

## Calculation of Motor Power Dissipation for Different Motion Profiles

Symbols:

$X$  = Distance to travel in meter

$T_1$  = Acceleration time in second

$T_2$  = Coasting time in second

$T_3$  = Deceleration time in second

$T_4$  = Stop time in second

$T = T_1 + T_2 + T_3$  = Time to move

$$\text{Duty Cycle} = \frac{T}{T + T_4}$$

$V_{\text{Peak}}$  = Peak velocity in meter / second

$a_1$  = Acceleration in meter / second<sup>2</sup>

$a_3$  = Deceleration in meter / second<sup>2</sup>

$F_1$  = Force during acceleration in Newton

$F_2$  = Force during coasting

$F_3$  = Force during deceleration in Newton

$F_4$  = Force during stop time

$F_{\text{rms}}$  = The Root Mean Square (RMS) of the force

$m$  = Total moving mass, mass of the motor + all other masses attached to it in Kg

$I_{\text{rms}}$  = The Root Mean Square (RMS) of current in Amp

$K_f$  = Force constant in Newton / Amp

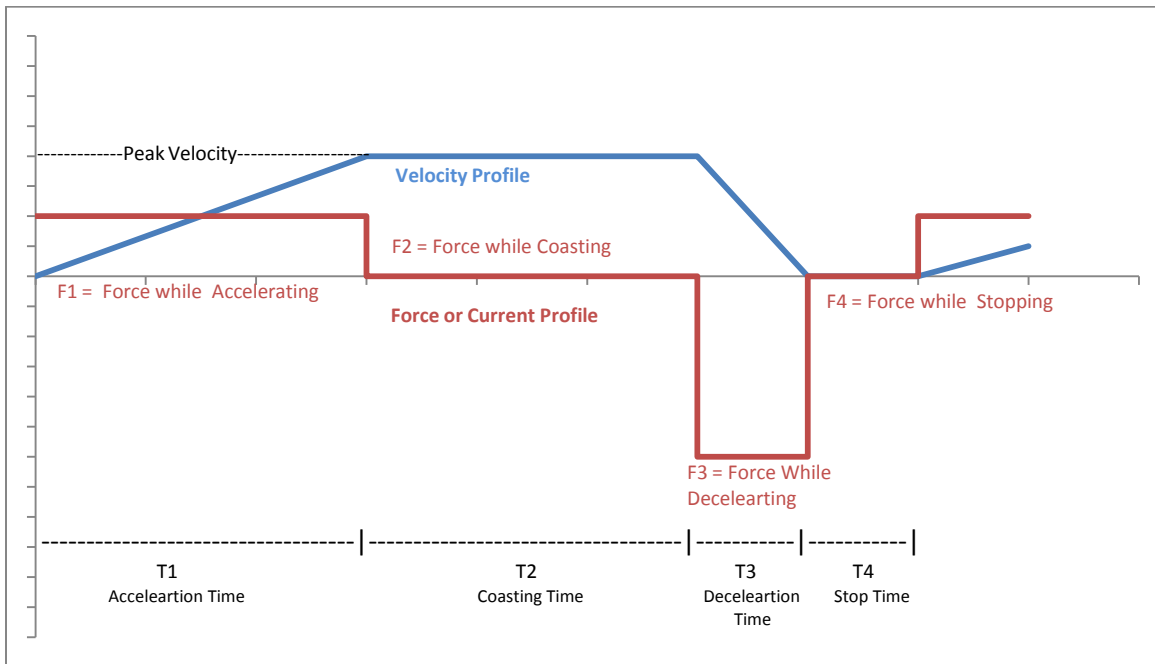
$K_e$  = BEMF constant in Volts / meter / second

$R$  = Resistance of the motor in Ohm

$f$  = Frequency in Hz

$P$  = Power dissipation in Watt

## Trapezoidal Velocity Profile



$$X = 0.5 V_{peak} (T_1 + 2T_2 + T_3)$$

$$V_{peak} = \frac{2x}{(T_1 + 2T_2 + T_3)}$$

$$a_1 = \frac{V_{peak}}{T_1} = \frac{2x}{T_1((T_1 + 2T_2) + T_3)}$$

$$a_3 = \frac{V_{peak}}{T_3} = \frac{2x}{(T_3((T_1 + 2T_2) + T_3))}$$

$$F_1 = a_1 m = \frac{2x m}{(T_1 + 2T_2 + T_3) (T_1)}$$

$F_2$  = Friction force

$$F_3 = a_3 m = \frac{2x m}{(T_3(T_3 + 2T_2) + T_3)}$$

$$F_{rms} = \sqrt{\frac{F_1^2 T_1 + F_2^2 T_2 + F_3^2 T_3 + F_4^2 T_4}{T_1 + T_2 + T_3 + T_4}}$$

