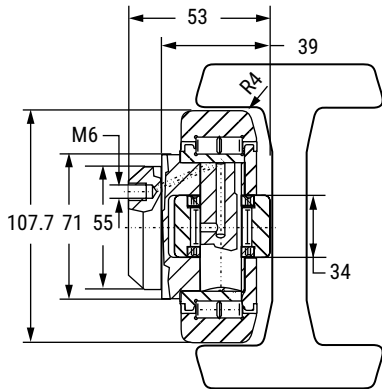
Weight = 2.30 kg

Maximum Bearing Loads:

Radial: Dynamic = 81 kN; Static = 95 kN

Axial: Dynamic = 31 kN; Static = 36 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

Radial: 23.8 kN/2.67 US Ton-Force

Axial: 7.44 kN/0.83 US Ton-Force

Note: Above loads are achievable when used with shown rails.

Rail – I Channel HVRI-11

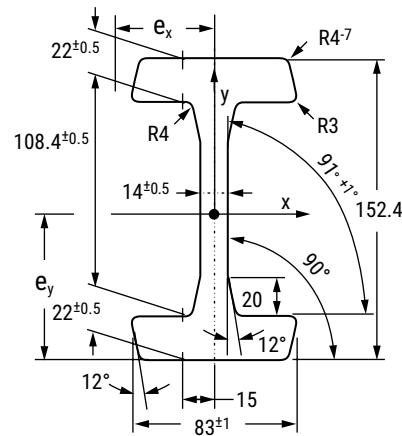
Weight = 40.5 kg/m

Moment of Inertia: $I_x = 1670.08 \text{ cm}^4$; $I_y = 184.52 \text{ cm}^4$

Moment of Resistance: $W_x = 219.17 \text{ cm}^3$; $W_y = 44.46 \text{ cm}^3$

Radius of Inertia: $i_x = 5.69 \text{ cm}$; $i_y = 1.91 \text{ cm}$

Distance to Center of Gravity: $e_y = 7.62 \text{ cm}$; $e_x = 4.15 \text{ cm}$



Eccentric Adjustable HVBEA-460

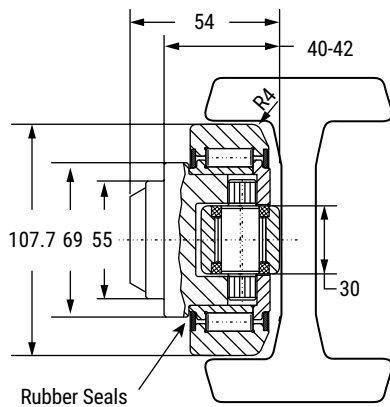
Weight = 2.27 kg

Maximum Bearing Loads:

Radial: Dynamic = 81 kN; Static = 95 kN

Axial: Dynamic = 31 kN; Static = 36 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Ordering Information

Part NO.	Description
HVB-060	Fixed axial bearing
HVBEA-460	Eccentric adjustable axial bearing
HVRI-11	I-channel profile rail

Units of Measurement mm

Hevi-Rail® HVB-061 • 2.67 US Ton-Force



Axial Bearing – Fixed HVB-061

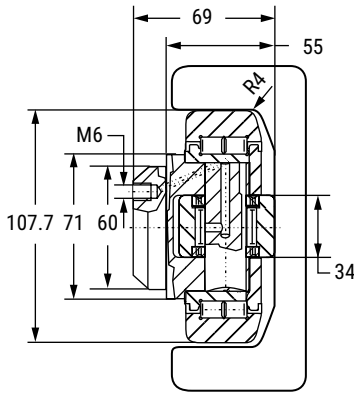
Weight = 2.82 kg

Maximum Bearing Loads:

Radial: Dynamic = 81 kN; Static = 95 kN

Axial: Dynamic = 31 kN; Static = 36 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

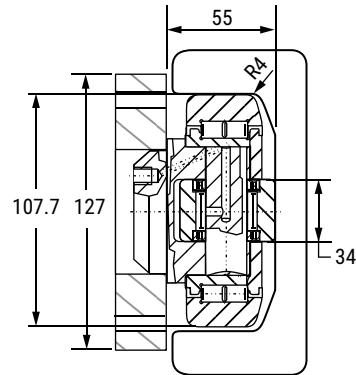
Radial: 23.8 kN/2.67 US Ton-Force

Axial: 7.44 kN/0.83 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-061/HVP4 with Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-461

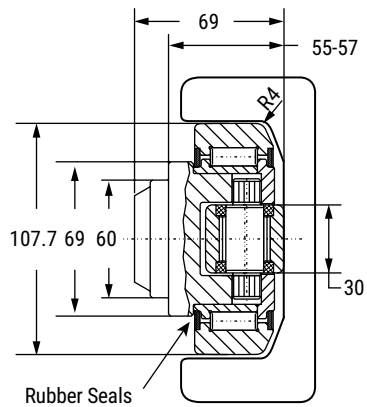
Weight = 2.82 kg

Maximum Bearing Loads:

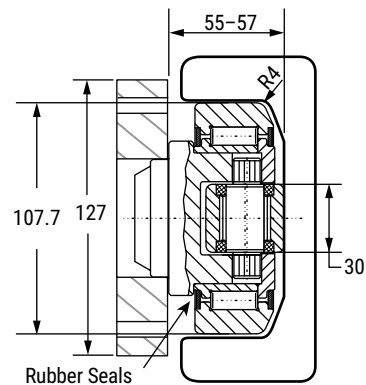
Radial: Dynamic = 81 kN; Static = 95 kN

Axial: Dynamic = 31 kN; Static = 36 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-461/HVP4 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

Hevi-Rail® HVB-061 • 2.67 US Ton-Force

Rail – U Channel HVR-4

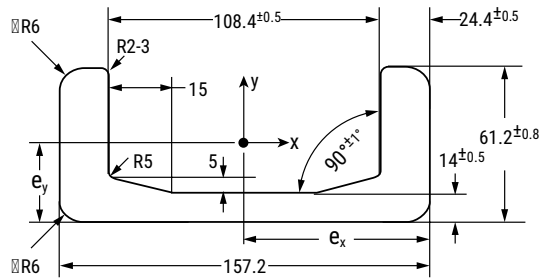
Weight = 35.9 kg/m

Moment of Inertia: $I_x = 150.98 \text{ cm}^4$; $I_y = 1494.32 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 39.00 \text{ cm}^3$;
 $W_{x\max} = 67.13 \text{ cm}^3$; $W_y = 190.12 \text{ cm}^3$

Radius of Inertia: $i_x = 1.82 \text{ cm}$; $i_y = 5.72 \text{ cm}$

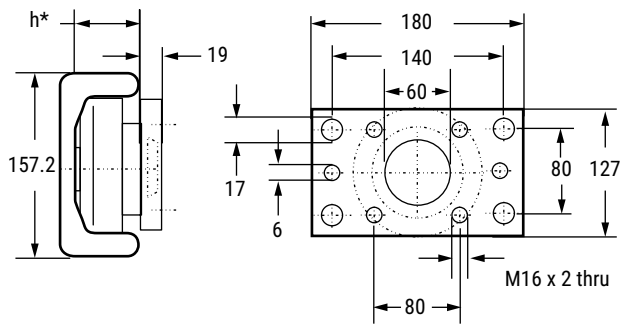
Distance to Center of Gravity: $e_y = 2.25 \text{ cm}$; $e_x = 7.86 \text{ cm}$



Hevi-Rail Bearings
 Can be ordered with pre-welded flange plate

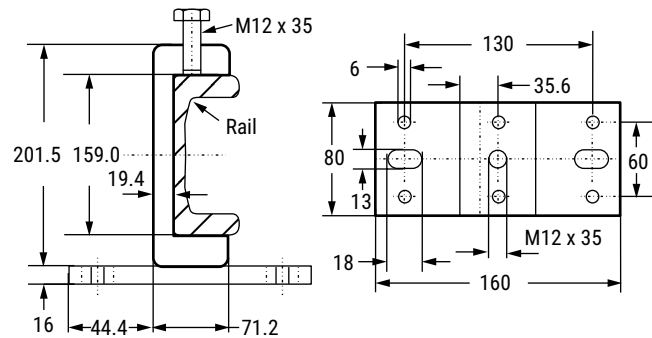
Flange Plate HVP4-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-061) or eccentric adjustable bearing (HVBEA-461).

