Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE	:	FMD 11102
SUBJECT TITLE	:	MACHINE ELEMENT
LEVEL	:	DIPLOMA
TIME / DURATION	:	9.00 am – 11.00 am (2 HOURS)
DATE	:	16 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) questions only.
6. Answer all questions in English.
7. Formulae are appended.

THERE ARE 6 PAGES OF QUESTIONS, 8 PAGES APPENDICES OF FORMULAE EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Named the gear types in figures 1 (a) to 1 (d) below.

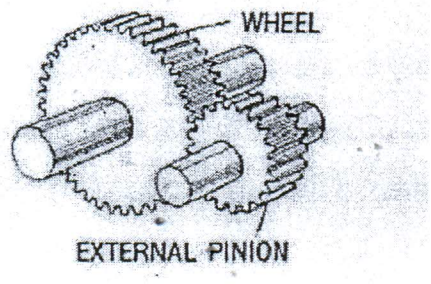


Figure 1 (a)

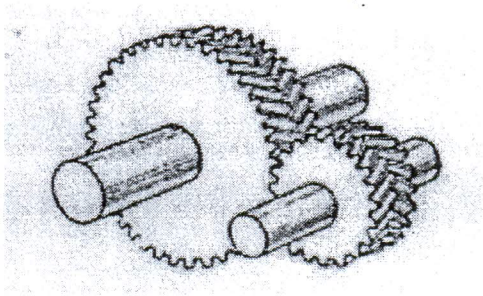


Figure 1 (b)

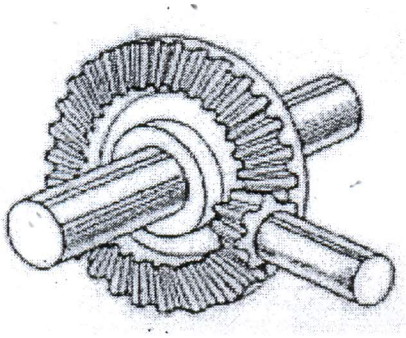


Figure 1 (c)

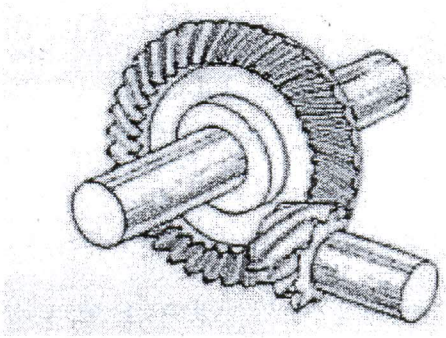


Figure 1 (d))

(10 Marks)

Question 2

Sketch a simple Adjustable Speed Drives and explain briefly on the mechanism.

(10 marks)

Question 3

Referring to figure 3 (a) below, describe the Shaft Alignment by using Feeler Gauge and Straight Edge methods.

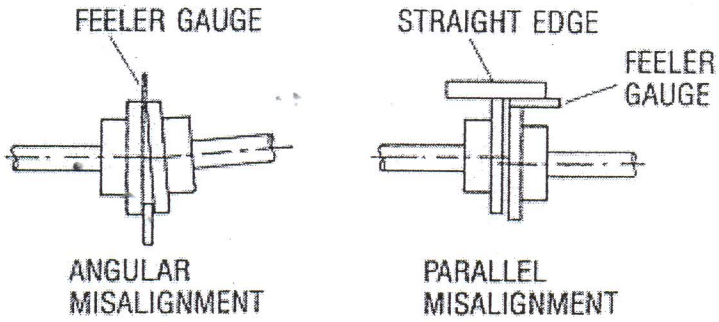


Figure 3 (a).

(10 marks)

Question 4

Named both coupling on Figure 4 (a) and 4 (b) below and describe briefly the advantage of both.

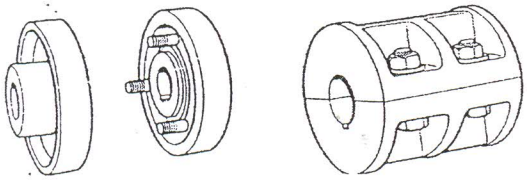


Figure 4 (a)

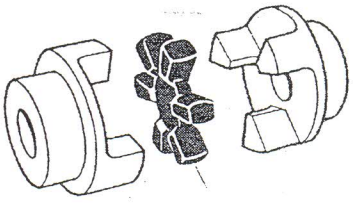


Figure 4 (b)

(10 marks)

Question 5

Given below Single Plate Clutch in Figure 5 (a) and Multiple Plate Clutch in Figure 5 (b). Describe briefly 3 main comparisons of these clutches.