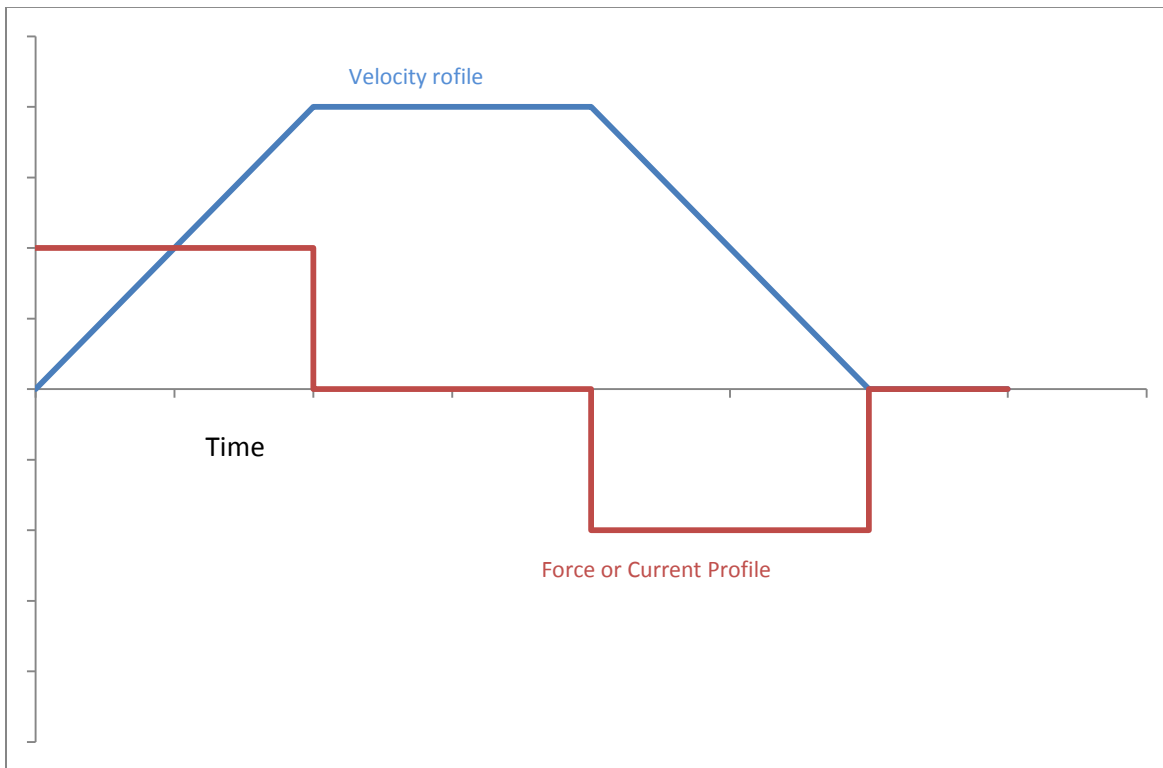
$$I_{rms} = \frac{F_{rms}}{K_f}$$

$$P = R I_{rms}^2$$

$F_{rms}$  Should be equal or less than the CONTINUOUS FORCE of the motor.

P should be equal or less than the MAX CONTINUOUS POWER of the motor.

## Trapezoidal Velocity Profile with Minimum Power Dissipation



$$\text{If } F_2 = F_4 = 0 \text{ and } T_1 = T_2 = T_3 = \frac{T}{3}$$

$$\text{Then } a_1 = a_3 = a = \frac{(4.5 X)}{T^2}$$

$$F_{rms} = 3.67 m \left( \frac{X}{T^2} \right) \sqrt{\text{Duty Cycle}}$$

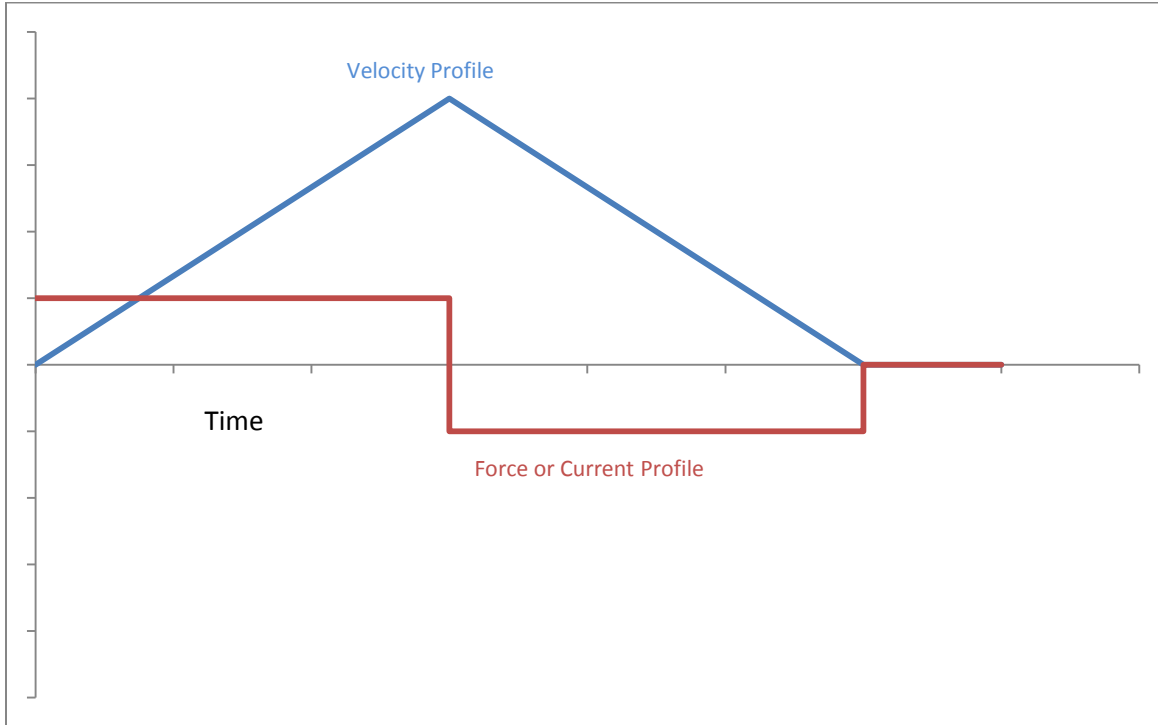
$$I_{rms} = \frac{3.67 m \left( \frac{X}{T^2} \right)}{K_f} \sqrt{\text{Duty Cycle}}$$

