Conveyor Pulley and Shaft Engineering

This information can be used for Martin pulleys with rigid end plate design. That includes the Standard Duty, Mine Duty, and Quarry Duty products that are designed using CEMA/ANSI standards. The foundation of that design is accomplished by designing around a maximum designated shaft deflection. Any questions in design should be run through Martin Engineering.

1. Calculate effective tension, T_e

$$T_e = \frac{HP \times 33{,}000}{FPM}$$

2. Calculate belt slack side tension, T_2

$$T_2 = K \times T_e$$

Table 1: K-factor

Single Drive	Auto TU		Manual/Screw TU	
Belt Wrap	Bare	Lagged	Bare	Lagged
180	0.84	0.5	1.2	0.8
190	0.77	0.46	1.1	0.8
200	0.72	0.42	1.1	0.7
210	0.67	0.38	1	0.7
220	0.62	0.35	0.9	0.6
230	0.58	0.33	0.9	0.6
240	0.54	0.3	0.8	0.6

3. Calculate belt tight side tension, T_1

$$T_1 = T_2 + T_e$$

4. Calculate resultant load for each non-drive pulley, R

$$R = T_2 \times \text{Wrap Factor}$$

Table 2: Non Drive Wrap Factor

Belt Wrap	Factor	Belt Wrap	Factor
10°	0.174	130°	1.813
15°	0.261	135°	1.848
20°	0.347	140°	1.879
25°	0.433	145°	1.907
30°	0.518	150°	1.932
35°	0.601	155°	1.953
40°	0.684	160°	1.97
45°	0.765	165°	1.983
50°	0.845	170°	1.992
55°	0.923	175°	1.998
60°	1	180°	2
65°	1.075	185°	1.998
70°	1.147	190°	1.992
75°	1.218	195°	1.983
80°	1.286	200°	1.97
85°	1.351	205°	1.953
90°	1.414	210°	1.932
95°	1.475	215°	1.907
100°	1.532	220°	1.879
105°	1.587	225°	1.848
110°	1.638	230°	1.813
115°	1.687	235°	1.774
120°	1.732	240°	1.732

5. Calculate resultant load for the drive pulley.

Divide T_1 by T_2 $\left(\frac{T1}{T_2}\right)$ to look up in table 4:

Then calculate drive R:

$R = T_2 \times \text{Factor}$

6. Belt and Pulley width relationship

PW = BW + 2 (Belting < 48")

PW = BW + 3 (Belting >=48")

7. Determine minimum shaft size by using Table 5. Subtract the face width from the bearing centers. Using the face width column go down and across from the proper bearing center minus face (interpolate if necessary) until a shaft load rating shows higher than the calculated resultant load from above.

8. Pulley diameters are recommended by the belt manufacturer and generally have greater impact on pulley diameter selection than the load itself. Table 3 is used to compare the recommended diameter from the belt manufacturer to the PIW ratings for standard duty pulleys.

Table 3: Pulley PIW Rating

Arc of Contact	Pulley Diameter (inches)													
	8	10	12	14	16	18	20	24	30	36	42	48	54	60
10	65	80	95	120	145	175	205	260	345	430	520	605	690	775
20	50	60	75	95	115	135	160	200	265	335	400	465	535	600
30	45	55	65	80	100	115	140	175	230	290	345	405	460	520
40	35	45	55	70	85	100	120	150	200	245	295	345	395	445
50	30	40	45	60	70	85	100	130	170	215	255	300	340	385
60	30	40	45	60	70	85	100	125	165	205	250	290	330	375
70	30	40	50	60	75	85	105	130	175	220	260	305	350	395
80	30	45	50	65	80	95	115	140	190	235	285	330	375	425
90	35	45	55	70	85	100	120	150	200	255	305	355	405	455
100	40	50	60	75	90	110	130	160	215	270	325	380	430	485
110	45	55	65	80	100	115	140	175	230	290	345	405	460	520
120	45	55	65	85	105	120	145	185	245	305	365	425	490	550
130	50	60	75	95	115	135	160	200	265	335	400	465	535	600
140	55	70	80	105	125	150	180	225	300	375	450	525	600	675
150	60	75	90	115	140	170	200	250	335	420	505	590	670	755
160	70	85	100	130	160	185	225	280	375	465	560	650	745	840
170	75	95	115	145	175	205	250	310	415	520	620	725	830	930
180	85	105	125	160	195	230	275	345	460	575	690	805	920	1035
190	75	95	115	145	175	205	250	310	415	520	620	725	930	930
200	70	85	100	130	160	185	225	280	375	465	560	650	745	840
210	60	75	90	115	140	170	200	250	335	420	505	590	670	755
220	55	70	80	105	125	150	180	225	300	375	450	525	600	675
230	50	60	75	95	115	135	160	200	265	335	400	465	535	600
240	45	55	65	85	105	120	145	185	245	305	365	425	490	550

Table 4: Resultant Load Factor, Drive Pulleys

T1/T2	Angle of Wrap												
	180	185	190	195	200	205	210	215	220	225	230	235	240
1.8	2.8	2.798	2.79	2.778	2.761	2.739	2.713	2.681	2.645	2.605	2.56	2.511	2.458
2	3	2.998	2.99	2.977	2.96	2.937	2.909	2.887	2.84	2.798	2.752	2.701	2.646
2.2	3.2	3.197	3.19	3.177	3.158	3.135	3.107	3.073	3.035	2.992	2.944	2.892	2.836
2.4	3.4	3.394	3.389	3.376	3.357	3.333	3.304	2.27	3.231	3.187	3.138	3.085	3.027
2.6	3.6	3.597	3.589	3.575	3.556	3.532	3.502	3.467	3.427	3.382	3.332	3.278	3.219
2.8	3.8	3.797	3.789	3.775	3.755	3.73	3.7	3.664	3.624	3.578	3.527	3.472	3.412
3	4	3.997	3.989	3.974	3.955	3.929	3.898	3.862	3.821	3.774	3.723	3.667	3.606
3.2	4.2	4.197	4.188	4.174	4.154	4.128	4.097	4.06	4.018	3.971	3.919	3.862	3.8
3.4	4.4	4.397	4.388	4.374	4.353	4.327	4.295	4.258	4.215	4.168	4.115	4.057	3.995
3.6	4.6	4.597	4.588	4.573	4.553	4.526	4.494	4.456	4.413	4.365	4.312	4.253	4.191
3.8	4.8	4.797	4.788	4.773	4.752	4.725	4.693	4.655	4.611	4.562	4.509	4.45	4.387
4	5	4.997	4.988	4.973	4.952	4.925	4.892	4.853	4.809	4.76	4.706	4.647	4.583
4.2	5.2	5.197	5.188	5.172	5.151	5.124	5.091	5.052	5.008	4.958	4.903	4.844	4.779
4.4	5.4	5.397	5.388	5.372	5.351	5.323	5.29	5.251	5.206	5.156	5.101	5.041	4.976