Roller Drive Chain Selection and Engineering Information

Required information for drive selection:

1. Type of input power (electric motor, internal combustion engine, etc.).
2. Type of equipment to be driven.
3. Horsepower (HP) to be transmitted.
4. Full load speed of the fastest running shaft (RPM).
5. Desired speed of the slow-running shaft. *NOTE: If the speeds are variable, determine the horsepower to be transmitted at each speed.*
6. Diameters of the driver and driven shafts.
7. Center distance of the shafts. *NOTE: If this distance is adjustable, determine the amount of adjustment.*
8. Position of drive and space limitations (if any).
9. Conditions of the drive. Drives with more than two sprockets, idlers, or unusual conditions such as severely abrasive or corrosive environments, severely high or low temperatures, widely fluctuating loads, frequent starts and stops, etc., require special attention. It is advisable to consult with Renold Jeffrey engineering personnel in these situations.

Abbreviations:

- **N** Number of teeth on large sprocket
- **n** Number of teeth on small sprocket
- **R** RPM of large sprocket
- **r** RPM of small sprocket
- **C** Shaft center distance in chain pitches
- **HP** Horsepower of drive motor

Step 1: Determine the Class of Driven Load.
From the Application Classifications chart on page 233, determine the class of driven load to be uniform, moderate, or heavy shock.

Step 2: Determine the Service Factor.
From Table 1, determine the service factor for the application under consideration.

Table 1: Service Factors

Class of Driven Load	Type of Input Power		
	Internal Combustion Engine with Hydraulic Drive	Electric Motor or Turbine	Internal Combustion Engine with Mechanical Drive
Uniform	1	1	1.2
Moderate	1.2	1.3	1.4
Heavy	1.4	1.5	1.7

Step 3: Calculate the Design Horsepower.

Design Horsepower = HP x Service Factor

The design horsepower equals the horsepower to be transmitted times the service factor found in Table 1.

Step 4: Select the Chain Pitch.
From the Quick Selector Chart on page 234, make a tentative chain selection as follows:

a) Locate the design horsepower calculated in Step 3 on the vertical axis by reading up the strand columns (single, double, etc.) in order until the *design horsepower* is located. The number of strands indicated at the top of the column in which the design horsepower is **FIRST** located is usually the recommended chain selection. *NOTE: Using the fewest number of chain strands will usually result in the most economical selection.*

b) Locate the RPM of the small sprocket on the horizontal axis of the chart.

c) The intersection of the two lines (design horsepower and small sprocket RPM) will be in an area designated with the recommended chain pitch. If the intersection is near the borderline of the designated pitch area, the chains on both sides of the borderline should be evaluated to assure the best overall selection.

Roller Drive Chain Selection

Step 5: Select the Number of Teeth on the small sprocket. The minimum number of teeth are found in the horsepower tables on pages 6-19. To determine, first calculate the Horsepower Table Rating (HP Table) from the following formula:

$$\text{HP Table} = \frac{\text{Design HP (Step 3)}}{\text{Multiple Strand Factor (Table 2)}}$$

Horsepower Table Ratings are given for each chain size on pages 6-19. Turn to the appropriate page from the tentative selection found in Step 4 and choose the number of teeth for the small sprocket using the following method:

a) Determine the Horsepower Table Rating from the above formula.

b) Read down the column in the horsepower table under the RPM of the small sprocket until the required Horsepower Table Rating is located. Read across the table to the first column (No. of Teeth Small Sprocket). This is the minimum number of teeth to specify for this application.

Note the lubrication method specified in the horsepower table for the selected chain. This lubrication method should be used in order to achieve reasonable service life.

Table 2: Multiple Strand Factors

No. of Strands	1	2	3	4	5	6
Factor	1	1.7	2.5	3.3	3.9	4.6

Step 6: Determine the Number of Teeth on the large sprocket.

$$N = (r \times n)/R$$

The number of teeth on the large sprocket equals the RPM of the small sprocket times the number of teeth on the small sprocket divided by the RPM of the large sprocket. *NOTE: For sprockets with less than 24 teeth, speeds over 600 RPM, ratios greater than 4:, heavy loading, or corrosive environments; the use of hardened-tooth sprockets is recommended.*

Step 7: Determine the Recommended Minimum Center Distance

$$C = (2N + n)/6$$

This formula is to be used as a guide for the MINIMUM center distance only. The final selection may vary due to:

1. Required clearance dimensions
2. Allowing the final chain length to be an even number of pitches. *NOTE: An odd number of pitches requires an offset link, which should be avoided if possible.*

Step 8: Check the Final Design. Use the checklist found on page 235 (Table 4) to assure the best balance of drive life, performance, and cost.

Step 9: Calculate the Chain Length.

$$\text{Chain Length in Pitches} = [(N + n)/2] + (2C) + (K/C)$$

To determine "K", subtract the number of teeth on the small sprocket from the number of teeth on the large sprocket. Consult Table 5 on page 236. Note that "C" is in chain pitches, thus:

$$C = \text{Center Distance (inches)/Chain Pitch (inches)}$$

The required chain length in feet (L) may be obtained from:

$$L = (\text{Chain Length in Pitches} \times \text{Chain Pitch in Inches})/12$$

Slow Speed Selection

If the linear chain speed is less than 160 ft./min., then a chain that is one size smaller than selected with the above method may be used. To verify, check to see if the calculated chain tension (T) is less than the "Rated Working Load" of the chain. "Rated Working Load" values are obtained in the specification tables found on pages 6-19. Use the following formula to calculate T:

$$S = (\text{Chain Pitch} \times n \times r)/12$$
$$T = [(HP \times 33{,}000)/S] \times F \text{ (Table 3)}$$

Table 3: Speed Factor

Chain Speed (ft./min.)	Factor (F)
0 - 50	1
50 - 100	1.2
100 - 160	1.4

Application Classifications

Agitators
- pure liquids U
- liquids and solids M
- liquids—variable density M

Blowers
- Centrifugal U
- Lobe M
- Vane U

Brewing and Distilling
- bottling machinery U
- brew kettles—cont. duty U
- cookers—cont. duty U
- mash tubs—cont. duty U
- scale hopper, freq. starts M

Can Filling Machines U
Cane Knives M
Car Dumpers H
Car Pullers M
Clarifiers U
Classifiers M

Clay Working Machinery
- brick press H
- briquette machine H
- clay working machine M
- pug mill M

Compressors
- Centrifugal U
- lobe M
- reciprocating multi-cyl. M
- reciprocating single-cyl. H

Conveyors
- apron U
- assembly U
- belt U
- bucket U
- chain U
- flight U
- oven U
- screw U

Conveyors, Heavy Duty
- apron M
- assembly M
- belt M
- bucket M
- chain M
- flight M
- oven M
- live roller M
- reciprocating H
- screw M
- shaker H

Cranes
- main hoists U
- bridge travel M
- trolley travel M

Crusher
- ore H
- stone H
- sugar M

Dredges
- cable reels and conveyors M
- cutter heads and jigs H
- maneuvering winches M
- pumps M
- screen drives H
- stackers M

Elevators
- bucket—uniform load U
- bucket—heavy load M
- bucket—continuous U
- centrifugal discharge U

Elevators (continued)
- escalators U
- freight M
- gravity discharge U
- man lifts and passenger H

Fans
- centrifugal U
- cooling towers U
- induced draft M
- large (mine, etc.) M
- large industrial M
- small diameter U

Feeders
- apron & belt M
- disc U
- reciprocating H
- screw M

Food Industry
- beet slicer M
- cereal cooker U
- dough mixer M
- meat grinder M

Generators—except welding U
Hammer Mills H

Hoists
- heavy duty H
- medium duty M
- skip hoist M

Laundry
- reversing washers M
- tumblers M

Line Shafts
- processing equipment M
- light or other line shafts U

Lumber Industry
- barkers hydr./mech. M
- burner conveyor M
- chain or drag saw H
- chain transfer H
- craneway transfer H
- de-barking drum H
- edger or gang feeder M
- green chain M
- live rolls H
- log deck H
- log haul—incline or well H
- log turning device H
- main log conveyor H
- off bearing rolls M
- planer feed chains M
- planer floor chains M
- planer tilting hoist M
- re-saw conveyor M
- roll cases H
- slab conveyor H
- small waste conveyor belt U
- small waste conveyor chain M
- sorting table M
- triple hoist drives and conv. M
- transfer rolls or conveyor M
- trimmer feed M
- waste conveyor M

Machine Tools
- bearing roll M
- punch press gear drives H
- notching press belt drives H
- plate planers H
- tapping machine H
- main drives M
- auxiliary drives U

Metal Mills
- draw bench M
- carriage & main drives M
- pinch & dryer rolls (rev.) H
- scrubber rolls (rev.) H
- slitters M
- non-reverse group drives M
- non-reverse individual drives H
- reversing drives H
- wire drawing & flattening M
- wire winding machine M

Mills Rotary Type
- ball M
- cement lines M
- dryers and coolers M
- kilns M
- pebbles M
- rod, plane, & wedge bar M
- tumbling barrels H

Mixers
- concrete mixers M
- constant density U
- variable density M

Oil Industry
- chillers M
- oil well pumping H
- paraffin filter press M
- rotary kilns M

