

Some typical properties of bowed strings

The table below shows some typical string properties for commonly used strings of the violin family. Notice that the term “Transverse impedance” corresponds with “characteristic wave resistance” in this connection. This parameter is of the outmost importance when it comes to how heavy the string feels under the bow. As long as the tuning frequency and string length are given for each string, the transverse impedance is varying proportionally with the string’s mass per unit length, and with the string tension. There exists also a “torsional impedance”, but the data here is rather scarce, and hence omitted in the table.

Instrument	Tuning pitch	Frequency [Hz]	String length [cm]	Mass per unit length [g/m]	Propagation speed [m/s]	Transverse impedance [g/s]	Tension [N]
Violin	E5	659.3	32.8	0.38 – 0.48	432.50	165 – 210	71.4 – 90.7
	A4	440.0		0.58 – 0.75	288.64	167 – 217	48.3 – 62.7
	D4	293.7		0.92 – 1.63	192.67	178 – 193	34.3 – 60.6
	G3	196.0		2.12 – 3.09	128.58	272 – 397	35.0 – 51.1
	Sum:						
Viola	A4	440.0	37.5	0.56 – 0.92	330.00	184 – 304	60.6 – 100.2
	D4	293.7		0.98 – 1.25	220.27	220 – 276	47.6 – 60.7
	G3	196.0		2.20 – 2.81	147.00	324 – 413	47.6 – 60.7
	C3	130.8		4.95 – 6.31	98.10	485 – 619	47.6 – 60.7
	Sum:						
Cello	A3	220.0	69.0	1.50 – 1.92	303.6	456 – 584	138.3 – 177.2
	D3	146.9		2.94 – 3.57	202.7	597 – 725	121.0 – 146.9
	G2	98.0		6.38 – 7.56	135.2	863 – 1023	116.7 – 138.3
	C2	65.4		14.33 – 16.98	90.3	1293 – 1532	116.7 – 138.3
	Sum:						
Double bass Solo tuning	A2	110.0	106.0	4.95 – 6.00	233.2	1154 – 1398	269.1 – 326.1
	E2	82.4		9.18 – 9.78	174.7	1604 – 1708	280.2 – 298.3
	B1	61.7		16.59 – 17.78	130.8	2170 – 2326	283.9 – 304.2
	F#1	46.2		29.59 – 34.04	97.9	2899 – 3335	283.9 – 326.5
	Sum:						
Double bass Orchestra tuning	G2	98.0	106.0	5.98 – 7.25	207.8	1242 – 1506	258.0 – 312.8
	D2	73.4		10.96 – 13.12	155.6	1705 – 2041	265.3 – 317.6
	A1	55.0		20.45 – 23.88	116.6	2384 – 2785	278.0 – 324.7
	E1	41.2		37.32 – 44.12	87.3	3260 – 3854	284.7 – 336.6
	B0	30.9		68.81 – 81.35	65.5	4507 – 5329	295.3 – 349.1
Sum:						1381.3 – 1640.8	

1 N \approx 98.1 gram force \approx 0.216 pound force. The author is indebted to Fan Tao of D’Addario & Company, and Michel Simane of Corelli/Savarez for their insightful comments on strings and contribution of values to this table.