Clamp Flange HVC-4



Ordering Information

Part NO.	Description
HVB-061	Fixed axial bearing
HVB-061/HVP4	Fixed axial bearing with welded flange plate
HVBEA-461	Eccentric adjustable axial bearing
HVBEA-461/HVP4	Eccentric adjustable axial bearing with welded flange plate
HVP4-1	Flange plate
HVR-4	U-channel rail for -61 bearings
HVC-4	Clamp flange

Units of Measurement mm

REDI-RAIL

COMMERCIAL RAIL

HARDENED CROWN ROLLER

FOLLOWER ROLLERS

V-GUIDE

HEVI-RAIL

Hevi-Rail® HVB-062 · 3.81 US Ton-Force



Axial Bearing – Fixed HVB-062

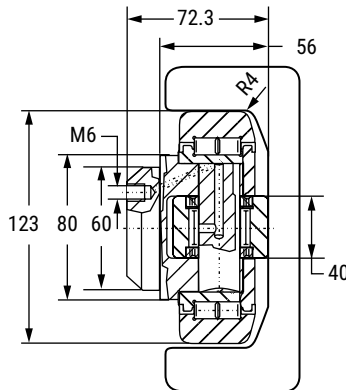
Weight = 4.50 kg

Maximum Bearing Loads:

Radial: Dynamic = 134.5 kN; Static = 242 kN

Axial: Dynamic = 44.7 kN; Static = 74.2 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

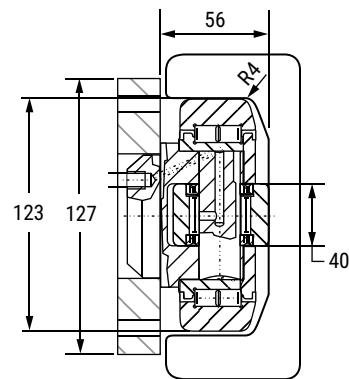
Radial: 33.9 kN/3.81 US Ton-Force

Axial: 10.6 kN/1.19 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-062/HVP4 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-462

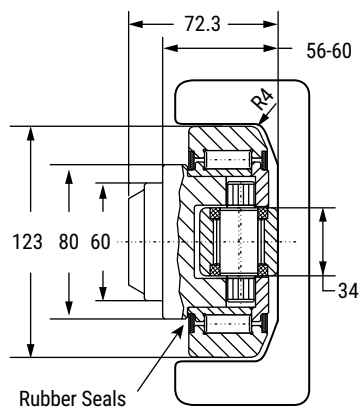
Weight = 3.90 kg

Maximum Bearing Loads:

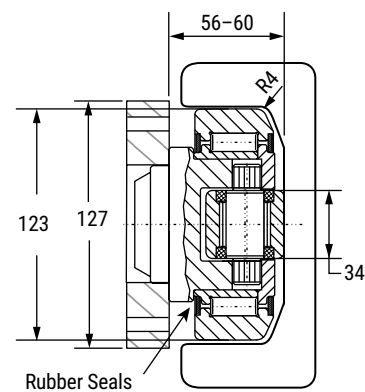
Radial: Dynamic = 110 kN; Static = 132 kN

Axial: Dynamic = 43 kN; Static = 50 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-462/HVP4 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

RED-RAIL
COMMERCIAL RAIL
HARDENED CROWN ROLLER
FOLLOWER ROLLERS
V-GUIDE
HEVI-RAIL

Hevi-Rail® HVB-062 · 3.81 US Ton-Force

Rail – U Channel HVR-5

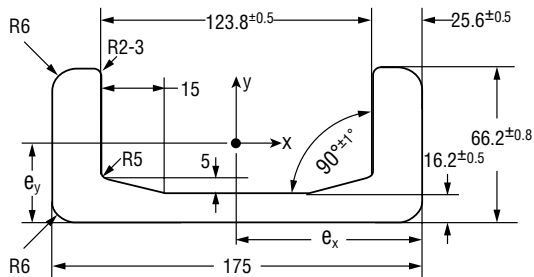
Weight = 42.9 kg/m

Moment of Inertia: $I_x = 205.84 \text{ cm}^4$; $I_y = 2185.32 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 48.42 \text{ cm}^3$;
 $W_{x\max} = 86.89 \text{ cm}^3$; $W_y = 249.75 \text{ cm}^3$

Radius of Inertia: $i_x = 1.94 \text{ cm}$; $i_y = 6.32 \text{ cm}$

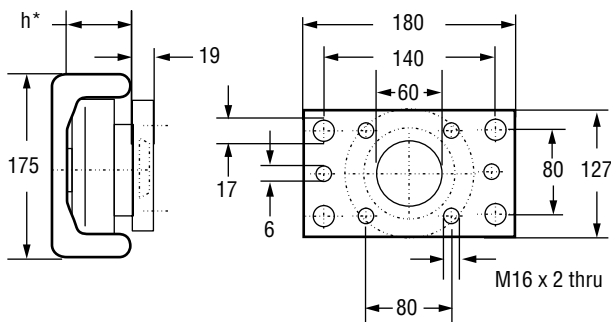
Distance to Center of Gravity: $e_y = 2.37 \text{ cm}$; $e_x = 8.75 \text{ cm}$



● **Hevi-Rail Bearings**
 Can be ordered with pre-welded flange plate

Flange Plate HVP4-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-062) or eccentric adjustable bearing (HVB EA-462).

Ordering Information

Part NO.	Description
HVB-062	Fixed axial bearing
HVB-062/HVP4	Fixed axial bearing with welded flange plate
HVB EA-462	Eccentric adjustable axial bearing
HVB EA-462/HVP4	Eccentric adjustable axial bearing with welded flange plate
HVP4-1	Flange plate
HVR-5	U-channel rail for -62 bearings

Units of Measurement mm

REDI-RAIL

COMMERCIAL RAIL

HARDENED CROWN ROLLER

FOLLOWER ROLLERS

V-GUIDE

HEVI-RAIL

Hevi-Rail® HVB-063 • 6.65 US Ton-Force



Axial Bearing – Fixed HVB-063

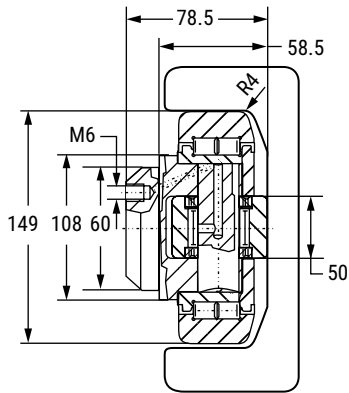
Weight = 6.52 kg

Maximum Bearing Loads:

Radial: Dynamic = 188 kN; Static = 370 kN

Axial: Dynamic = 68 kN; Static = 71 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



System Maximum Static Loads:

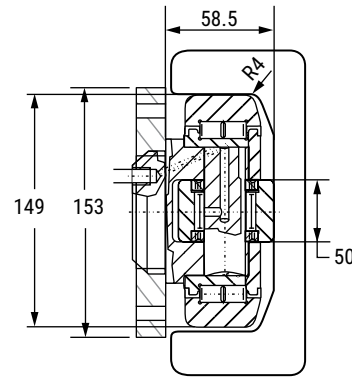
Radial: 59.2 kN/6.65 US Ton-Force

Axial: 18.5 kN/2.07 US Ton-Force

Note: Above loads are achievable when used with shown rails.



Axial Bearing – Fixed HVB-063/HVP6 with Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.



Eccentric Adjustable HVBEA-463

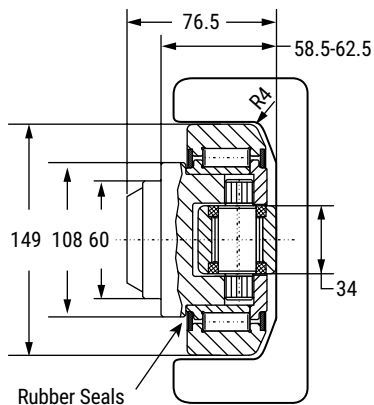
Weight = 6.50 kg

Maximum Bearing Loads:

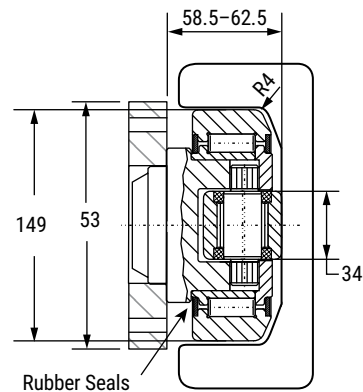
Radial: Dynamic = 151 kN; Static = 192 kN

Axial: Dynamic = 68 kN; Static = 71 kN

Note: Above loads achievable when used with a hardened rail HRC 55 minimum 2.54 mm deep.



