Specification for Oil Field Chain and Sprockets

API SPECIFICATION 7F
SEVENTH EDITION, JANUARY 2003
EFFECTIVE DATE JUNE 1, 2003

American
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Upstream Segment

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FOREWORD

This specification is under the jurisdiction of the API Subcommittee on Standardization of Drilling and Servicing Equipment.

The purpose of this specification is to provide standards for roller chains suitable for use in oil field drilling and producing operations.

Much of the engineering material pertaining to roller chains and sprockets was taken from ASME B29.1 *Precision Power Transmission Roller Chains*, *Attachments and Sprockets*; and the book, published by the American Chain Association, *Chains for Power Transmission and Material Handling*. Additionally, portions of the standard ASME B29.1 are requirements of this specification as referenced herein.

Some of the performance related characteristics of the chains that are contained in this document are specific to oil field chains and to their application to oil field drives. This information cannot be found in other publications and imposes performance testing that goes beyond the basic requirements found in any other standards or specifications.

A section on drive design has not been included in this edition of the specification due to the great variety of applications and the complexity of the subject drives.

Conversions of U.S. customary units to International System (SI) metric units are provided throughout the text of this specification in parentheses, e.g., 6 in. (152.4 mm). SI equivalents have also been included in all tables. Formulas and certain relationships are intentionally presented only in U.S. customary units to preclude any ambiguity between them and tabulated values. Conversion factors are provided below if SI equivalents are desired for the calculated unit values.

U.S. customary units are in all cases preferential and shall be standard in this specification. Products are to be marked in the units in which ordered unless there is an agreement to the contrary between the purchaser and the manufacturer.

1 in. (in.)	= 25.4 millimeters (mm) exactly
1 foot (ft)	= 0.3048 meters (m) exactly
1 pound force (lbf)	= 4.448222 Newtons (N)
1 foot•pound force (ft•lbf) torque	= 1.355818 Newton•meters (N•m)
1 horsepower (hp) (550 ft•lbf/s)	= 0.7456999 kilowatts (kW)
1 gallon per minute (gpm)	= 0.0630920 cubic decimeters/second (dm^3/s)

The following formula was used to convert degrees Fahrenheit (F) to degrees Celsius (C):

$$°C = \frac{5}{9}(°F–32)$$

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Suggested revisions are invited and should be submitted to the general manager of the Upstream Segment, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

CONTENTS

CONTENTS

Specification for Oil Field Chain and Sprockets

1 Scope

1.1 COVERAGE

This specification covers the manufacture of the components for, and the assembly and packaging of, single and multiple strand, number 40 through 240, standard and heavy series roller chains for oil field applications, including chain designation, chain length tolerance, tensile strength specifications, pin and bushing press-out specifications, and dynamic test requirements.

For informational purposes, appendices have been included on recommendations for installation, lubrication, and maintenance of oil field chain drives and a basic description of roller chain sprockets.

1.2 POLICY

American Petroleum Institute (API) specifications are published as an aid to procurement of standardized equipment and materials. It must be noted that this specification goes beyond the requirements of other existing standards and specifications but does not preclude any party from manufacturing chains that meet the requirements of API Spec 7F.

2 References

ACA[1]

Chains for Power Transmission Material Handling

Connect and Disconnect Instructions for ASME B29.1 Chains

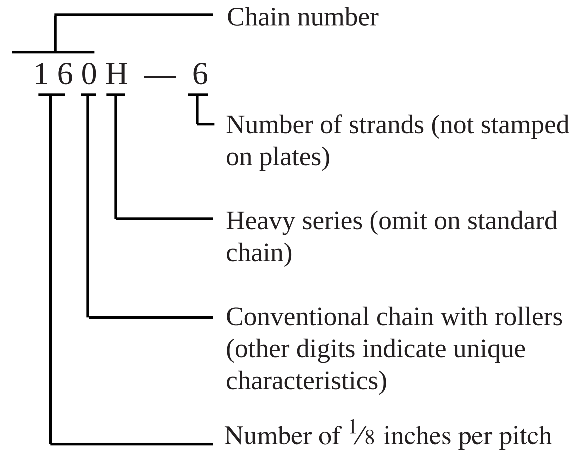
ASME[2]

B15.1	*Safety Standard for Mechanical Power Transmission Apparatus*
B29.1	*Precision Power Transmission Roller Chains, Attachment, and Sprockets*
B29.26	*Fatigue Testing Power Transmission Roller Chain*

3 Roller Chain

3.1 CHAIN DESIGNATION

Chain covered by this specification is identified by the designation shown in the following example and in more detail in ASME B29.1.



3.2 HEAVY SERIES CHAINS

Heavy series chains are made in ¾ in. (19.05 mm) and larger pitches and differ from standard series chains in thicknesses of link plates. Their value is only in the acceptance of higher loads during low-speed operation.

3.3 DIMENSIONS

The general dimensions for roller chains shown in Figures 1 and 2 shall be as specified in ASME B29.1.

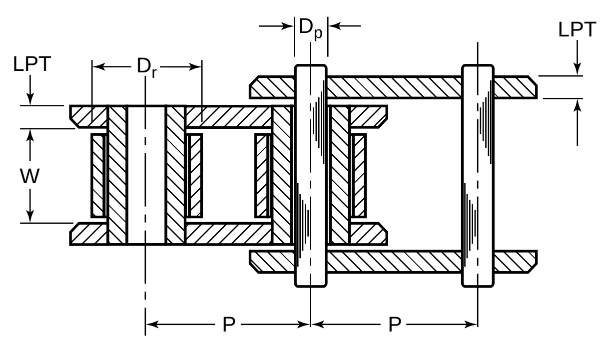


Figure 1—Chain Assembly

3.4 CHAIN LENGTH TOLERANCE

Measuring load is the load under which a chain is to be when measured for length. It is equal to 1% of the minimum ultimate tensile strength, with a minimum of 18 lb and a maximum of 1000 lb, for both single and multiple strand chains.

Chains shall be measured for chain length tolerance after all manufacturing processes, except final lubrication, are complete.

[1]American Chain Association, 6724 Lone Oak Blvd., Naples, FL 34109.
[2]American Society of Mechanical Engineers, Three Park Avenue, New York, New York 10016-5990.

Chain No.	Overlength Tolerance	
	in./ft	mm/m
40	0.019	1.58
50	0.018	1.50
60, 60H	0.017	1.42
80, 80H	0.016	1.33
100, 100H	0.016	1.33
120, 120H	0.015	1.25
140, 140H	0.015	1.25
160, 160H	0.015	1.25
180, 180H	0.015	1.25
200, 200H	0.015	1.25
240, 240H	0.015	1.25

Length measurements are to be taken over a length of at least 12 in. (300 mm).

New chains, under standard measuring load, must not be underlength.

3.5 TENSILE STRENGTH

3.5.1 Single Strand Chain

Standard and heavy series single strand chain meeting the requirements of this specification will have a minimum ultimate tensile strength equal to or greater than the values listed in Table 1.

3.5.2 Multiple Strand Chain

For multiple strand chain, the minimum ultimate tensile strength equals that of the single strand multiplied by the number of strands.

3.5.3 Minimum Ultimate Tensile Strength

Minimum Ultimate Tensile Strength (MUTS), for chains covered by this specification, is defined in ASME B29.1. Chains covered by this specification shall have a MUTS equal to, or greater than, the values listed in Table 1.

MUTS is not a measure of the load at which a chain may be applied; it is indicative only of the tensile strength quality of the chain.

Any chain tests made to verify the MUTS set by this specification are to be considered destructive. Consequently, all chain specimens subjected to such tests, failed or otherwise, are deemed unfit for application purposes.

3.6 PRELOADING

Chains covered by this specification shall be preloaded during manufacture to a tensile load of at least 30% of the Minimum Ultimate Tensile Strength listed in Table 1.