Paper Mills
- agitators or mixers M
- barkers M
- barking drums H
- beater and pulper M
- bleacher U
- calendars M
- calendars—super H
- council M
- cutters and platers H
- cylinders M
- dryers M
- felt stretcher M
- felt whipper H
- jordans H
- log haul H
- presses U
- pulp machine reel M
- stock chests M
- suction rolls U
- washers and thickeners M
- winders U

Printing Presses U

Pullers
- barge haul H

Pumps
- centrifugal U
- proportioning M

reciprocating H
- single acting, three or more cylinders M
- double acting, two or more cylinders M
- single acting, one or two cylinders M
- double acting, one cylinder M
- rotary gear type, vane, or lobe U

Rubber and Plastics Industries
- crackers H
- laboratory equipment M
- mixing mills H
- refiners M
- rubber calendars M
- rubber mill 2 on line M
- rubber mill 3 on line U
- sheeters M
- tire building machines M
- tire and tube press openers M
- tubers and strainers M
- warming mills M

Sand Muller M

Sewage Disposal Equipment
- bar screens U
- chemical feeders U
- collectors U
- de-watering screws M
- scum breakers M
- slow or rapid mixers M
- thickeners M
- vacuum filters M

Screens
- air washing U
- rotary, stone, or gravel M
- traveling water intake U

Slab Pushers M
Steering Gear H
Stokers U

Sugar Industry
- cane knives M
- crushers M
- mills H

Textile Industry
- batchers M
- calendars M
- cards M
- dry cans M
- dryers M
- dyeing machines M
- knitting machines M
- looms M
- mangles M
- nappers M
- pads M
- range drives M
- slashers M
- soapers M
- spinners M
- tenter frames M
- washers M
- winders M

Note: Table gives typical values only. Care should be taken to assure these values conform to the actual application.

U: Uniform Load
M: Moderate Load
H: Heavy Load

Quick Selector Chart

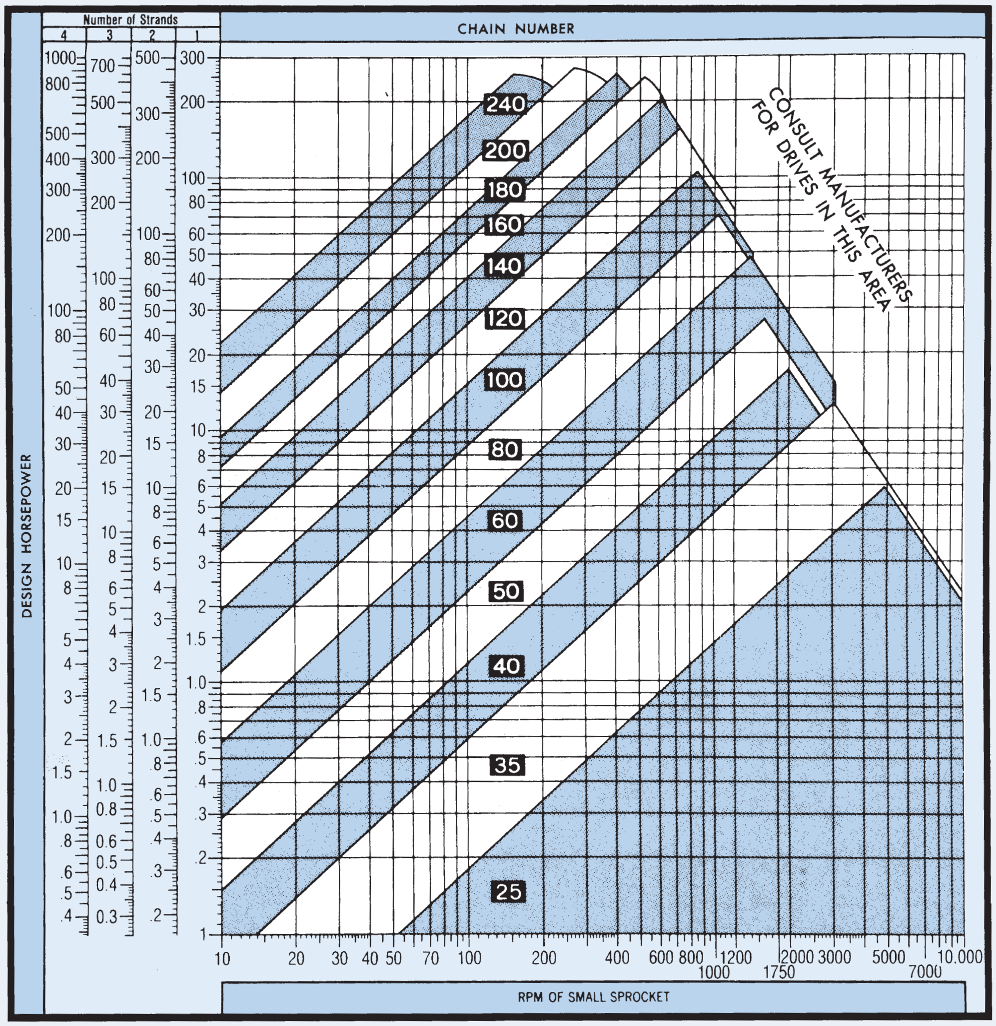


Table 4: Chain Drive Checklist

Item	Item to Check	Suggested Alternatives
1	Small sprocket (driver sprocket) should have 17 or more teeth.	a) Use next smaller chain pitch
2	Large sprocket (driven sprocket) should have less than 120 teeth.	a) Use next larger chain b) Use more chain strands c) Speed ratio too large – divide into two drives
3	Speed ratio should be 7:1 or less (optimum) – 10:1 minimum.	a) Divide into two drives
4	With speed ratios greater than 3:1, the center distance between shafts should not be less than the outside diameter of the large sprocket less the outside diameter of the small sprocket to provide the minimum recommended chain wrap of 120 degrees on the small sprocket.	a) Increase center distance b) Divide into two drives c) Use more chain strands d) Use next larger chain pitch e) Use next smaller chain pitch (with additional strands)
5	Center distance must be greater than 1/2 the sum of the outside diameter of both sprockets to prevent interference.	a) Increase center distance b) Use more chain strands c) Use next larger chain pitch d) Use next smaller chain pitch (with additional strands)
6	Selected sprockets must accommodate the specified shafts.	a) Select the closest size sprockets which will accept the shafts
7	Drive should fit into available space.	a) Use next larger chain pitch b) Use more chain strands c) Use next smaller chain pitch (with additional strands)
8	Shaft center distance should be less than 80 pitches of chain.	a) Install guide or idlers
9	Center distance should be equal to or greater than the minimum center distances shown in the table below.	a) Use next smaller chain pitch (with additional strands) b) Use more chain strands

Chain Pitch (in.)	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/2	3
Min. Center Distance (in.)	6	9	12	15	21	27	33	39	45	57	66

Item	Item to Check	Suggested Alternatives
10	Center distance should be within the optimum range of 30 – 50 pitches.	a) Use next larger chain pitch b) Use more chain strands c) Use next smaller chain pitch (with additional strands)
11	The final drive should have adequate capacity to handle the required horsepower for the chain pitch as calculated in step 3 of the Selection Procedure.	a) Make new selection or contact Renold Jeffrey chain engineering
12	For sprockets with less than 24 teeth, speeds greater than 600 RPM, ratios over 4:1, and chains selected by the Slow Speed Chain Selection formula (page 232).	a) Hardened teeth sprockets are recommended

Roller Drive Chain Selection

Table 5: "K" Values

N–n	K	N–n	K	N–n	K	N–n	K	N–n	K	N–n	K	N–n	K	N–n	K	N–n	K
21	11.17	41	42.58	61	94.25	81	166.19	101	258.39	121	370.86	141	503.59	161	656.59	181	829.85
22	12.26	42	44.68	62	97.37	82	170.32	102	263.54	122	377.02	142	510.76	162	664.77	182	839.04
23	13.40	43	46.84	63	100.54	83	174.50	103	268.73	123	383.22	143	517.98	163	673.00	183	848.29
24	14.59	44	49.04	64	103.75	84	178.73	104	273.97	124	389.48	144	525.25	164	681.28	184	857.58
25	15.83	45	51.29	65	107.02	85	183.01	105	279.27	125	395.79	145	532.57	165	689.62	185	866.93
26	17.12	46	53.60	66	110.34	86	187.34	106	284.67	126	402.14	146	539.94	166	698.00		
27	18.47	47	55.95	67	113.71	87	191.73	107	290.01	127	408.55	147	547.36	167	706.44		
28	19.86	48	58.36	68	117.13	88	196.16	108	295.45	128	415.01	148	554.83	168	714.92		
29	21.30	49	60.82	69	120.60	89	200.64	109	300.95	129	421.52	149	562.36	169	723.46		
30	22.80	50	63.33	70	124.12	90	205.18	110	306.50	130	428.08	150	569.93	170	732.05		
31	24.34	51	65.88	71	127.69	91	209.76	111	312.09	131	434.69	151	577.56	171	740.68		
32	25.94	52	68.49	72	131.31	92	214.40	112	317.74	132	441.36	152	585.23	172	749.37		
33	27.58	53	71.15	73	134.99	93	219.08	113	323.44	133	448.07	153	592.96	173	758.11		
34	29.28	54	73.86	74	138.71	94	223.82	114	329.19	134	454.83	154	600.73	174	766.90		
35	31.03	55	76.62	75	142.48	95	228.61	115	334.99	135	461.64	155	608.56	175	775.74		
36	32.83	56	79.44	76	146.31	96	233.44	116	340.84	136	468.51	156	616.44	176	784.63		
37	34.68	57	82.30	77	150.18	97	238.33	117	346.75	137	475.42	157	624.37	177	793.57		
38	36.58	58	85.21	78	154.11	98	243.27	118	352.70	138	482.39	158	632.35	178	802.57		
39	38.53	59	88.17	79	158.09	99	248.26	119	358.70	139	489.41	159	640.38	179	811.61		
40	40.53	60	91.19	80	162.11	100	253.30	120	364.76	140	496.47	160	648.46	180	820.70		

Roller Conveyor Chain Selection and Engineering Information

Successful conveyor chain selection involves an accurate assessment of conditions on and around the conveyor together with the performance of several simple calculations. Roller chains are typically used in relatively light to moderate material handling applications. Special materials, platings, and coatings are available to handle a wide variety of special environmental conditions, including extremes in temperatures and/or difficult corrosive circumstances. Contact Renold Jeffrey engineering personnel for assistance in choosing the best conveyor chain product for your application.