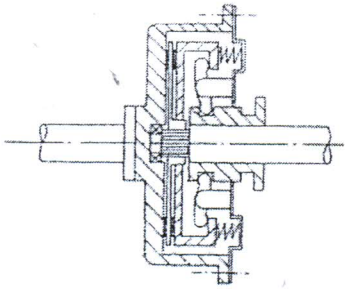


Figure 5 (a)

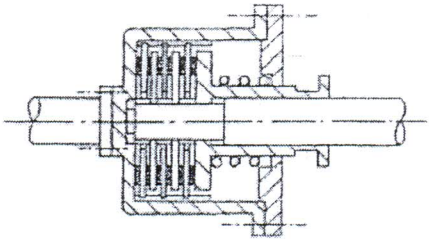


Figure 5 (b)

(10 marks)

Question 6

"Equipment overloads can occur for many different reasons and are particularly likely to occur when extra output is required. Increased speeds, feed rates, operating temperature and pressure can all create overload conditions which lead to machine elements such as bearing to perform above the design limits."

Describe briefly symptoms on a plain journal bearing that has undergone an overload operation as described above.

(10 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer Two (2) of (3) Questions ONLY.
Please use the answer booklet provided.

Question 7

A fan is belt driven by an electric motor running at 1500 rpm. The pulley diameters for the fan and motor are 500 and 355mm, respectively. A flat belt has been selected with a width of 100mm, thickness of 3.5mm, coefficient of friction of 0.8, density of 1100 kg/m^3 and permissible stress of 11MN/m^2. The centre distance is 1500mm. Determine the power capacity of the belt.

a) What is the arc of contact of larger pulley?

(2.5 marks)

b) What is the arc of contact of smaller pulley.

(2.5 marks)

c) What is the maximum tension of the tight side of the belt.

(2.5 marks)

d) What is the velocity of the belt.

(2.5 marks)

e) What is the mass per unit length of the belt?

(2.5 marks)

f) What is the centrifugal Force that react on the belt?

(2.5 marks)

g) What is the centrifugal load?

(2.5 marks)

h) What is the power capacity of the system?

(2.5 marks)

Question 8

Select a wedge belt and determine the pulley diameters for a reciprocating compressor driven by a 28kW two-cylinder diesel engine. The engine speed is 1500 rpm and the compressor speed is 950 rpm. The proposed distances between the engine and compressor shaft centers are approximately 1.5 m. The system is expected to be used for less than 10 hours per day.

a) What is the speed ratio?

(1 marks)

b) What is the service factor?(please refer to the appendixes)

(1 marks)

c) What is the design power?(Please refer to appendixes)

(1 marks)

d) What is the minimum pulley suits the drives? (Please refer to appendixes)

(1 marks)

e) What is the actual pulleys diameter of driver and driven, the exact center distance of the pulleys, the belt length and the arc correction factor? (Please refer to appendixes)

(8 marks)

f) What is the rated power per belt? (Please refer to appendixes)

(1 marks)

g) What is the additional power for the belt? (Please refer to appendixes)

(2 marks)

h) What is the corrected power for the belt? (Please refer to appendixes)

(2 marks)

i) What is the number of the belt to be used?

(3 marks)

Question 9

A chain drive is required for a gear pump operating at 400 rpm driven by a 5.5 kW electric motor running at 1440 rpm. The centre distances between the motor and pump shafts is approximately 470mm.

a) What is the desired reduction ratio?

(2 marks)

b) What is the application ratio? (Please refer to the table given in the appendix.)

(2 marks)

c) What is the nearest sprocket ratio available and give the size of driver and driven sprocket. (Please refer to the table given in the appendix.)

(6 marks)

d) State the tooth factor.

(2 marks)

e) Calculate the selection power.

(2 marks)

f) Using the BS/ISO selection chart given in the appendix, state the best chain types to be used.

(2 marks)

g) Calculate the length of the chain in pitches.

(2 marks)

h) Calculate the exact center distance of the sprocket.

(2 marks)

END OF QUESTION

APPENDICES

Formulae:

$$m = \frac{p}{\pi} = \frac{D_o}{t}$$

Service factor of the belt table.

Table 8.2 Service factors

	Type of prime mover					
	Soft starts Electric motors: AC, star delta start DC, shunt wound IC engines with four or more cylinders Prime movers fitted with centrifugal clutches, dry or fluid couplings or electronic soft start drives			Heavy starts Electric motors: AC, star delta start DC, shunt wound IC engines with less than four cylinders Prime movers not fitted with soft start drives		
	Duty (hours per day)					
Types of driven machine	<10	10–16	>16	<10	10–16	>16
Light duty, e.g. agitators (uniform density), blowers, exhausters and fans (up to 7.5 kW), centrifugal compressors, rotodynamic pumps, uniformly loaded belt conveyors	1.0	1.1	1.2	1.1	1.2	1.3
Medium duty, e.g. agitators (variable density), blowers exhausters and fans (over 7.5 kW), rotary compressors and pumps (other than centrifugal), nonuniformly loaded conveyors, generators, machine tools, printing machinery, sawmill machinery	1.1	1.2	1.3	1.2	1.3	1.4
Heavy duty, e.g. brick machinery, bucket elevators, reciprocating compressors and pumps, heavy duty conveyors, hoists, pulverizers, punches, presses, quarry plant, textile machinery	1.2	1.3	1.4	1.4	1.5	1.6
Extra heavy duty, e.g. crushers	1.3	1.4	1.5	1.5	1.6	1.8

After Fenner Power Transmission UK.

