SLINGSHOT BAND SPEED TEST

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Slingshot Band Speed Test

Introduction

In order to establish a better understanding for how different slingshot elastic bands affect the speed of the ball when shooting a speed test was carried out. The balls were shot through a fixed set up where the speed was measured using a chronograph. Tests were carried out using a wide range of bands and different types of ammunition.

Background

The slingshot has been used in many different applications over the years. Modern slingshots are used for a variety of tasks including hunting and recreational or competition target shooting. The velocity of the projectile leaving the slingshot is of great importance and much debate. This is especially true for hunting and competition use. The ball velocity is mainly determined by the material and geometry of the band used on the slingshot.

Bands have a variety of designs that aid the shooting style and technique of the user. These tests assume the use of standard shooting style where the pouch is drawn to the shooters cheek (except one set of trials with varying draw length). This style of shooting requires the use of shorter and stiffer bands. Shooting using the butterfly style means that the draw length become significantly longer, which requires using a long and very elastic band.

Method

Setup

To ensure that all bands were tested under the same circumstances, a fixed setup for the tests was prepared, and a mechanical release was used.

Test equipment:

- Mechanical release
- Vise
- Montie Gear Y-shot slingshot
- Chronograph
- Montie Gear Whisker Biscuit Holder
- Whisker Biscuit
- Ball stop
- 1/2” diameter steel balls
- 3/8” diameter steel balls
- Montie Gear Breakdown arrow, with field point
- Bands, see section “Bands” below

The equipment was attached to a table according to Fig. 1. Each band was tested with 3/8” and 1/2” diameter steel balls. The bands that achieved the highest speeds during the ball tests were also tested with the Montie

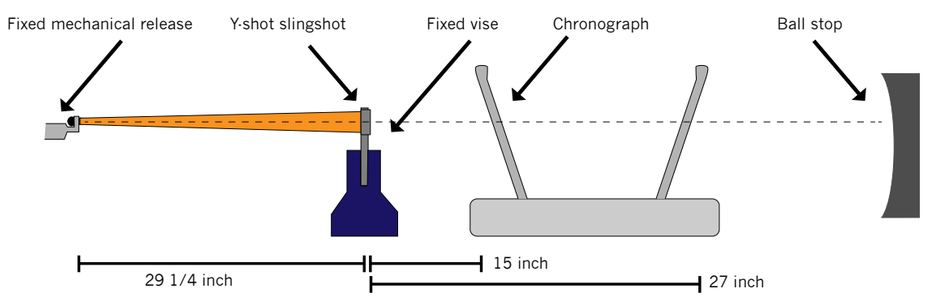

Fig. 1

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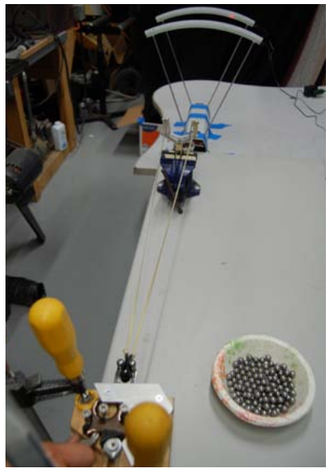
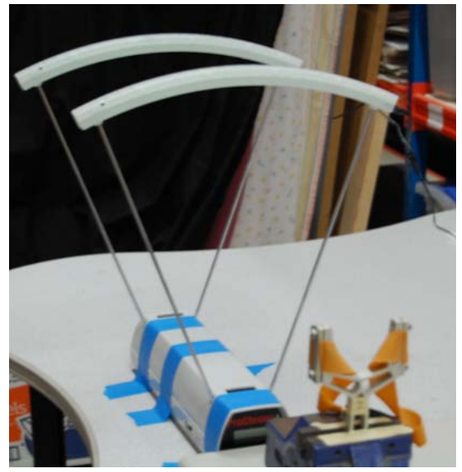
Gear Break Down Arrow. During tests using an arrow projectile a Montie Gear Whisker Biscuit Holder was attached to the slingshot to support the arrow.

Procedure

Each test was performed 8 times, after which the average velocity was calculated. Using multiple shots for each band helps increase the accuracy of the testing. The bands were stretched a distance of 29.25”, based on the average draw length of the test crew when shooting a ball projectile. A comfortable pull force for this draw length is generated by using a 10,5” long band, which is why the majority of the bands were tested at that length. This is also the standard band length with which the Y-Shot slingshot is shipped. During the arrow tests the bands were drawn until the front end of the tubing reached the whisker biscuit, which was 27.25”. Each band was held in its stretched position for 3 seconds before every release, helping to assure a consistent level of band relaxation during the tests. The air in the lab was at the time of the testing at a constant temperature of 74 degrees.





