Designing of Chain Drive Mechanism 2

Specification Selection for Low-Speed Operation

In operations using a chain speed of 50 m/min. or less, chain elongation due to wear can almost be ignored. Under such low-speed conditions, the service life of the chain largely depends on its fatigue strength. Low-speed operation is more economical than operation under "normal conditions". Low speed is recommended for operations with fewer startups and stops that enable smooth power transmission. Selection of ambient atmosphere, layout, lubrication, etc. for low-speed operation is the same as that for operation under normal conditions. Selection should be made in accordance with the following formula.

Max. Allowable Tension of Chain ≥ Max. Tension N Working on Chain × Application Coefficient (Table 1) P.2815 × Speed Coefficient (Table 4)

Table 4. Speed Coefficients

Roller Chain Speed	Speed Coefficient
0~15 m/min	1.0
15~30	1.2
30~50	1.4
50~70	1.6

[1]Operating Conditions

Same as for "Specifications Selection for Operation under Normal Conditions"

[2] Chain and Number of Small Sprocket Teeth

From the selection guide table 3(P. 2815), select a chain and a sprocket slightly undersized for the rotary speed(r/min)and the prime mover(kW)used.

[3] Calculating the Chain Speed

Based on the sprocket selected(chain pitch, number of teeth)and the number of revolutions(r/min), calculate the chain speed as follows.

$$V=\frac{P\cdot N\cdot n}{1000}\ (\text{m/min})$$

V: Chain Speed(m/min)
P: Chain Peach(mm)
N: Number of Sprocket Teeth
n: Rotary of Sprocket Teeth(r/min)

[4] Calculating the Max. Working Load on Chain

Calculating the Maximum Working Load on the Chain

$$F=\frac{6120\cdot kW}{V}\ (\text{kN})$$

F : Load on Chain(kN)
V : Chain Speed(m/min)
kW: Power Transmission(kW)

[5] Application Coefficient

From the application coefficient table(Table 1), select the appropriate coefficient.

[6] Speed Coefficient

Based on the chain speed obtained in[3]above, calculate the appropriate speed coefficient.

[7] Maximum Allowable Tension of Chain

In the formula, substitute the values obtained in[4]~[6]above as well as the maximum allowable tension(P.2141~P.2152)for the chain selected in[2]above. Check whether these values satisfy the formula. If not, try again with another chain and sprocket set.

[8] Number of Large Sprocket Teeth, Shaft Diameter, and Chain Length same as for "Specification Selection for Operation under Normal Conditions".

Specification Selection for Low-Speed Operation with Impact Load

In operations with a great amount of impact loading due to frequent startups, stops, reversing, or braking, the inertia(GD^2)of the prime mover and the driven machine needs to be taken into account.

Under such conditions, exercise extreme caution, as the chain can be subjected to loads much greater than in operation under normal conditions.

Select the chain using the following formula.

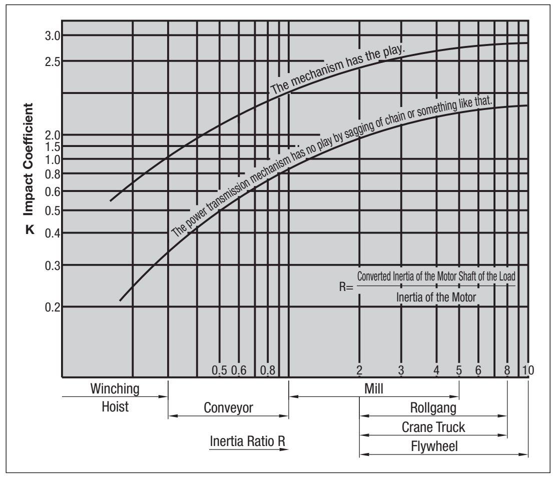
Max. Allowable Load of Chain N ≥ Load Acting on Chain as Calculated from the Starting Torque of the Prime Mover × Impact Coefficient (Table 5) × Speed Coefficient (Table 4)

Impact Coefficient

This is a constant, shown in(Table 5), determined by the ratio of inertia(GD^2)of prime mover to driven machine as well as the magnitude of play in the power transmission mechanism used.

When the power transmission mechanism has excessive play, it loads greater impact than those in the table can result.

Table 5. Impact Coefficient



Selection of Stainless Roller Chains(CHES)

Selection of stainless roller chains follows the specification selection for low-speed operation.

1). The maximum allowable tension for CHES(stainless type) is lower than that for CHE(steel type).

2). Avoid using offset links as much as possible.

Selection based on temperature

Selection of Roller Chains Based on Temperature

The following table shows selection criteria for roller chains by size based on temperature and the associated reduction in strength.