3.7 MINIMUM PRESS-OUT FORCE (TABLE 1)

These values represent the minimum force, in pounds (or newtons), required to start movement of a single pin or bushing in a single link plate. The purpose of these values is to provide for the testing of pin and bushing retention characteristics. This is indicative of the aperture condition in the link plates and the interference fits of the pins and bushings in their respective link plates.

3.7.1 Pin and Pin-link Plates

Chain link assemblies that are assembled with riveted pinheads shall have the rivet removed, exercising care not to remove the link plate metal below the surface of the link plate. One of the link plates shall be removed carefully to avoid destroying the joint integrity between the pins and the link plates. The remaining plate shall be placed in a hydraulically or mechanically operated testing machine with the pin link level and supported to prevent movement when pressure is applied. A single axial load shall be slowly applied to the pin, pressing the pin out of the joint toward the inside of the plate. A force less than the specified press-out load, as applicable for the subject chain, shall constitute failure of the test.

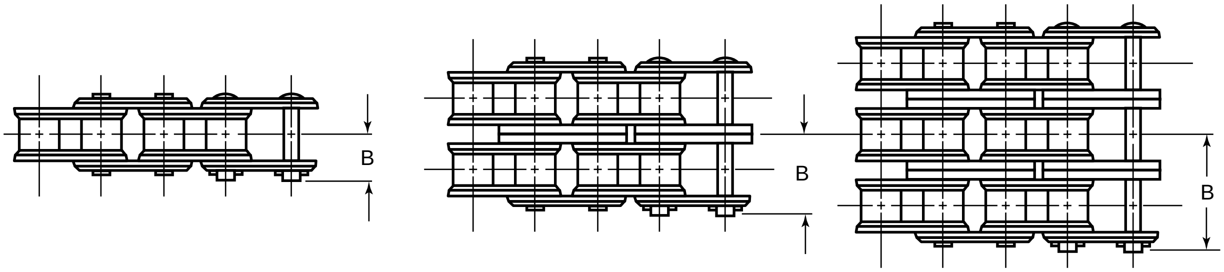


Figure 2—Single and Multiple Chain Assemblies

3.7.2 Roller Link Plate

One of the roller link plates shall be removed using the same method as described for the pin link. Remove the two rollers from the bushings and place the plate with the two bushings in the testing machine with the plate supported to prevent movement when pressure is applied. A single axial load shall be slowly applied to the end of the bushing, pressing the bushing out of the plate. A load that is less than the specified press-out load shall constitute failure of the test.

3.8 MINIMUM DYNAMIC STRENGTH

Standard and heavy series single strand chain confoming to this specification shall be capable of surviving a conformance test at the minimum dynamic strength listed in Table 1. Connecting links, offset links, and multiple strand chains are not subject to the conformance test.

3.8.1 Conformance Test

Initially, the manufacturer shall conduct a conformance test on at least one representative sample from each design family of oil field chain. A design family being defined as different sizes of chain designed to the same parameters, and manufactured by the same processing operations.

Thereafter, the manufacturer shall conduct a conformance test on a representative sample of each model of oil field chain at least once every five years.

The sample chain shall survive a conformance test conducted at the minimum dynamic strength listed for the subject chain in Table 1.

Note: The dynamic strength values are not valid characteristics for designing actual applications. Neither the specified dynamic strength values nor the conformance test results are to be interpreted as allowable working loads.

Note: The conformance test is a destructive test. Even though the chain may survive the test without failure, it will have been damaged and will be unfit for service.

3.8.2 Conformance Test Procedure

Sample chains shall be tested according to the conformance test described in ASME B29.26.

3.9 MARKING REQUIREMENTS

For compliance with API Spec 7F, the chain shall be marked with the ANSI chain number and the manufacturer's identifying mark at least once in every foot (0.3 m). API Spec 7F shall be marked on the chain packaging.

Table 1—Table of Standard Chain Capacities

ANSI Number	Minimum Ultimate Tensile Strength lb	Minimum Press-out Force lb Pin	Bush	Minimum Dynamic Strength lb
40	3125	180	108	720
50	4880	300	180	1120
60	7030	412	247	1600
80	12500	728	437	2810
100	19500	1060	635	4300
120	28100	1430	859	6060
140	38300	1880	1120	8030
160	50000	2370	1420	10200
180	63300	3540	2120	12500
200	78100	4580	2740	15000
240	112500	5380	3540	20100
60H	7030	548	329	1850
80H	12500	910	546	3140
100H	19500	1270	762	4710
120H	28100	1670	1000	6550
140H	38300	2150	1280	8580
160H	50000	2670	1600	10800
180H	63300	3930	2360	13200
200H	78100	5500	3290	16400
240H	112500	7170	4720	23200
	(N)	(N)		(N)
40	13900	800	480	3200
50	21710	1334	801	4980
60	31270	1833	1099	7120
80	55600	3238	1944	12500
100	86870	4715	2825	19130
120	125100	6361	3821	26960
140	170270	8363	4982	35720
160	222400	10542	6316	45370
180	281470	15747	9430	55600
200	347500	20373	12188	66720
240	529400	23931	15747	89410
60H	31270			8230
80H	55600			13970
100H	86870			20950
120H	125100			29140
140H	170270			38170
160H	222400			48040
180H	281470			58720
200H	347500			72950
240H	529400			103200

APPENDIX A—RECOMMENDED PRACTICE FOR INSTALLATION, LUBRICATION, AND MAINTENANCE OF ROLLER CHAIN DRIVES

A.1 Installation

A.1.1 CHECK CONDITION OF COMPONENTS

Check shafts and bearings and assure they are in good condition. Check bearings mounts and make sure they are correctly positioned and secure. If the chain is not new, be sure that it is clean, well lubricated, and not excessively worn. If sprockets are not new, make sure they are not excessively worn or otherwise damaged.

A.1.2 ALIGN SHAFTS AND SPROCKETS

Good drive alignment is necessary to prevent uneven loading across the width of the chain and damaging wear between the sprockets teeth and the roller link plates of the chain. Aligning the drive is a straightforward, two-step procedure.

1. The shafts must be parallel within fairly close limits. This is readily done by using a machinist's level and feeler bars (See Figure A-1). First, using the machinist's level, make sure the shafts are level or in the same plane. Then, using the feeler bars, make sure the shafts are parallel in that plane. If the shafts can float axially, lock them in the normal running position before attempting to align them.
   Most single strand drives will perform acceptable if the shafts are parallel and in the same plane within 0.050 in./ft (4.2 mm/m) of shaft length, or $\frac{1}{4}$ degree. However, high speed, high horsepower, or multiple strand drives should be aligned within the tolerance obtained from the following formula:

$$\text{Tolerance} = \frac{0.00133C}{Pn}(\text{in./ft}),\ \text{or}\ \frac{0.111C}{Pn}(\text{mm/m})$$

where

C = center distance, in in., or mm,

P = chain pitch, in in., or mm,

n = number of chain strands.

2. The sprockets must be mounted on the shafts as closely in line axially as practicable, normally with a straight edge or a length of piano wire (See Figure A-2). In practice, the maximum amount of axial misalignment is obtained from the following formula:

$$\text{Maximum Offset} = 0.045P\ \text{in. (mm)}$$

where

P = chain pitch, in in., or (mm).

This formula applies to both single and multiple strand chains.

A.1.3 INSTALL CHAIN

If the chain is not the correct length—in pitches—to properly fit on the drive, a longer stock length may have to be shortened or several sections may have to be connected to make the chain the correct length. A brochure entitled "Connect and Disconnect Instructions for ASME B29.1 Chains," published by the American Chain Association, describes how to do this. It is recommended that all sections of a particular chain be from the same manufacturer.