Required information for conveyor chain selection:

1. Type of chain conveyor (slat, pusher, cross bar, etc.).
2. The basic layout of the conveyor, including sprocket center distances, angles of incline, etc.
3. The type and weight of material to be conveyed (**M** lbs/ft).
4. An estimate of the required weight of chain, attachments, and other moving parts of the conveyor (**W** lbs/ft).
5. Chain speed (**S** ft/min).
6. Type of environment the chain will operate in (i.e., temperature, corrosion, etc.).

Step 1

Make a Preliminary Chain Selection
Use the following formula to estimate conveyor pull.

$$P = \text{Total weight} \times f \times \text{Speed Factor}$$
$$T = P/\text{Number of strands}$$

Where:
P = Conveyor pull
Total Weight = The entire weight of chains, attachments, and material to be conveyed
f = Friction coefficient (see Table 6)
Speed Factor (see Table 7)

Table 6: Friction Coefficients

Type of Carrier	Dry	Lubricated
Standard Roller	0.21	0.14
Carrier Roller	0.12	0.08
Top Roller	0.09	0.06
Chain Sliding on Steel	0.33	0.24

Table 7: Speed Factors

Chain Speed	Factor
0 to 50 ft/min	1.0
51 to 100 ft/min	1.2
101 to 150 ft/min	1.4
151 to 230 ft/min	1.6
231 to 300 ft/min	2.2
301 to 350 ft/min	2.8
351 to 400 ft/min	3.2

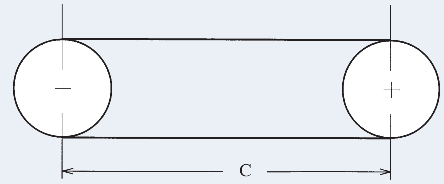
Step 2

Calculate the Conveyor Pull
Use the appropriate formula to calculate the actual Conveyor Pull (P).

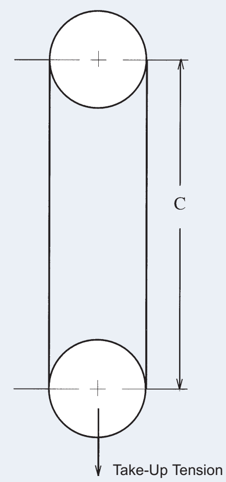
Horizontal Conveyor
$$P = (2.1W + M) \times f \times C$$

Vertical Conveyor
$$P = (M + W) \times C + (1/2 \text{ of take-up force})$$

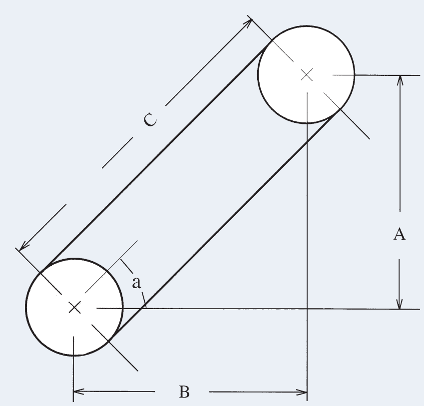
Inclined Conveyor
$$P = (M + W) \times (f \times C \times \text{COS}a + C \times \text{SIN}a) + (f \times \text{COS}a - \text{SIN}a) \times W \times C$$



Horizontal Conveyor



Vertical Conveyor



Inclined Conveyor

Step 3

Calculate Maximum Chain Tension
Use the following formula to determine the maximum chain tension (T):

T = (P x MSF)/N

Where:
P = Calculated conveyor pull
MSF = Multi-strand factor (see Table 8)
N = Number of strands

Table 8: Multi-Strand Factors

Number of Strands	Factor (MSF)
1	1.0
2	1.2
3	1.3
4	1.4

Step 4

Check Rated Working Load of chain
Use the following formula to verify the chain selection:

RWL > T x SF x TF

Where:
RWL = Rated working load for selected chain
SF = Speed factor (see Table 7 on page 237)
TF = Temperature factor (see Table 9)

Table 9: Temperature Factors (carbon steel)

Chain Temperature (ºF)	Factor
-20 to -4	4.0
-3 to 15	3.0
16 to 300	1.0
301 to 390	1.3
391 to 450	2.0

Step 5

Check Allowable Roller Load of chain
Use Table 10 to check the allowable roller load if the chain roller or a top roller will directly support the weight of the conveyed material.

Table 10: Allowable Roller Loads

Chain Size	Allowable Roller Load (lbs)		
	Carrier Roller	Plastic Roller	Standard Roller
40	—	—	33
50	—	—	44
60	—	—	66
80	—	—	120
100	—	—	180
120	—	—	260
140	—	—	300
160	—	—	430
C2040	143	44	33
C2050	220	66	44
C2060H	350	110	66
C2080H	590	198	120
C2100H	880	286	180
C2120H	1,320	—	260
C2160H	2,160	—	430

Stainless Steel Roller Chain Selection and Engineering Information

The following formula may be used to verify the selection of stainless steel roller chains:

Rated Working Load ≥ T x SF x SC x TF x LF x CF

Where:
Rated Working Load is found on pages 45–47.
T = Calculated chain tension (see page 238)
SF = Service Factor (see table below)
SC = Chain Speed Coefficient (see table below)
TF = Chain Temperature Factor (see table below)
LF = Chain Lubrication Factor (see table below)
CF = Chain Corrosion Factor (see table below)

Service Factor (SF)

Operating Condition	Factor
Little or no impact	1
Moderate impact	1.2
Large impact	1.5

Temperature Factor (TF)

Temperature (˚F)	SS	PHSS	316SS
-250 to -50	1	X	1
-50 to 750	1	1	1
750 to 950	1.2	1.8	1
950 to 1,100	1.5	X	1.2
1,100 to 1,300	1.8	X	1.5
1,300 to 1,500	X	X	2

Speed Coefficient (SC)

Chain Speed (Ft/Min)	Coefficient
0-50	1
50-100	1.2
100-150	1.4
150-250	1.6

Corrosion Factor (CF)(see page 240)

Corrosion Rating	Factor
1	1
2	1.23
3	1.44
4	Do Not Use

Lubrication Factor (LF)

Lubrication	Factor
Chain will be lubricated	1
Little or no lubrication	1.44

Stainless Steel Roller Chain Selection

Corrosion Resistance Guide

The table below represents a guide to the relative resisting qualities of the indicated stainless steel materials and a variety of corrosive substances.

Actual performance depends on true conditions in the application, which may vary substantially from this data.

Corrosion factor ratings appear on page 239.
Best = 1

Agent		304SS	600SS	316SS
Acidic Acid	70° F	1	1	1
	Boiling to 50%	2	2	1
Acedic Vapors		3	4	2
Acetone		1	1	1
Alcohol		1	1	1
Aluminum Chloride		3	4	2
Aluminum Sulfate	70° F	1	1	1
	Boiling	2	3	1
Ammonia		1	1	1
Ammonium Chloride	70° F	1	1	1
	Boiling	2	3	1
Ammonium Nitrate		1	1	1
Baking Soda		1	1	1
Barium Carbonate		1	1	1
Barium Chloride	70° F	1	1	1
	Hot	2	3	1
Beer		1	1	1
Beet Juice		1	1	1
Benzine		1	1	1
Bleaching Powder		2	4	1
Blood (meat juices)		1	1	1
Boric Acid		1	1	1
Calcium Chloride (alkaline)		2	2	1
Calcium Oxychloride		3	4	2
Calcium Sulfate		1	1	1
Carbolic Acid		1	1	1
Carbon Tetrachloride		1	2	1
Caustic Lime, Potash, or Soda		1	1	1
Chlorine Gas	Dry	3	4	2
	Moist	4	4	3
Chlorinated Water		2	3	1
Chromic Acid	70° F	1	1	1
	Boiling	3	4	1
Citric Acid	70° F	1	1	1
	Boiling	3	4	1
Ferric Chloride		3	4	2
Formic Acid		2	3	1
Fruit Juices		1	2	1
Fuel Oil		1	1	1
Fuel Oil with Sulfuric Acid		3	4	3
Gasoline		1	1	1
Glue		1	1	1
Glue, acidified		2	3	1
Glycerine		1	1	1
Grape Juice		1	1	1
Gypsum (Calcium Sulfate)		1	1	1
Hydrochloric Acid 2%		4	4	4
Hydrogen Peroxide 30%		1	2	1
Hydrogen Sulfide	Dry	1	1	1
	Moist	4	4	4
Iodine	Dry	1	1	1
	Moist	4	4	3
Ketchup		1	1	1
Lactic Acid	70° F	1	1	1
	150° F	3	4	1
Lard		1	1	1