Eccentric Adjustable HVBEA-463/HVP6 With Welded Flange Plate



Note: Above values do not include stack up tolerances for flange plate and bearing assembly.

Units of Measurement mm

RED-RAIL
COMMERCIAL RAIL
HARDENED CROWN ROLLER
FOLLOWER ROLLERS
V-GUIDE
HEVI-RAIL

Hevi-Rail® HVB-063 • 6.65 US Ton-Force

Rail – U Channel HVR-6

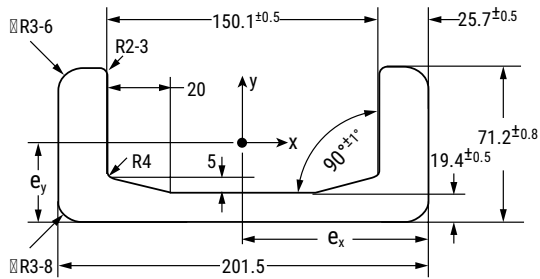
Weight = 52.3 kg/m

Moment of Inertia: $I_x = 269.52 \text{ cm}^4$; $I_y = 3423.08 \text{ cm}^4$

Moment of Resistance: $W_{x\min} = 57.15 \text{ cm}^3$;
 $W_{x\max} = 112.11 \text{ cm}^3$; $W_y = 339.76 \text{ cm}^3$

Radius of Inertia: $i_x = 2.01 \text{ cm}$; $i_y = 7.17 \text{ cm}$

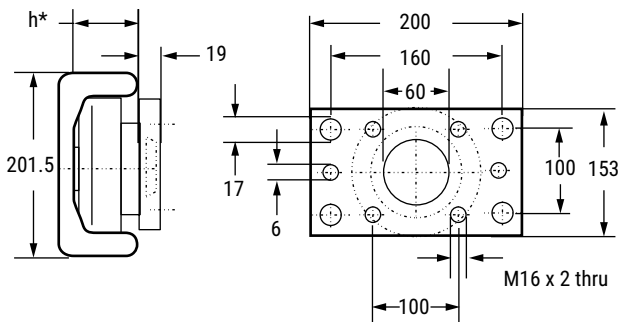
Distance to Center of Gravity: $e_y = 2.40 \text{ cm}$; $e_x = 10.08 \text{ cm}$



Hevi-Rail Bearings
 Can be ordered with pre-welded flange plate

Flange Plate HVP6-1

For Ordering Separate Flange Plate Only



*Note: "h" refers to the depth of the axial bearing. This dimension depends on the choice of fixed axial bearing (HVB-063) or eccentric adjustable bearing (HVBEA-463).

Ordering Information

Part NO.	Description
HVB-063	Fixed axial bearing
HVB-063/HVP6	Fixed axial bearing with welded flange plate
HVBEA-463	Eccentric adjustable axial bearing
HVBEA-463/HVP6	Eccentric adjustable axial bearing with welded flange plate
HVP6-1	Flange plate
HVR-6	U-channel rail for -63 bearings

Units of Measurement mm

Technical • Specifications & Cantilevered Loads

Redi-Rail®

Commercial Rail

Hardened Crown Roller

V-Guide

Hevi-Rail®

Technical Specifications

Linear Bearing for Axial & Radial Loads

Prior to welding, disassemble bearing components. To avoid cracks in welded joints, please use welding electrodes and core weld for unalloyed steel.

Outer ring – Case-hardened steel En 31 - SAE 52100 hardened at 60+2 HRC.

Inner ring – Hardened steel En 31 - SAE 52100 hardened at 62-2 HRC.

Cylindrical rollers – Flat ground heads are hardened steel, En 31 - SAE 52100, hardened at 59-64 HRC.

Bolt tolerance – 0.05 mm:

Profile rails – High quality S450J2 MOD. steel at standard lengths of 6 m (19.7 ft). Yield point of 430 N/mm², tensile strength of 550-770 N/mm². Rails are not hardened but have a Brinell hardness of 160-210. The guide ways in the rails should be lightly greased and not painted.

Clamp flange – Low carbon steel, adjustable clamp.

Flange plate – Low carbon steel. Special designs available, contact manufacturer.

Seals – Fixed Axial Bearings (HVB-053 to HVB-063): Radial roller has steel labyrinth and axial roller has rubber seals.

Eccentric Adjustable Axial Bearings (HVBEA-454 to HVBEA-463) Both radial roller and axial roller have rubber seals. Rubber seals are RS type.

Lubrication – Bearings are supplied lubricated with grease grade 3. Bearings from HVB-055 to HVB-063 can be re-lubricated with grease zerk. Adjustable bearings are not available with zerk.

Bearing coefficient of frictions – 0.010 static, 0.005 dynamic.

Temperature – Resistant from -30°C to 120°C (-22°F to 248°F).

Bearing Life Calculations:

$$L_{10} = \frac{(16,667)}{n} \cdot \left(\frac{C}{P}\right)^{10/3} \cdot (\text{Hours})$$

C = Dynamic load rating (kN)

P = Automatic dynamic load (kN)

n = Revolutions per minute (rpm)

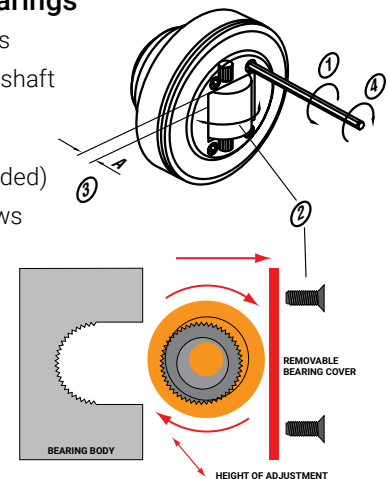
Note: Above calculation formula is for predicting life expectancy with 90% reliability level. Customers shall use their discretion to determine the reduction factor based on the actual operation needs and conditions such as reliability level, load, speed, impact, and environments.



Link to video "How to Adjust Hevi-Rail Bearing Systems"

Adjusting Axial Bearings

1. Remove front screws
2. Rotate axial bearing shaft (see diagram below)
3. Check dimension A (repeat step 2, if needed)
4. Re-install front screws
5. Recommend use of a breakable Loctite®



Calculation of f_{max} for cantilevered loads

Q = Load capacity (N)

L = Load distance to suspension point (mm)

P = Suspension point

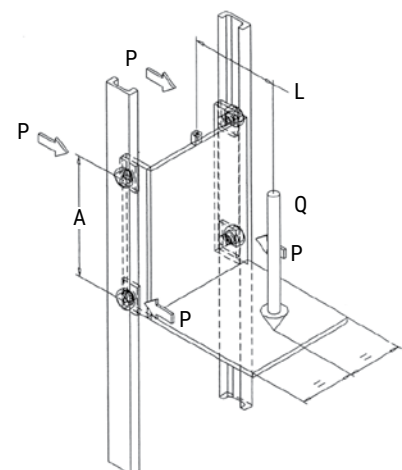
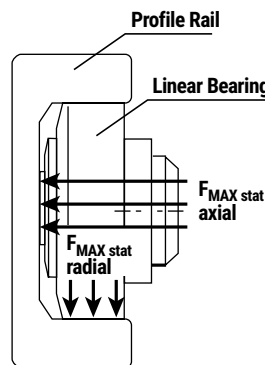
A = Bearing distance (mm)

