

# 3M Unitek

## Orthodontic Wire Properties – Beta III, Stainless Steel and Blue Flexiloy Wires

### ISO 15841.

# FORCE MAGNITUDES

**Beta III Titanium Archwires**  
Elastic Modulus: 14,000,000 PSI +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force	
	min.	max.	min.	min.	min.	max.	min.	max.
	(ksi)	(ksi)	(ksi)		(gf/mm)	(gf/mm)	(gf)	(gf)
16x22	164	235	74	4	768	1152	683	1138
16x25	164	235	74	4	852	1278	709	1181
175x175	164	235	74	4	885	1328	716	1194
17x25	164	235	74	4	980	1470	788	1313
19x25	164	235	74	4	1382	2073	1070	1784
21x21	164	235	74	4	1573	2360	1147	1912
21x25	164	235	74	4	1963	2944	1546	2576

**Permachrome – Standard Archwires**  
Elastic Modulus: 22,000,000 PSI +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force	
	min.	max.	min.	min.	min.	max.	min.	max.
	(ksi)	(ksi)	(ksi)		(gf/mm)	(gf/mm)	(gf)	(gf)
10	320	350	224	1.5	146	219	110	184
12	316	346	221	1.5	295	442	217	362
14	312	342	218	1.5	512	768	338	563
15	310	340	217	1	654	981	414	689
16	308	338	216	1.5	911	1366	548	913
18	304	334	213	1.5	1263	1894	754	1257
20	300	330	210	1.5	1864	2796	1065	1775
21	296	326	207	1.2	2273	3409	1266	2111
22	296	326	207	1.2	2605	3908	1375	2291
25	289	319	202	1.5	3891	5836	2101	3501
26	289	319	202	1.5	4291	6436	2403	4005
28	286	316	200	1.5	5132	7698	2851	4752
30	277	307	194	1.5	5897	8846	3231	5385
32	277	307	194	1.7	6914	10371	3780	6299
36	273	303	191	1.7	8380	12570	4571	7619
40	235	270	165	2	9525	14287	5189	8648
45	230	265	161	2	10948	16422	5957	9928
51	225	260	158	2	11392	17088	6197	10328
55	215	250	151	2	11894	17841	6468	10779
62	205	240	144	2	12396	18594	6739	11231
16x22	275	305	124	1.5	1717	2576	1034	1724
17x22	275	305	124	1.5	2015	3023	1257	2095
17x25	275	305	124	1.5	2375	3563	1382	2303
18x25	275	305	124	1.5	2669	4004	1588	2647
19x25	275	305	124	1.5	2939	4409	1666	2777
21x25	275	305	124	1.5	3905	5857	2126	3543

**Permachrome – Resilient Archwires**  
Elastic Modulus: 22,000,000 PSI +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force		
	min.	max.	min.	min.	min.	max.	min.	max.	
	(ksi)	(ksi)	(ksi)		(gf/mm)	(gf/mm)	(gf)	(gf)	
12	346	376	242	1	298	447	202	336	
14	342	372	239	1	512	767	352	586	
16	338	368	237	1	853	1280	570	951	
18	334	364	234	1.2	1296	1944	745	1242	
20	330	360	231	1.2	2021	3032	1133	1888	
Retainer	25	235	265	165	1.5	3731	5597	1761	2936
Retainer	28	235	265	165	1.5	5015	7522	2361	3935
Retainer	30	235	265	165	1.7	5977	8966	3034	5057
Retainer	32	235	265	165	1.7	6781	10171	3708	6180
Retainer	36	235	265	165	2	8298	12447	4527	7544
16x16	305	335	137	1.5	1448	2172	924	1540	
16x22	305	335	137	1.5	1768	2652	1140	1901	
16x25	305	335	137	1.5	1967	2950	1225	2042	
175x175	305	335	137	1.5	1963	2944	1226	2043	
17x22	305	335	137	1.5	1971	2957	1287	2146	
17x25	305	335	137	1.5	2324	3487	1438	2396	
17x25 Hybrid	305	335	137	1.5	2203	3305	1352	2254	
18x18	305	335	137	1.5	1917	2876	1165	1942	
18x22	305	335	137	1.5	2313	3469	1468	2447	
18x25	305	335	137	1.5	2580	3869	1549	2582	
18x25 Hybrid	305	335	137	1.5	2371	3557	1397	2329	
19x25	305	335	137	1.5	3190	4785	1822	3036	
19x25 Hybrid	305	335	137	1.5	2836	4254	1681	2802	
20x25	305	335	137	1.5	3431	5147	2054	3423	
21x25	305	335	137	1.5	3784	5677	2231	3718	
21x25 Hybrid	305	335	137	1.5	3423	5134	1933	3222	
215x28	305	335	137	1.5	4254	6382	2646	4411	

**Beta III Titanium Archwires**  
Elastic Modulus: 96.5 Gpa +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force	
	min.	max.	min.	min.	min.	max.	min.	max.
	(MPa)	(MPa)	(MPa)		(N/mm)	(N/mm)	(N)	(N)
16x22	1131	1620	509	4	7.53	11.30	6.69	11.16
16x25	1131	1620	509	4	8.36	12.53	6.95	11.58
175x175	1131	1620	509	4	8.68	13.02	7.02	11.70
17x25	1131	1620	509	4	9.61	14.42	7.72	12.87
19x25	1131	1620	509	4	13.56	20.33	10.50	17.50
21x21	1131	1620	509	4	15.43	23.14	11.25	18.75
21x25	1131	1620	509	4	19.25	28.87	15.16	25.26