$$V_{peak} = \frac{1.5 X}{T}$$

$$P = R I_{rms}^2$$

## Triangular Velocity Profile with Fastest Move Time

If  $F_2 = F_4 = 0$  and  $T_2 = 0$



$$\text{Then } a_1 = a_3 = a = \frac{4X}{T^2}$$

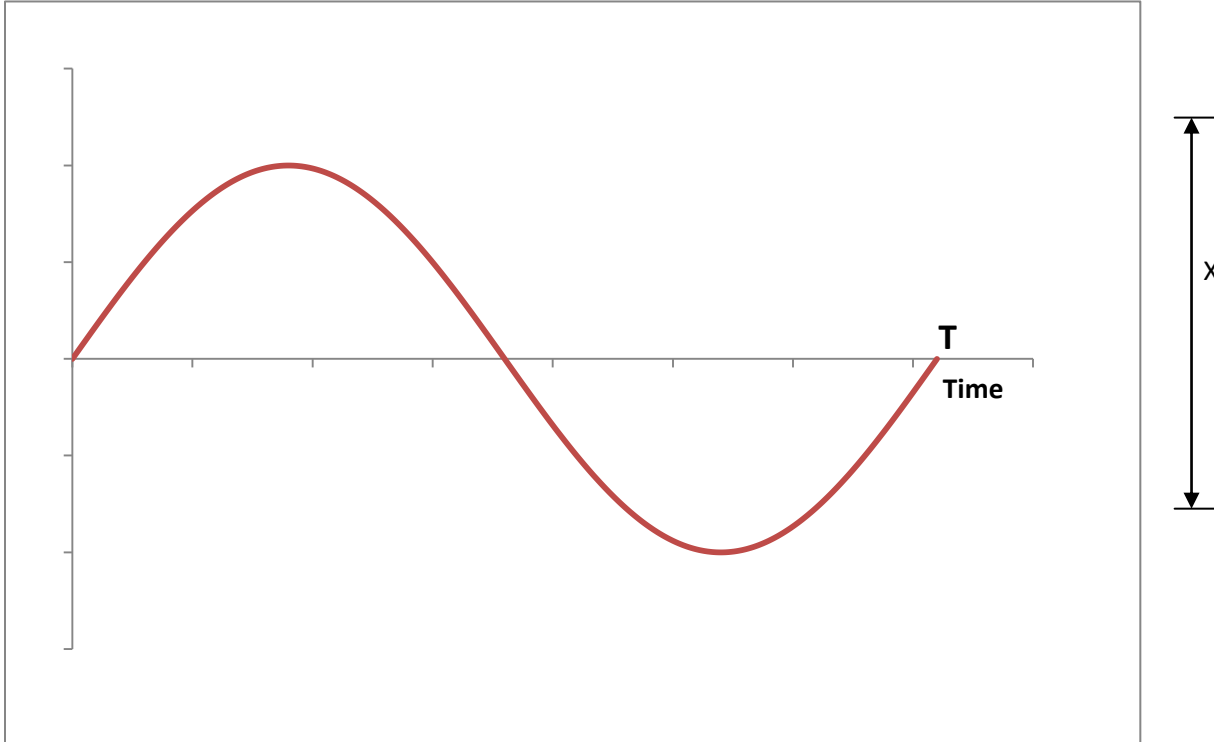
$$F_{rms} = 4 m \left( \frac{X}{T^2} \right) \sqrt{\text{Duty Cycle}}$$

$$I_{rms} = \frac{4 m \left( \frac{X}{T^2} \right)}{K_f} \sqrt{\text{Duty Cycle}}$$

$$V_{peak} = \frac{2X}{T}$$

$$P = R I_{rms}^2$$

## Sinusoidal Profile



$$x(t) = \frac{X}{2} \sin(\omega t) \quad \text{Position Equation}$$

$$v(t) = \frac{X}{2} \omega \cos(\omega t) \quad \text{Velocity Equation}$$

$$a(t) = -\frac{X}{2} \omega^2 \sin(\omega t) \quad \text{Acceleration Equation}$$

$$a_{peak} = +\frac{X}{2} \omega^2$$

$$a_{rms} = \frac{\sqrt{2}}{2} \frac{X}{2} 4\pi^2 f^2$$

$$a_{rms} = 13.956 X f^2$$

$$F_{rms} = 13.956 m X f^2 = \frac{13.956 m X}{T^2}$$

$$I_{rms} = \frac{13.956 m X}{K_f T^2}$$








$$Velocity_{peak} = \frac{2\pi X}{T}$$

$$P = R I_{rms}^2$$










# Linear DC Motors



















## Linear DC Motors Comparison Table










Model #	Stroke		Continuous Force		Intermittent Force @ 10% Duty Cycle		Force Constant		Coil Mass		Body Mass		Housing Outside Diameter		Housing Length	
<a href="#">LVCM-010-013-01</a>	0.25	inch	1.0	oz	3.2	oz	1.0	oz/A	0.09	oz	0.13	oz	0.375	inch	0.500	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	0.28	N	0.88	N	0.29	N/A	2.5	gr	3.8	gr	9.5	mm	12.7	mm
<a href="#">LVCM-013-013-02</a>	0.25	inch	3.1	oz	9.8	oz	2.5	oz/A	0.19	oz	0.27	oz	0.500	inch	0.500	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	0.86	N	2.73	N	0.69	N/A	5.4	gr	7.6	gr	12.7	mm	12.7	mm
<a href="#">LVCM-013-019-02</a>	0.50	inch	2.9	oz	9.2	oz	2.8	oz/A	0.23	oz	0.37	oz	0.500	inch	0.750	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	0.81	N	2.55	N	0.77	N/A	6.4	gr	10.6	gr	12.7	mm	19.1	mm
<a href="#">LVCM-013-025-02</a>	0.75	inch	2.9	oz	9.0	oz	2.9	oz/A	0.32	oz	0.49	oz	0.500	inch	1.000	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	0.79	N	2.51	N	0.80	N/A	9.0	gr	13.8	gr	12.7	mm	25.4	mm
<a href="#">LVCM-013-032-02</a>	1.00	inch	2.5	oz	7.9	oz	2.7	oz/A	0.38	oz	0.60	oz	0.500	inch	1.250	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	0.70	N	2.20	N	0.76	N/A	10.8	gr	17	gr	12.7	mm	31.8	mm
<a href="#">LVCM-013-044-02</a>	1.50	inch	2.5	oz	8.0	oz	3.0	oz/A	0.52	oz	0.88	oz	0.500	inch	1.750	inch
<a href="#">Datasheet in PDF</a> 	38.1	mm	0.71	N	2.23	N	0.84	N/A	14.6	gr	25	gr	12.7	mm	44.5	mm
<a href="#">LVCM-013-044-03</a>	0.60	inch	6.9	oz	21.7	oz	8.01	oz/A	0.51	oz	0.88	oz	0.500	inch	1.750	inch
<a href="#">Datasheet in PDF</a> 	15.2	mm	1.9	N	6.0	N	2.23	N/A	14.5	gr	25	gr	12.7	mm	44.5	mm
<a href="#">LVCM-016-010-01</a>	0.125	inch	5.9	oz	18.6	oz	4.0	oz/A	0.18	oz	0.25	oz	0.625	inch	0.375	inch