1) Problems associated with roller chain operation at high temperature
(1)Reduced hardness and resultant increase in wear
(2)Elongation due to softening
(3)Poor lubrication and flexing and wear increase due to oil deterioration and carbonization
(4)Wear increase and poor flexing due to scale

2) Problems associated with roller chain operation at low temperature
(1)Low-temperature brittleness and resultant reduction in impact strength
(2)Solidification of lubricating oil
(3)Poor flexing due to attachment of frost and ice

Guide Table for Roller Chain Power Transmission Efficiency at High, Low Temperature

Temperature	CHE Roller Chain	
	CHE60 or Less	CHE80 or Above
-60˚C or below	–	–
-60˚C ~ -50˚C	–	–
-50˚C ~ -40˚C	–	Cannot Be Used
-40˚C ~ -30˚C	Cannot Be Used	Catalog Value×1/4
-30˚C ~ -20˚C	Catalog Value×1/4	Catalog Value×1/3
-20˚C ~ -10˚C	Catalog Value×1/3	Catalog Value×1/2
-10˚C ~ 60˚C	Catalog Value	Catalog Value
60˚C ~ -150˚C	Catalog Value	Catalog Value
150˚C ~ 200˚C	Catalog Value×3/4	Catalog Value×3/4
200˚C ~ 250˚C	Catalog Value×1/2	Catalog Value×1/2
Above 250˚C	Cannot Be Used	Cannot Be Used

Selection of Stainless Roller Chains for High-Temperature Operation

(1)Follow the specification selection for low-speed operation up to 400˚C.(Do not use the specification selection method for operation under normal conditions.)
(2)Above 400˚C, use the temperature coefficient described below.
(3)Formula

Max. Working Load on Chain × Application Coefficient (Table 1) × Speed Coefficient (Table 4) × Temperature Coefficient (Kt) ≤ Max. Allowable Tension of Chain

Temperature Coefficient(Kt)

Temperature	Coefficient(Kt)
400˚C Less	1.0
400˚C ~ 500˚C	1.2
500˚C ~ 600˚C	1.5
600˚C ~ 700˚C	1.8
Above 700˚C	Cannot Be Used

Take account of corrosion resistance, which begins to decline above 400˚C.

Power and Torque

1kW=102kgf·m/sec 1PS=735.5W(Metric Power)
1kW=1000W 1HP=745.7W(Imperial Power) } ≈750W

*Torque :1kg·m=100kg·cm
1kg·m=9.8N·m (newton metre)
1N·m=0.120kg·m
1r/min =1rpm

Obtaining Power from Torque and Rotary Speed

$$\text{Output (kW)}=\frac{\text{Torque((N·m)}\times\text{ Rotary speed(r/min)}}{9.55\times1000}$$

CHE35 (Single Chain) (kW)