Another set of trials were done where the draw length varied from 19 to 49”, with 10” interval. At each draw length a set of three trials were shot. This test was done using the 3/8” steel balls.

For each band and draw distance the required pull force was also recorded.

Bands

The following bands were tested:

Material	Double	Thickness	Unmounted width	Effective width	Length, un-mounted	Effective length
Thera-Band Gold	No	.027”	0.75-1.25”	0.75-1.15”	10.5”	8.5”
Thera-Band Gold	Yes	.027”	0.75-1.25”	0.75-1.15”	10.5”	8.5”
Thera-Band Gold	No	.027”	15-22 mm	15-20.7 mm	10.5”	8.5”
Thera-Band Gold	No	.027”	0.5-0.75”	0.5-0.72”	10.5”	8.5”
Thera-Band Gold	No	.027”	0.875”	0.875”	10.5”	8.5”
Thera-Band Gold	No	.027”	0.75”	0.75”	10.5”	8.5”
Thera-Band Gold	No	.027”	1.5-2.5”	N/A, folded	8.75”	6.75”
Latex	No	.03”	0.75-1.25”	0.75-1.15”	10.5”	8.5”
Latex	No	.03”	15-22 mm	15-20.7 mm	10.5”	8.5”
Latex	No	.03”	0.5-0.75”	0.5-0.72”	10.5”	8.5”

Latex	No	.03”	0.875”	0.875”	10.5”	8.5”
Latex	No	.03”	0.75	0.75”	10.5”	8.5”
Latex	No	.04”	0.75-1.25”	0.75-1.15”	10.5”	8.5”
Latex	Yes	.04”	0.75-1.25”	0.75-1.15”	10.5”	8.5”
Latex	No	.04”	15-22 mm	15-20.7 mm	10.5”	8.5”
Latex	No	.04”	0.5-0.75”	0.5-0.72”	10.5”	8.5”
Latex	No	.04”	0.875”	0.875”	10.5”	8.5”
Latex	No	.04”	0.75	0.75”	10.5”	8.5”
Linatex	No	0.065”	15-22 mm	15-20.7 mm	10.5”	8.5”
Linatex short	No	0.065”	15-22 mm	15-19.5 mm	7.5”	5.5”

Bands of which the width is specified as an interval are linear tapered. The wide end was attached to the slingshot, and the narrow end to the pouch. Due to the Y-Shot’s band fastening principle the effective band length and width will be less than in the unmounted state, as stated in the table above.

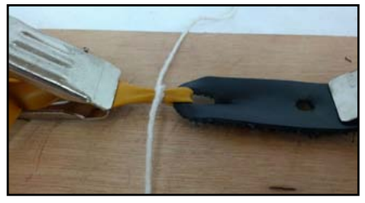
Band tying

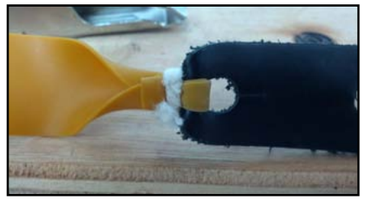
The bands are tied using clamps attached to a wooden board, see Fig 2. The procedure is as follows:

Attach the pouch to one of the clamps. Fold the band and pull it through the outer hole in the pouch, see Fig 3.

Fold the end of the band over itself, and clamp it together, see Fig 4. Tie a moderately tight clove hitch over the band using cotton string, see Fig 5.

Loosen the clamps and cut off any excess string, see Fig 6





Results

All speed data can be found in the appendix.

The average speeds for the different bands and band setups for different ammunition types are found in the table below.