<a href="#">Datasheet in PDF</a> 	3.2	mm	1.6	N	5.2	N	1.1	N/A	5.0	gr	7.0	gr	15.9	mm	9.5	mm
<a href="#">LVCM-016-013-01</a>	0.25	inch	6.3	oz	20.0	oz	5.1	oz/A	0.25	oz	0.42	oz	0.625	inch	0.500	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	1.8	N	5.6	N	1.4	N/A	7.0	gr	12	gr	15.9	mm	12.7	mm
<a href="#">LVCM-016-019-01</a>	0.50	inch	6.1	oz	19.3	oz	6.3	oz/A	0.32	oz	0.60	oz	0.625	inch	0.750	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	1.7	N	5.4	N	1.7	N/A	9.0	gr	17	gr	15.9	mm	19.1	mm
<a href="#">LVCM-019-016-02</a>	0.25	inch	8.9	oz	28.0	oz	5.28	oz/A	0.28	oz	0.9	oz	0.750	inch	0.875	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	2.5	N	7.8	N	1.5	N/A	8	gr	26	gr	19.1	mm	22.2	mm
<a href="#">LVCM-019-022-02</a>	0.5	inch	8.1	oz	25.7	oz	5.74	oz/A	0.39	oz	1.3	oz	0.750	inch	0.875	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	2.3	N	7.1	N	1.6	N/A	11	gr	36	gr	19.1	mm	22.2	mm
<a href="#">LVCM-019-032-02</a>	0.875	inch	8.1	oz	25.7	oz	7.12	oz/A	0.49	oz	1.7	oz	0.750	inch	1.250	inch
<a href="#">Datasheet in PDF</a> 	22.2	mm	2.3	N	7.2	N	2.0	N/A	14	gr	48	gr	19.1	mm	31.8	mm
<a href="#">LVCM-019-048-02</a>	1.5	inch	7.4	oz	23.5	oz	7.06	oz/A	0.71	oz	2.6	oz	0.750	inch	1.875	inch
<a href="#">Datasheet in PDF</a> 	38.1	mm	2.1	N	6.5	N	2.0	N/A	20	gr	73	gr	19.1	mm	47.6	mm
<a href="#">LVCM-025-022-01</a>	0.38	inch	16.9	oz	53.5	oz	11.1	oz/A	0.71	oz	2.2	oz	1.000	inch	0.875	inch
<a href="#">Datasheet in PDF</a> 	9.5	mm	4.7	N	14.9	N	3.1	N/A	20	gr	62	gr	25.4	mm	22.2	mm
<a href="#">LVCM-025-029-01</a>	0.63	inch	18.2	oz	57.7	oz	13.5	oz/A	0.95	oz	2.8	oz	1.000	inch	1.125	inch
<a href="#">Datasheet in PDF</a> 	15.9	mm	5.1	N	16.0	N	3.75	N/A	27	gr	78	gr	25.4	mm	28.6	mm