When the correct chain length has been obtained, fit the chain around the sprockets and bring the free ends together on one sprocket using the sprocket teeth to hold the chain ends in position. With large heavy chains it may be necessary to block the sprockets to prevent them from turning while the chain ends are brought together. Insert the pins of the connecting link through the bushing holes to couple the chain endless. With long chain spans, it may be necessary to support the chain with a plank or rod while the connection is made. Then install the cover plate and the spring clip or cotters. After the fasteners have been installed, the ends of the pins should be pressed back until the fasteners are snug against the cover plate. This restores the intended clearances across the chain

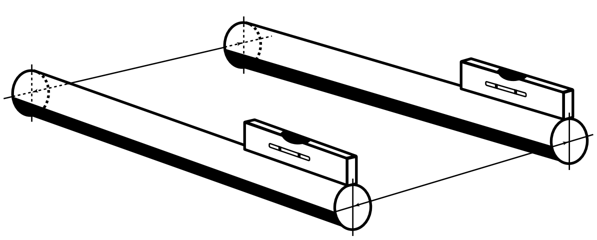


Figure A-1—Align Shafts

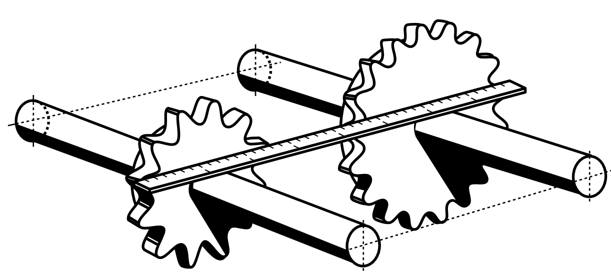


Figure A-2—Align Sprockets

and allows the joint to flex freely as it should. Again, the connection procedure is well described in the brochure "Connect and Disconnect Instructions for ASME B29.1 Chains."

A.1.4 CONNECTING LINKS

Connecting links should use interference fit cover plates because their capacity is virtually the same as the rest of the chain. The use of slip fit cover plates should be avoided because their capacity can be much less than the rest of the chain.

A.1.5 OFFSET LINKS

The use of offset links should be avoided whenever possible because their capacity can be much less than the rest of the chain. If an offset link is necessary, an offset section, assembled with press fit pins, should be used.

A.1.6 ADJUST CHAIN TENSION

First, turn one sprocket to tighten one span of the chain. Then use a straight edge and a scale to measure the total mid-span movement in the slack span (Figure A-3). Adjust the drive center distance or the idler to produce 4 to 6% mid-span movement for drives that are on horizontal centers to a 45° incline, and 2 to 3% for drives that are inclined 45° to vertical or subject to high shock loads.

A.1.7 ENSURE FREEDOM FROM INTERFERENCES

Check the drive carefully to ensure that there is no contact between the chain or sprockets and any adjacent object. Ample clearance must be provided to allow for chain pulsations, chain wear elongation, and shaft end float.

A.1.8 PROVIDE ADEQUATE LUBRICATION

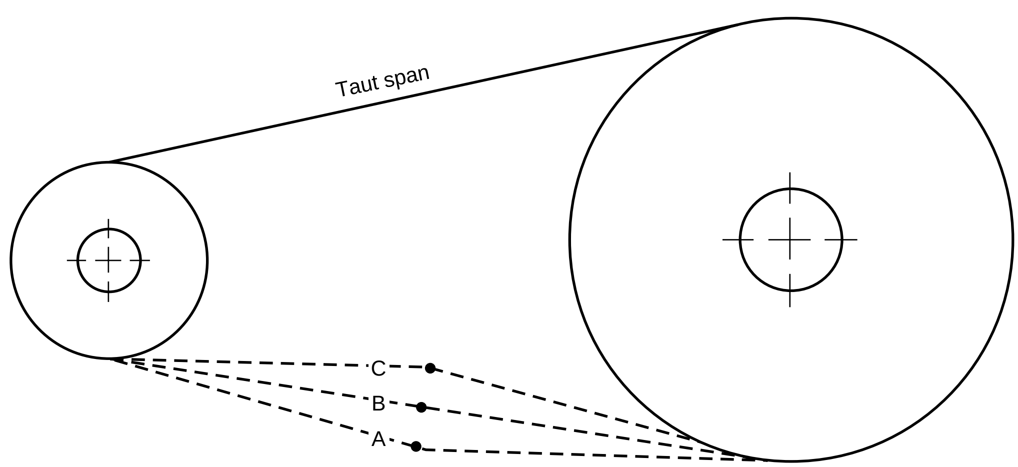
Before starting the drive, be sure that the specified lubrication system is working properly. See A.2.

A.1.9 INSTALL GUARDS

If the roller chain drive does not run in a chain casing, it should be enclosed by guarding that will prevent personnel from being injured by inadvertent contact with the moving components of the drive. More detailed information can be found in ASME B15.1, *Safety Standard for Mechanical Power Transmission Apparatus.*

Prior to installation, inspect the guard to make sure it is not broken or damaged, especially at or near the mounting points. Then, install the guard making sure that all fasteners are secure and all safe-guarding devices (such as presence sensors and interlocks) are functioning.

Recommended Possible Mid-Span Movement, AC, in in. (mm)						
Drive Center-Line	Tangent Length Between Sprockets, in in. (cm)					
	10 (25)	20 (51)	30 (76)	50 (127)	70 (178)	100 (254)
Horizontal to 45°	0.4–0.5 (10–15)	0.8–1.2 (20–30)	1.2–1.8 (30–45)	2.0–3.0 (51–76)	2.8–4.2 (71–107)	4.0–6.0 (102–152)
45° to Vertical	0.2–0.3 (5–8)	0.4–0.6 (10–15)	0.5–0.9 (15–23)	1.0–1.5 (25–38)	1.4–2.1 (36–53)	2.0–3.0 (51–76)



AC = Total possible mid-span movement.
Depth of free sag = 0.866 AB, approximately.

Figure A-3—Mid-Span Movement

A.2 Lubrication

A.2.1 LUBRICATION FLOW

Each joint in a roller chain is a journal bearing, so it is essential that the chain receive an adequate amount of the proper lubricant to achieve maximum wear life. In addition to resisting wear between the pins and bushings, an adequate flow of lubricant smooths the engagement of the chain rollers with the sprockets, cushions roller to sprocket impacts, dissipates heat, flushes away wear debris and foreign materials, and retards rust.

The lubricant should be applied to the upper edges to the link plates in the lower span of the chain shortly before the chain engages a sprocket (Figures A-4 and A-5). Then, gravity and centrifugal force both will aid in carrying the lubricant to the critical pin and bushing surfaces. Surplus lubricant spilling over the link plate edges will supply the roller and bushing surfaces.

A.2.2 LUBRICANT CHARACTERISTICS

Lubricants for roller chain drives should have the following characteristics:

a. Sufficiently low viscosity to penetrate into the critical internal surfaces.

b. Sufficiently high viscosity, or appropriate additives, to maintain the lubricating film under the prevailing bearing pressures.

c. Clean and free of corrodents.

d. Capability to maintain lubrication qualities under the prevailing operating conditions.

These requirements usually are met by a good grade of nondetergent petroleum-base oil. Detergents normally are not necessary, but antifoam, antirust, and film strength improving additives often are beneficial.

Low-grade or impure oils should be avoided. Low-grade oils cannot provide effective lubrication and acids or abrasive particles in the oil can damage the chain beyond repair. Heavy oils or greases should not be used because they are too thick to penetrate into the internal surfaces of the chain. The recommended oil viscosity for various surrounding temperature ranges is shown in Table A-1.

A.2.3 TYPES OF LUBRICATION

The ASME Standards list three types of lubrication for roller chain drives. The recommended type is mainly influenced by the chain speed and may be selected from Table A-2. The recommended types should be regarded as minimum lubrication requirements and the use of a better type may be beneficial.