Agent		304SS	600SS	316SS
Linseed Oil		1	1	1
Lye	70° F	1	1	1
	Boiling	2	3	1
Magnesium Chloride	70° F	2	3	1
	Hot	3	4	2
Malic Acid		1	1	1
Marsh Gas		1	1	1
Mayonnaise		2	3	1
Mercury		1	1	1
Milk		1	1	1
Mine Water (acid)		1	1	1
Molasses		1	1	1
Nickel Chloride		2	3	1
Nickel Sulfate		1	1	1
Nitric Acid	70° F	1	1	1
	Concentrated Boiling	3	4	2
	Fuming	3	4	2
Oleic Acid		2	3	1
Oils	Mineral	1	1	1
	Vegetable	1	1	1
	Refined	1	1	1
	Crude	2	3	1
Oxalic Acid		1	1	1
Paraffin		1	1	1
Pheonol (Carbolic Acid)		1	1	1
Phosphoric Acid	Boiling	4	4	3
Potash		1	1	1
Potassium Chloride		2	3	1
Potassium Cyanide		1	1	1
Potassium Nitrate		1	1	1
Potassium Sulfate		1	1	1
Potassium Sulfide		1	1	1
Salt	70° F	1	2	1
	150° F	2	3	1
Sea Water		2	3	1
Sewage (sulfuric acid present)		2	3	1
Sodium Acetate		1	1	1
Sodium Chloride	70° F	1	1	1
	Boiling	2	3	1
Sodium Cyanide		1	1	1
Sodium Fluoride		2	3	1
Sodium Hydroxide		1	1	1
Sodium Peroxide		1	1	1
Sodium Sulfate		1	1	1
Sodium Sulfide		2	3	1
Sodium Sulfite		1	1	1
Soap		1	1	1
Sulfuric Acid	70° F	2	3	1
	Boiling	4	4	2
	Fuming	3	4	1
	Vapor	2	3	1
Vinegar (Acetic Acid)		1	1	1
Whiskey		1	1	1
Wood Pulp		1	1	1
Zinc Chloride	70° F	1	1	1
	Boiling	3	4	2

Leaf Chain Selection and Engineering Information

Renold Jeffrey Leaf Chains are made specifically for applications that require flexible, high-strength tension linkages for lifting and reciprocating motion devices. They operate over sheaves rather than sprockets and are often found on forklift trucks or as counterweight chains for machine tools or similar balancing applications.

Leaf Chains are usually supplied cut to length and may be supplied with “male” (inside) or “female” (outside) links at the ends. Chains supplied in an even number of pitches possess one female and one male end. If an odd number of pitches is required, please specify whether the ends should be male or female. The type of clevis used will determine the end style required.

The following formula may be used to verify the selection of leaf chains:

Minimum Tensile Strength $\geq$ T x DF x SF

Where:
Minimum Tensile Strength is found on pages 71–72
T = Calculated maximum chain tension
DF = Duty Factor (see table below)
SF = Service Factor (see table below)

Service Factor (SF)

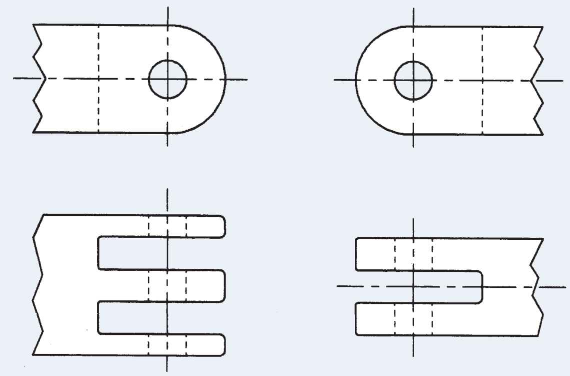
Operating Condition	Factor
Smooth, little or no impact	1.0
Moderate impact	1.3
Large impact	1.5

Duty Factor (DF)

Type of Chain	Max. Cycles/Day	Factor
“AL” Series	10	9
	100	12
“BL” Series	1000	9

Note: Maximum chain speed = 100 ft./min.

The type of end clevis used will determine whether male (inside) or female (outside) links are required at each end.



Outer End Clevis **Inner End Clevis**

When an outer end clevis is used, the clevis manufacturer should supply the connecting links.

When an inner end clevis is used, drive fit connecting links (riveted or cottered) are recommended.

Engineering Class Drive Chain Selection and Engineering Information

Two methods can be used to properly select the Engineering Class Drive Chains found on pages 91–92 of this catalog. Both require the following information at the outset.

Required information for engineering class drive chain and sprocket selection:

1. Hours of operation and desired service life of the drive system.
2. Horsepower (HP) to be transmitted.
3. Revolutions per minute (RPM) of driving and driven shafts.
4. Source of power.
5. Space limitations.
6. Driving shaft diameter. This may affect sprocket size since the sprocket must be large enough for the required hub.
7. Type of equipment to be driven.

Method I

Selecting Chain from Horsepower Tables

Step 1:
Determine the combined service factor by multiplying the individual service factors provided in the table on page 252.

Step 2:
Calculate the design horsepower by applying the combined service factor to the horsepower to be transmitted.

Design HP = HP x Combined Service Factor

Step 3:
Refer to the Quick Selector Chart on page 244 to find the tentative chain selection, located at the intersection of the design horsepower and the RPM of the driving sprocket. (Consult the Engineering Department for horsepower ratings of chains not listed.)

Step 4:
Using the appropriate horsepower table (pages 245-248) for your tentative chain selection, find the horsepower capacity that exceeds the design horsepower under the RPM of the driving sprocket. Read across the table to the left to determine the number of teeth required for the driving sprocket. (Consult the Engineering Department for special applications with slow speeds and high horsepower or where proper lubrication cannot be applied.)

Step 5:
The horsepower tables show the types of lubrication required. Consider all factors of the application when determining the type of lubrication to use. Note that for continuous operation in the tables' shaded areas, some galling may be expected in the live bearing surfaces of the chain joints, even when properly lubricated.

Step 6:
Determine the number of teeth in the driven (large) sprocket by multiplying the number of teeth in the driving sprocket by the drive ratio.

$$\text{Drive Ratio} = \frac{\text{RPM of Driving Shaft}}{\text{RPM of Driven Shaft}}$$

Step 7:
Calculate chain length for a two-sprocket drive using the following equation:

$$L = 2C + \frac{N}{2} + \frac{n}{2} + \frac{(N - n)^2}{39.5C}$$

Where:
L = Chain length (pitches)
C = Distance between shaft centers (pitches)
N = Number of teeth on larger (driven) sprocket
n = Number of teeth on smaller (driving) sprocket

For a drive in which both sprockets are equal (N = n):

$$L = 2C + N$$

Example:
Determine the length of 2.5-inch pitch chain for 31- and 9-tooth sprockets on 75-inch centers.

$$C = \frac{75}{2.5} = 30 \text{ ptiches}$$

$$N - n = 22 \quad \frac{(N - n)^2}{39.5C} = 4.08$$

$$L = 30 + 30 + 15.5 + 4.5 + .408 = 80.408 \text{ pitches}$$

81 links will be required or 81 x 2.50 =	202.5 in. of chain.
Actual length 80.408 x 2.50 =	201.0 in.
Excess chain =	1.5 in.

Method I Selection Example
Select a chain drive for driving an apron conveyor head shaft operating at 25 RPM and requiring 30 HP. Operation is an average of 18 hours per day and power will be supplied by an electric motor with output speed of 60 RPM.

Step 1: Determine service factors
a) moderate shock load, electric motor = 1.3
b) moderately dirty = 1.2
c) 18-hour service = 1.2
Combined service factor = 1.3 X 1.2 x 1.2 x 1.2 = 1.87

Step 2: Design HP = 30 x 1.87 = 56.1

Step 3: Refer to Quick Selector Chart on page 244. The intersection of the 56.1 HP and 60 RPM falls with the parameters of 3514 chain, which will be the tentative chain selection.

Step 4: Refer to the horsepower table for 3514 chain At 60 RPM, a 10-tooth sprocket will transmit 58.7 HP. Since 58.7 exceeds the design HP, the 3514 chain and 10-tooth sprocket satisfy the requirements.

Step 5: Lubrication The horsepower table shows that an oil-bath lubrication is required.

Step 6: $\text{Drive ratio} = \frac{60}{25} = 2.4$

Number of teeth of driven sprocket:
2.4 x 10 = 24 teeth

Step 7: Chain length Since the recommended center distance for an average application would be 30 to 50 pitches, for this example 40 pitches will be used.

$$L = 2C + \frac{N + n}{2} + \frac{(N - n)^2}{39.5C}$$

$$= (2 \times 40) + \frac{(24 + 10)}{2} + \frac{(24 - 10)^2}{39.5 \times 40} =$$

$$= 80 + 17 + .124 = 97.124$$

Since a fractional link cannot be used, 98 links of chain are required for the drive.