recommended 500 mm to 1,000 mm

$$\text{Formula: } F_{\text{MAX stat radial}} = \frac{Q \cdot L}{2 \cdot A}$$

MAX Hertzian = 850 N/mm² for all profile rails

Indicated here are F_{MAX stat radial} + axial for each bearing



Technical • Mounting

Redi-Rail®

Commercial Rail

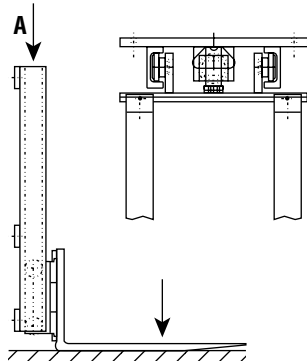
Hardened Crown Roller

V-Guide

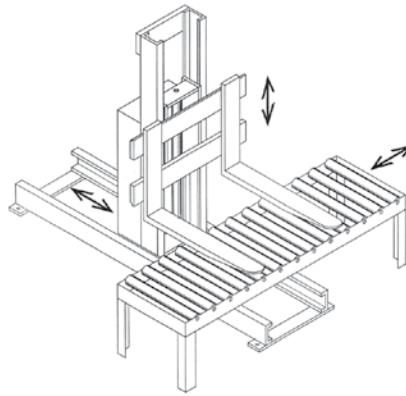
Hevi-Rail®

Mounting Configurations

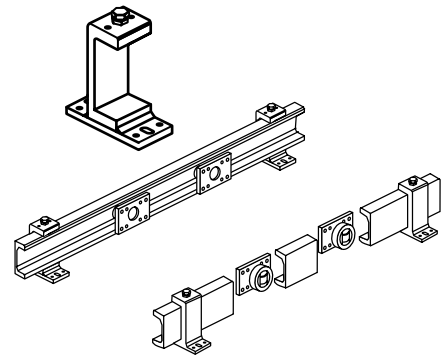
Lifting Units



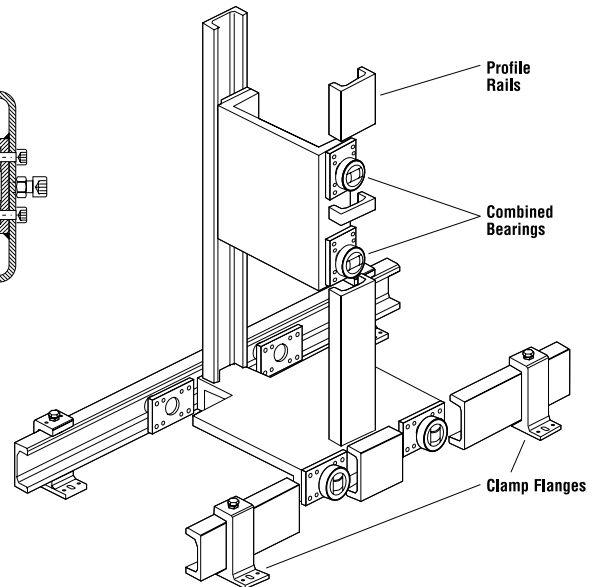
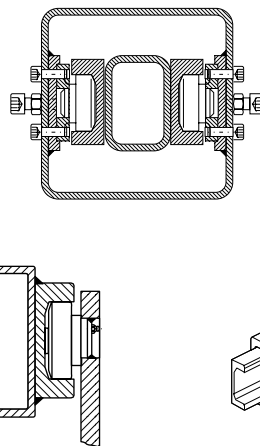
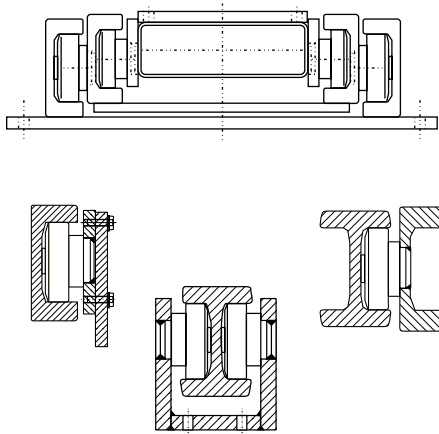
Handling Units



Adjustable Clamp System

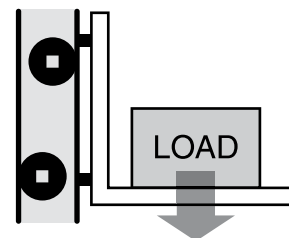
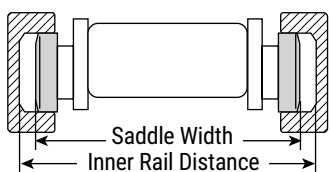


Horizontal Telescope



Mounting Instructions

1. The overall system clearance should be 1.524 mm to 3.048 mm Inner Rail Distance = Saddle Width + (1.524 mm to 3.048 mm)
2. Verify that the axial bearing is aligned parallel to the rail; especially in vertical operations



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Important Notice about Lifetime Calculations

There is no known formula for accurately and reliably calculating the actual lifetime of a linear or rotary bearing system.

The formulas within this section are solely based upon the statistical probability of success. It is important to recognize and distinguish between formulas of absolute certainty and probability.

Even though these formulas are not absolutely certain, they have been generally accepted as the best available method for determining bearing lifetime by the International Organization for Standardization (ISO), as well as its membership bodies; including, but not limited to: American National Standards Institute (ANSI), Deutsches Institut für Normung (DIN) & Japanese Industrial Standards Committee (JISC).

Static & Dynamic Load Ratings

PBC Linear uses the two internationally accepted methods for calculating the Rated Lifetime, Static, and Dynamic Capacities. Per the international standard, all lifetimes are calculated to an L10 life of 100 km (105 meters or ≈ 3.94 million inches). The two standards used are:

- ISO76 Rolling Bearings – Static Load Ratings
- ISO281 Rolling Bearings – Dynamic Load Ratings & Rating Life

Note: Some suppliers may choose to rate their bearings based upon a useful life of less than 100 km or a probability of success less than 90%. This causes their bearings to falsely appear to have a higher static and dynamic load capacity. If a catalog does not specifically note L10 = 100 km, caution should be used when comparing load capacity or life values between suppliers. The most commonly used values are L10 = 50 km and L25 = 50 km. For comparison, at L10 = 100 km, an example bearing has a maximum static load of 1,000 N. That exact same bearing as an L10 = 50 km maximum static load of $\approx 2,300$ N and an L25 = 50 km maximum static load of $\approx 4,600$ N!

In summary, the static load ratings are defined as the maximum applied load (or moment) which will result in the permanent deformation which does not exceed 1/10,000 of the diameter of the rolling element (ball or rod) within the bearing. The basic dynamic load rating, C, is the load of a constant magnitude and direction, which a sufficiently large number of apparently identical bearings can endure for a basic rating life of one million revolutions. It's important to note that both the static and dynamic values are determined through ISO-Approved formulas. These formulas take into account several factors, including the design, internal geometry, material type, material quality, and lubrication type.

Note: Additional factors are provided so that the estimated lifetime (default = 100 km) and/or the probability of success (default = 90%) can be changed from their default value to any desired value.

Operating Lifetime

The Operating Life (or Operating Lifetime) is the actual life achieved by a rolling bearing. The actual lifetime typically varies from the calculated lifetime, sometimes significantly. It is not possible to accurately and reliably determine the actual Operating Life through calculations due to the large variety of operating and installation conditions. The most reliable method to achieve an approximation is by comparing the current application to similar applications. Primary factors which can negatively affect the life and are generally not included in calculations are:

- Contamination within the application
- Inadequate or improper lubrication
- Operational conditions different from calculated values, including unexpected forces and moments
- Insufficient and/or excessive operating clearance between the roller and guideway
- Excessive interference between roller and guideway (typically due to misalignment or excessive preload)
- Temperature out of range
- High shock loads (exceeding static load capacity)
- Vibration (which causes false brinelling resulting from fretting)
- Short stroke reciprocating motion (also causes False Brinelling)
- Damage caused during installation or from improper handling
- Improper mating surface hardness (when not used with a PBC Linear rail)

Technical • Life Calculation

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Commercial Rail

Hardened Crown Roller

V-Guide

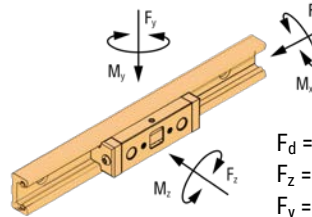
Hevi-Rail®

Terms, Definitions & Symbols

The following variables are used within the equations listed on the following pages:

- $F_{y\ app}$ = Force applied in the Y direction (radial force), N
- $F_{z\ app}$ = Force applied in the Z direction (axial force), N
- $M_{x\ app}$ = Moment applied about the X axis, N
- $M_{y\ app}$ = Moment applied about the Y axis, N
- $M_{z\ app}$ = Moment applied about the Z axis, N
- F_{MAX} = Maximum allowable force in the Y direction (radial force), N
- $F_{z\ MAX}$ = Maximum allowable force in the Z direction (axial force), N
- $M_{x\ MAX}$ = Maximum allowable moment about the X axis, N • m
- $M_{y\ MAX}$ = Maximum allowable moment about the Y axis, N • m
- $M_{z\ MAX}$ = Maximum allowable moment about the Z axis, N • m
- D_a = Rolling contact diameter, from product tables, mm
- f_h = Shaft (rail)hardness reduction factor
- f_l = Required Lifetime (km) reduction factor
- f_r = Reliability reduction factor
- f_{ss} = Short stroke reduction factor
- L10 = Basic rating life, km (103 m)
- Pr = Equivalent radial (F_y) load, N
- s.f = safety factor

Note: PBC Linear has chosen to depart from the nomenclature standards used by ISO. Instead, PBC Linear uses a convention that is more in line with other PBC Linear products. This ensures that all PBC Linear products use the same naming conventions, making it easier to compare multiple products from different product families. The Y direction (radial force) and Z direction (axial force) are dependant upon the orientation of the wheel bearing.