Graph 1 - Average speed grouped by band geometry (ft/sec)

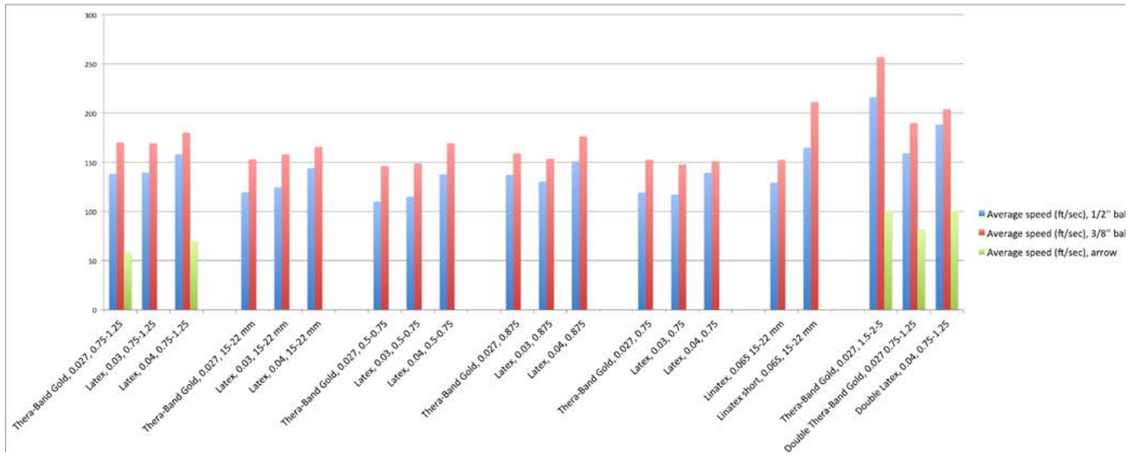
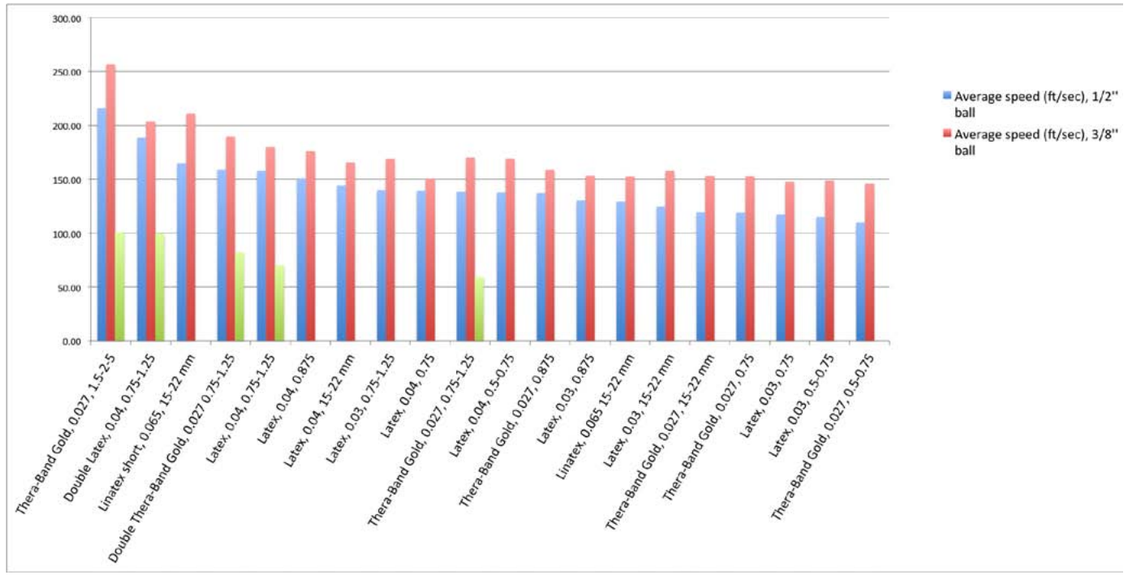


Table 1 - Average speed grouped by band geometry (ft/sec)

Band type	Average speed (ft/sec), 1/2" ball	Average speed (ft/sec), 3/8" ball	Average speed (ft/sec), arrow
Thera-Band Gold, 0.027, 0.75-1.25	138.375	170	59.125
Latex, 0.03, 0.75-1.25	139.625	169	
Latex, 0.04, 0.75-1.25	157.875	180.125	70.375
Thera-Band Gold, 0.027, 15-22 mm	119.375	153	
Latex, 0.03, 15-22 mm	124.625	157.875	
Latex, 0.04, 15-22 mm	144	165.5	
Thera-Band Gold, 0.027, 0.5-0.75	110	146	
Latex, 0.03, 0.5-0.75	115	148.875	
Latex, 0.04, 0.5-0.75	137.75	169.125	
Thera-Band Gold, 0.027, 0.875	137.25	158.875	
Latex, 0.03, 0.875	130.25	153.375	
Latex, 0.04, 0.875	150.875	176.25	
Thera-Band Gold, 0.027, 0.75	119.125	152.625	
Latex, 0.03, 0.75	117.125	147.625	
Latex, 0.04, 0.75	139.125	150.75	
Linatex, 0.065 15-22 mm	129.25	152.5	
Linatex short, 0.065, 15-22 mm	164.75	211	
Thera-Band Gold, 0.027, 1.5-2-5	216.125	256.75	101
Double Thera-Band Gold, 0.027 0.75-1.25	159	189.75	82.25
Double Latex, 0.04, 0.75-1.25	188.5	203.625	100

The overall fastest band configurations for the 1/2” balls range as follows. Graph 2a shows the speed for the 3/8” balls and graph 2b shows the kinetic energy (x 10) achieved with the 1/2” balls.