Table 8.3 Minimum recommended pulley diameters for wedge belt drives

Speed of faster shaft (rpm)	Minimum pulley diameters (mm) Design power (kW)																			
	<1	3.0	4.0	5.0	7.5	10.0	15.0	20.0	25	30	40	50	60	75	90	110	130	150	200	250
500	56	90	100	112	125	140	180	200	212	236	250	280	280	315	375	400	450	475	500	560
600	56	85	90	100	112	125	140	180	200	212	224	250	265	280	300	335	375	400	475	500
720	56	80	85	90	100	106	132	150	160	170	200	236	250	265	280	300	335	375	450	500
960	56	75	80	85	95	100	112	132	150	180	180	200	224	250	280	280	300	335	400	450
1200	56	71	80	80	95	95	106	118	132	150	160	180	200	236	236	250	265	300	335	355
1440	56	63	75	80	85	85	100	112	125	140	160	170	190	212	236	236	250	280	315	335
1800	56	63	71	75	80	85	95	106	112	125	150	160	170	190	212	224	236	265	300	335
2880	56	60	67	67	80	80	85	90	100	112	125	140	160	170	180	212	224	236	—	—

Courtesy of Fenner Power Transmission UK.

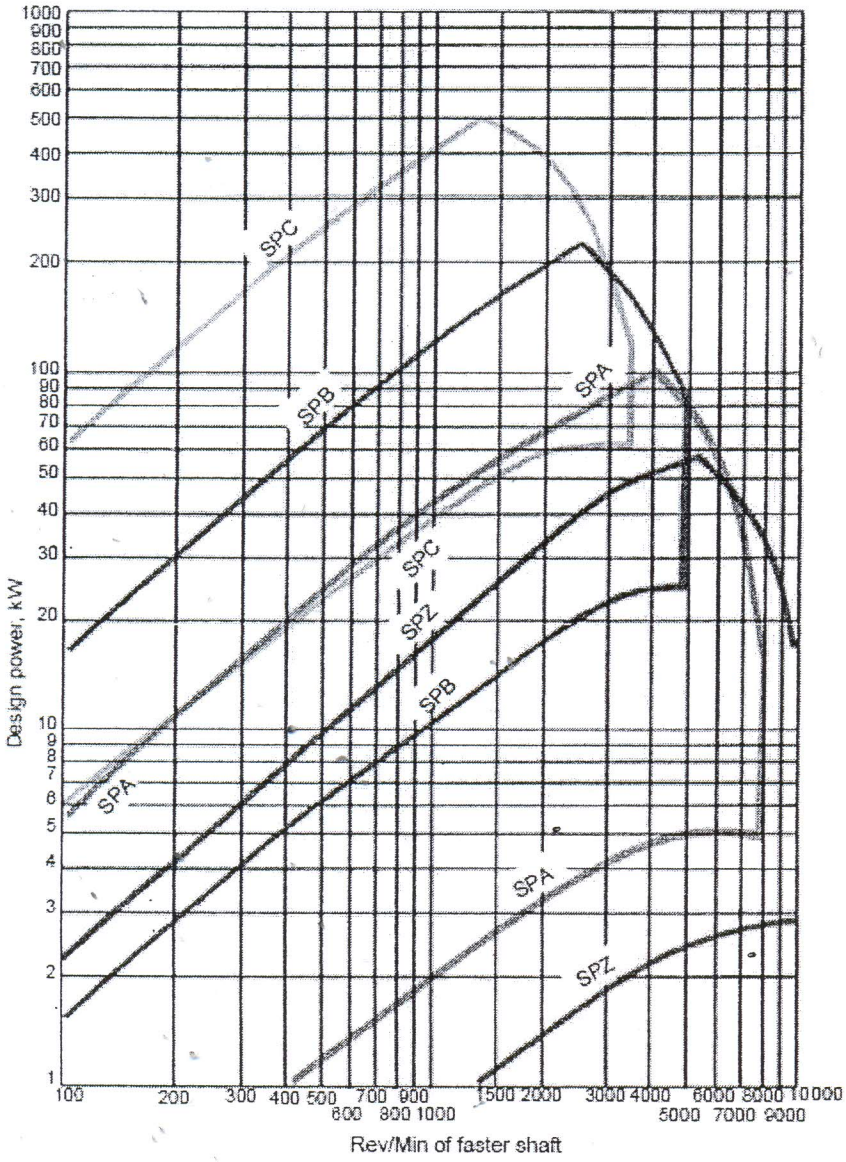


Figure 8.5 Selection chart for wedge belts (courtesy of Fenner Drives UK).