- F_d = Dynamic capacity (LC)
- F_z = Axial capacity
- F_y = Radial capacity
- M_x, M_y, M_z = Moment capacities

Conversions

- newton (N) • 0.2248 = lb.
- (lb) meter • 0.0397 = inch
- newton - meter (N-m) • 8.851 = in.-lb.

Derivation

The lifetime formula within ISO 281 gives the life in millions of revolutions. The conversion from rotary life to linear life is done using the conversion factors listed in the following three equations. This derivation applies to both individual rollers and carriages. Lrev and Ldistance represent the lifetime of the bearing in revolutions and linear distance, respectively.

Note: Attention must be paid to units of measure, especially when considering products from different manufacturers. All of the lifetime formulas within this section yield results in kilometers; however, not all companies follow the same standard. Some companies may express life in meters or 100's of kilometers.

$$L_{Distance} [1 \cdot 10^5 m] = L_{rev} [1,000,000 rev] \cdot \left(3.14 D_a \left[\frac{mm}{rev} \right] \right) \cdot \left(\frac{1 \cdot 10^5 m}{1,000,000,000} \left[\frac{m}{mm} \right] \right) \quad \text{Eq. 1}$$

$$L_{Distance} [1 \cdot 10^5 m] = L_{rev} \cdot (0.0314 D_a) \quad \text{Eq. 2}$$

$$L_{Distance} [km] = 100 \cdot L_{rev} \cdot (0.0314 D_a) = 3.14 \cdot D_a \cdot L_{rev} \quad \text{Eq. 3}$$

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Link to whitepaper "The Facts About Roller Bearing Life Calculations"

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Individual Rollers – All products except Hevi-Rail Rollers

Most of the individual rollers within this catalog are Radial Ball Bearings. The following formulas should be used for all individual bearings except Hevi-Rail bearings (which are roller bearings). This formula calculates the basic rating life (L10 life), which does not take into account any reduction factors based upon the application.

$$L_{10} [km] = 3.14 \cdot D_a \cdot \left(f_L \cdot f_H \cdot f_{SS} \cdot \frac{F_{y \max}}{P_r} \right)^3 \cdot (f_R) \quad \text{Eq. 4}$$

$$P_r = X \cdot F_{y \text{ app}} + Y \cdot F_{z \text{ app}} \quad \text{Eq. 5}$$



The values for X & Y can be found using the table listed below.

Values of X & Y for Radial Ball Bearing Life Formula

Product	$\frac{F_{z \text{ app}}}{F_{y \text{ app}}} \leq \epsilon$		$\frac{F_{z \text{ app}}}{F_{y \text{ app}}} > \epsilon$		ϵ
	X	Y	X	Y	
Commercial Rail (all sizes)	1	0	0.41	0.87	0.68
Hardened Crown Rollers	1	0	0.41	0.87	0.68
Integral-V (IVT) (Compact Linear Guides)	1	0.78	0.63	1.24	0.80
Integral-V (IVT) (all other sizes & types)	1	0.78	0.63	1.24	0.80
Redi-Rail (all sizes & types)	1	0.78	0.63	1.24	0.80
Steel-Rail (all sizes & types)	1	0.78	0.63	1.24	0.80
V-Rail (all sizes)	1	0.78	0.63	1.24	0.80

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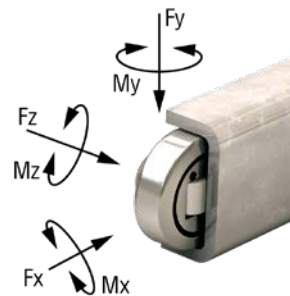
Individual Rollers – Hevi-Rail Rollers

Hevi-Rail bearings are roller bearings, as opposed to radial ball bearings. The formulas are very similar to the formulas shown above, with only some minor changes.

Note: Hevi-Rail rollers are combined bearings. Essentially two bearings combined into one. Life calculations should be performed for both the radial and the axial bearing.

$$L_{L10} [km] = 3.14 \cdot D_a \cdot \left(f_L \cdot f_H \cdot f_{SS} \cdot \frac{F_{y \max}}{F_{y \text{ app}}} \right)^{\frac{10}{3}} \cdot (f_R) \quad \text{Eq. 6}$$

$$L_{a10} [km] = 3.14 \cdot D_a \cdot \left(f_L \cdot f_H \cdot f_{SS} \cdot \frac{F_{z \max}}{F_{z \text{ app}}} \right)^{\frac{10}{3}} \cdot (f_R) \quad \text{Eq. 7}$$



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Carriage Assemblies

Formulas for calculating the estimated lifetime for carriage assemblies are fundamentally similar to the calculations for the individual rollers. The most accurate method for determining the life of a carriage assembly is to create a free body diagram for the carriage and determine the axial, radial, and moment load applied to each individual roller. This method is cumbersome and is usually only required in the most severe of circumstances. In most cases, the carriage assembly can be treated as a rigid body and calculations can be completed based upon the load ratings for the entire carriage:



$$L_{10} [km] = 100 \cdot \left(f_L \cdot f_H \cdot f_{SS} \cdot \left(\frac{F_{y app}}{F_{y max}} + \frac{F_{z app}}{F_{z max}} + \frac{M_{x app}}{M_{x max}} + \frac{M_{y app}}{M_{y max}} + \frac{M_{z app}}{M_{z max}} \right) \right)^3 \cdot (f_R) \quad \text{Eq. 8}$$

Redi-Rail®	Commercial Rail	Hardened Crown Roller	V-Guide	Hevi-Rail®
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Safety Factor

All individual rollers and carriages are subject to use a balancing formula, which ensures an adequate product life. The following formulas should be used for all CRT products:

$$\text{Carriages } \frac{1}{s.f.} \geq \frac{F_{y app}}{F_{y max}} + \frac{F_{z app}}{F_{z max}} + \frac{M_{x app}}{M_{x max}} + \frac{M_{y app}}{M_{y max}} + \frac{M_{z app}}{M_{z max}} \quad \text{Eq. 9}$$

$$\text{Individual Bearings } \frac{1}{s.f.} \geq \frac{F_{y app}}{F_{y max}} + \frac{F_{z app}}{F_{z max}} \quad \text{Eq. 10}$$

Where the safety factor value can be determined using the following table.

Recommended Safety Factor (s.f.)

Duty	Shock/Vibration	Reverse Frequency	Contamination	S.F.
Very Light	None	Smooth & Low	None	1.0 - 1.2
Light	Light	Light	Light	1.2 - 1.5
Medium	Medium	Medium	Medium	1.5 - 2.0
Heavy	Heavy	High & Fast	Heavy	2.0 - 3.5

Note: The table above contains suggested safety factors based upon the most commonly encountered adjustment criteria. Additional criteria may require raising the safety factor.

Minimum Load Notice

It is possible to apply too small of a load to a bearing/carriage. In this case, there is a possibility of the outer ring slipping or the roller lifting off the track. This can cause unexpected vibration or skidding, which reduces the life of the bearing. Therefore, the following condition should be met under dynamic load conditions:

There is no minimum load requirement under static conditions.

$$\text{Minimum Dynamic Load } \rightarrow \frac{F_{y max}}{F_{y app}} \leq 50 \quad \text{Eq. 11}$$

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Heavy Load Notice

It is also possible to over load the bearings. Extra-heavy loads can cause unexpected stress concentrations in the bearing or railway, which reduce the actual lifetime below the minimally acceptable level. These stress concentrations typically come from unexpected vibrations within the application or unexpectedly high preload forces caused by misalignment, damage, or thermal expansion. In these cases, a larger safety factor should be used.

$$\text{Use Caution} \rightarrow P_{re} > 0.5 C_r \quad \text{Eq. 12}$$

Note: Although typically applying to linear motion rolling bearings, ISO 14728-1 states that the above equation should be followed. It should be treated as a rule as opposed to a guideline.

If the product under consideration is a carriage (slider) assembly and $P_r > 0.5 \cdot C_r$, then it is recommended to consider the axial, radial and moment load applied to each individual roller to ensure each roller still has an adequate safety factor.

Shaft/Rail Hardness Factor, f_H

It is possible to use a softer rail material in combination with PBC Linear CRT products; however, it is necessary to reduce the static and dynamic load capacities of each product. The reduced load capacity is known as the "Effective Load Capacity", which can be calculated using the formula below. The reduction factor, f_H , can be determined using the table below.