Method II

Selecting Chain without Horsepower Tables

This alternative method of selecting Engineering Class Drive Chains, based on the rated working load of the chain, must be used when horsepower tables are not available. The calculations in this method must be reworked until a chain is found that has a rated working value that equals or exceeds the calculated chain load. If the rated working value of a chain used in the formula is lower than the calculated load, the load must be recalculated using a stronger chain and/or increasing the number of teeth in the driving sprocket. If the working load is far in excess of the calculated load, the opposite applies.

$$\text{Working Load} = \frac{HP_D \times 396{,}000}{\text{Chain Pitch} \times \text{No. of Teeth} \times \text{RPM}}$$

Where:
HP_D = Design HP (including service factors)

Method II Selection Example

Select a chain drive for driving the head shaft of an elevator that operates at 25 RPM, requires 20 HP, and runs 18 hours per day. The power is supplied by an electric motor at 75 RPM.

Step 1: Apply service factors
a) moderate shock load, electric motor = 1.3
b) moderately dirty = 1.2
c) 18-hour service = 1.2
Combined service factors = 1.3 x 1.2 x 1.2 = 1.87

Step 2: Design HP = 20 x 1.87 = 37.4

Step 3: Tentatively select No. 3125 Engineering Class Drive Chain with 10-tooth sprocket.

$$WL = \frac{HP_D \times 396{,}000}{\text{Chain Pitch} \times \text{No. of Teeth} \times \text{RPM}}$$

$$= \frac{37.4 \times 396{,}000}{3.125 \times 10 \times 75 \text{ RPM}}$$

$$= 6{,}319 \text{ lbs.}$$

Since this is less than the 6,800 lbs. rated working value for No. 3125 Engineering Class Drive Chain, this chain is acceptable with a 10-tooth drive sprocket.

$$\text{Drive Ratio} = \frac{75}{25} = 3$$

Number of teeth in driven sprocket = 3 x 10 = 30

Assuming 40 pitches as the center distance for the sprocket, the chain length is as follows:

$$L = 2C + \frac{(N + n)}{2} + \frac{(N-n)^2}{39.5C}$$

$$= 2 \times 40 + \frac{30 + 10}{2} + \frac{(30 - 10)^2}{39.5 \times 40}$$

$$= 80 + 20 + .253$$

$$= 100.253 \text{ (rounded to 101 links)}$$

Quick Selector Chart

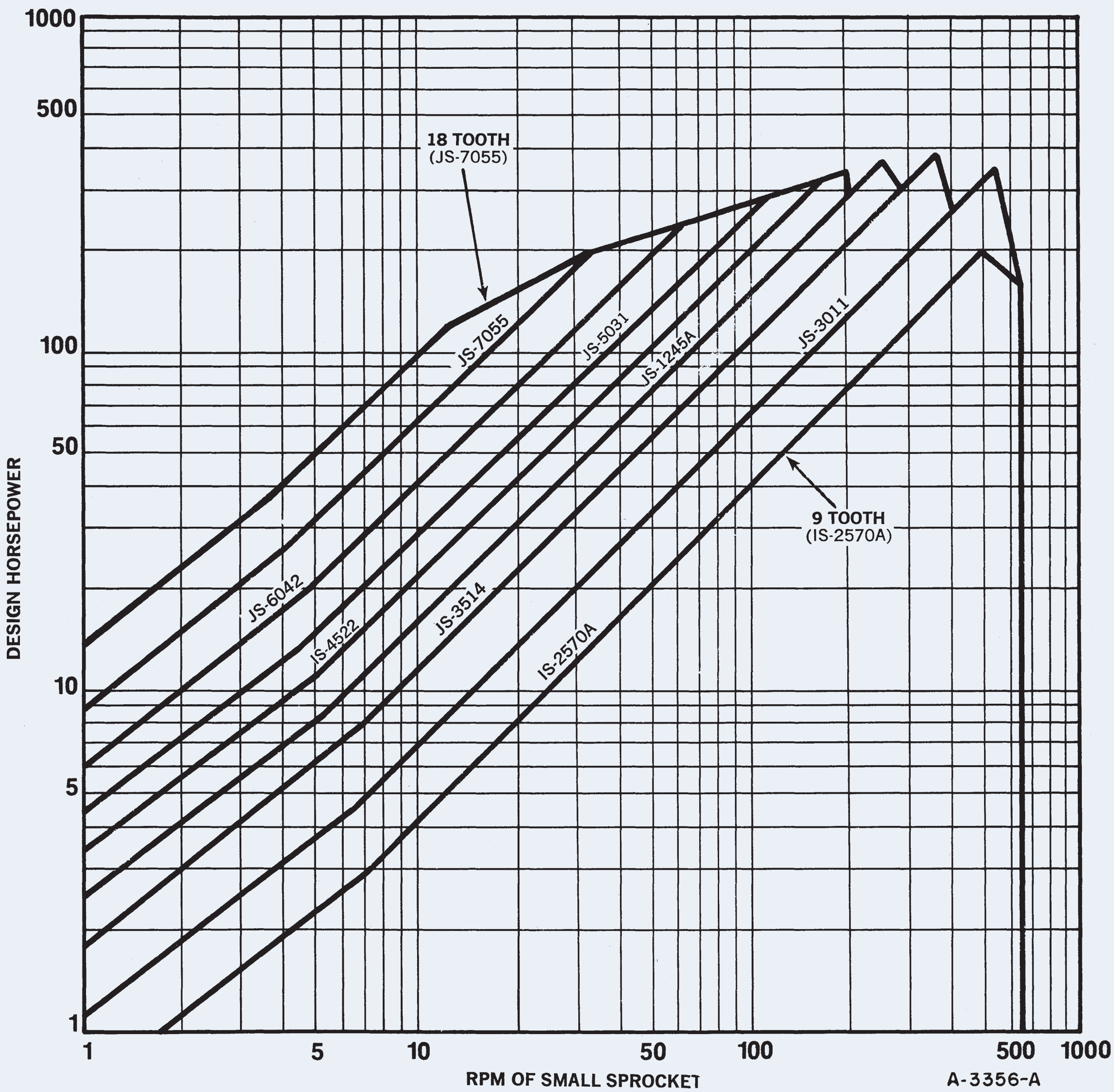
$$S = \frac{PTN}{12}$$

$$HP = \frac{LS}{33,000} \text{ or } \frac{Nt}{63,000}$$

$$t = \frac{63,000\ HP}{N}$$

Where:

- **S = Linear chain speed (ft./min.)**
- **T = Number of sprocket teeth**
- **P = Chain pitch (in.)**
- **N = Sprocket RPM**
- **L = Chain load (lbs.)**
- **HP = Horsepower**
- **T = Torque (in./lb.)**



Notes:
- Lower line is 9-tooth IS-2570A.
- Top line is 18-tooth JS-7055.
- Intermediate lines are approximate midpoints for sprocket-tooth range shown.
- If the HP-RPM intersection takes place near a line, both chains should be considered.

Horsepower Ratings

IS-2570A Engineering Class Drive Chain
2.500-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	2	3	7	10	20	30	40	100	200	250	350	450	600
9	1.1	1.4	2.7	3.9	7.7	11.6	15.4	38.6	77.2	96.5	135.1	100.1	65.0
10	1.1	1.5	3.0	4.3	8.6	12.9	17.2	42.9	85.8	107.3	150.2	117.2	76.1
11	1.2	1.7	3.3	4.7	9.4	14.2	18.9	47.2	94.4	118.0	165.2	135.2	87.8
12	1.3	1.8	3.6	5.1	10.3	15.4	20.6	51.5	103.0	128.7	180.2	154.1	100.1
13	1.4	1.9	3.9	5.6	11.2	16.7	22.3	55.8	111.5	139.4	195.2	173.7	112.8
14	1.5	2.0	4.2	6.0	12.0	18.0	24.0	60.1	120.1	150.2	210.2	194.2	126.1
15	1.5	2.1	4.5	6.4	12.9	19.3	25.7	64.4	128.7	160.9	225.2	215.3	139.9
16	1.6	2.2	4.8	6.9	13.7	20.6	27.5	68.6	137.3	171.6	240.3	237.2	154.1
17	1.7	2.3	5.1	7.3	14.6	21.9	29.2	72.9	145.9	182.3	255.3	259.8	168.8
18	1.8	2.4	5.4	7.7	15.4	23.2	30.9	77.2	154.5	193.1	270.3	283.1	183.9
19	1.9	2.5	5.7	8.2	16.3	24.5	32.6	81.5	163.0	203.8	285.3	307.0	
20	1.9	2.6	6.0	8.6	17.2	25.7	34.3	85.8	171.6	214.5	300.3	331.5	
21	2.0	2.7	6.3	9.0	18.0	27.0	36.0	90.1	180.2	225.2	315.3	356.7	
22	2.1	2.8	6.6	9.4	18.9	28.3	37.8	94.4	188.8	236.0	330.4	382.5	
23	2.1	3.0	6.9	9.9	19.7	29.6	39.5	98.7	197.4	246.7	345.4	405.3	
24	2.2	3.1	7.2	10.3	20.6	30.9	41.2	103.0	205.9	257.4	360.4	414.4	
	Type A						Type B		Type C				