Graph 2a - Average speed sorted after top speed for 3/8” ball (ft/sec)



Graph 2b - Kinetic engery sorted after top speed for 3/8” ball (ft/sec)

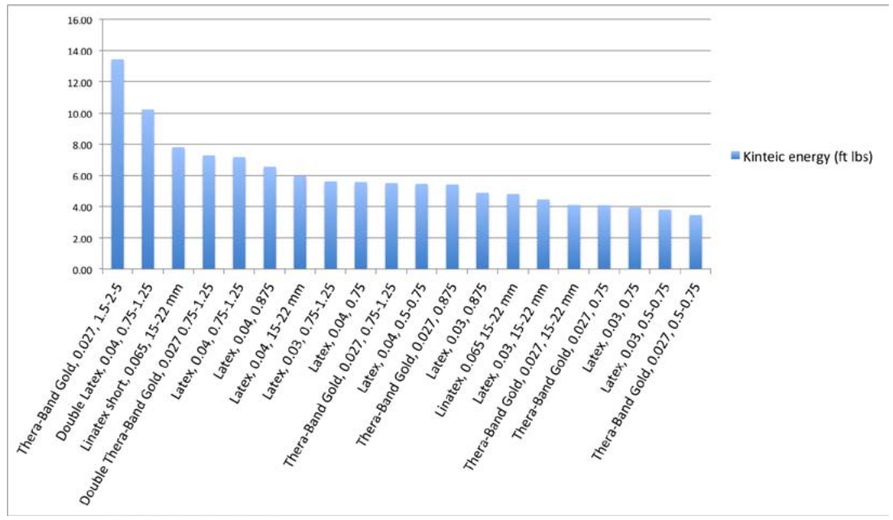


Table 2 - Average speed and kinetic engery sorted after top speed for 3/8” ball (ft/sec)

Band type	Average speed (ft/sec), 1/2" ball	Average speed (ft/sec), 3/8" ball	Average speed (ft/sec), arrow	Kinteic energy (ft lbs), 1/2" ball
Thera-Band Gold, 0.027, 1.5-2-5	216.13	256.75	101.00	13.44
Double Latex, 0.04, 0.75-1.25	188.50	203.63	100.00	10.23
Linatex short, 0.065, 15-22 mm	164.75	211.00		7.81
Double Thera-Band Gold, 0.027 0.75-1.25	159.00	189.75	82.25	7.28
Latex, 0.04, 0.75-1.25	157.88	180.13	70.38	7.17
Latex, 0.04, 0.875	150.88	176.25		6.55
Latex, 0.04, 15-22 mm	144.00	165.50		5.97
Latex, 0.03, 0.75-1.25	139.63	169.00		5.61
Latex, 0.04, 0.75	139.13	150.75		5.57
Thera-Band Gold, 0.027, 0.75-1.25	138.38	170.00	59.13	5.51
Latex, 0.04, 0.5-0.75	137.75	169.13		5.46
Thera-Band Gold, 0.027, 0.875	137.25	158.88		5.42
Latex, 0.03, 0.875	130.25	153.38		4.88
Linatex, 0.065 15-22 mm	129.25	152.50		4.81
Latex, 0.03, 15-22 mm	124.63	157.88		4.47
Thera-Band Gold, 0.027, 15-22 mm	119.38	153.00		4.10
Thera-Band Gold, 0.027, 0.75	119.13	152.63		4.08
Latex, 0.03, 0.75	117.13	147.63		3.95
Latex, 0.03, 0.5-0.75	115.00	148.88		3.81
Thera-Band Gold, 0.027, 0.5-0.75	110.00	146.00		3.48

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For each band configuration the efficiency of the band was determined. This measurement is based on the relation between the achieved ball speed and the required pull force for that specific shot. Hence, the efficiency is calculated a dividing the speed with the pull force. A higher number indicates a greater speed using less pull force. The speed, pull force and efficiency for each band are found in graph 3.