For easy reference, some of the most common materials have been plotted on the on the table below:

$$\text{Dynamic} \rightarrow F_{Y\text{Eff}} = F_Y \cdot f_H \quad \text{Eq. 13}$$

$$\text{Static} \rightarrow F_{OY\text{Eff}} = F_{OY} \cdot f_H \quad \text{Eq. 14}$$

Approximate Comparison of Common International Materials

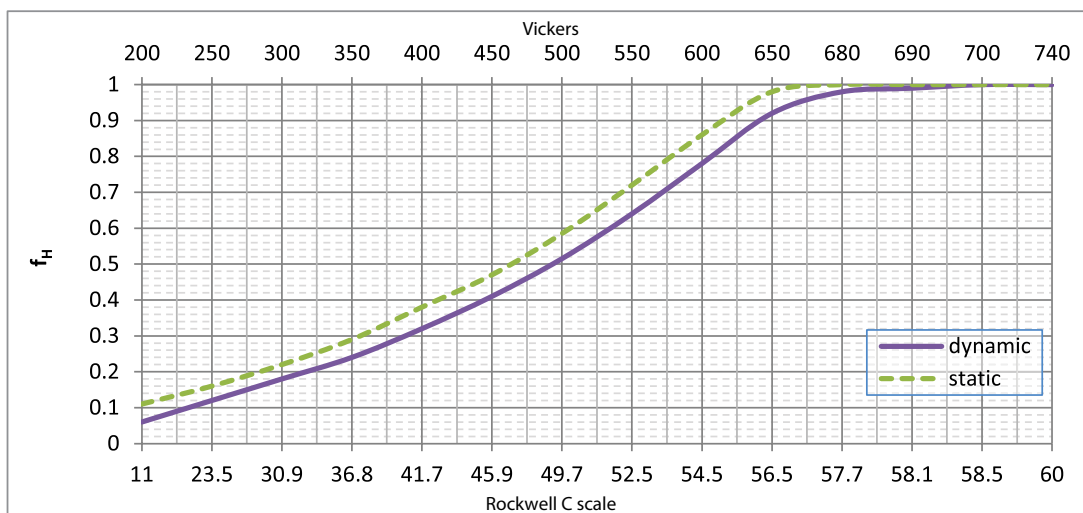
For easy reference, some of the most common materials have been plotted on the table below:

#	TYPE	EN NAME	EN #	ASTM/AISI	TYPICAL HARDNESS ²	f_H
1	Steel	C60	1.0601	1060	60-62	1.0
2	Steel	52-3	1.0570	1024	19-22	0.1
3	Stainless Steel	X46 Cr13	1.4034	420	51-53	0.7
4	Stainless Steel	X90 CrMoV18	1.4112	440B	53-55	0.8
5	Stainless Steel	X105 CrMo17	1.4125	440C	59-61	0.95-1.0

Note: The values listed in the above table should be considered for reference only. It is critical that individual suppliers are contacted to ensure an accurate hardness rating. Depending upon the supplier, "hardness" can actually be the minimum, maximum, or average value. The wrong interpretation can have unexpected consequences for the application. When given the choice, PBC Linear recommends using the "minimum hardness" when determining the reduction factor as this is the most conservative method.

1. Material Types may not be an exact match. PBC Linear has carefully reviewed the material standards and has determined that if there is not an exact match, the listed materials are the closest approximation. A material specialist should be consulted before translating one material type to another.
2. Different suppliers may have alternate ranges for material hardness, depending upon their heat treating process. Consult manufacturer's specifications for a more exact number/range.

Static & Dynamic Reduction Factors for Lower Raceway Hardness



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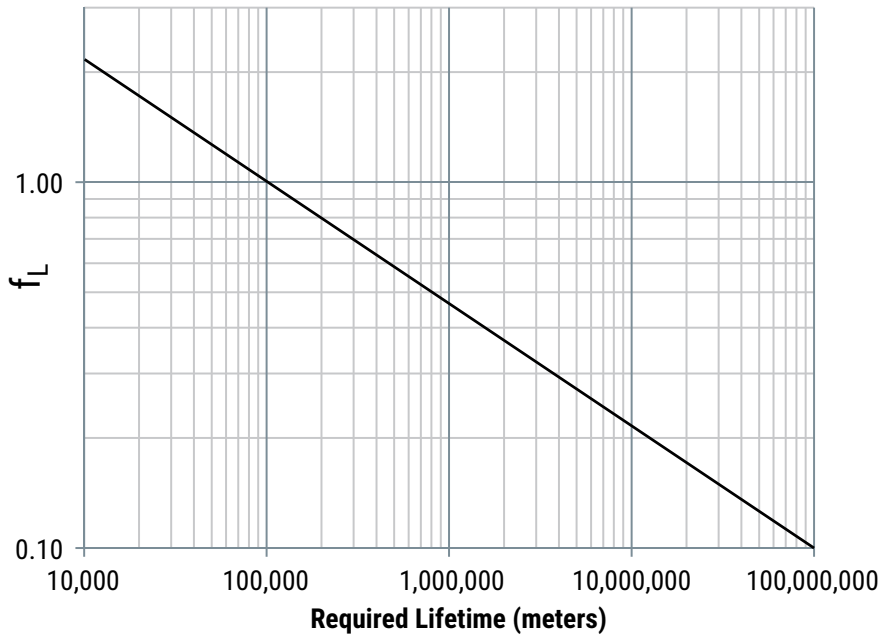
Commercial Rail

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Required Lifetime (km) Factor, f_L



The standard lifetime formulas listed within this catalog describe an L10 life based upon 100 km, in accordance to the applicable ISO standards. Sometimes 100 km is either excessive or shy of the target life of a machine and the required lifetime needs to be adjusted. An appropriate adjustment factor can be found using the chart.

Reliability Factor, f_R

Reliability	L_n	f_R
50%	L_{50}	5.04
60%	L_{40}	3.83
70%	L_{30}	2.77
80%	L_{20}	1.82
90%	L_{10}	1.0
95%	L_5	0.64
96%	L_4	0.55
97%	L_3	0.47
98%	L_2	0.37
99%	L_1	0.25
99.2%	$L_{0.8}$	0.22
99.4%	$L_{0.6}$	0.19
99.6%	$L_{0.4}$	0.16
99.8%	$L_{0.2}$	0.12
99.9%	$L_{0.1}$	0.093
99.92%	$L_{0.08}$	0.087
99.94%	$L_{0.06}$	0.080
99.95%	$L_{0.05}$	0.077

The L10 Life Formulas are a statistical probability formula with a success rate of 90%. Sometimes an L10 life (90% success) is just not good enough and the formulas need to be modified in order to have a higher probability of success. In this case, choose the desired reliability rate and insert the f_R value into the life equation.

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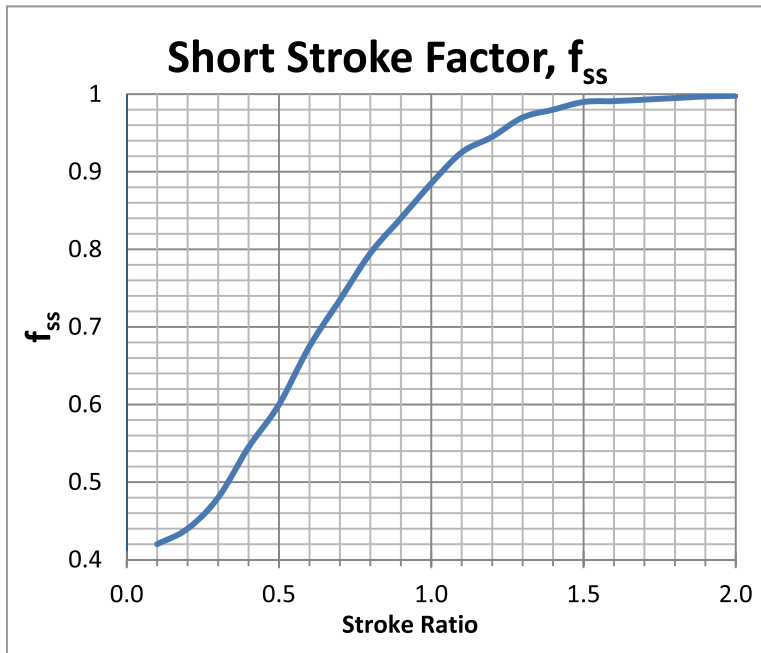
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Short Stroke Factor, f_{ss}

In the case that the travel distance is low, a short stroke reduction factor must be included. In general, this factor only applies when the stroke is less than 2x the carriage length. In the case of individual bearings, use two full revolutions of the bearing.

$$\text{Stroke ratio, carriage (slider)} = \frac{\text{stroke [mm]}}{\text{carriage length [mm]}} \quad \text{Eq. 15}$$

$$\text{Stroke ratio, individual bearing} = \frac{\text{stroke [mm]}}{\pi D_p \text{ [mm]}} \quad \text{Eq. 15}$$



Technical • Installation

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Commercial Rail

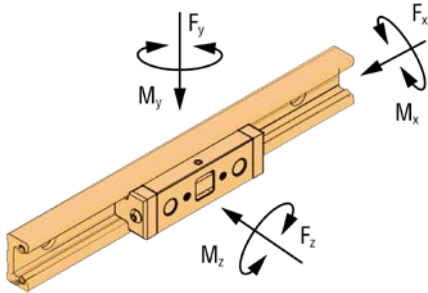
Hardened Crown Roller

V-Guide

Hevi-Rail®

General Installation

As a general rule, all of the products within the catalog have a higher radial (F_y) than axial (F_z) load capacity. Whenever possible, designers should attempt to orient the bearings so the primary applied load is in the radial direction.