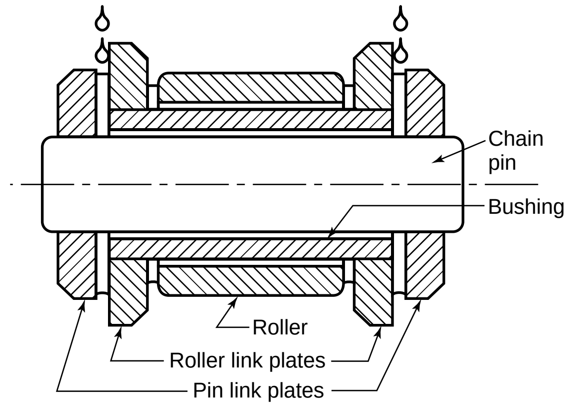


Figure A-4—Lubricant Flow Into the Chain Joint

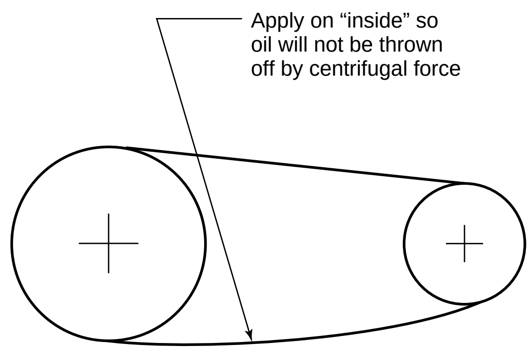


Figure A-5—Application of Lubricant to Chain

Table A-1—Recommended Oil Viscosities for Various Temperatures

Recommended Grade	Temperature °F	Temperature °C
SAE 5	–50 to +50	–46 to + 10
SAE 10	–20 to +80	–29 to + 27
SAE 20	+10 to + 110	–12 to + 43
SAE 30	+20 to + 130	–7 to + 54
SAE 40	+30 to + 140	–1 to + 60
SAE 50	+40 to + 150	+4 to + 66

Note: When the temperature range permits a choice, the heavier grade should be used.

A.2.3.1 Type I—Manual or Drip Lubrication

For manual lubrication, oil is applied periodically with a brush or a spout can, preferably once each 8 hours of operation. The time may be longer than 8 hours, if it has proven adequate for that particular drive. The volume and frequency of oil application must be sufficient to prevent a red-brown (rust) discoloration of the oil in the joints. The red-brown discoloration indicates that the oil in the joints is inadequate.

Table A-2—Lubrication Type for Chain Size and Speed

Chain Pitch in. (mm)		Type 1		Type 2		Type 3
0.500 (12.70)	up to	290 (88)	up to	2200 (670)	over	2200 (670)
0.625 (15.88)		240 (73)		1930 (588)		1930 (588)
0.750 (19.05)		210 (64)		1740 (530)		1740 (530)
1.000 (25.40)		170 (52)		1480 (451)		1480 (451)
1.250 (31.75)		145 (44)		1300 (396)		1300 (396)
1.500 (38.10)		125 (38)		1170 (357)		1170 (357)
1.750 (44.45)		110 (34)		1080 (329)		1080 (329)
2.000 (50.80)		100 (30)		1000 (305)		1000 (305)
2.250 (57.15)		90 (27)		930 (283)		930 (283)
2.500 (63.50)		85 (26)		880 (268)		880 (268)
3.000 (76.20)		75 (23)		790 (241)		790 (241)

Chain Speed, ft/min (m/min)

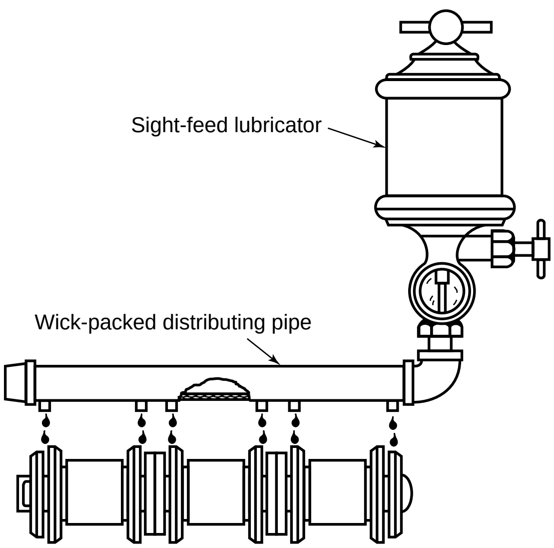


Figure A-6—Drip Feed Lubrication

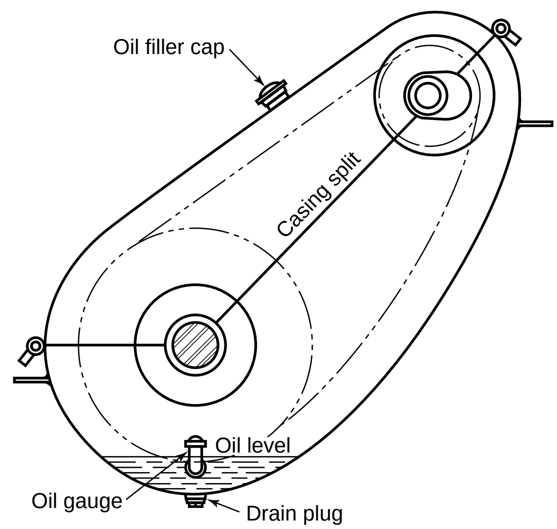


Figure A-7—Oil Bath Lubrication

When the rust discoloration is found, remove, clean, relubricate, and reinstall the chain prior to continuing operation.

Note: Manual lubrication is to be done only when the drive is stopped and power to the drive is locked out.

For drip lubrication, oil is dripped between the link plate edges from a drip lubricator. Drip rates range from 4 to 20 or more drops per minute, depending on chain speed. Here again, the drip rate must be sufficient to prevent a red-brown (rust) discoloration of the lubricant in the chain joints. Care must be taken to prevent windage from misdirecting the oil drops. The oil level in the reservoir should be checked after each 8 hours of operation, and the reservoir refilled when needed.

For multiple strand chains, a distribution pipe is needed to feed oil to all the rows of link plates, and a wick packing usually is required to distribute oil uniformly to all holes in the pipe (Figure A-6).

A.2.3.2 Type II—Oil Bath or Slinger Disc Lubrication

For oil bath lubrication, a short section of the lower strand of the chain runs through a sump of oil in the chain casing (Figure A-7). The oil level should just reach the pitch-line of the chain at its lowest point in operation. Long sections of chain running through the oil bath, as in a nearly horizontal lower span, should be avoided because they can cause oil foaming and overheating.

In slinger disc lubrication, the chain operates above the oil level. A disc on one shaft picks oil up from the sump and slings it against a collector plate. Then, the oil usually flows into a trough that applies it to the upper edges of the link