Table 8.4 Centre distances for selected SPB wedge belts

Combined arc and belt length correction factor					0.85		0.90		0.95		1.00			1.05			1.10		1.15	
	Pitch diameter of pulleys		Power per belt (kW)		Belt length for SPB belt type															
Speed ratio	Driver	Driven	1440 rpm	960 rpm	1250	1400	1800	2000	2240	2500	2800	3150	3550	4000	4500	5000	5600	6300	7100	8000
1.27	315	400	24.56	17.91	–	–	–	436	557	687	837	1013	1213	1438	1688	1938	2238	2588	2988	3438
1.27	118	150	6.37	4.58	414	489	689	789	–	–	–	–	–	–	–	–	–	–	–	–
1.28	125	160	7.24	5.18	401	476	676	776	–	–	–	–	–	–	–	–	–	–	–	–
1.29	140	180	7.69	5.54	373	448	648	748	869	998	1148	1342	1524	1749	1999	2249	2549	2899	3299	3749
1.29	132	170	8.10	5.78	387	462	663	763	–	–	–	–	–	–	–	–	–	–	–	–
1.53	118	180	6.51	4.67	390	465	665	765	–	–	–	–	–	–	–	–	–	–	–	–
1.56	180	280	12.03	8.61	259	335	536	637	757	887	1038	1213	1413	1638	1888	2138	2438	2788	3188	3638
1.56	160	250	9.95	7.13	300	375	576	676	797	927	1077	1252	1452	1677	1927	2178	2478	2828	3228	3678
1.57	150	236	8.89	6.37	319	394	595	696	816	946	1096	1271	1471	1696	1946	2196	2496	2847	3247	3697
1.57	200	315	14.05	10.05	–	290	492	593	713	844	994	1169	1369	1594	1845	2095	2395	2745	3145	3595
1.58	224	355	16.54	11.86	–	–	440	541	662	793	943	1118	1319	1544	1794	2044	2344	2694	3095	3545
1.59	315	500	24.81	18.09	–	–	–	–	471	603	754	930	1131	1357	1607	1858	2158	2508	2908	3359
1.60	125	200	7.49	5.35	368	443	644	744	–	–	–	–	–	–	–	–	–	–	–	–
1.60	140	224	7.95	5.71	336	412	613	713	833	963	1113	1288	1489	1714	1964	2214	2514	2864	3264	3714
1.60	250	400	19.02	13.68	–	–	382	484	605	736	886	1062	1262	1488	1738	1988	2288	2638	3039	3489
1.87	190	355	13.17	9.42	–	–	465	566	687	818	968	1144	1344	1570	1820	2070	2371	2721	3121	3571
1.89	212	400	15.37	11.00	–	–	409	511	633	764	915	1090	1291	1516	1767	2017	2317	2668	3068	3518
1.89	125	236	7.49	5.35	337	413	614	714	–	–	–	–	–	–	–	–	–	–	–	–
1.89	112	212	5.88	4.23	367	443	644	744	–	–	–	–	–	–	–	–	–	–	–	–
1.89	132	250	8.36	5.95	320	396	597	697	–	–	–	–	–	–	–	–	–	–	–	–
2.09	170	355	11.21	8.02	–	–	479	580	702	833	983	1159	1360	1585	1835	2086	2386	2736	3136	3586
2.10	150	315	9.11	6.53	–	324	528	629	750	881	1031	1207	1407	1633	1883	2133	2433	2784	3184	3634
2.11	190	400	13.26	9.48	–	–	424	526	648	780	931	1107	1307	1533	1784	2034	2334	2685	3085	3535
2.11	112	236	5.97	4.30	346	422	624	724	–	–	–	–	–	–	–	–	–	–	–	–
2.12	118	250	6.72	4.81	429	406	607	708	–	–	–	–	–	–	–	–	–	–	–	–

(continued)