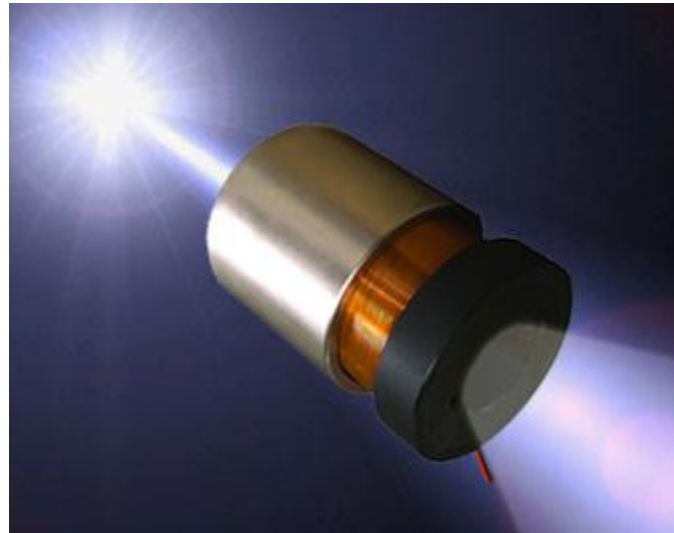
<a href="#">LVCM-025-038-01</a>	0.37	inch	2.5	lb	7.8	lb	2.00	lb/A	1.16	oz	3.6	oz	1.000	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	9.5	mm	11.0	N	34.7	N	9.0	N/A	33	gr	102	gr	25.4	mm	38.1	mm
<a href="#">LVCM-025-038-02</a>	1.00	inch	16.4	oz	51.9	oz	0.88	lb/A	1.22	oz	3.6	oz	1.000	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	4.6	N	14.4	N	3.9	N/A	35	gr	102	gr	25.4	mm	38.1	mm
<a href="#">LVCM-032-025-02</a>	0.50	inch	2.1	lb	6.6	lb	0.88	lb/A	0.99	oz	4.5	oz	1.250	inch	1.00	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	9.3	N	29.3	N	3.9	N/A	28	gr	127	gr	31.8	mm	25.4	mm
<a href="#">LVCM-032-038-02</a>	1.00	inch	1.9	lb	5.9	lb	0.94	lb/A	1.34	oz	6.5	oz	1.250	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	8.3	N	26.1	N	4.2	N/A	38	gr	184	gr	31.8	mm	28.6	mm
<a href="#">LVCM-032-076-02</a>	2.50	inch	1.8	lb	5.7	lb	1.11	lb/A	2.40	oz	12.7	oz	1.250	inch	3.0	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	8.0	N	25.3	N	5.0	N/A	68	gr	360	gr	31.8	mm	76.2	mm
<a href="#">LVCM-038-038-01</a>	0.75	inch	3.0	lb	9.5	lb	2.3	lb/A	1.90	oz	9.5	oz	1.500	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	13.4	N	42.5	N	10.1	N/A	54	gr	270	gr	38.1	mm	38.1	mm
<a href="#">LVCM-038-038-02</a>	0.38	inch	5.6	lb	17.7	lb	3.9	lb/A	1.83	oz	9.3	oz	1.500	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	9.5	mm	24.9	N	78.8	N	17.3	N/A	52	gr	265	gr	38.1	mm	38.1	mm
<a href="#">LVCM-044-032-02</a>	0.50	inch	5.0	lb	15.8	lb	2.8	lb/A	2.3	oz	11.3	oz	1.750	inch	1.25	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	22.2	N	70.4	N	12.3	N/A	64	gr	320	gr	44.5	mm	31.8	mm

<a href="#">LVCM-044-051-01</a>	1.25	inch	4.9	lb	15.4	lb	2.3	lb/A	5.8	oz	14.3	oz	1.750	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	31.8	mm	21.6	N	68.4	N	10.3	N/A	165	gr	405	gr	44.5	mm	50.8	mm
<a href="#">LVCM-044-051-02</a>	1.25	inch	5.0	lb	15.8	lb	1.6	lb/A	3.2	oz	17.5	oz	1.750	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	31.8	mm	22.3	N	70.4	N	6.9	N/A	90	gr	497	gr	44.5	mm	50.8	mm
<a href="#">LVCM-051-025-01</a>	0.50	inch	5.3	lb	16.9	lb	1.6	lb/A	3.2	oz	11.5	oz	2.000	inch	1.00	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	23.7	N	74.8	N	6.9	N/A	92	gr	326	gr	50.8	mm	25.4	mm
<a href="#">LVCM-051-032-01</a>	0.75	inch	6.3	lb	20.0	lb	1.9	lb/A	3.6	oz	14.4	oz	2.000	inch	1.25	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.2	N	89.9	N	8.4	N/A	103	gr	409	gr	50.8	mm	31.8	mm
<a href="#">LVCM-051-051-01</a>	0.75	inch	6.6	lb	20.8	lb	1.98	lb/A	4.23	oz	23.6	oz	2.000	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	29.3	N	92.6	N	8.8	N/A	120	gr	670	gr	50.8	mm	50.8	mm
<a href="#">LVCM-051-051-05</a>	1.00	inch	6.3	lb	19.9	lb	1.8	lb/A	4.23	oz	24.2	oz	2.000	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	28.0	N	88.6	N	8.0	N/A	120	gr	685	gr	50.8	mm	50.8	mm
<a href="#">LVCM-051-064-01</a>	1.25	inch	6.6	lb	20.9	lb	2.2	lb/A	5.3	oz	30.0	oz	2.000	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	31.8	mm	29.4	N	92.9	N	9.6	N/A	150	gr	850	gr	50.8	mm	63.5	mm
<a href="#">LVCM-051-064-02</a>	0.50	inch	15.3	lb	48.5	lb	4.8	lb/A	4.9	oz	29.6	oz	2.000	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	68.2	N	215.5	N	21.6	N/A	140	gr	840	gr	50.8	mm	63.5	mm
<a href="#">LVCM-051-089-01</a>	2.25	inch	5.9	lb	18.6	lb	2.3	lb/A	6.9	oz	40.7	oz	2.000	inch	3.50	inch