Graph 3 - Average speed, pull force, and efficiency

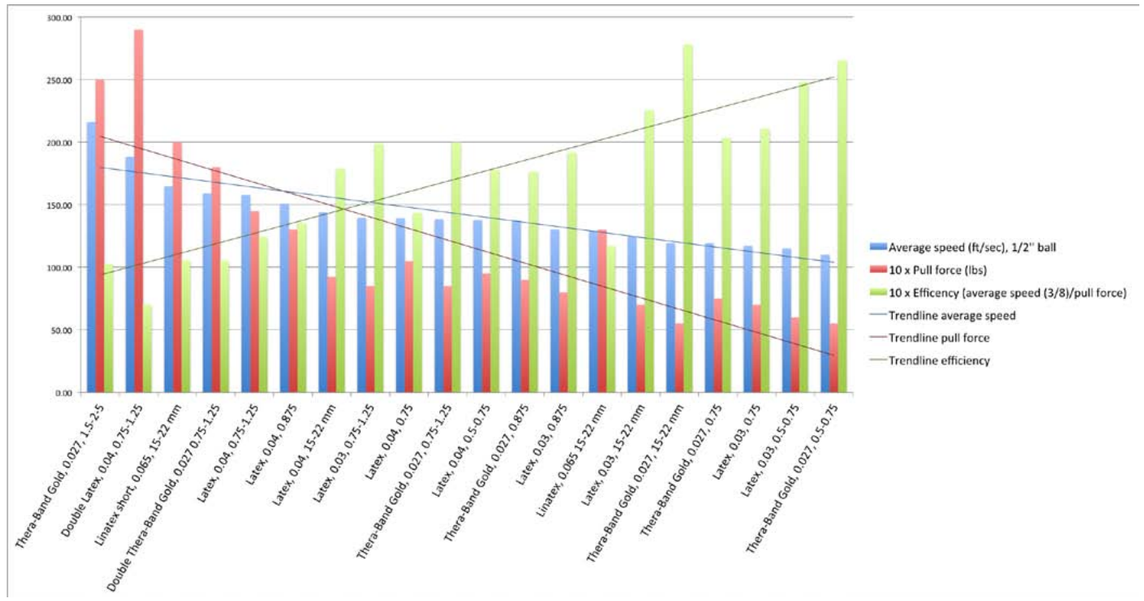

Table 3 - Average speed, pull force, and efficiency

Band type	Average speed (ft/sec), 1/2" ball	10 x Pull force (lbs)	10 x Efficency (average speed (3/8)/pull force)
Thera-Band Gold, 0.027, 1.5-2-5	216.13	250	102.70
Double Latex, 0.04, 0.75-1.25	188.50	290	70.22
Linatex short, 0.065, 15-22 mm	164.75	200	105.50
Double Thera-Band Gold, 0.027 0.75-1.25	159.00	180	105.42
Latex, 0.04, 0.75-1.25	157.88	145	124.22
Latex, 0.04, 0.875	150.88	130	135.58
Latex, 0.04, 15-22 mm	144.00	92.5	178.92
Latex, 0.03, 0.75-1.25	139.63	85	198.82
Latex, 0.04, 0.75	139.13	105	143.57
Thera-Band Gold, 0.027, 0.75-1.25	138.38	85	200.00
Latex, 0.04, 0.5-0.75	137.75	95	178.03
Thera-Band Gold, 0.027, 0.875	137.25	90	176.53
Latex, 0.03, 0.875	130.25	80	191.72
Linatex, 0.065 15-22 mm	129.25	130	117.31
Latex, 0.03, 15-22 mm	124.63	70	225.54
Thera-Band Gold, 0.027, 15-22 mm	119.38	55	278.18
Thera-Band Gold, 0.027, 0.75	119.13	75	203.50
Latex, 0.03, 0.75	117.13	70	210.89
Latex, 0.03, 0.5-0.75	115.00	60	248.13
Thera-Band Gold, 0.027, 0.5-0.75	110.00	55	265.45

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To see how the pull force varies with the elongation of the band, measurements were made at different draw lengths. Tha graph below displays how the force varies with the length of the draw. As the required pull force increased significantly after 49 inch this was choosen as the maximum draw lengths for this test.