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

JS-3011 Engineering Class Drive Chain
3.067-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	1	3	6	10	20	40	100	150	200	250	300	350	400
9	1.0	2.4	4.0	6.4	12.7	25.5	63.7	95.6	127.4	159.3	191.1	171.8	140.6
10	1.1	2.6	4.3	7.1	14.2	28.3	70.8	106.2	141.6	177.0	212.4	198.9	164.7
11	1.2	2.7	4.7	7.8	15.6	31.1	77.9	116.8	155.7	194.7	231.3	215.5	190.0
12	1.3	2.9	5.1	8.5	17.0	34.0	85.0	127.4	169.9	212.4	248.6	231.5	216.5
13	1.4	3.1	5.5	9.2	18.4	36.8	92.0	138.0	184.1	230.1	265.3	247.0	232.3
14	1.4	3.3	5.9	9.9	19.8	39.6	99.1	148.7	198.2	247.8	281.4	262.1	246.4
15	1.5	3.5	6.4	10.6	21.2	42.5	106.2	159.3	212.4	265.5	296.9	276.6	260.0
16	1.6	3.7	6.8	11.3	22.7	45.3	113.3	169.9	226.5	283.2	312.0	290.6	273.2
17	1.7	3.8	7.2	12.0	24.1	48.1	120.3	180.5	240.7	300.9	326.5	304.1	285.9
18	1.7	4.0	7.6	12.7	25.5	51.0	127.4	191.1	245.9	318.6	340.5	317.1	
19	1.8	4.2	8.1	13.5	26.9	53.8	134.5	201.8	269.0	336.3	354.0	329.7	
20	1.9	4.3	8.5	14.2	28.3	56.6	141.6	212.4	283.2	354.0	367.1	341.9	
21	1.9	4.5	8.9	14.9	29.7	59.5	148.7	223.0	297.3	371.7	379.2	353.0	
22	2.0	4.7	9.3	15.6	31.1	62.3	155.7	233.6	311.5	389.4	391.7	364.8	
23	2.1	4.9	9.8	16.3	32.6	65.1	162.8	244.2	325.6	407.1	403.4	375.7	
24	2.2	5.1	10.2	17.0	34.0	68.0	169.9	254.9	339.8	424.8	414.6	386.1	
	Type A					Type B		Type C					

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

Notes:
- Ratings shown are for machine-toothed sprockets.
- Continuous operation in the tables' shaded areas may produce some galling of the live bearing surfaces of the chain joints, even when properly lubricated.

IS-3514 Engineering Class Drive Chain
3.500-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	1	3	6	10	20	35	60	100	125	150	200	250	300
9	1.4	3.3	5.5	8.8	17.6	30.8	52.8	88.1	110.1	132.1	176.1	178.7	170.8
10	1.5	3.5	6.0	9.8	19.6	34.2	58.7	97.8	122.3	146.8	195.7	196.1	187.4
11	1.6	3.8	6.5	10.8	21.5	37.7	64.6	107.6	134.5	161.4	215.2	213.0	203.6
12	1.8	4.1	7.0	11.7	23.5	41.1	70.4	117.4	146.8	176.1	234.8	229.5	219.4
13	1.9	4.3	7.6	12.7	25.4	44.5	76.3	127.2	159.0	190.8	254.4	245.6	234.7
14	2.0	4.6	8.2	13.7	27.4	47.9	82.2	137.0	171.2	205.5	273.9	261.2	249.6
15	2.1	4.8	8.8	14.7	29.4	51.4	88.1	146.8	183.4	220.1	292.1	276.3	264.1
16	2.2	5.1	9.4	15.7	31.3	54.8	93.9	156.5	195.7	234.8	307.7	291.1	278.2
17	2.3	5.3	10.0	16.6	33.3	58.2	99.8	166.3	207.9	249.5	322.8	305.5	
18	2.4	5.5	10.6	17.6	35.2	61.6	105.7	176.1	220.1	264.2	337.6	319.4	
19	2.5	5.8	11.2	18.6	37.2	65.1	115.5	185.9	232.4	278.8	351.9	333.0	
20	2.6	6.0	11.7	19.6	39.1	68.5	117.4	195.7	244.6	293.5	365.8	346.1	
21	2.7	6.2	12.3	20.5	41.1	71.9	123.3	205.5	256.8	308.2	379.3	358.9	
	Type A						**Type B**		**Type C**				

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

JS-1245A Engineering Class Drive Chain
4.073-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	1	3	6	10	20	30	40	65	80	100	125	150	200
9	2.0	4.7	8.0	12.8	25.5	38.3	51.1	83.0	102.1	127.7	159.6	168.2	166.3
10	2.2	5.1	8.7	14.2	28.4	42.6	56.7	92.2	113.5	141.8	177.3	185.0	182.9
11	2.4	5.5	9.4	15.6	31.2	46.8	62.4	101.4	124.8	156.0	195.0	201.5	199.2
12	2.5	5.9	10.2	17.0	34.0	51.1	68.1	110.6	136.2	170.2	212.8	217.6	215.1
13	2.7	6.3	11.1	18.4	36.9	55.3	73.8	119.9	147.5	184.4	230.5	233.4	230.7
14	2.9	6.6	11.9	19.9	39.7	59.6	79.4	129.1	158.9	198.6	248.2	248.8	246.0
15	3.0	7.0	12.8	21.3	42.6	63.8	85.1	138.3	170.2	212.8	265.9	263.9	261.0
16	3.2	7.3	13.6	22.7	45.4	68.1	90.8	147.5	181.6	227.0	280.7	278.7	275.6
17	3.3	7.7	14.5	24.1	48.2	72.3	96.5	156.7	192.9	241.1	295.3	293.2	289.9
18	3.5	8.0	15.3	25.5	51.1	76.6	102.1	166.0	204.3	255.3	309.6	307.3	303.9
19	3.6	8.4	16.2	27.0	53.9	80.9	107.8	175.2	215.6	269.5	323.5	321.2	317.6
20	3.8	8.7	17.0	28.4	56.7	85.4	113.5	184.4	227.0	283.7	337.1	334.7	
21	3.9	9.0	17.9	29.8	59.6	89.4	119.2	193.6	238.3	297.9	350.5	347.9	
	Type A						**Type B**			**Type C**			

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

Notes:
- Ratings shown are for machine-toothed sprockets.
- Continuous operation in the tables' shaded areas may produce some galling of the live bearing surfaces of the chain joints, even when properly lubricated.

IS-4522 Engineering Class Drive Chain
4.500-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	1	3	6	10	20	30	35	50	65	80	100	125	150
9	2.6	6.0	10.2	16.3	32.6	48.9	57.0	81.5	105.9	130.4	153.8	156.6	158.8
10	2.8	6.5	11.1	18.1	36.2	54.3	63.4	90.5	117.7	144.9	169.5	172.5	175.0
11	3.0	7.0	12.0	19.9	39.8	59.8	69.7	99.6	129.5	159.4	184.8	188.1	190.8
12	3.3	7.5	13.0	21.7	43.5	65.2	76.1	108.7	141.3	173.9	199.8	203.4	206.3
13	3.5	8.0	14.1	23.5	47.1	70.6	82.4	117.7	153.0	188.3	214.6	218.4	221.6
14	3.7	8.5	15.2	25.4	50.7	76.1	88.7	126.8	164.8	202.8	229.1	233.2	236.6
15	3.9	8.9	16.3	27.2	54.3	81.5	95.1	135.8	176.6	217.3	243.4	247.7	251.3
16	4.1	9.4	17.4	29.0	58.0	86.9	101.4	144.9	188.3	231.8	257.4	261.9	265.7
17	4.2	9.8	18.5	30.8	61.6	92.4	107.8	153.9	200.1	246.3	271.1	275.9	279.9
18	4.4	10.2	19.6	32.6	65.2	97.8	114.1	163.0	211.9	260.8	284.6	289.6	293.8
19	4.6	10.7	20.6	34.4	68.8	103.2	120.4	172.0	223.7	275.3	297.8	303.1	307.5
20	4.8	11.1	21.7	36.2	72.4	108.7	126.8	181.1	235.4	289.8	310.7	316.3	320.9
21	5.0	11.5	22.8	38.0	76.1	114.1	133.1	190.1	247.2	304.2	323.5	329.2	334.0
	Type A						Type B			Type C			

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

JS-5031 Engineering Class Drive Chain
5.000-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	0.5	1	3	6	10	20	30	35	50	65	80	100	125
9	2.0	3.4	7.8	13.3	21.1	42.2	63.3	73.8	105.5	133.9	139.3	145.3	151.6
10	2.2	3.7	8.5	14.4	23.4	46.9	70.3	82.0	117.2	147.6	153.6	160.2	
11	2.3	3.9	9.1	15.5	25.8	51.6	77.4	90.3	128.9	161.2	167.7	174.9	
12	2.5	4.2	9.7	16.9	28.1	56.3	84.4	98.5	140.7	174.5	181.6	189.4	
13	2.6	4.5	10.3	18.3	30.5	61.0	91.4	106.7	152.4	187.7	195.2	203.7	
14	2.8	4.7	10.9	19.7	32.8	65.6	98.5	114.9	164.1	200.6	208.7	217.7	
15	2.9	5.0	11.5	21.1	35.2	70.3	105.5	123.1	175.8	213.4	222.0	231.6	
16	3.1	5.2	12.1	22.5	37.5	75.0	112.5	131.3	187.5	225.9	235.0	245.2	
17	3.2	5.5	12.7	23.9	39.9	79.7	119.6	139.5	199.3	238.2	247.8	258.6	
18	3.4	5.7	13.3	25.3	42.2	84.4	126.6	147.7	211.0	250.4	260.5	271.7	
	Type A						Type B				Type C		

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

Notes:
- Ratings shown are for machine-toothed sprockets.
- Continuous operation in the tables' shaded areas may produce some galling of the live bearing surfaces of the chain joints, even when properly lubricated.