<a href="#">Datasheet in PDF</a> 	57.2	mm	26.2	N	82.7	N	10.1	N/A	195	gr	1155	gr	50.8	mm	88.9	mm
<a href="#">LVCM-051-089-02</a>	1.00	inch	14.9	lb	48.2	lb	5.7	lb/A	6.7	oz	40.6	oz	2.000	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	66.4	N	210	N	25.5	N/A	190	gr	1150	gr	50.8	mm	63.5	mm
<a href="#">LVCM-051-165-01</a>	5.25	inch	4.8	lb	15.3	lb	2.4	lb/A	12.0	oz	74.0	oz	2.000	inch	6.50	inch
<a href="#">Datasheet in PDF</a> 	133.4	mm	21.5	N	68.1	N	10.6	N/A	340	gr	2100	gr	50.8	mm	165.1	mm
<a href="#">LVCM-051-165-02</a>	2.50	inch	13.4	lb	42.3	lb	6.6	lb/A	12.0	oz	74.0	oz	2.000	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	59.4	N	187.8	N	29.3	N/A	340	gr	2100	gr	50.8	mm	63.5	mm
<a href="#">LVCM-051-165-03</a>	1.00	inch	26.5	lb	83.8	lb	13.1	lb/A	11.6	oz	72.7	oz	2.000	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	117.7	N	372.3	N	58.2	N/A	330	gr	2060	gr	50.8	mm	63.5	mm
<a href="#">LVCM-070-038-01</a>	0.50	inch	14.5	lb	45.9	lb	4.7	lb/A	0.42	oz	2.1	lb	2.750	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	64.6	N	204.4	N	21.2	N/A	192	gr	0.95	kg	69.9	mm	28.6	mm
<a href="#">LVCM-070-051-01</a>	1.00	inch	14.6	lb	46.0	lb	5.5	lb/A	0.53	oz	2.74	oz	2.750	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	64.7	N	204.3	N	24.4	N/A	240	gr	1.24	kg	69.9	mm	50.8	mm
<a href="#">LVCM-070-064-01</a>	1.50	inch	14.4	lb	45.5	lb	2.5	lb/A	0.67	oz	3.37	lb	2.750	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.2	mm	64.0	N	202.0	N	11.0	N/A	305	gr	1.53	kg	69.9	mm	63.5	mm
<a href="#">LVCM-070-089-01</a>	2.50	inch	14.1	lb	44.6	lb	2.6	lb/A	0.904	oz	4.67	lb	2.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	62.8	N	198.3	N	11.5	N/A	410	gr	2.12	kg	69.9	mm	88.9	mm










<a href="#">LVCM-070-089-02</a>	1.00	inch	33.9	lb	107.1	lb	6.3	lb/A	0.873	oz	4.69	lb	2.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	150.7	N	476.3	N	28.2	N/A	396	gr	2.13	kg	69.9	mm	88.9	mm
<a href="#">LVCM-095-038-01</a>	0.50	inch	23.1	lb	73.1	lb	8.5	lb/A	0.72	oz	4.07	lb	3.750	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	102.7	N	324.4	N	38.0	N/A	326	gr	1.85	kg	95.3	mm	28.6	mm
<a href="#">LVCM-095-051-01</a>	1.00	inch	23.4	lb	70.0	lb	10.1	lb/A	0.87	oz	5.34	lb	3.750	inch	2.0	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	104.0	N	328.7	N	44.8	N/A	395	gr	2.42	kg	95.3	mm	50.8	mm
<a href="#">LVCM-095-064-01</a>	1.50	inch	24.4	lb	77.1	lb	4.8	lb/A	1.07	lb	6.61	lb	3.750	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.2	mm	108.2	N	342.0	N	21.1	N/A	484	gr	3.00	kg	95.3	mm	63.5	mm
<a href="#">LVCM-095-089-01</a>	2.50	inch	25.0	lb	79.0	lb	5.0	lb/A	1.39	lb	9.14	lb	3.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	111.2	N	351.3	N	22.2	N/A	632	gr	4.14	kg	95.3	mm	88.9	mm
<a href="#">LVCM-095-089-02</a>	1.00	inch	58.0	lb	183.1	lb	11.6	lb/A	1.37	lb	9.15	lb	3.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	257.7	N	814.5	N	51.6	N/A	621	gr	4.15	kg	95.3	mm	88.9	mm

# Hollow Core Linear Voice Coil Motors








### Hollow Core Linear Voice Coil Motors Comparison Table

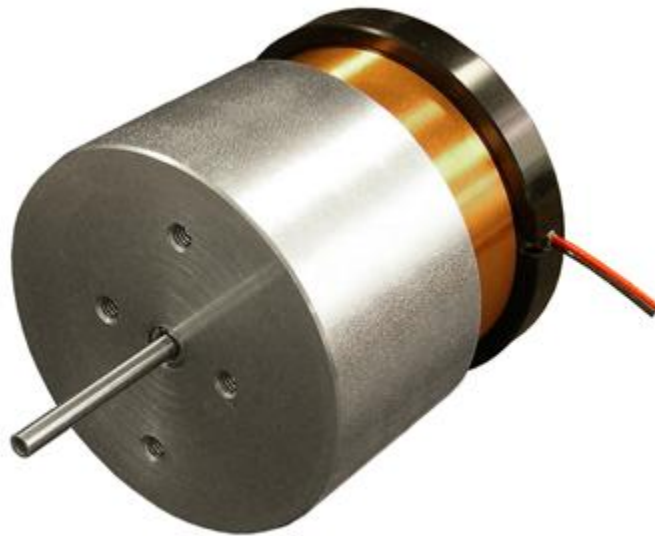
Model #	Stroke		Continuous Force		Intermittent Force @ 10% Duty Cycle		Force Constant		Coil Mass		Body Mass		Housing Outside Diameter		Housing Length	
<a href="#">HVCM-016-010-003-01</a>	0.125	inch	5.0	oz	15.7	oz	3.3	lb/A	0.18	oz	0.25	oz	0.625	inch	0.375	inch
<a href="#">Datasheet in PDF</a> 	3.2	mm	1.4	N	4.4	N	0.9	N/A	5	gr	7	gr	15.9	mm	9.5	mm
<a href="#">HVCM-016-013-003-01</a>	0.25	inch	5.7	oz	17.9	oz	4.5	lb/A	0.25	oz	0.42	oz	0.625	inch	0.500	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	1.6	N	5.0	N	1.3	N/A	7	gr	12	gr	15.9	mm	12.7	mm
<a href="#">HVCM-016-019-003-01</a>	0.50	inch	5.3	oz	16.6	oz	5.4	lb/A	0.32	oz	0.60	oz	0.625	inch	0.750	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	1.5	N	4.6	N	1.5	N/A	9	gr	17	gr	15.9	mm	19.1	mm
<a href="#">HVCM-019-016-003-02</a>	0.250	inch	7.4	oz	23.7	oz	4.9	lb/A	0.28	oz	0.91	oz	0.750	inch	0.625	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	2.1	N	6.6	N	1.4	N/A	8	gr	26	gr	19.1	mm	15.9	mm
<a href="#">HVCM-019-022-003-02</a>	0.500	inch	8.4	oz	26.6	oz	6.4	lb/A	0.39	oz	1.22	oz	0.750	inch	0.625	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	2.3	N	7.4	N	1.8	N/A	11	gr	35	gr	19.1	mm	15.9	mm
<a href="#">HVCM-019-032-003-02</a>	0.875	inch	7.4	oz	23.3	oz	6.5	lb/A	0.49	oz	1.7	oz	0.750	inch	1.250	inch