Graph 4 - Pull force over varying draw lenghts

Table 4 - Pull force over varying draw lenghts

Draw length (inch)	Thera-Band Gold	Latex 0.03	Latex 0.04	Linatex	Percentage elongation
19 inch	3,25	4,75	6	7,5	224%
29 inch	5,75	7,25	9,5	11	341%
39 inch	8	10,5	16,89	14	459%
49 inch	10,25	15,5	15,53	17	576%

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To understand the relation between the elongation of the band and the efficiency at that length, another graph was plotted. This shows the different band performances (efficiency) at different draw lengths.

Graph 5 - Efficency over varying draw lenghts

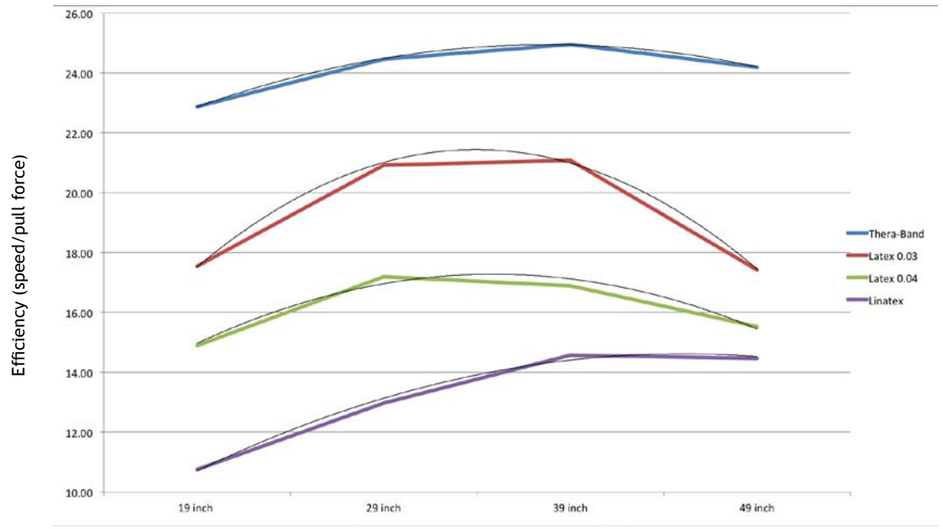

Table 5 - Efficency over varying draw lenghts

Draw length (inch)	Thera-Band Gold	Latex 0.03	Latex 0.04	Linatex	Percentage elongation
19 inch	22,87	17,54	14,89	10,76	224%
29 inch	24,46	20,92	17,19	12,97	341%
39 inch	24,96	21,08	16,89	14,57	459%
49 inch	24,20	17,42	15,53	14,47	576%

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Conclusions

Looking at the top speeds for the regular shooting style draw length, it is clear that the extra wide, extra short or double band configurations achieve the highest speeds. The pull force for all these shots are very high though. High pull forces cause shooter fatigue and decrease accuracy. Higher levels of shooter fatigue may be acceptable for hunting applications.

Single Layer Band Results

The fastetst single layer, standard length and width bands use the 0.04 inch thick latex band achieve the highest speeds in this category. The .04 inch thick latex material was the second thickest band material tested. The Linatec band was the only band using a thicker material. It is important to note that the Linatex band was only tested in a narrower 15-22 mm tapered version. As a result, we do not have a comparison including the wider Linatex band. However, it is important to note that the 0.04 latex band shoots the projectile faster than the Linatex band when comparing the 15-22 mm bands.

Efficiency and Effort

More interesting than the top speeds might be to look at the band efficiencies, which is measured through the relationship between the speed and the required pull force. Looking at the efficiency numbers, it's clear that the TB followed by the 0.03 Latex are most efficient. Also, the narrower bands seem to have higher efficiency. The bands that achieved the best speeds at the standard shooting style draw length have the lowest efficiency.

Another way to look at this is to look at the effort required to pull each band to a specific draw length and compare that to the velocity. This can help you determine which band and band geometry to use for a given draw length and application (target shooting, hunting, etc.).

Optimum Draw Lengths for Each Band

By looking at the efficiency change over different draw lengths further conclusions can be made. Extending the draw length increases the efficiency up to a certain length. We observed a limit to these bands where the elasticity of the material changes resulting in limited gains from longer draws. This confirms that there is an optimum draw length for each band. Although we didn't test this, we think that this limit may also play a key role in band life. Measuring the efficiency of each band is possibly a good way to determine the optimum draw length for each material and geometry. It is possible that maximum band life may be achieved by measuring the limit of efficiency and then only pulling the band to a percentage of that draw length which could help to not overstress the band during use. This could be a great tool to characterize each a band and its performance in a specific shooter's setup.