JS-6042 Engineering Class Drive Chain
6.000-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	0.5	**1**	**3**	**6**	**10**	**20**	**30**	**35**	**40**	**45**	**50**	**60**	**70**
9	3.1	5.3	12.2	20.7	30.3	66.0	96.1	101.5	106.3	110.8	115.0	122.6	129.0
10	3.4	5.7	13.2	22.4	36.6	73.3	106.2	112.1	117.5	122.5	127.1	135.5	
11	3.6	6.2	14.2	24.2	40.3	80.6	116.1	122.6	128.5	133.9	139.0	148.2	
12	3.9	6.6	15.2	26.4	44.0	87.9	126.0	133.0	139.4	145.3	150.8	160.8	
13	4.1	7.0	16.2	28.6	47.6	95.3	135.7	143.2	150.1	156.5	162.4	173.2	
14	4.4	7.4	17.1	30.8	51.3	102.6	145.3	153.4	160.8	167.6	173.9	185.4	
15	4.6	7.8	18.0	33.0	55.0	109.9	154.8	163.4	171.3	178.5	185.3	197.5	
16	4.8	8.2	18.9	35.2	58.6	117.3	164.2	173.3	181.6	189.3	196.5	209.5	
17	5.1	8.6	19.8	37.4	62.3	124.6	173.4	183.1	191.9	200.0	207.6	221.3	
18	5.3	9.0	20.7	39.6	66.0	131.9	182.6	192.7	202.0	210.6	218.5	233.0	
					Type A					**Type B**		**Type C**	

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

JS-7055 Engineering Class Drive Chain
7.000-Inch Pitch

No. of Teeth	Horsepower Capacity												
	RPM												
	0.1	**0.5**	**1**	**2**	**4**	**6**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
9	1.3	4.6	7.7	13.1	22.2	30.2	48.1	67.1	76.7	85.0	92.5	99.4	105.7
10	1.4	4.9	8.4	14.2	24.0	32.7	53.5	74.2	84.8	94.0	102.3	109.9	
11	1.6	5.3	9.0	15.2	25.9	35.3	58.8	81.2	92.8	103.0	112.0	120.3	
12	1.7	5.7	9.6	16.3	27.6	38.5	64.2	88.2	100.8	111.8	121.7	130.7	
13	1.8	6.0	10.2	17.3	29.4	41.7	69.5	95.1	108.7	120.6	131.2	140.9	
14	1.9	6.4	10.8	18.3	31.1	44.9	74.8	102.0	116.5	129.2	140.6	151.1	
15	2.0	6.7	11.4	19.3	32.7	48.1	80.2	108.8	124.3	137.8	150.0	161.1	
16	2.1	7.1	12.0	20.3	34.4	51.3	85.5	115.5	132.0	146.4	159.3	171.1	
17	2.2	7.4	12.5	21.2	36.4	54.5	90.9	122.2	139.6	154.8	168.5	180.9	
18	2.3	7.7	13.1	22.2	38.5	57.7	96.2	128.8	147.1	163.2	177.5	190.7	
						Type A							**Type B**

Type A: Manual Lubrication • Type B: Oil Bath Lubrication • Type C: Oil Stream Lubrication

Notes:
- Ratings shown are for machine-toothed sprockets.
- Continuous operation in the tables' shaded areas may produce some galling of the live bearing surfaces of the chain joints, even when properly lubricated.

Engineering Class Conveyor Chain Selection and Engineering Information

Use the following procedure when selecting the rollerless chains detailed on pages 95-97 of this catalog and listed in the table below.

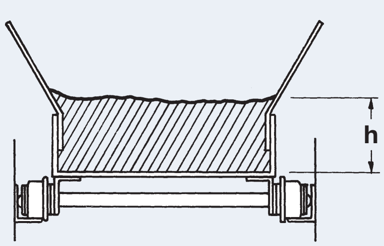
Step 1: Determine the type of chain required.

Chain Type	Advantages	Disadvantages
Roller Chains Engineering Class Drive Chains Malleable Roller Chains	Lower coefficient of friction permits longer shaft centers, higher speeds with less vibration, less horsepower at the drive, and less chain loading than an equivalent rollerless chain.	Not suited for dirty environments in which foreign materials could jam rollers. Can cost more than equivalent rollerless chains.
Rollerless Chains Welded Steel Drag Chain Rivetless Barloop Pintle H Mill Steel Bushed Combination Steel Knuckle Steel Block	Simpler construction, lower cost, perform better in dirty environments and under impact loading than an equivalent roller chain.	Higher coefficient of friction results in higher chain loads, lower speeds, and higher horsepower at the drive than an equivalent roller chain.

Step 2: Make tentative chain selection.
Consider the following: The longer the chain pitch:

- the larger the sprocket diameter
- the slower the permissible chain speed
- the higher load each roller must carry due to fewer chain joints per foot
- the lower in cost than an equivalent shorter-pitch chain.

Attachment spacing should also be considered when determining chain pitch.



Step 3: Calculate the conveyor pull.
Select the formula that applies to the type of conveyor to be used. For conveyors that are partly horizontal and partly inclined, calculate the chain pull for each conveyor section and add together to obtain the total chain pull. The formulas listed on these pages calculate total chain pull for the entire conveyor, as opposed to chain pull per chain strand.

F_R = Coefficient of rolling friction

$$F_R = F_1 \times \frac{d_1}{D}$$

Bearing Type	Pin or Race Type	Lubrication	F1
Machined Bore	C.R.S. Pin	None	.25-.35
		Greased	.20-.25
Roller Bearing	Hardened Race	Greased	.10
Ball Bearing	Hardened Race	Greased	.07

D = Roller diameter (in.)
d_1 = Roller bore (in.)

Approximate Roller Bore (d_1)

Pin Dia	d_1 (in.)	Pin Dia.	d_1 (in.)
7/16	.625	1 1/8	1.500
1/2	.750	1 1/4	1.750
9/16	.813	1 3/8	2.000
5/8	.937	1 1/2	2.125
11/16	1.000	1 3/4	2.250
3/4	1.125	1 7/8	2.375
7/8	1.250	2	2.500
1	1.375		

HP = Horsepower at head shaft

$$HP = \frac{1.1 P_H S}{33{,}000}$$

J = Chain load due to material sliding against skirt boards

$$J = \frac{Ch^2}{R}$$

Where:
C = Length of conveyor (ft.)
h = Height of material (in.)

R = Variable factor for different materials (see table)

Engineering Class Conveyor Chain Selection

Variable Factor for Materials (R)

Material	R
Coal	14.0
Coke	35.0
Limestone	7.5
Gravel	7.0
Sand	5.5
Ashes	14.0

M = Weight per foot of conveyor or elevator (including buckets) (lbs./ft.)

P_1, P_2, P_3 = Total chain pull at various points on conveyor or elevator

PD = Design working load of chain per strand (lbs.)

PH = Effective chain pull at head shaft (lbs.) (used in HP formula)

PT = Total maximum chain pull (lbs.)

PW = Total weight supported by bearings (shaft, conveyor around sprockets) and sprockets (lbs.)

RD = Resultant bending load on head shaft (lbs.)

S = Speed (ft./min.) (see table)

T = Capacity (tons/hour)

W = Weight per foot of material to be conveyed (lbs./ft.)

$$W = \frac{33.33T}{S}$$

F_M = Coefficient of sliding friction for chains on steel track
.15 to .20 when lubricated
.30 to .33 when dry

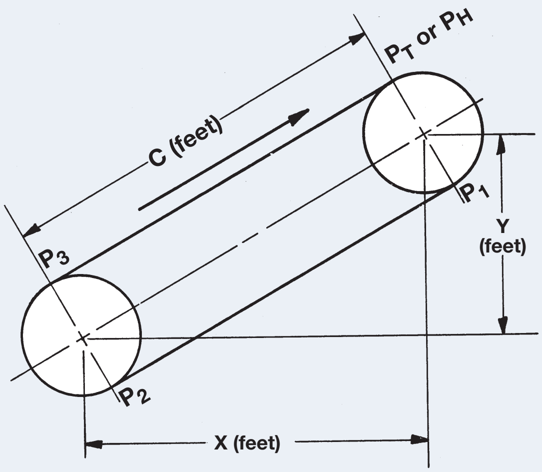
F_W = Coefficient of sliding friction for conveyed material on steel (see table)

Maximum Conveyor Chain Speeds (S)

No. of Sprocket Teeth	Pitch in Inches					
	2	4	6	9	12	18
6	254	180	147	120	104	85
7	297	210	171	140	121	99
8	340	240	196	160	138	113
9	382	270	220	180	155	127
10	425	300	245	200	173	141
11	466	330	270	220	190	156
12	509	360	294	240	207	170
13	551	390	318	260	224	184
14	594	420	343	280	242	198
15	636	450	367	300	259	212

Coefficient of Sliding Friction for Conveyed Material on Steel (F_W)

Material	F_W	Material	F_W
Ashes	.45 - .55	Lime, pebble	.50 - .60
Bagasse	.35 - .45	Sand, dry	.60 - .70
Beans	.30 - .40	Sand, damp	.70 - .80
Cement	.80	Sand, Foundry	
Coal, Anth.	.30 - .50	• Shakeout	.60 - .70
Coal, Bit.	.45 - .50	• Tempered	.65 - .75
Coke	.45 - .55	Stone	.45 - .60
Clay	.60 - .70	Wood Chips	.35 - .45
Gravel	.40 - .55		



Inclined

Note: For chains sliding on runways, substitute F_M for F_R.