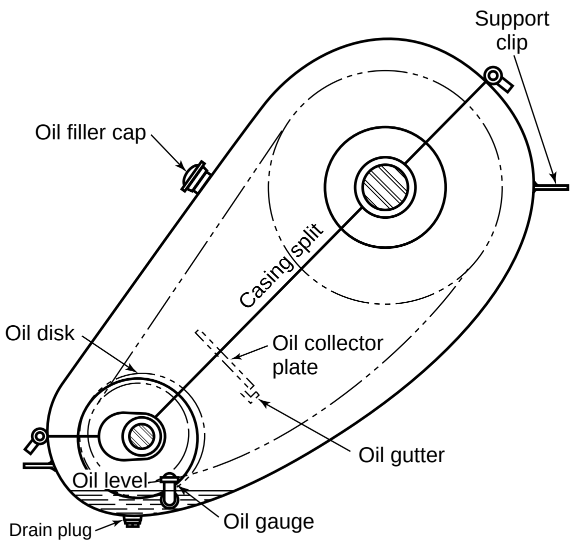


Figure A-8—Slinger Disc Lubrication

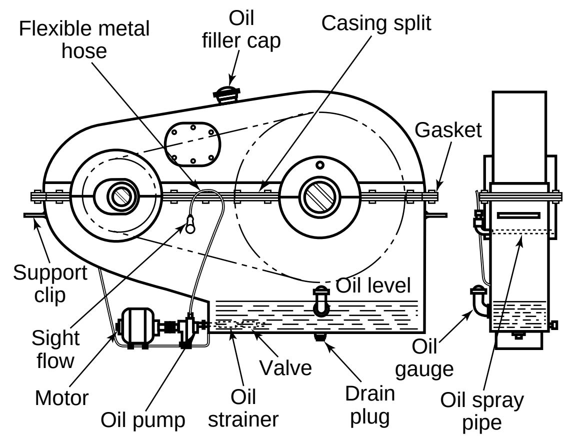


Figure A-9—Oil Stream Lubrication

Table A-3—Required Oil Flow for Chain Drives

Transmitted		Minimum Required	
HP	kW	gal/min.	L/min
50	37	0.25	0.95
100	75	0.50	1.89
150	112	0.75	2.84
200	149	1.00	3.78
300	224	1.50	5.68
400	298	2.00	7.57
500	373	2.50	9.46
600	447	3.00	11.40
800	597	3.75	14.20
1000	746	4.75	18.00
1500	1119	7.00	26.50
2000	1491	10.00	37.90

plates in the lower strand of the chain (Figure A-8). The diameter of the disc should produce rim speeds between 600 ft/min. (183 m/min.) and 8000 ft/min. (2438 m/min.). Lower speeds may not pick up the oil effectively, while higher speeds may cause oil foaming or overheating.

In both oil bath and slinger disc lubrication, the temperature of the oil bath and the chain should not exceed 180°F. Also, the volume of oil applied to the chain must be great enough to prevent the red-brown (rust) discoloration of lubricant in the chain joints. The oil level in the sump of both oil bath and slinger disc systems should be checked after each 8 hours of operation, and oil added when needed. At the same time, the system should be checked for leaking, foaming, or overheating.

A.2.3.3 Type III—Oil Stream Lubrication

With oil stream lubrication, a pump delivers oil under pressure to nozzles that direct a stream or spray onto the chain. The oil should be applied evenly across the width of the chain, and be directed onto the lower span from inside the chain loop (Figure A-9). Excess oil collects in the bottom of the casing and is returned to the pump suction reservoir. A pressure-regulating valve may be used to divert excess pump discharge to the reservoir. Oil cooling may occur by radiation from the external surfaces of the reservoir or by a separate heat exchanger.

Oil stream lubrication is always recommended for chains operating at relatively high speeds and loads. It is absolutely essential for roller chains that operate in the indicated galling region for any extended time period. The oil stream not only lubricates the chain, but also cools the chain and carries away wear debris from a drive being run at or near full rated capacity. The minimum oil flow rate for the amount of horsepower being transmitted is shown in Table A-3.

Here again, the oil level in the sump should be checked after each 8 hours of operation, and oil added when needed. At the same time, the system should be checked for leaking or overheating.

A.2.4 CHAIN CASINGS

Chain casings (Figure A-10) are used to facilitate lubrication and to protect the drive from being damaged by debris or contamination. Chain casings are usually made of sheet metal, stiffened by steel angles or embossed ribs, and have access doors or panels for inspection and maintenance of the drive.

Adequate clearances must be provided inside the chain casing or the useful wear life of the chain may be restricted. As chain wear elongation accumulates in the slack span, chain sag can become great enough to allow the chain to

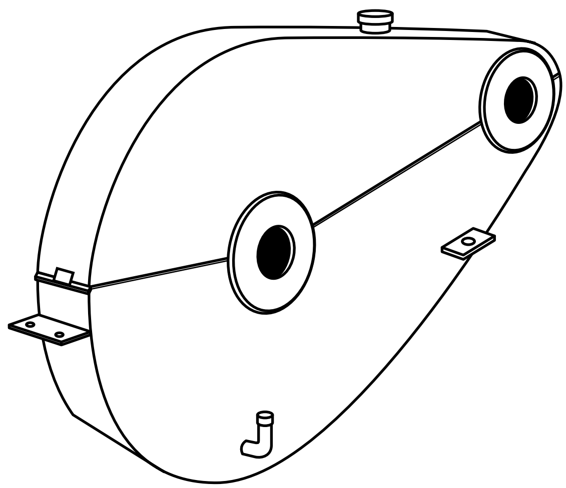


Figure A-10—Typical Oil Retaining Chain Casing

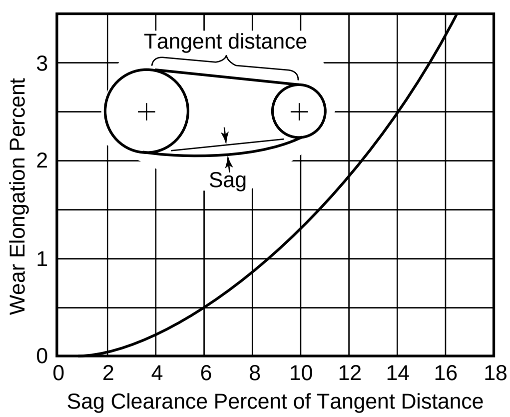


Figure A-11—Casing Clearance Wear Limit

strike the bottom of the chain casing, damaging both the chain and the casing. Casing clearances to allow for maximum wear elongation percentages may be determined from Figure A-11. In addition to the clearance to accommodate chain sag, there should be at least a 3-in. (76-mm) clearance around the periphery of the chain and 0.75 in. (19 mm) on each side of the chain.

When a chain casing is used, it may need to be sized for adequate heat dissipation. The temperature rise of the oil in a chain casing may be estimated by the use of Figures A-12 and A-13 and the procedures that accompany them.

To estimate the probable temperature rise of a chain case, the following formula may be used:

$$T = \frac{50.9\text{HP}}{AK} = \text{°F above ambient}$$

$$T = \text{Temperature rise, °F}$$

where

HP = Transmitted horsepower,

A = Casing area exposed to air circulation in ft^2,

K = Radiation constant in Btu per square foot per hour per degree Fahrenheit temperature difference,

K = 2.0 for still air
2.7 for normal free air circulation
4.5 for rapid air circulation.

Good practice limits the allowable operating temperature to approximately 180°F (temperature rise plus ambient). If the calculated temperature is greater than this value, a larger casing could be used or an oil cooler added to reduce the operating temperature to allowable limits. The accompanying chart may be used for a quick approximation of possible temperature rise (Figure A-13).

Explanation:

1. Compute value of X and plot point #1.
2. Draw vertical line from X value (point #1) to intersect appropriate centers (point #2).
3. Draw horizontal line from “centers” (point #2) and read exposed projected casing area (point #3).
4. At intersection of appropriate HP and horizontal line (point #4) from step 3, draw a vertical line and read approximate casing temperature rise (point #5).

<u>Values of X</u>

Standard Casing

$$X = \frac{P}{6}(t + T) + W_c + 9$$

Oversize Casing

$$X = R_1 + R_2 + W$$

where

P = Chain pitch, in.,

t = No. teeth small sprocket,

W_c = Chain width, in.,

R_1 = Casing rad., small end, in.,

R_2 = Casing rad., large end, in.,

W = Casing width, in.,

HP = Horsepower,

T = No. teeth large sprocket,

A = Area in ft^2.