**Permachrome – Standard Archwires**  
Elastic Modulus: 152 Gpa +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force	
	min.	max.	min.	min.	min.	max.	min.	max.
	(MPa)	(MPa)	(MPa)		(N/mm)	(N/mm)	(N)	(N)
10	2206	2413	1544	1.5	1.43	2.14	1.08	1.80
12	2179	2386	1525	1.5	2.89	4.33	2.13	3.55
14	2151	2358	1506	1.5	5.02	7.53	3.31	5.52
15	2137	2344	1496	1	6.42	9.63	4.06	6.76
16	2124	2330	1487	1.5	8.93	13.40	5.37	8.95
18	2096	2303	1467	1.5	12.38	18.57	7.40	12.33
20	2068	2275	1448	1.5	18.28	27.42	10.45	17.41
21	2041	2248	1429	1.2	22.29	33.44	12.42	20.70
22	2041	2248	1429	1.2	25.55	38.32	13.48	22.47
25	1993	2199	1395	1.5	38.16	57.23	20.60	34.34
26	1993	2199	1395	1.5	42.08	63.12	23.56	39.27
28	1972	2179	1380	1.5	50.33	75.50	27.96	46.60
30	1910	2117	1337	1.5	57.83	86.75	31.68	52.81
32	1910	2117	1337	1.7	67.80	101.7	37.07	61.78
36	1882	2089	1318	1.7	82.18	123.27	44.83	74.71
40	1620	1862	1134	2	93.41	140.11	50.88	84.81
45	1586	1827	1110	2	107.36	161.04	58.42	97.36
51	1551	1793	1086	2	111.72	167.58	60.77	101.28
55	1482	1724	1038	2	116.64	174.97	63.43	105.71
62	1413	1655	989	2	121.57	182.35	66.08	110.14
16x22	1896	2103	853	1.5	16.84	25.26	10.14	16.90
17x22	1896	2103	853	1.5	19.76	29.65	12.33	20.54
17x25	1896	2103	853	1.5	23.29	34.94	13.55	22.58
18x25	1896	2103	853	1.5	26.18	39.27	15.57	25.96
19x25	1896	2103	853	1.5	28.83	43.24	16.34	27.23
21x25	1896	2103	853	1.5	38.29	57.44	20.85	34.75

**Permachrome – Resilient Archwires**  
Elastic Modulus: 152 Gpa +/- 25%

Size Descriptor	Tensile Strength		0.2% Proof Strength	% Elongation After Break	Bending Stiffness		0.1 mm Offset Bending Force		
	min.	max.	min.	min.	min.	max.	min.	max.	
	(MPa)	(MPa)	(MPa)		(N/mm)	(N/mm)	(N)	(N)	
12	2386	2592	1670	1	2.92	4.38	1.98	3.30	
14	2358	2565	1651	1	5.02	7.52	3.45	5.75	
16	2330	2537	1631	1	8.37	12.55	5.59	9.32	
18	2303	2510	1612	1.2	12.71	19.06	7.31	12.18	
20	2275	2482	1593	1.2	19.82	29.73	11.11	18.51	
Retainer	25	1620	1827	1134	1.5	36.59	54.89	17.27	28.79
Retainer	28	1620	1827	1134	1.5	49.18	73.77	23.15	38.59
Retainer	30	1620	1827	1134	1.7	58.62	87.93	29.76	49.59
Retainer	32	1620	1827	1134	1.7	66.50	99.75	36.36	60.60
Retainer	36	1620	1827	1134	2	81.37	122.06	44.39	73.98
16x16	2103	2310	946	1.5	14.20	21.30	9.06	15.10	
16x22	2103	2310	946	1.5	17.34	26.01	11.18	18.64	
16x25	2103	2310	946	1.5	19.29	28.93	12.01	20.02	
175x175	2103	2310	946	1.5	19.25	28.87	12.02	20.03	
17x22	2103	2310	946	1.5	19.33	29.00	12.62	21.04	
17x25	2103	2310	946	1.5	22.79	34.19	14.10	23.50	
17x25 Hybrid	2103	2310	946	1.5	21.61	32.41	13.26	22.10	
18x18	2103	2310	946	1.5	18.80	28.21	11.42	19.04	
18x22	2103	2310	946	1.5	22.68	34.02	14.40	23.99	
18x25	2103	2310	946	1.5	25.30	37.94	15.19	25.32	
18x25 Hybrid	2103	2310	946	1.5	23.26	34.88	13.70	22.84	
19x25	2103	2310	946	1.5	31.29	46.93	17.86	29.77	
19x25 Hybrid	2103	2310	946	1.5	27.81	41.72	16.49	27.48	
20x25	2103	2310	946	1.5	33.65	50.48	20.14	33.56	
21x25	2103	2310	946	1.5	37.11	55.67	21.87	36.46	
21x25 Hybrid	2103	2310	946	1.5	33.56	50.35	18.96	31.60	
215x28	2103	2310	946	1.5	41.72	62.58	25.95	43.25	