$P_1 = 0$

$P_2 = M(XF_R - Y)$

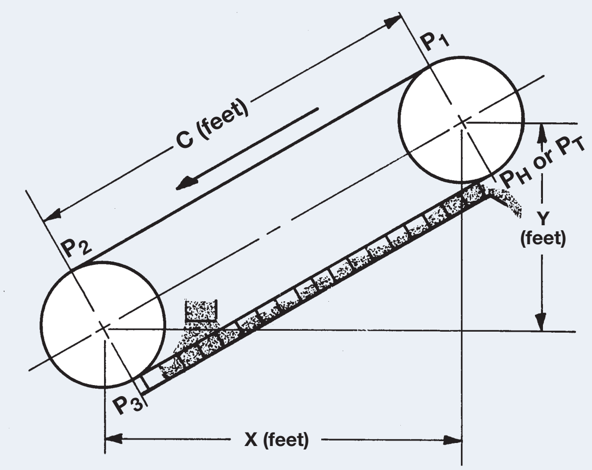
$P_3 = .9\ P_2$ when P_2 is negative

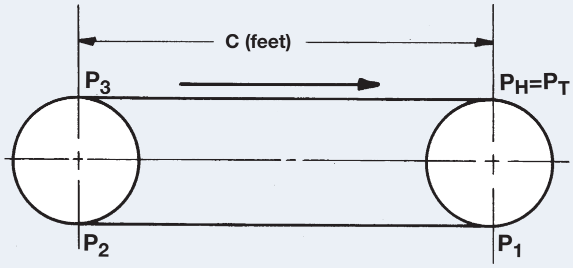
$= 1.1\ P_2$ when P_2 is positive

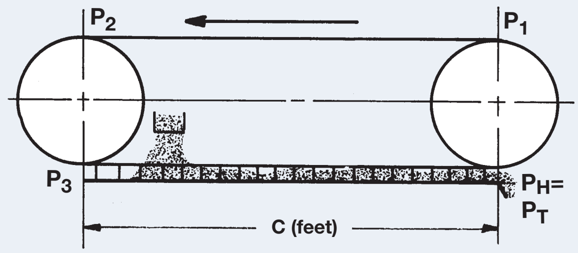
$P_H = (M + W)(XF_R + Y) \pm P_3 + J$

$P_T = (M + W)(XF_R + Y) + J$ when P_3 is negative

$= (M + W)(XF_R + Y) + P_3 + J$ when P_3 is positive







Bucket Elevators

Q_1 = Chain pull due to digging action = P_Q

$$P_Q = \frac{12W_BZ}{D} \times \text{Boot sprocket diameter (in.)}$$

Where:

W_B = Weight of material in one bucket (lbs.)

d = Bucket spacing (in.)

Z = Empirical corrective factor with the following values for stated conditions:

1.0 for centrifugal discharge elevators handing coarse, lumpy material

0.67 for centrifugal discharge elevators handling fine, free-flowing material

0.50 for continuous bucket elevators

P_1 = Takeup tension for screw-type takeups with proper adjustment will be as near to zero as possible. P_1 for gravity takeups will be equal to the tail carriage machinery plus any resultant force from added weights (see drawing).

$P_2 = MY$

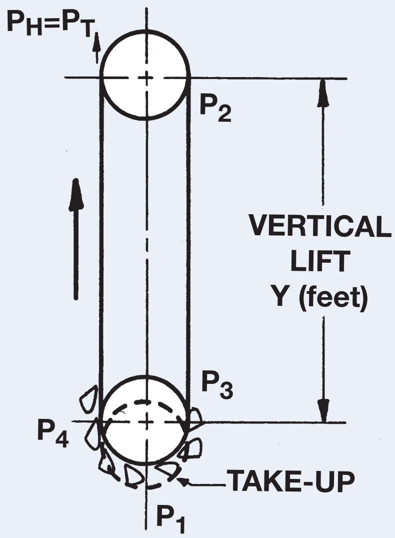
$$P_3 = \frac{P_1 \text{ (least tension)}}{2}$$

$$P_4 = PQ + \frac{P_1}{2}$$

$$PT = Y(W + M) + P_Q + \frac{P_1}{2}$$

$PH = PT - P_2$

$$HP = \frac{1.1\ P_H S}{33{,}000}$$



Inclined

$P_1 = 0$

$P_2 = M(XF_R - Y)$

$P_3 = .9\ P_2$ when P_2 is negative

$= 1.1\ P_2$ when P_2 is positive

$P_H = X(MF_R + WF_W) + Y(M + W) \pm P_3 + J$

$P_T = X(MF_R + WF_W) + Y(M + W) + J$ when P_3 is negative

$= X(MF_R + WF_W) + Y(M + W) + P_3 + J$ when P_3 is positive

Material Carried on Chain — Horizontal

Note: For chains sliding on runways, substitute F_M for F_R.

$P_1 = 0$

$P_2 = CF_RM$

$P_3 = 1.1P_2$

$P_T = P_H = CF_R(2.1M + W) + J$

Chain Rolling and Material Sliding — Horizontal

Note: For chains sliding on runways, substitute F_M for F_R.

$P_1 = 0$

$P_2 = CF_RM$

$P_3 = 1.1P_2$

$P_T = P_H = C(2.1F_RM + F_WW) + J$

S_F = Speed factor (ft./min.) (see table on page xx)

	Loading	Factor
Conveyor Chain	Smooth	1.0
	Moderate Shock	1.2
	Heavy Shock	1.4

S_N = Multiple strand factor for single-strand conveyors for multiple-strand conveyors

Service Factor (S_S)

Type of Driven Load		Type of Input Power: Internal Combustion Engine with Hydraulic Drive	Electric Motor or Turbine	Internal Combustion Engine with Mechanical Drive
Drive Chain	Smooth	1.0	1.0	1.2
	Moderate Shock	1.2	1.3	1.4
	Heavy Shock	1.4	1.5	1.7
Drive and Conveyor Chain	Atmospheric Conditions	Clean, moderate temps.		1.0
		Moderate		1.2
		Harsh		1.4
	Daily Operating Range	8-10 hours		1.0
		10-24 hours		1.2

Step 4: Calculate the design working load (P_D).

$$P_D = P_T \times S_F \times S_S \times S_N$$

Step 5: Repeat steps 2–4.

Use actual chain and attachment weights if different from previous selection.

Step 6: Calculate horsepower at head shaft.

Speed Factor for Steel Table Chains (S_F)

No. of Teeth	Feet Per Minute																			
	10	25	50	75	100	125	150	175	200	225	250	275	300	400	500	600	700	800	900	1000
6	.917	1.09	1.37	1.68	2.00	2.40	2.91	3.57	4.41	5.65	7.35	10.6	16.7	—	—	—	—	—	—	—
7	.855	.971	1.13	1.27	1.44	1.61	1.81	2.04	2.29	2.60	2.96	3.42	3.95	8.62	—	—	—	—	—	—
8	.813	.909	1.04	1.16	1.26	1.37	1.49	1.63	1.76	1.93	2.10	2.29	2.48	3.62	6.21	—	—	—	—	—
9	.794	.870	.980	1.07	1.17	1.26	1.36	1.45	1.55	1.65	1.76	1.88	2.00	2.56	2.94	4.29	6.09	9.90	—	—
10	.775	.840	.943	1.02	1.09	1.16	1.24	1.31	1.37	1.45	1.53	1.61	1.68	2.03	2.41	2.81	3.31	3.82	4.48	5.37
11	.758	.820	.901	.971	1.03	1.09	1.15	1.22	1.28	1.34	1.40	1.46	1.52	1.78	2.05	2.33	2.63	2.96	3.37	3.82
12	.741	.787	.862	.926	.990	1.05	1.10	1.16	1.21	1.26	1.32	1.37	1.42	1.63	1.84	2.05	2.26	2.51	2.77	3.05
14	.735	.769	.833	.885	.935	.980	1.02	1.07	1.11	1.15	1.19	1.24	1.28	1.47	1.61	1.78	1.94	2.10	2.29	2.48
16	.725	.763	.813	.855	.893	.935	.971	1.01	1.05	1.08	1.12	1.16	1.19	1.34	1.48	1.63	1.77	1.93	2.09	2.28
18	.719	.752	.800	.833	.877	.909	.943	.980	1.01	1.04	1.08	1.11	1.14	1.27	1.40	1.53	1.67	1.80	1.95	2.11
20	.717	.746	.787	.826	.855	.893	.917	.952	.980	1.01	1.04	1.07	1.10	1.22	1.34	1.45	1.57	1.69	1.82	1.96
24	.714	.735	.769	.800	.820	.847	.877	.901	.935	.962	.980	1.01	1.04	1.15	1.26	1.37	1.48	1.59	1.71	1.84