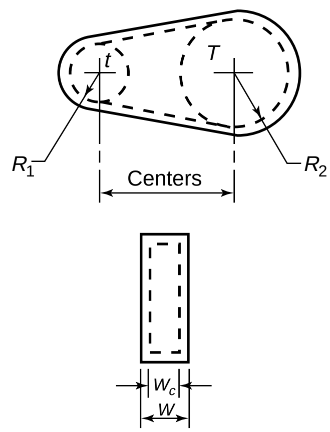


Figure A-12—Chain Casing Schematic

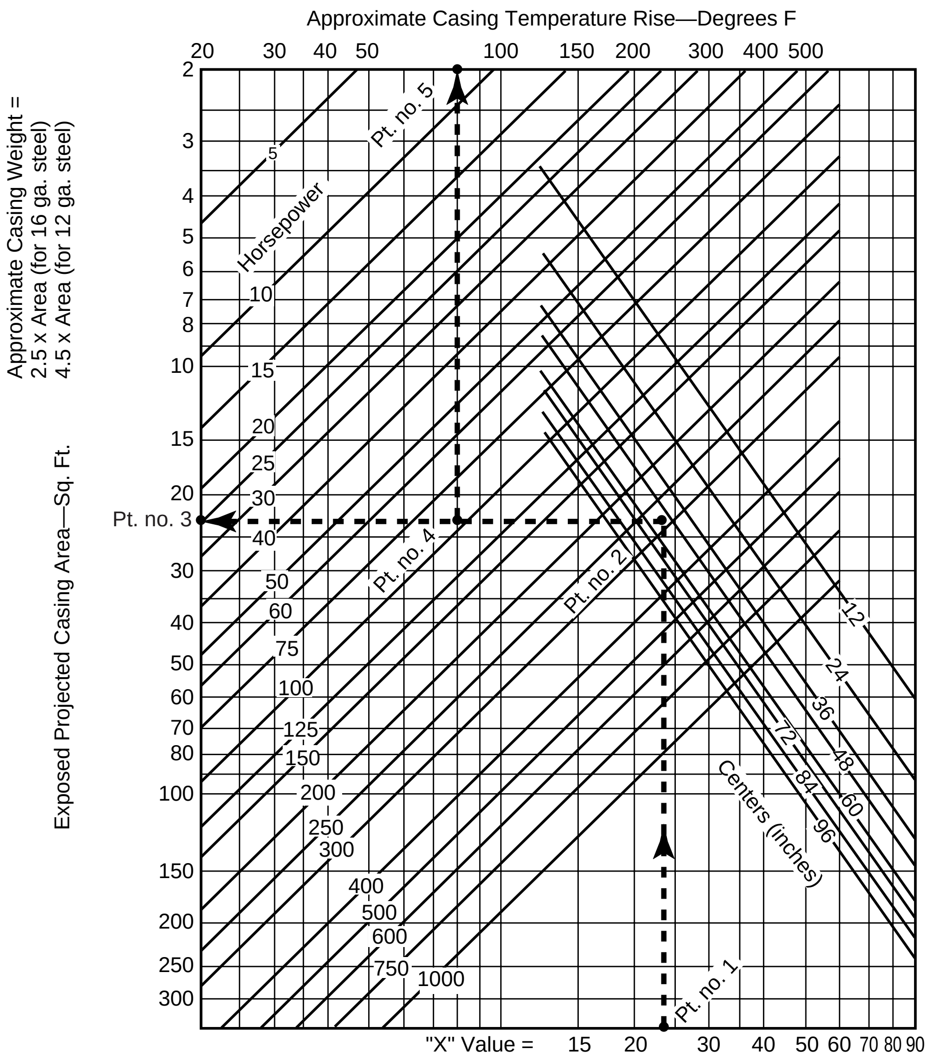


Figure A-13—Approximation of Temperature Rise of a Chain Casing

A.3 Maintenance

A.3.1 INSPECTION AND SERVICE SCHEDULE

A roller chain drive requires proper and timely maintenance to deliver satisfactory performance and service life. It is assumed that the shafts, bearings, and supports; the chain and sprockets; and the lubrication type have been properly selected and installed. Then, a maintenance program must be established to assure the following:

a. The drive is correctly lubricated.
b. Drive interferences are eliminated.
c. Damaged chains or sprockets are replaced.
d. Worn chains or sprockets are replaced.
e. The sprockets are properly aligned.
f. The chain is correctly tensioned.
g. Guarding is in good condition and is properly installed.

A roller chain drive should be inspected after the first 50 hours of operation. After that, drives subject to heavy shock loads or severe operating conditions should be inspected after each 200 hours of operation, while more ordinary drives may be inspected after each 500 hours of operation. Experience may indicate a longer or shorter interval between inspections.

At each inspection, the following items should be checked and corrected when necessary. In addition, maintenance personnel should refer to the "Roller Chain Drive Troubleshooting Guide" (see Table A-5).

A.3.2 INSPECT LUBRICATION SYSTEM

For manual lubrication, be sure that the lubrication schedule is being followed and the correct grade of oil is being used. If the chain is dirty, clean it with kerosene or a nonflammable solvent and relubricate it.

For drip lubrication, check the flow rate and be sure that the oil is being directed onto the chain correctly.

For oil bath, slinger disc, or oil stream lubrication, be sure that all orifices are clear and that the oil is being directed onto the chain correctly. Change the oil after the first 50 hours of operation, and after each 500 hours thereafter (200 hours in severe service).

A.3.3 INSPECT FOR DRIVE INTERFERENCES

Inspect for any evidence of interference between the drive components and other parts of the equipment. If any is found, correct it immediately. Rubbing between the chain or sprockets and other parts of the machine can cause abnormal wear and damage. Impact between the chain link plates and a rigid object can cause link plate fatigue and chain failure.

Also inspect for and eliminate any buildup of debris or foreign material between the chain and sprockets. A relatively small amount of debris in the sprocket roller seat can cause tensile loads great enough to break the chain if forced through the drive.

A.3.4 INSPECT FOR DAMAGED CHAIN OR SPROCKETS

Inspect the chain for cracked, broken, deformed, or corroded parts; and for tight joints or turned pins. If any are found, find and correct the cause of the damage and replace the entire chain. Even though the rest of the chain appears to be in good condition, it very probably has been damaged and more failures are likely to occur in a short time.

Inspect sprockets for chipped, broken, or deformed teeth. If any are found, find and correct the cause of the damage and replace the sprocket. Sprockets normally are stronger and less sensitive to damage than chain, but running a worn chain on new sprockets can ruin the sprockets in a short time. This is because a worn chain rides very high on the sprocket teeth and wears the sprocket teeth in an abnormal pattern.

A.3.5 INSPECT FOR CHAIN WEAR

In most roller chain drives, the chain is considered worn out when it has reached 3% wear elongation. With 3% wear, the chain does not engage the sprocket properly and can cause sprocket damage or chain breakage. On drives with large sprockets (more than 66 teeth), allowable wear is limited to $^{200}/_{N}$ (N = no. of teeth on largest sprocket) and may be substantially less than 3%. On fixed-center, nonadjustable drives, allowable wear elongation is limited to about one-half of one chain pitch.

Measure a representative section of chain, as shown in Figure A-14, and Table A-4, and if wear elongation exceeds 3% or the functional limit, replace the entire chain. Do not connect a new section of chain to a worn section because it may run rough and damage the drive.

A.3.6 INSPECT FOR SPROCKET WEAR

A worn out sprocket is not nearly as well defined as a worn out chain. However, there are some sprocket characteristics that indicate when a sprocket should be replaced. Check for roughness or binding when a new chain engages or disengages the sprocket. Inspect for reduced tooth thickness and hooked tooth tips (Figure A-15). If sprocket teeth are hooked visibly, without aid of a template, chain life can be significantly reduced, and the sprocket should be replaced.

Do not run new chain on worn out sprockets because it can cause the chain to wear rapidly. The pitch of the new chain is much shorter than the effective pitch of the worn sprocket, so the total chain load is concentrated on the final sprocket tooth before disengagement. Then, when the chain disengages from the sprocket, the roller is jerked out of the hooked portion of the sprocket tooth and that results in a shock load on the chain as the load is transferred from one tooth to the next.