References and additional information

1. Test Components

Montie Gear Y-shot slingshots were used for all tests. (www.montiegear.com) The bands were supplied by FlippinOut Slingshots (www.flippinoutslingshots.com).

The chronograph is a Pro Chrono Chronograph with the lighting adapter from Competition Electronics to allow the chronograph to be used under flourescent lights.

The 3/8 inch and ½ inch balls used are plain steel balls.

2) For more reading on additional reading on the the subject see the follow links:

http://nicos-resorterablog.blogspot.com/2013/02/slingshot-projectile-velocity.html

http://slingshotforum.com/topic/12571-thera-band-gold-vs-natural-latex-speed-tests/

http://talk.slingshots.com/forums/showthread.php?t=112

Appendix

Pull force (lbs)
8.5
8.5
14.5
5.5
7
9.25
5.5
9.5
9
8
13
7.5
7
10.5
13
20
25
18
29

Pull force (lbs)	Efficency (average speed (3/8))/(pull force)
8.5	20.00
8.5	19.88
14.5	12.42
5.5	27.82
7	22.55
9.25	17.89
5.5	26.55
6	24.81
9.5	17.80
9	17.65
8	19.17
13	13.56
7.5	20.35
7	21.09
10.5	14.36
13	11.73
20	10.55
25	10.27
18	10.54
29	7.02

1/2 inch ball

	Average speed (ft/s)	Average speed (m/s)	Kinetic energy (J)	Kinetic energy (ft lbs)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Average
Teraband Gold, 0.027, 0.75-1.25	138.38	42.18	7.47	5.51	140	139	139	138	139	138	137	137	137
Latex, 0.03, 0.75-1.25	139.63	42.56	7.61	5.61	141	140	140	140	139	139	139	139	139
Latex, 0.04, 0.75-1.25	157.88	48.12	9.73	7.17	163	161	158	157	157	157	157	152	158
Teraband Gold, 0.027, 15-22 mm	119.38	36.39	5.56	4.10	121	119	119	119	119	121	119	118	119
Latex, 0.03, 15-22 mm	124.63	37.99	6.06	4.47	127	125	125	124	124	123	124	125	124
Latex, 0.04, 15-22 mm	144.00	43.89	8.09	5.97	145	145	144	144	144	144	144	143	143
Teraband Gold, 0.027, 0.5-0.75	110.00	33.53	4.72	3.48	111	109	110	110	110	110	110	110	110
Latex, 0.03, 0.5-0.75	115.00	35.05	5.16	3.81	116	116	115	115	115	114	115	115	115
Latex, 0.04, 0.5-0.75	137.75	41.99	7.40	5.46	141	138	138	138	137	139	137	136	136
Teraband Gold, 0.027, 0.875	137.25	41.83	7.35	5.42	140	138	138	137	138	135	137	137	137
Latex, 0.03, 0.875	130.25	39.70	6.62	4.88	133	132	131	130	131	130	130	128	128
Latex, 0.04, 0.875	150.88	45.99	8.88	6.55	157	153	152	154	150	150	145	145	146
Teraband Gold, 0.027, 0.75	119.13	36.31	5.54	4.08	121	120	119	120	119	119	119	119	119
Latex, 0.03, 0.75	117.13	35.70	5.35	3.95	120	118	117	117	117	117	116	117	117
Latex, 0.04, 0.75	139.13	42.41	7.55	5.57	143	141	140	141	141	138	138	134	138
Linatex, 0.065 15-22 mm	129.25	39.40	6.52	4.81	130	131	133	124	129	129	129	131	130
Linatex short, 0.065, 15-22 mm	164.75	50.22	10.59	7.81	168	162	165	169	164	162	164	164	164
Teraband Gold, 0.027, 1.5-2.5	216.13	65.87	18.23	13.44	217	216	217	217	216	214	215	215	217
Double Teraband Gold, 0.027 0.75-1.25	159.00	48.46	9.86	7.28	175	163	159	147	152	160	160	156	156
Double Latex, 0.04, 0.75-1.25	188.50	57.45	13.86	10.23	191	190	193	190	191	191	183	188	182