Commercial Rail

Commercial Rail is typically used in applications which require low to moderate accuracy. It is generally not necessary to use any advanced manufacturing or assembly techniques to secure this rail system into place.

Note: If an assembly plan requires Commercial Rail to be installed with dial indicators, calipers, or other sensitive measuring equipment, then likely this product has probably been over-specified for an application. Consider using a more accurate product for these applications, such as the V-Guide System, Redi-Rail, Integral-V (IVT), or Steel Rail.

Hardened Crown Roller Rail

Note: If an assembly plan requires Hardened Crown Roller rails to be installed with dial indicators, calipers, or other sensitive measuring equipment, then it is likely this product has probably been over-specified for an application. Consider using a more accurate product in these applications, such as the V-Guide System, Integral-V (IVT), Redi-Rail, or Flexible Steel Rail.

Redi-Rail

The Redi-Rail product is very versatile and can be used in applications that require low accuracy or moderate-high accuracy. In applications that require low accuracy, no special installation, and alignment procedures are needed. In applications that require moderate to high accuracy, use advanced assembly techniques similar to those used for installing profile rail guideways.

Note: Refer to the PRT (Profile Rail Technology) catalog for more detailed information related to advanced assembly techniques.

Hevi-Rail

Hevi-Rail is typically used in applications that require moderate accuracy. There are two common methods for installing Hevi-Rail: Welding & Clamp Flanges.

Welding

The preferred method of welding Hevi-Rail, Flange Plates, and Hevi-Rail Clamp Flanges is MIG Welding. Please follow the guidelines listed below when MIG welding Hevi-Rail, Flange Plates and Hevi-Rail Clamp Flanges.

1. Use a metal brush or grinder to remove rust or paint from surface to be welded.
2. Bevel joint edges on metals thicker than 3/8" to ensure the weld fully penetrates to the base of the metal. (HVR-2, HVR-3, HVR-4, HVR-5 HVR-6, HVRI-08, HVRI-09, HVRI-10, and HVRI-11).
3. Ensure that grounding clamp is engaged in clean metal.
4. When welding HVR-S, HVR-0, HVR-1, and HVRI-07 sections of Hevi-Rail it is recommended to use 0.03" diameter wire. A preferable grade wire for mild steel is ER70S-3.
5. When welding thick sections of Hevi-Rail, it is recommended to use 0.035"-0.045" ER70S-3 wire. Weld at a higher heat level to obtain a deep penetration. This is recommended for HVR-2, HVR-3, HVR-4, HVR-5 HVR-6, HVRI-08, HVRI-09, HVRI-10, and HVRI-11.
6. A 75% Argon/25% Carbon Dioxide mix is a preferable general purpose shielding gas when welding mild steels like Hevi-Rail.
7. Know your load calculations, when in doubt meet with your structural or mechanical engineer.
8. Destructive testing facilities are recommended for testing weld strength. Periodic destructive testing ensures that the welding equipment and welding practices are yielding safe and strong welds.
9. Never weld a mild steel Hevi-Rail product to a dissimilar metal such as cast iron or stainless steel.

Clamp Flanges

When using bolts to hold a Clamp Flange to Hevi-Rail HVR1, HVR-2, HVR-3, HVR-4, HVR-5, or HVR-6, it is recommend to drill a detent in the top of the rail where the screw seats. Many customers use a drill point smaller than the minor diameter of the tap diameter to put a point in the rail. This is preferred in systems that have vibrations and harmonics in its environment. Some customers use bolts to align and assemble the system, then weld the clamp to the rail.

Technical • Installation

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Commercial Rail

Hardened Crown Roller

V-Guide

Hevi-Rail®

V-Guide

V-Rail is typically used in applications that require low to moderate accuracy. The installation accuracy is primarily limited by the accuracy of the mounting surface. It is possible to successfully install V-Rail onto as-extruded bars and plates, or to rolled metal bars and plates. These materials typically do not have very tight dimensional, parallelism, flatness, and straightness tolerances. The loose tolerances add to the overall tolerance stack-up, which reduces the installation accuracy.

A higher grade of accuracy can be achieved by machining the mounting plate, typically through a milling or grinding process. It is possible to achieve an accuracy rating as high as ± 0.025 mm (± 0.001 in.) using machine tool design and assembly techniques. In this case, the mounting surface must be meticulously prepared, and reference edge or dowel pins should be used for alignment purposes.

Note: Integral-V (IVT) products eliminate this alignment process. If an application requires two parallel rails, PBC Linear highly recommends the consideration of the IVT products. Customers have reported significant Total Installed Cost (TIC) savings that have been achieved through the use of IVT products.

General Notes

Handling

Proper handling of PBC Linear products is critical to ensure specified product performance, product life, and to prevent accidental injury. Some products come from the factory with a clearance type preload. These carriages will freely slide if the rail is not kept horizontal. Special attention must be paid when installing the rail overhead or in a vertical orientation.

Special care must also be given to long length units. Single point lifting some products may cause enough bend as to result in permanent, plastic deformation to the railway. Always use suitable lifting equipment that provides enough support to minimize deflection.

Storage

Proper storage is critical in order to maintain an adequate product shelf life. If immediate installation is not possible or practical, it is best to store the product within the package provided by (or designated by) PBC Linear. The product and package should be stored in a horizontal orientation and environmental extremes (high temperature, low temperature, and high humidity) should be avoided. It may be necessary to lubricate steel components during prolonged storage in order to prevent corrosion.

Securing Fasteners

PBC Linear makes no specific recommendation as to whether or not thread-locking fluid (i.e. Loctite®), lock nuts, lock washers, etc., should be used within a given application. Sound engineering fundamentals and company policies should dictate the use of anti-vibration components and technology. Some common reference materials include, but are not limited to:

- Your company's policies and/or engineering specifications
- Marks's Standard Handbook for Mechanical Engineers, published by McGraw-Hill (English)
- Machinery's Handbook, published by Industrial Press (English)
- Roloff/Matek Maschinenelemente, published by Vieweg (German)

Fastener Quantity

It may not be necessary to use a fastener within every supplied fixing hole. This is especially true for applications carrying a light load (high factor of safety). Engineering statics equations can be used to determine the amount of deflection within a rail if not all fixing holes are used. Modern tools, such as FEA, can also be used to speed up this process.

Welding

The recommendations and guidelines listed herein are recommendations only. Always follow your specific company's policies, welding equipment manufacturer's instructions, guidelines established by national standards agencies (i.e. ANSI/DIN) and city/state/federal laws or civil guidelines related to proper welding practices. Improper application or installation of PBC Linear products can result in property damage, death, or serious bodily injury.

Note: Improper installation of carriages with spring-loaded lubricators can permanently damage the lubricator material. Damage caused by improper installation is not covered by PBC Linear warranty.

Initial Lubrication

After installation, follow the initial lubrication instructions located within this catalog or at pbclinear.com. All products are shipped with a preservative material, which should not be considered a true performance lubricant. Lubricant should be added before initial use.

Painting/Powder Coating

Most PBC Linear products can be painted or powder coated after installation to match the aesthetic appearance of the parent structure. It is highly recommended that the bearing's raceway be masked during this process. These coatings will typically not withstand the pressure of a typical operation and will flake off. These flakes will act as bumps causing the rollers to experience unplanned vibration. This can cause an unexpected shortening of the life of the rollers/carriage.