Table 8.4 Continued

Combined arc and belt length correction factor					0.85		0.90		0.95		1.00			1.05			1.10		1.15	
	Pitch diameter of pulleys		Power per belt (kW)		Belt length for SPB belt type															
Speed ratio	Driver	Driven	1440 rpm	960 rpm	1250	1400	1800	2000	2240	2500	2800	3150	3550	4000	4500	5000	5600	6300	7100	8000
2.23	224	500	16.64	11.92	–	–	–	408	534	667	820	997	1198	1425	1676	1926	2227	2578	2978	3429
2.24	125	280	7.59	5.42	297	374	577	677	–	–	–	–	–	–	–	–	–	–	–	–
2.25	140	315	8.04	5.78	252	331	535	637	758	888	1039	1214	1415	1640	1891	2141	2441	2791	3191	3642
2.25	280	630	21.87	15.81	–	–	–	–	364	505	662	842	1046	1273	1525	1777	2078	2429	2830	3281
2.35	170	400	11.21	8.02	–	–	437	540	663	794	945	1121	1322	1548	1799	2049	2350	2700	3100	3550
2.54	315	800	24.81	18.15	–	–	–	–	–	–	–	654	865	1097	1353	1606	1909	2261	2663	3115
2.63	190	500	13.26	9.48	–	–	–	430	557	691	844	1021	1223	1450	1701	1952	2253	2603	3004	3455
2.67	150	400	9.11	6.53	–	–	451	554	677	808	960	1136	1337	1563	1814	2064	2365	2715	3116	3566
2.67	118	315	6.72	4.81	267	346	551	652	–	–	–	–	–	–	–	–	–	–	–	–
2.67	236	630	17.79	12.77	–	–	–	–	390	533	692	873	1077	1305	1557	1809	2111	2462	2863	3314
3.39	236	800	17.86	12.82	–	–	–	–	–	–	–	705	918	1152	1408	1662	1966	2319	2722	3174
3.50	180	630	12.31	8.80	–	–	–	–	425	569	729	911	1116	1345	1598	1850	2152	2504	2905	3356
3.57	112	400	6.04	4.34	–	–	476	580	–	–	–	–	–	–	–	–	–	–	–	–
3.57	140	500	8.11	5.82	–	–	351	462	590	725	879	1057	1259	1486	1738	1989	2290	2641	3042	3493
3.57	224	800	16.71	11.97	–	–	–	–	–	–	–	713	926	1160	1416	1671	1975	2328	2731	3183
3.57	280	1000	21.94	15.85	–	–	–	–	–	–	–	–	673	925	1190	1450	1758	2114	2519	2973
3.71	170	630	11.28	8.06	–	–	–	–	431	576	736	918	1123	1352	1605	1857	2159	2511	2913	3364
3.77	212	800	15.53	11.11	–	–	–	–	–	–	–	720	934	1168	1425	1679	1983	2337	2739	3192
3.79	132	500	8.52	6.06	–	–	356	467	–	–	–	–	–	–	–	–	–	–	–	–
3.94	160	630	10.23	7.32	–	–	–	–	437	582	742	925	1130	1359	1612	1865	2167	2519	2920	3371
4.72	212	1000	15.53	11.11	–	–	–	–	–	–	–	–	714	968	1235	1496	1805	2162	2568	3022
5.00	160	800	10.23	7.32	–	–	–	–	–	–	554	753	968	1203	1461	1716	2021	2374	2778	3230
5.00	200	1000	14.34	10.25	–	–	–	–	–	–	–	–	722	976	1243	1504	1813	2171	2576	3031
5.26	190	1000	13.33	9.53	–	–	–	–	–	–	–	–	728	982	1250	1511	1820	2178	2584	3038
5.33	150	800	9.18	6.57	–	–	–	–	–	–	–	759	975	1210	1468	1723	2028	2382	2785	3238

NB This is only a partial selection from a typical catalogue relevant to the worked examples and worksheet questions.
Courtesy of Fenner Power Transmission UK