Number of Small Sprocket Teeth	Rotary Speed of Small Sprockets min(r/min)																								
	50	100	300	500	700	900	1200	1500	1800	2100	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	10000
9	0.06	0.11	0.29	0.46	0.63	0.79	1.02	1.25	1.48	1.69	1.98	1.62	1.29	1.05	0.88	0.75	0.66	0.57	0.51	0.46	0.41	0.37	0.34	0.31	0.27
10	0.07	0.12	0.33	0.52	0.71	0.89	1.15	1.40	1.65	1.89	2.22	1.90	1.51	1.23	1.04	0.88	0.77	0.67	0.60	0.53	0.48	0.43	0.40	0.37	0.31
11	0.07	0.13	0.37	0.57	0.78	0.98	1.27	1.55	1.83	2.10	2.46	2.19	1.74	1.42	1.19	1.02	0.88	0.78	0.69	0.61	0.55	0.50	0.46	0.43	0.36
12	0.08	0.15	0.40	0.63	0.86	1.07	1.40	1.71	2.01	2.31	2.70	2.50	1.98	1.62	1.36	1.16	1.01	0.88	0.78	0.70	0.63	0.57	0.52	0.48	0.41
13	0.09	0.16	0.44	0.69	0.94	1.17	1.52	1.86	2.19	2.52	2.95	2.81	2.24	1.83	1.53	1.31	1.13	0.99	0.88	0.79	0.71	0.65	0.59	0.54	0.46
14	0.10	0.18	0.47	0.75	1.01	1.28	1.65	2.01	2.37	2.73	3.19	3.15	2.50	2.04	1.72	1.46	1.27	1.11	0.98	0.88	0.80	0.72	0.66	0.60	0.51
15	0.10	0.19	0.51	0.81	1.10	1.37	1.78	2.17	2.56	2.94	3.44	3.49	2.77	2.27	1.90	1.62	1.40	1.23	1.10	0.98	0.88	0.80	0.73	0.67	0.57
16	0.11	0.20	0.54	0.87	1.17	1.47	1.90	2.33	2.75	3.15	3.69	3.84	3.05	2.50	2.10	1.79	1.55	1.36	1.21	1.08	0.97	0.88	0.81	0.74	0.63
17	0.12	0.22	0.58	0.93	1.25	1.57	2.04	2.48	2.93	3.36	3.94	4.21	3.34	2.74	2.29	1.95	1.69	1.49	1.32	1.18	1.07	0.97	0.88	0.81	0.69
18	0.13	0.23	0.62	0.98	1.33	1.67	2.16	2.64	3.12	3.58	4.19	4.59	3.64	2.98	2.50	2.13	1.85	1.62	1.44	1.29	1.16	1.05	0.96	0.88	0.75
19	0.13	0.25	0.66	1.04	1.41	1.77	2.29	2.80	3.30	3.80	4.44	4.98	3.95	3.23	2.71	2.31	2.01	1.76	1.56	1.40	1.26	1.14	1.04	0.95	0.82
20	0.14	0.26	0.69	1.10	1.49	1.87	2.42	2.96	3.49	4.01	4.69	5.37	4.27	3.49	2.94	2.50	2.16	1.90	1.69	1.51	1.36	1.23	1.13	1.04	0.88
21	0.15	0.28	0.73	1.16	1.57	1.97	2.55	3.13	3.68	4.23	4.95	5.78	4.59	3.75	3.15	2.69	2.33	2.04	1.81	1.62	1.46	1.33	1.21	1.11	0.95
22	0.16	0.28	0.77	1.22	1.66	2.07	2.69	3.28	3.87	4.47	5.20	6.12	4.92	4.03	3.37	2.88	2.50	2.19	1.95	1.74	1.57	1.42	1.30	1.19	1.02
23	0.16	0.30	0.81	1.28	1.74	2.18	2.82	3.45	4.06	4.66	5.45	6.43	5.26	4.30	3.60	3.08	2.67	2.34	2.08	1.86	1.68	1.52	1.39	1.28	1.09
24	0.17	0.31	0.85	1.34	1.82	2.28	2.95	3.61	4.25	4.89	5.71	6.73	5.60	4.59	3.84	3.28	2.84	2.50	2.22	1.98	1.79	1.62	1.48	1.36	1.16
25	0.18	0.33	0.89	1.40	1.90	2.38	3.08	3.77	4.44	5.10	5.97	7.03	5.96	4.88	4.09	3.49	3.02	2.66	2.36	2.10	1.90	1.72	1.57	1.45	1.23
26	0.19	0.34	0.93	1.46	1.98	2.48	3.22	3.93	4.63	5.33	6.23	7.34	6.32	5.17	4.33	3.70	3.21	2.81	2.50	2.24	2.01	1.83	1.67	1.53	1.31
28	0.20	0.37	1.00	1.58	2.15	2.69	3.48	4.26	5.02	5.77	6.75	7.98	7.06	5.78	4.84	4.14	3.59	3.15	2.79	2.50	2.25	2.04	1.87	1.72	1.46
30	0.22	0.40	1.08	1.71	2.31	2.90	3.75	4.59	5.41	6.21	7.27	8.58	7.83	6.41	5.37	4.59	3.98	3.49	3.10	2.77	2.50	2.27	2.07	1.90	1.62
32	0.23	0.43	1.16	1.83	2.48	3.11	4.02	4.92	5.80	6.60	7.76	9.18	8.65	7.06	5.92	5.05	4.38	3.84	3.41	3.05	2.75	2.50	2.28	2.10	0
35	0.25	0.48	1.28	2.01	2.73	3.42	4.44	5.42	6.39	7.34	8.58	10.1	9.85	8.06	6.77	5.78	5.01	4.40	3.90	3.49	3.15	2.86	2.61	2.40	0
40	0.29	0.54	1.47	2.33	3.16	3.95	5.13	6.27	7.38	8.50	9.92	11.7	12.1	9.85	8.28	7.06	6.12	5.37	4.77	4.27	3.84	3.49	0		
45	0.34	0.62	1.67	2.65	3.58	4.49	5.82	7.11	8.36	9.62	11.3	13.3	14.4	11.8	9.85	8.43	7.30	6.41	5.68	5.09	0				
Lubrication Method	A		B							C															

Lubrication Method A:Drop Lubrication, B:Oil Bath Lubrication C:Forced Circulation Lubrication by Pump

Not applicable to selection of CHES-type chains.