3/8 inch ball

	Average speed (ft/s)	Average speed (m/s)	Kinetic energy (J)	Kinetic energy (ft lbs)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Average
Teraband Gold, 0.027, 0.75-1.25	170.00	51.82	4.83	3.56	173	171	171	171	170	170	170	167	168
Latex, 0.03, 0.75-1.25	169.00	51.51	4.78	3.52	170	170	169	169	169	169	169	168	168
Latex, 0.04, 0.75-1.25	180.13	54.90	5.43	4.00	183	181	181	180	180	179	179	179	179
Teraband Gold, 0.027, 15-22 mm	153.00	46.63	3.91	2.89	156	155	154	155	155	151	151	152	150
Latex, 0.03, 15-22 mm	157.88	48.12	4.17	3.07	160	160	159	156	156	158	156	157	157
Latex, 0.04, 15-22 mm	165.50	50.44	4.58	3.38	168	166	164	170	167	166	166	164	159
Teraband Gold, 0.027, 0.5-0.75	146.00	44.50	3.56	2.63	146	146	146	146	146	146	146	146	146
Latex, 0.03, 0.5-0.75	148.88	45.38	3.71	2.73	150	150	150	149	149	149	148	149	146
Latex, 0.04, 0.5-0.75	169.13	51.55	4.78	3.53	170	171	168	166	170	170	170	168	170
Teraband Gold, 0.027, 0.875	158.88	48.43	4.22	3.11	167	163	174	157	145	152	152	160	153
Latex, 0.03, 0.875	153.38	46.75	3.93	2.90	158	142	158	157	157	157	157	151	152
Latex, 0.04, 0.875	176.25	53.72	5.19	3.83	181	180	179	173	173	167	175	177	178
Teraband Gold, 0.027, 0.75	152.63	46.52	3.90	2.87	154	153	153	152	152	152	153	152	152
Latex, 0.03, 0.75	147.63	45.00	3.64	2.69	150	149	149	148	148	148	147	145	145
Latex, 0.04, 0.75	150.75	45.95	3.80	2.80	159	158	161	140	148	141	146	138	155
Linatex, 0.065 15-22 mm	152.50	46.48	3.89	2.87	153	154	152	153	153	150	152	153	153
Linatex short, 0.065, 15-22 mm	211.00	64.31	7.45	5.49	212	211	211	211	211	211	211	210	211
Teraband Gold, 0.027, 1.5-2.5	256.75	78.26	11.02	8.13	259	258	258	257	257	255	256	257	254
Double Teraband Gold, 0.027 0.75-1.25	189.75	57.84	6.02	4.44	193	191	190	190	189	189	189	189	188
Double Latex, 0.04, 0.75-1.25	203.63	62.06	6.93	5.11	204	204	204	204	203	203	204	203	204

Arrow

	Average	Kinetic energy (J)	Kinetic energy (ft lbs)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Average
Teraband Gold, 0.027, 0.75-1.25	59.13	7.14	5.27	60	59	60	60	59	59	59	59	58
Latex, 0.03, 0.75-1.25	70.38	10.12	7.47	71	70	70	70	70	72	71	70	69
Teraband Gold, 0.027, 15-22 mm	101.00	20.85	15.38	100	102	103	100	100	102	99	102	102
Double Teraband Gold, 0.027 0.75-1.25	82.25	13.83	10.20	81	81	81	81	83	82	83	83	84
Double Latex, 0.04, 0.75-1.25	100.00	20.44	15.07	101	103	102	101	101	101	98	97	97

Varying draw distance

Distance (inch)		Thera-Band	Latex 0.03	Latex 0.04	Linatex
19	Trial 1	73	83	88	78
	Trial 2	75	86	89	82
	Trial 3	75	81	91	82
	Average	**74.33**	**83.33**	**89.33**	**80.67**
	Pull force	3.25	4.75	6.00	7.50
	Efficency	22.87	17.54	14.89	10.76
29	Trial 1	138	151	166	143
	Trial 2	142	155	163	143
	Trial 3	142	149	161	142
	Average	**140.67**	**151.67**	**163.33**	**142.67**
	Pull force	5.75	7.25	9.50	11.00
	Efficency	24.46	20.92	17.19	12.97
39	Trial 1	199	224	232	196
	Trial 2	199	219	228	208
	Trial 3	201	221	224	208
	Average	**199.67**	**221.33**	**228.00**	**204.00**
	Pull force	8.00	10.50	13.50	14.00
	Efficency	24.96	21.08	16.89	14.57
49	Trial 1	249	271	297	247
	Trial 2	248	271	297	247
	Trial 3	247	268	291	244
	Average	**248.00**	**270.00**	**295.00**	**246.00**
	Pull force	10.25	15.50	19.00	17.00
	Efficency	24.20	17.42	15.53	14.47