Table 8.5 Power ratings for SPB wedge belts

Speed of faster shaft (rpm)	Rated power (kW) per belt for small pulley pitch diameter (mm)												
	140	150	160	170	180	190	200	212	224	236	250	280	315
100	0.73	0.82	0.92	1.01	1.10	1.20	1.29	1.40	1.51	1.62	1.74	2.01	2.33
200	1.33	1.51	1.69	1.87	2.05	2.22	2.40	2.61	2.82	3.02	3.26	3.78	4.37
300	1.89	2.15	2.41	2.67	2.93	3.18	3.44	3.74	4.04	4.35	4.70	5.44	6.30
400	2.42	2.76	3.09	3.43	3.77	4.10	4.43	4.83	5.22	5.61	6.07	7.04	8.15
500	2.92	3.33	3.75	4.16	4.57	4.98	5.39	5.87	6.36	6.84	7.39	8.58	9.94
600	3.40	3.89	4.38	4.87	5.35	5.83	6.31	6.89	7.45	8.02	8.67	10.06	11.66
700	3.86	4.43	4.99	5.55	6.11	6.66	7.21	7.87	8.52	9.17	9.92	11.50	13.32
720	3.95	4.53	5.11	5.69	6.26	6.82	7.39	8.06	8.73	9.39	10.16	11.79	13.65
800	4.31	4.95	5.59	6.22	6.84	7.47	8.08	8.82	9.55	10.28	11.12	12.90	14.93
900	4.75	5.46	6.16	6.86	7.56	8.25	8.93	9.75	10.56	11.36	12.29	14.25	16.47
960	5.00	5.75	6.50	7.24	7.98	8.71	9.43	10.29	11.15	11.99	12.97	15.03	17.37
1000	5.17	5.95	6.72	7.49	8.25	9.01	9.76	10.65	11.53	12.41	13.42	15.55	17.96
1100	5.58	6.42	7.27	8.10	8.93	9.75	10.56	11.52	12.48	13.43	14.52	16.80	19.39
1200	5.97	6.89	7.79	8.69	9.58	10.46	11.34	12.37	13.40	14.41	15.57	18.01	20.75
1300	6.36	7.34	8.31	9.27	10.22	11.16	12.09	13.19	14.28	15.36	16.59	19.17	22.05
1400	6.73	7.77	8.81	9.83	10.84	11.84	12.82	13.99	15.14	16.27	17.57	20.28	23.28
1440	6.88	7.95	9.00	10.06	11.08	12.10	13.11	14.30	15.47	16.63	17.96	20.70	23.75
1500	7.09	8.20	9.29	10.37	11.44	12.49	13.53	14.76	15.97	17.15	18.51	21.33	24.43
1600	7.44	8.61	9.76	10.90	12.02	13.12	14.21	15.50	16.76	18.00	19.41	22.33	25.51
1700	7.78	9.01	10.21	11.40	12.58	13.73	14.87	16.21	17.52	18.81	20.27	23.27	26.51
1800	8.11	9.39	10.65	11.90	13.12	14.32	15.50	16.89	18.25	19.58	21.08	24.15	27.43
1900	8.43	9.76	11.08	12.37	13.64	14.88	16.11	17.54	18.94	20.31	21.85	24.97	28.27
2000	8.73	10.12	11.48	12.82	14.14	15.43	16.69	18.16	19.60	20.99	22.57	25.72	29.01
2100	9.02	10.46	11.88	13.26	14.62	15.94	17.24	18.75	20.22	21.64	23.23	26.41	29.67
2200	9.31	10.79	12.25	13.68	15.07	16.44	17.76	19.31	20.80	22.24	23.85	27.03	30.22
2300	9.57	11.11	12.61	14.08	15.51	16.90	18.26	19.83	21.35	22.80	24.42	27.57	30.68
2400	9.83	11.41	12.95	14.46	15.92	17.34	18.72	20.32	21.85	23.31	24.93	28.06	31.04
2500	10.08	11.70	13.28	14.82	16.31	17.76	19.16	20.77	22.31	23.78	25.38	28.44	–
2600	10.31	11.97	13.59	15.16	16.68	18.14	19.56	21.19	22.73	24.19	25.78	28.76	–
2700	10.53	12.23	13.88	15.47	17.02	18.50	19.93	21.56	23.11	24.56	26.12	28.99	–
2800	10.73	12.47	14.15	15.77	17.33	18.83	20.27	21.90	23.44	24.87	26.40	–	–
2880	10.89	12.65	14.35	15.99	17.57	19.07	20.51	22.14	23.67	25.08	26.57	–	–
2900	10.93	12.69	14.40	16.04	17.62	19.13	20.57	22.20	23.72	25.12	26.61	–	–
3000	11.10	12.90	14.63	16.30	17.89	19.40	20.84	22.46	23.96	25.33	26.76	–	–

Courtesy of Fenner Power Transmission UK.