Table A-4—Chain Wear Elongation Limits

ANSI Chain	Chain Pitch			Measured Length			
				Nominal		At 3% Wear	
Number	in.	mm	No. of Pitches	in.	mm	in.	mm
25	0.250	6.35	48	12.00	305	12.375	314
35	0.375	9.52	32	12.00	305	12.375	314
41	0.500	12.70	24	12.00	305	12.375	314
40	0.500	12.70	24	12.00	305	12.375	314
50	0.625	15.88	20	12.50	318	12.875	327
60, 60H	0.750	19.05	16	12.00	305	12.375	314
80, 80H	1.000	25.40	12	12.00	305	12.375	314
100, 100H	1.250	31.75	20	25.00	635	25.750	654
120, 120H	1.500	38.10	16	24.00	610	24.719	628
140, 140H	1.750	44.45	14	24.50	622	25.250	641
160, 160H	2.000	50.80	12	24.00	610	24.719	628
180, 180H	2.250	57.15	12	27.00	686	27.812	706
200, 200H	2.500	63.50	10	25.00	635	25.750	654
240, 240H	3.000	76.20	8	24.00	610	24.375	628

A.3.7 INSPECT FOR SPROCKET MISALIGNMENT

Inspect for significant wear on the inside surfaces of the chain roller link plates and on the sprocket flange faces. If this type of wear is present, the sprockets may be misaligned. Realign the sprockets as described in the installation instructions to prevent further abnormal chain and sprocket wear. If 5% or more of the link plate thickness is worn away, or if there are sharp gouges in the link plate surface, the chain should be replaced immediately. If 10% or more of the sprocket tooth flange thickness is worn away, the sprocket should be replaced.

A.3.8 INSPECT CHAIN TENSION

Measure the total midspan movement (Figure A-3). If it exceeds the tabulated limit, adjust the center distance to obtain the desired amount of slack. If elongation exceeds the available adjustment, and wear elongation still has not exceeded 3% or the functional limit, remove two pitches and reinstall the chain. If the minimum adjustment will not permit shortening the chain two pitches, the chain may be shortened one pitch by using an offset link or an offset section.

A.3.9 INSPECT GUARDS

Inspect the guards to ensure they are in serviceable condition. The guards must not be bent or deformed so that intended clearance is reduced. Any designed openings in the guard (mesh) must not be enlarged. The guards must not be broken or damaged, especially at or near the mounting points.

If the guards are in serviceable condition, reinstall them on the drive, making sure that all fasteners are secure and that all safeguarding devices (such as presence sensors and interlocks) are functioning.

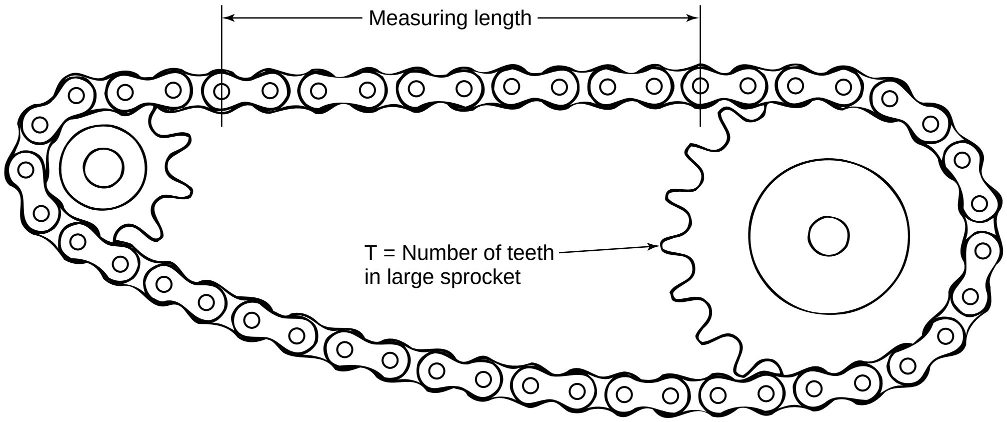


Figure A-14—Measurement of Chain for Wear Elongation

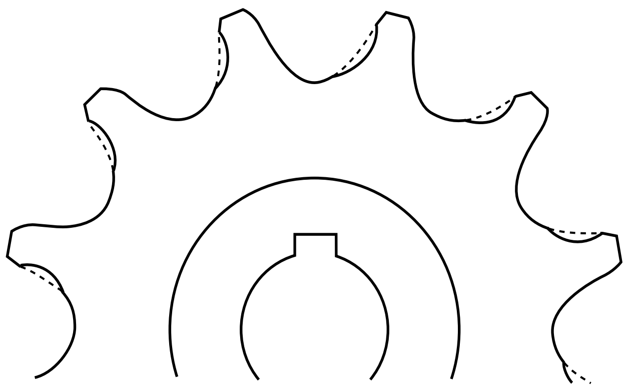


Figure A-15—Worn Sprocket

Table A-5—Roller Chain Drive Troubleshooting Guide

Condition/Symptom	Possible Cause	What To Do
Missing parts	❒ Missing at assembly.	Replace chain.
	❒ Broken and lost.	Find and correct cause of damage. Replace chain.
Rusted chain	❒ Exposed to moisture.	Replace chain. Protect from moisture.
	❒ Water in lubricant.	Change lubricant. Protect lubrication system from water. Replace chain.
	❒ Inadequate lubrication.	Provide or re-establish proper lubrication. Replace chain, if needed.
Excessive noise	❒ Chain striking an obstruction.	Replace chain. Eliminate interference.
	❒ Loose casing or shaft mounts.	Tighten fasteners, mounts.
	❒ Excess chain slack.	Retension chain.
	❒ Excessive chain wear.	Replace and retension chain.
	❒ Excessive sprocket wear.	Replace sprockets and chain.
	❒ Sprocket misalignment.	Replace chain and sprockets, if needed. Realign sprockets.
	❒ Inadequate lubrication.	Replace chain if needed. Re-establish proper lubrication.
	❒ Chain pitch too large.	Redesign drive for smaller pitch chain.
	❒ Too few sprocket teeth.	Check to see if larger sprockets can be used. If not, redesign drive.
Wear on inside of roller link plates and one side of sprockets	❒ Sprocket misalignment.	Replace sprockets and chain if needed. Realign drive. Retension chain.
Chain clings to sprocket	❒ Excessive sprocket wear.	Replace sprockets and chain.
	❒ Sprocket misalignment.	Replace sprockets and chain if needed. Realign sprockets.
Chain climbs sprocket teeth	❒ Excess chain slack.	Retension chain.
	❒ Excessive chain wear.	Replace and retension chain.
	❒ Excessive sprocket wear.	Replace sprockets and chain.
	❒ Extreme overload.	Replace chain. Eliminate cause of overload.
Missing or broken cotters	❒ Cotters installed improperly.	Install new cotters per manufacturer's instructions.
	❒ Striking obstruction.	Replace chain. Eliminate interference.
	❒ Vibration.	Replace chain. Reduce vibration. Use larger sprockets.
	❒ Excessively high speed.	Replace chain. Reduce speed. Redesign drive for smaller pitch chain.
Exposed chain surfaces corroded or pitted	❒ Exposure to corrosive environment.	Replace chain. Protect from hostile environment.