<a href="#">Datasheet in PDF</a> 	22.2	mm	2.1	N	6.5	N	1.8	N/A	14	gr	48	gr	19.1	mm	31.8	mm
<a href="#">HVCM-051-025-013-01</a>	0.50	inch	5.3	lb	16.9	lb	1.6	lb/A	3.2	oz	10.6	oz	2.0	inch	1.00	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	23.7	N	74.8	N	6.9	N/A	92	gr	300	gr	50.8	mm	25.4	mm
<a href="#">HVCM-051-025-019-01</a>	0.50	inch	4.8	lb	15.15	lb	1.4	lb/A	3.0	oz	9.8	oz	2.0	inch	1.00	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	21.3	N	67.4	N	6.2	N/A	86	gr	277	gr	50.8	mm	25.4	mm
<a href="#">HVCM-051-032-013-01</a>	0.75	inch	6.3	lb	20.0	lb	1.9	lb/A	3.6	oz	13.2	oz	2.0	inch	1.25	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.2	N	89.9	N	8.4	N/A	103	gr	375	gr	50.8	mm	31.8	mm
<a href="#">HVCM-051-032-019-01</a>	0.75	inch	4.9	lb	15.7	lb	1.5	lb/A	3.4	oz	12.1	oz	2.0	inch	1.25	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	22.0	N	69.6	N	6.5	N/A	97	gr	343	gr	50.8	mm	31.8	mm
<a href="#">HVCM-051-051-013-01</a>	0.75	inch	6.3	lb	19.9	oz	1.8	lb/A	4.23	oz	22.2	oz	2.0	inch	2.0	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.0	N	88.6	N	8.0	N/A	120	gr	630	gr	50.8	mm	50.8	mm
<a href="#">HVCM-051-051-019-01</a>	0.75	inch	5.2	lb	16.4	lb	1.56	lb/A	4.13	oz	20.1	oz	2.0	inch	2.0	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	23.1	N	72.9	N	7.0	N/A	117	gr	570	gr	50.8	mm	50.8	mm
<a href="#">HVCM-051-064-013-01</a>	1.25	inch	6.6	lb	20.9	lb	2.2	lb/A	5.3	oz	27.9	oz	2.0	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.1	mm	29.4	N	92.9	N	9.6	N/A	150	gr	790	gr	50.8	mm	63.5	mm
<a href="#">HVCM-051-064-019-01</a>	1.5	inch	4.7	lb	14.9	lb	1.6	lb/A	4.8	oz	24.7	oz	2.0	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.1	mm	21.0	N	66.3	N	7.0	N/A	135	gr	700	gr	50.8	mm	63.5	mm













<a href="#">HVCM-051-089-019-01</a>	2.25	inch	4.2	lb	13.4	lb	1.6	lb/A	6.7	oz	33.7	oz	1.0	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	57.2	mm	18.8	N	59.5	N	7.3	N/A	190	gr	954	gr	25.4	mm	88.9	mm
<a href="#">HVCM-095-038-051-01</a>	0.50	inch	15.0	lb	47.5	lb	5.6	lb/A	0.63	lb	2.80	lb	3.750	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	66.7	N	211.0	N	24.8	N/A	286	gr	1.27	kg	95.3	mm	38.1	mm
<a href="#">HVCM-095-051-051-01</a>	1.00	inch	16.1	lb	50.8	lb	6.9	lb/A	0.78	lb	3.61	lb	3.750	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	71.4	N	225.8	N	30.8	N/A	353	gr	1.64	kg	95.3	mm	50.8	mm
<a href="#">HVCM-095-064-051-01</a>	1.50	inch	15.4	lb	48.6	lb	3.0	lb/A	0.97	lb	4.43	lb	3.750	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.1	mm	68.3	N	215.9	N	13.3	N/A	443	gr	2.01	kg	95.3	mm	63.5	mm
<a href="#">HVCM-095-089-051-01</a>	2.50	inch	16.3	lb	51.5	lb	3.26	lb/A	1.30	lb	6.12	lb	3.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	72.4	N	228.9	N	14.5	N/A	591	gr	2.78	kg	95.3	mm	88.9	mm









# Linear DC Motors with Internal Bearing



### Linear Voice Coil Motors with Internal Bearing Comparison Table

Model #	Stroke		Continuous Force		Intermittent Force @ 10% Duty Cycle		Force Constant		Coil Mass		Body Mass		Housing Outside Diameter		Housing Length	
<a href="#">GVCM-016-010-01</a>	0.125	inch	5.0	oz	15.7	oz	3.3	oz/A	0.22	oz	0.35	oz	0.625	inch	0.375	inch
<a href="#">Datasheet in PDF</a> 	3.2	mm	1.4	N	4.4	N	0.9	N/A	6	gr	10	gr	15.9	mm	9.5	mm
<a href="#">GVCM-016-013-01</a>	0.25	inch	5.7	oz	17.9	oz	4.5	oz/A	0.27	oz	0.42	oz	0.625	inch	0.500	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	1.6	N	5.0	N	1.3	N/A	8	gr	12	gr	15.9	mm	12.7	mm
<a href="#">GVCM-016-019-01</a>	0.50	inch	5.3	oz	16.6	oz	5.4	oz/A	0.39	oz	0.60	oz	0.625	inch	0.750	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	1.5	N	4.6	N	1.5	N/A	11	gr	17	gr	15.9	mm	19.1	mm
<a href="#">GVCM-019-016-02</a>	0.250	inch	7.4	oz	23.7	oz	4.9	oz/A	0.33	oz	0.91	oz	0.750	inch	0.625	inch
<a href="#">Datasheet in PDF</a> 	6.4	mm	2.1	N	6.6	N	1.4	N/A	9	gr	26	gr	19.1	mm	15.9	mm