Table 8.6 Additional power increment per SPB belt

Speed of faster shaft (rpm)	Additional power (kW) per belt for speed ratio									
	1.00 to 1.01	1.02 to 1.05	1.06 to 1.11	1.12 to 1.18	1.19 to 1.26	1.27 to 1.38	1.39 to 1.57	1.58 to 1.94	1.95 to 3.38	3.39 and over
100	0.00	0.01	0.02	0.04	0.04	0.06	0.07	0.07	0.08	0.08
200	0.00	0.01	0.04	0.07	0.09	0.11	0.13	0.15	0.16	0.17
300	0.00	0.02	0.06	0.10	0.14	0.17	0.20	0.22	0.24	0.25
400	0.00	0.03	0.07	0.13	0.19	0.22	0.26	0.29	0.32	0.34
500	0.00	0.04	0.09	0.17	0.23	0.28	0.33	0.37	0.40	0.43
600	0.00	0.04	0.12	0.20	0.28	0.34	0.40	0.45	0.48	0.51
700	0.00	0.05	0.13	0.24	0.33	0.39	0.46	0.52	0.57	0.59
720	0.00	0.05	0.14	0.25	0.33	0.41	0.48	0.54	0.59	0.62
800	0.00	0.06	0.16	0.28	0.37	0.45	0.53	0.60	0.65	0.69
900	0.00	0.07	0.18	0.31	0.42	0.51	0.60	0.66	0.72	0.77
960	0.00	0.07	0.19	0.32	0.44	0.54	0.62	0.70	0.77	0.81
1000	0.00	0.07	0.19	0.34	0.46	0.56	0.66	0.74	0.81	0.86
1100	0.00	0.08	0.22	0.37	0.51	0.62	0.72	0.81	0.89	0.94
1200	0.00	0.09	0.23	0.41	0.56	0.68	0.79	0.89	0.97	1.03
1300	0.00	0.09	0.25	0.44	0.60	0.73	0.86	0.96	1.05	1.11
1400	0.00	0.10	0.28	0.48	0.65	0.79	0.93	1.04	1.13	1.20
1440	0.00	0.10	0.28	0.48	0.66	0.79	0.94	1.06	1.15	1.21
1500	0.00	0.10	0.29	0.51	0.69	0.84	0.99	1.11	1.21	1.28
1600	0.00	0.11	0.31	0.54	0.75	0.90	1.05	1.19	1.29	1.37
1700	0.00	0.12	0.34	0.58	0.79	0.95	1.12	1.26	1.37	1.45
1800	0.00	0.13	0.35	0.61	0.84	1.01	1.19	1.34	1.45	1.54
1900	0.00	0.13	0.37	0.65	0.88	1.07	1.25	1.41	1.54	1.63
2000	0.00	0.14	0.39	0.68	0.93	1.13	1.32	1.48	1.62	1.71
2100	0.00	0.15	0.41	0.72	0.98	1.18	1.39	1.56	1.69	1.79
2200	0.00	0.16	0.43	0.75	1.02	1.24	1.45	1.63	1.78	1.88
2300	0.00	0.16	0.45	0.78	1.07	1.29	1.51	1.71	1.86	1.97
2400	0.00	0.17	0.47	0.82	1.11	1.35	1.58	1.78	1.94	2.05
2500	0.00	0.18	0.49	0.85	1.16	1.41	1.65	1.86	2.02	2.14
2600	0.00	0.19	0.51	0.89	1.21	1.46	1.72	1.92	2.10	2.22
2700	0.00	0.19	0.53	0.92	1.25	1.52	1.78	1.99	2.18	2.31
2800	0.00	0.20	0.54	0.95	1.29	1.57	1.84	2.07	2.26	2.39
2880	0.00	0.20	0.56	0.97	1.32	1.60	1.88	2.11	2.31	2.44
2900	0.00	0.21	0.57	0.99	1.34	1.63	1.91	2.15	2.34	2.48
3000	0.00	0.22	0.59	1.02	1.39	1.69	1.98	2.23	2.42	2.57

Courtesy of Fenner Power Transmission UK

$$\text{Speed Ratio} = \frac{\text{Driver RPM}}{\text{Driven RPM}}$$

$$\text{Design Power} = \text{Given Power x Service Factor}$$

Corrected value for the power = (rated power + additional power) X arc length correction factor

$$\text{Total Number of Belts} = \frac{\text{Design Power}}{\text{Corrected Value for Power}}$$

Table 8.10 Application factor

Driven machine characteristics	Driver characteristics		
	Smooth running, e.g. electric motors, IC engines with hydraulic coupling	Slight shocks, e.g. IC engines with more than six cylinders, electric motors with frequent starts	Heavy shocks, e.g. IC engines with less than six cylinders
Smooth running, e.g. fans, pumps, compressors, printing machines, uniformly loaded conveyors	1	1.1	1.3
Moderate shocks, e.g. concrete mixing machines, non-uniformly loaded conveyors, mixers	1.4	1.5	1.7
Heavy shocks, e.g. planars, presses, drilling rigs	1.8	1.9	2.1