Table A-5—Roller Chain Drive Troubleshooting Guide (continued)

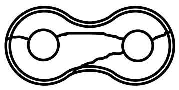
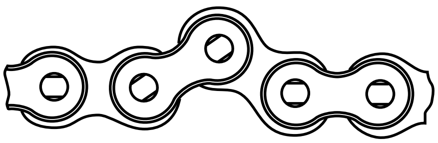
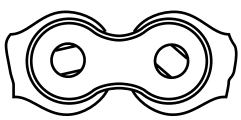
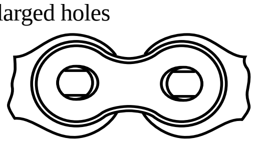
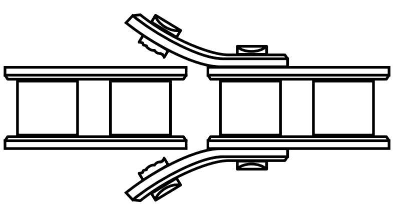
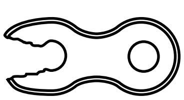
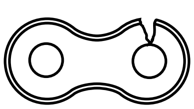
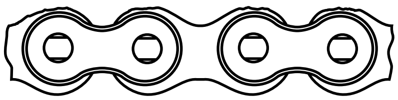
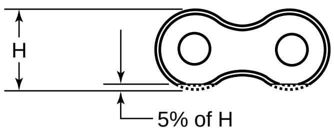
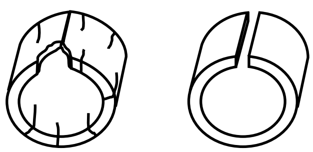
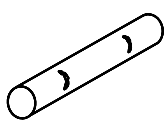
Condition/Symptom	Possible Cause	What To Do
Cracked link plates (stress corrosion) 	❒ Exposure to corrosive environment combined with stress from press fits.	Replace chain. Protect from hostile environment.
Tight joints 	❒ Dirt or foreign material in chain joints. ❒ Inadequate lubrication. ❒ Misalignment. ❒ Internal corrosion or rust. ❒ Overload bends pins or spreads roller link plates.	Clean and relubricate chain. Replace chain. Re-establish proper lubrication. Replace sprockets and chain if needed. Realign sprockets. Replace chain. Eliminate cause of corrosion or protect chain. Replace chain. Eliminate cause of overload.
Turned pins 	❒ Inadequate lubrication. ❒ Overload.	Replace chain. Re-establish proper lubrication. Replace chain. Eliminate cause of overload.
Enlarged holes 	❒ Overload.	Replace chain. Eliminate cause of overload.
Broken pins  Broken link plates 	❒ Extreme overload.	Replace chain. Replace sprockets if indicated. Eliminate cause of overload or redesign drive for larger pitch chain.
Cracked link plates (Fatigue) 	❒ Loading greater than chain's dynamic capacity.	Replace chain. Reduce dynamic loading or redesign drive for larger chain.

Table A-5—Roller Chain Drive Troubleshooting Guide (continued)

Condition/Symptom	Possible Cause	What To Do
Battered link plate edges 	❐ Chain striking an obstruction.	Replace chain. Eliminate interference.
Worn link plate contours 	❐ Chain rubbing on casing, guide, or obstruction.	Replace chain if 5% or more of height worn away, *or if any evidence of heat discoloration*. Retension chain. Eliminate interference.
Broken, cracked, or deformed rollers 	❐ Speed too high. ❐ Sprockets too small. ❐ Chain riding too high on sprocket teeth.	Replace chain. Reduce speed. Replace chain. Use larger sprockets, or possibly redesign drive for smaller pitch chain. Replace chain. Retension chain more often.
Pin galling 	❐ Speed or load too high. ❐ Inadequate lubrication.	Reduce speed or load. Possibly redesign drive for smaller pitch chain. Provide or re-establish proper lubrication.

APPENDIX B—SPROCKETS FOR ROLLER CHAIN

B.1 Sprocket Types

Four types of sprockets are shown in Figure B-1 and are designated as follows:

a. Type A—plain plate.
b. Type B—hub on one side only.
c. Type C—hub on both sides.
d. Type D—hub detachable.

B.2 Tooth Profile

Figure B-2, Sections A and B, shows the recommended sprocket tooth chamfer for roller chains. Figure B-2, Section C, shows sprocket tooth flange location for multiple-strand roller chains. All sprocket flanges are chamfered to guide the chain onto the sprocket in case of misalignment due to sprocket misalignment or permissible flange weave. Flange chamfer may be either as in Section A or B or any intermediate profile. The fillet radius r_f max equals 0.04 x pitch for maximum hub diameter. Other dimensions indicated in Figure B-2 are as specified in ASME B29.1 for precision sprockets.

B.3 Tooth Form

Shall conform dimensionally to those described by ASME B29.1.

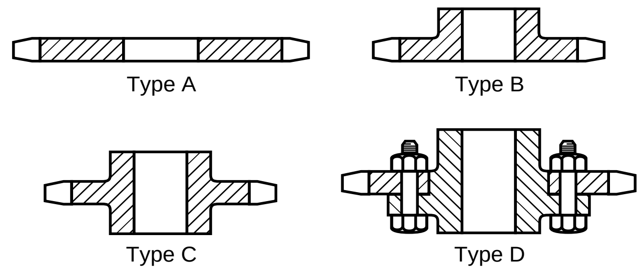


Figure B-1—Sprocket Types

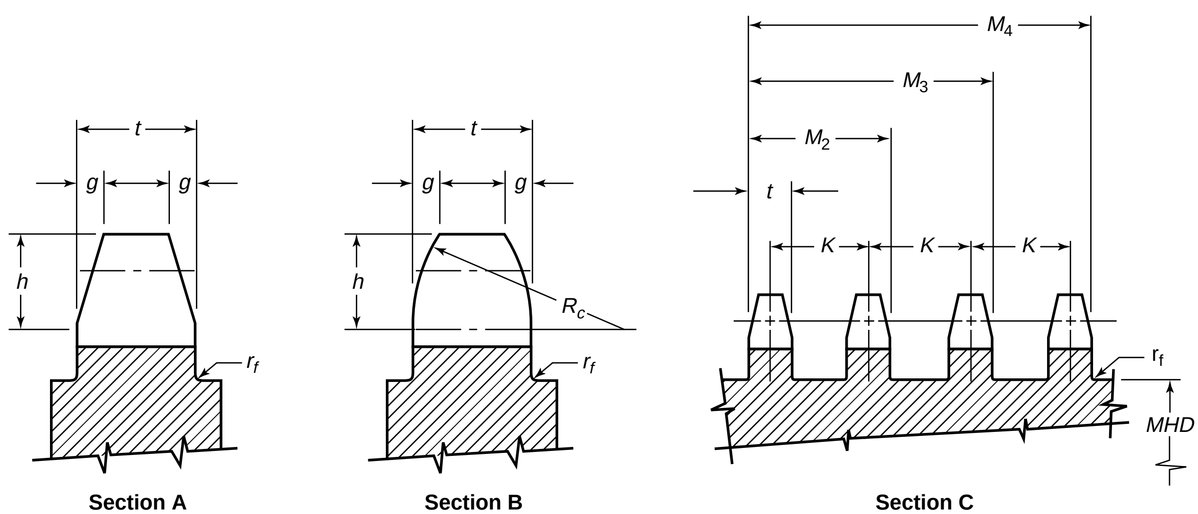


Figure B-2—Sprocket Tooth Profile

APPENDIX C—USE OF THE API MONOGRAM

C.1 Design Verification of Compliance to Spec 7F Chain Capacities

The licensee shall perform verification testing in accordance with 3.5, 3.7, and 3.8 and maintain such records for a 5-year period from the date of manufacture.

C.2 Marking Requirements

For compliance with the API Monogram program the chain marking shall comply with 3.9 of Spec 7F, and the API Monogram, date of manufacture and API License Number shall appear on the packaging.

C.3 Certification

The manufacturer shall, upon request by the purchaser, furnish the purchaser a certificate of compliance stating that the product has been manufactured, sampled, tested and inspected in accordance with the requirements of this specification and has been found to be in compliance.

The inclusion of information relative to "special processes" such as steel chemistry, heat treatment, and any other information that may be considered proprietary in nature, will be by mutual agreement between the purchaser and the manufacturer.

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