Technical • Lubrication

Redi-Rail®

Commercial Rail

Hardened Crown Roller

V-Guide

Hevi-Rail®

Roller Lubrication

All smaller rollers (in the Redi-Rail, IVT, V-Guide, Commercial Rail, Hardened Crown Roller families, and smaller diameter Hevi-Rail bearings) are lubricated internally for long life.

No additional lubrication is necessary. The rollers are sealed (or shielded) against the operating environment to prevent egress of lubricant, and prevent ingress of contaminants. Some larger rollers (in the Hevi-Rail family) are supplied with a grease access point and can be re-lubricated using a zerk fitting.

Raceway/Guideway Lubrication

To ensure long life, it is necessary to have a thin film of lubrication on the Raceway/Railway at all times. When properly applied, lubrication:

- Reduces wear
- Reduces stress on the contact surfaces
- Reduces friction (and therefore heat buildup)
- Allows for operation at specifications in this catalog (de-rating is required for un-lubricated applications)
- Helps protect the metal surfaces against corrosion (rust and fretting corrosion)

Lubrication Type

Technical, environmental, ecological, and economic factors will determine whether oil or grease should be used in an application. One of the most significant factors in the lubrication selected is the environmental conditions. If extreme conditions are expected, it is highly recommended that a representative from a lubrication company is consulted. This includes heavy contamination when the expected particle size is smaller than 0.1 mm (0.005 in.) as small particles can more easily bypass seals and wipers.

CAUTION! The compatibility of lubricants must always be checked! This check should be



done under both static and dynamic conditions and within the operating environment. Some lubricants may

have unexpected, negative reactions with the plastics, elastomers or non-ferrous metals within the products. It is possible to draw upon previous and practical experience or guidelines from the lubricant manufacturer. When in doubt, consult the lubricant manufacturer.

Initial Lubrication (during installation)

PBC Linear Guides and Raceways are shipped with a preservative lubrication applied to the raceway. During installation, it is necessary to apply additional lubrication. Provided there are no application conflicts, PBC Linear recommends high quality lithium soap grease as the initial lubricant. This grease should be applied to the entire raceway, not just the portion used during normal operation. Oil or grease may be used for re-lubrication.

Note: Coated/Plated rails, Commercial Rail, Hardened Crown Roller, and Hevi-Rail rails are typically shipped without any preservative lubrication. See the Hevi-Rail section for more details: sandblast and lightly oiled option is available for Hevi-Rail.

Periodic Lubrication/Maintenance

The lubrication interval is dependent on many operating and environmental conditions, such as load, stroke, velocity, acceleration, mounting position/orientation, type of lubrication used, temperature, humidity, UV exposure, etc. The actual lubrication interval should be determined by tests conducted under actual application conditions.

While the actual lubrication intervals are application specific and determined only through testing, the following guidelines can typically be used as a starting reference point under normal conditions:

- Re-lubrication every 1,000 km; 50,000 cycles or six months (whichever occurs first).

Technical • Lubrication

Redi-Rail®

Commercial Rail

Hardened Crown Roller

V-Guide

Hevi-Rail®

Oil Filled Polymer Lubricator

Some PBC Linear products offer a high quality polymer lubricator. PBC Linear uses an advanced, oil filled porous polymer, which has been tested to show better performance and longer life than similar wiper/lubricators made of oil or grease filled felt. In some applications, this special lubricator will last the life of the application without additional re-lubrication.

This lubricant within the polymer is NSF Registered for both H1 & H2 applications (Direct and Indirect contact with food). It can also be used for wash down and industrial applications. The lubrication within the polymer contains corrosion inhibitors, anti-oxidants, and extreme pressure (E.P.) additives. The table below shows some specific properties for the lubricant.

Properties for Lubrication in Advanced Oil-Filled Plastic Properties for Lubrication in Advanced Oil-Filled Plastic

Upper Temp Limit	Lower Temp Limit	Specific Gravity	Viscosity at 40°C cSt	Viscosity at 100°C CST
99° (210°F)	-40° (-40°F)	0.86	150	16.5

Used Lubricants

Used lubricants should be disposed of using environmentally-friendly methods. Most lubricant manufacturers have guidelines regarding their allowable storage, use, and disposal. In addition, some countries have regulations regarding storage, use, and disposal of lubricants for occupational safety and/or environmental protection. Furthermore, some companies may have adopted internationally accepted quality and standards policies (i.e. ISO14001), which will further regulate the use of lubricants within an application.

These guidelines and regulations must be followed. Care should be exercised as to not specify a lubricant which is forbidden.

Lubrication Failure

Contamination and lack of lubrication are the two primary causes of (ball based) linear guide failures. Lack of lubrication will cause fretting corrosion, which can cause permanent system damage and eventually lead to system failure. As it applies to this product, fretting corrosion is a form of damage caused as a combination of corrosion and abrasive wear. Fretting corrosion can typically be seen as a reddish discoloration on either mating raceway (track or roller). Fretting corrosion can sometimes be confused with rust. Both are signs that additional lubrication is necessary and the re-lubrication period must be decreased.

Operation in an Un-Lubricated State

While not recommended, it is possible to run most systems without lubrication; however, there will be significant reductions to maximum load, maximum speed, and expected life. The table below shows that a typical un-lubricated system will have a significantly reduced maximum load and a reduced maximum speed when compared to a properly lubricated system.

Typical Reductions for Max Load & Speed for Un-Lubricated Systems

Product		Lubricated	Un-Lubricated	Reduction	
A	Max Load	kg	100	25	75%
	Max Speed	m/s	2	1.5	25%

In addition to significant reductions in maximum load and speed, un-lubricated system will also experience an extreme reduction in expected life. The table below shows the expected life for both a lubricated and un-lubricated system for two different products with two different applied loads. The approximate reduction in lifetime has also been calculated.

Typical Life Reductions for Un-Lubricated Systems

Product		Lubricated	Un-Lubricated	Reduction	
B	Applied Load 1	kg	45.4	45.4	-
	Life 1	m	5,410,200	88,900	≈ 98%
	Applied Load 2	kg	22.7	22.7	-
	Life 2	m	22,860,000	533,400	≈ 98%
C	Applied Load 3	kg	45.4	45.4	-
	Life 3	m	50,800,000	863,600	≈ 98%
	Applied Load 4	kg	90.7	90.7	-
	Life 4	m	8,382,000	152,400	≈ 98%

Note: Actual performance will vary depending upon specific application conditions. PBC Linear has removed the actual product name from the examples listed above as the results may not be repeatable, depending upon specific application conditions. While these values are typical, specific reductions should be determined by tests conducted under actual application conditions.

Technical • General

Redi-Rail®

Commercial Rail

Hardened Crown Roller

V-Guide

Hevi-Rail®

Operating Temperature

The Cam Roller products shown in the catalog have a wide operating temperature limit. All of the products within this catalog can be used within the following range: -20°C to +80°C (-4°F to 176°F). For applications outside of this range, first refer to the specifications for individual products. If a wider range is still needed, please contact our applications engineering group using the contact information below.

The temperature range for these products is limited by the lubricant, engineered polymer wipers, and composite cover materials. In most cases, changing the lubricant or the engineered polymer will extend the operating temperature limit for the product.

Velocity & Acceleration

For maximum velocities, check the product specifications. The maximum velocities will range from 0.76 m/s up to 12 m/s. Higher speeds may be possible, but may not be sustainable. Please contact our applications engineering group for sustained speeds above 12 m/s (33 ft/s).

Unless otherwise noted, the maximum possible acceleration of all CRT products is approximately 5 G's (50 m/s², 160 ft/s²). Higher accelerations are possible, but may not be sustainable. Please contact our applications engineering group for sustained accelerations above 5 G's.

Contact Information

If you need to contact our applications engineering group, please use one of the following methods:

Phone: +1.800.962.8979 (inside USA)

Phone: +1.815.389.5600 (outside USA)

Email: application.engineering@pbclinear.com



Safety guidelines

Product Safety

PBC Linear products are designed and manufactured to the most current level of technology and research. If the bearing (or linear guide) arrangement is designed, handled, installed, and maintained correctly, then they do not give rise to any known or direct hazards. Misapplication, improper handling, improper installation, or improper maintenance may lead to premature product failure, which may have unintended consequences.

Read & Follow Instructions

This publication describes standard products. Since these are used in numerous applications, PBC Linear cannot make a judgment as to whether any malfunctions will cause harm to persons or property. It is always, and fundamentally, the responsibility of the designer and user to ensure that all specifications are observed, and that all necessary safety information is communicated to the end user. This applies in particular to applications in which product failure and/or malfunction may constitute a hazard to human beings.

Symbols

This publication uses several hazard, warning and notification symbols which are defined in accordance to ANSI Z535.6-2006.

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