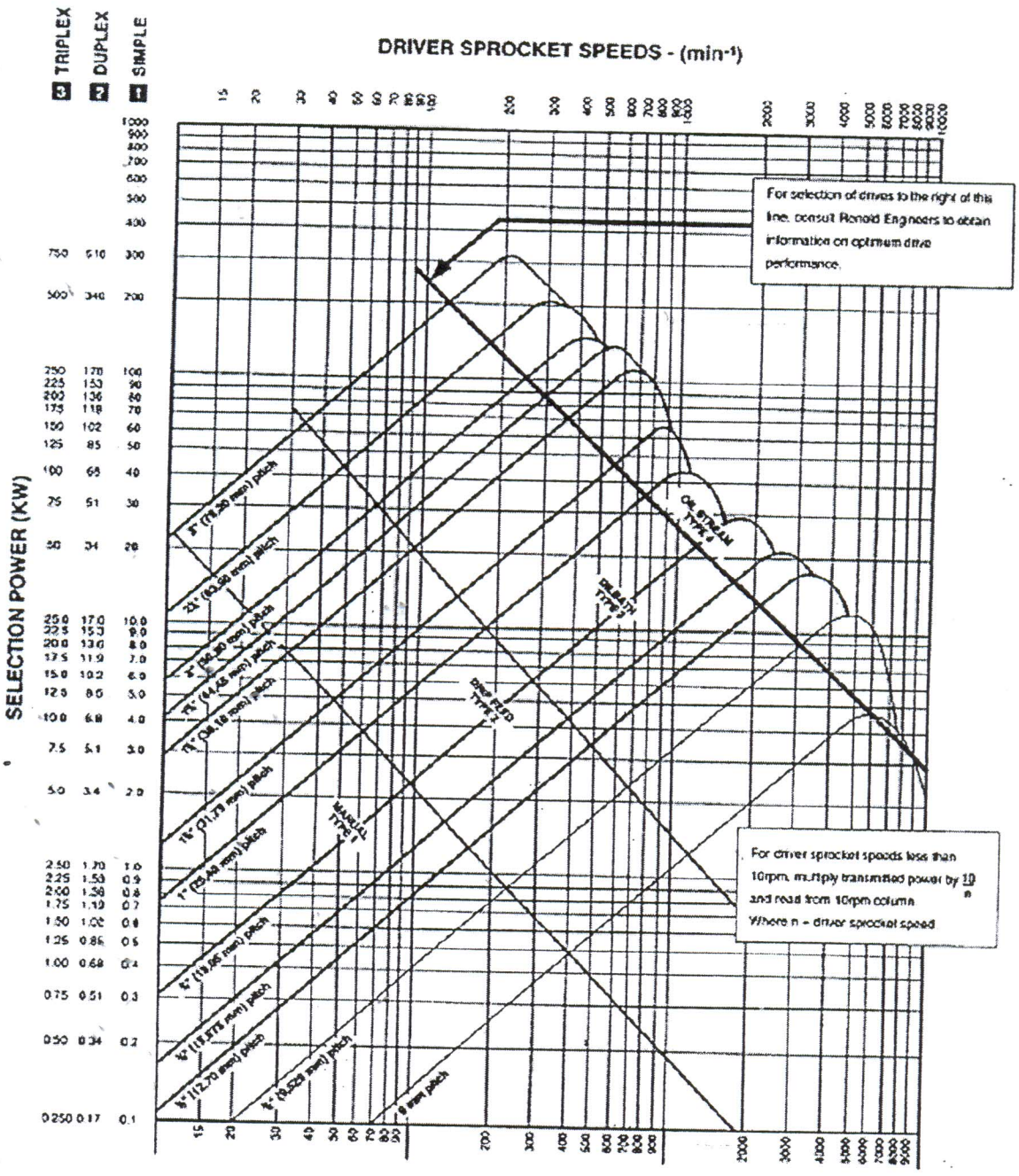
Table 8.9 Chain reduction ratios as a function of the standard sprockets available

Number of teeth in the driven sprocket N_2	Number of teeth in the drive sprocket N_1					
	15	17	19	21	23	25
25	–	–	–	–	–	1.00
38	2.53	2.23	2.00	1.80	1.65	1.52
57	3.80	3.35	3.00	2.71	2.48	2.28
76	5.07	4.47	4.00	3.62	3.30	3.04
95	6.33	5.59	5.00	4.52	4.13	3.80
114	7.60	6.70	6.00	5.43	4.96	4.56

Reproduced from Renold, 1996.

$$L = \frac{N_1 + N_2}{2} + \frac{2C}{p} + \left(\frac{N_2 - N_1}{2\pi}\right)^2 \frac{p}{C}$$

$$C = \frac{p}{8}\left[2L - N_2 - N_1 + \sqrt{(2L - N_2 - N_1)^2 - \frac{\pi}{3.88}(N_2 - N_1)^2}\right]$$



1 Kilowatt = 1.34 hp.

Figure 8.15 British Standard chain drives rating chart using 19 tooth drive sprocket (courtesy of Renold Chain).

$$\theta_d = \pi - 2\sin^{-1}\left(\frac{D-d}{2c}\right)$$

$$\theta_D = \pi + 2\sin^{-1}\left(\frac{D-d}{2c}\right)$$

$$F_1 = \sigma_{max} \cdot A$$

$$V = RPM \cdot \frac{2\pi}{60} \cdot \frac{d}{2}$$

$$m = \rho \cdot A$$

$$F_c = m \cdot V^2$$

$$\frac{F_1 - F_c}{F_2 - F_c} = e^{\mu\theta}$$

$$P_c = (F_1 - F_2) \cdot V$$