<a href="#">GVCM-019-022-02</a>	0.500	inch	8.4	oz	26.6	oz	6.4	oz/A	0.41	oz	1.22	oz	0.750	inch	0.875	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	2.3	N	7.4	N	1.8	N/A	12	gr	35	gr	19.1	mm	22.2	mm
<a href="#">GVCM-019-032-02</a>	0.875	inch	7.4	oz	23.3	oz	6.5	oz/A	0.56	oz	1.7	oz	0.750	inch	1.250	inch
<a href="#">Datasheet in PDF</a> 	22.2	mm	2.1	N	6.5	N	1.8	N/A	16	gr	48	gr	19.1	mm	31.8	mm
<a href="#">GVCM-051-025-01</a>	0.75	inch	6.3	lb	19.9	lb	1.8	lb/A	5.7	oz	23.6	oz	2.000	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.0	N	88.6	N	8.0	N/A	162	gr	668	gr	50.8	mm	50.8	mm
<a href="#">GVCM-051-032-01</a>	0.75	inch	6.3	lb	19.9	lb	1.8	lb/A	5.7	oz	23.6	oz	2.000	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.0	N	88.6	N	8.0	N/A	162	gr	668	gr	50.8	mm	50.8	mm
<a href="#">GVCM-051-051-01</a>	0.75	inch	6.3	lb	19.9	lb	1.8	lb/A	5.7	oz	23.6	oz	2.000	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	19.1	mm	28.0	N	88.6	N	8.0	N/A	162	gr	668	gr	50.8	mm	50.8	mm
<a href="#">GVCM-051-064-01</a>	1.25	inch	6.6	lb	20.9	lb	2.2	lb/A	6.8	oz	28.9	oz	2.000	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	31.8	mm	29.4	N	92.9	N	9.6	N/A	192	gr	818	gr	50.8	mm	63.5	mm
<a href="#">GVCM-051-089-01</a>	2.25	inch	5.9	lb	18.6	lb	2.3	lb/A		oz		oz	2.000	inch	3.50	inch
	57.2	mm	26.2	N	82.7	N	10.1	N/A		gr		gr	50.8	mm	88.9	mm
<a href="#">GVCM-051-165-01</a>	5.25	inch	4.8	lb	15.3	lb	2.4	lb/A		oz		oz	2.000	inch	6.50	inch
	133.4	mm	21.5	N	68.1	N	10.6	N/A		gr		gr	50.8	mm	165.1	mm

<a href="#">GVCM-070-038-01</a>	0.50	inch	14.5	lb	45.9	lb	4.7	lb/A	0.52	lb	2.10	lb	2.750	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	64.6	N	204.4	N	21.2	N/A	234	gr	0.93	kg	69.9	mm	28.6	mm
<a href="#">GVCM-070-051-01</a>	1.00	inch	14.6	lb	46.0	lb	5.5	lb/A	0.62	lb	2.70	lb	2.750	inch	2.00	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	64.7	N	204.3	N	24.4	N/A	282	gr	1.22	kg	69.9	mm	50.8	mm
<a href="#">GVCM-070-064-01</a>	1.50	inch	14.4	lb	45.5	lb	2.5	lb/A	0.77	lb	3.30	lb	2.750	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.2	mm	64.0	N	202.0	N	11.0	N/A	350	gr	1.50	kg	69.9	mm	63.5	mm
<a href="#">GVCM-070-089-01</a>	2.50	inch	14.1	lb	44.6	lb	2.6	lb/A	1.08	lb	4.6	lb	2.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	62.8	N	198.3	N	11.5	N/A	488	gr	2.1	kg	69.9	mm	88.9	mm
<a href="#">GVCM-095-038-01</a>	0.50	inch	23.1	lb	73.1	lb	8.5	lb/A	0.81	lb	4.03	lb	3.750	inch	1.50	inch
<a href="#">Datasheet in PDF</a> 	12.7	mm	102.7	N	324.4	N	38.0	N/A	368	gr	1.83	kg	95.3	mm	28.6	mm
<a href="#">GVCM-095-051-01</a>	1.00	inch	23.4	lb	70.0	lb	10.1	lb/A	0.96	lb	5.29	lb	3.750	inch	2.0	inch
<a href="#">Datasheet in PDF</a> 	25.4	mm	104.0	N	328.7	N	44.8	N/A	437	gr	2.40	kg	95.3	mm	50.8	mm
<a href="#">GVCM-095-064-01</a>	1.50	inch	23.1	lb	73.1	lb	4.8	lb/A	1.17	lb	6.55	lb	3.750	inch	2.50	inch
<a href="#">Datasheet in PDF</a> 	38.2	mm	102.7	N	102.7	N	21.1	N/A	529	gr	2.97	kg	95.3	mm	63.5	mm
<a href="#">GVCM-095-089-01</a>	2.50	inch	25.0	lb	79.0	lb	5.0	lb/A	1.57	lb	9.1	lb	3.750	inch	3.50	inch
<a href="#">Datasheet in PDF</a> 	63.5	mm	111.2	N	351.3	N	22.2	N/A	710	gr	4.1	kg	95.3	mm	88.9	mm