

# Specification for Oil-Field Chain and Sprockets

API SPECIFICATION 7F  
SIXTH EDITION, AUGUST 1999



**American  
Petroleum  
Institute**

**Helping You  
Get The Job  
Done Right.<sup>SM</sup>**

# **Specification for Oil-Field Chain and Sprockets**

## **Upstream Segment**

API SPECIFICATION 7F  
SIXTH EDITION, AUGUST 1999



**Helping You  
Get The Job  
Done Right.<sup>SM</sup>**

## SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Upstream Segment [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the general manager of the Upstream Segment, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

*All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.*

Copyright © 1999 American Petroleum Institute

## 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 ANSI 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 ANSI 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 inch (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 <sup>3</sup> /s)

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

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

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

	Page
1 SCOPE .....	1
1.1 Coverage .....	1
1.2 Policy .....	1
2 REFERENCES .....	1
3 ROLLER CHAIN .....	1
3.1 Chain Designation .....	1
3.2 Heavy Series Chains .....	1
3.3 Dimensions .....	1
3.4 Chain Length Tolerance .....	1
3.5 Tensile Strength .....	2
3.6 Minimum Press-out Force (Table 1) .....	2
3.7 Minimum Dynamic Strength .....	3
3.8 Marking Requirements .....	3
APPENDIX A RECOMMENDED PRACTICE FOR INSTALLATION, LUBRICATION, AND MAINTENANCE OF ROLLER CHAIN DRIVES .....	5
APPENDIX B SPROCKETS FOR ROLLER CHAIN .....	19
APPENDIX C USE OF THE API MONOGRAM .....	21
Figures	
1—Chain Assembly .....	1
A-1—Align Shafts .....	5
A-2—Align Sprockets .....	5
A-3—Mid-Span Movement .....	6
A-4—Lubricant Flow Into the Chain Joint .....	7
A-5—Application of Lubricant to Chain .....	7
A-6—Drip Feed Lubrication .....	8
A-7—Oil Bath Lubrication .....	8
A-8—Slinger Disc Lubrication .....	9
A-9—Oil Stream Lubrication .....	9
A-10—Typical Oil Retaining Chain Casing .....	10
A-11—Casing Clearance Wear Limit .....	10
A-12—Chain Casing Schematic .....	11
A-13—Approximation of Temperature Rise of a Chain Casing .....	11
A-14—Measurement of Chain for Wear Elongation .....	14
A-15—Worn Sprocket .....	14
B-1—Sprocket Types .....	19
B-2—Sprocket Tooth Profile .....	19
Tables	
1—Table of Standard Chain Capacities .....	3
A-1—Recommended Oil Viscosities for Various Temperatures .....	7
A-2—Lubrication Type for Chain Size and Speed .....	8
A-3—Required Oil Flow for Chain Drives .....	9
A-4—Chain Wear Elongation Limits .....	13
A-5—Roller Chain Drive Troubleshooting Guide .....	15
B-1—Sprocket Types .....	19
B-2—Sprocket Tooth Profile .....	19

# Specification for Oil-Field Chain and Sprockets

## 1 Scope

### 1.1 COVERAGE

This specification covers 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<sup>1</sup>

*Chains for Power Transmission Material Handling*

*Connect and Disconnect Instructions for ANSI B29.1 Chains*

ANSI<sup>2</sup>

B15.1 *Safety Standard for Mechanical Power Transmission Apparatus*

B29.1 *Precision Power Transmission Roller Chains, Attachment, and Sprockets*

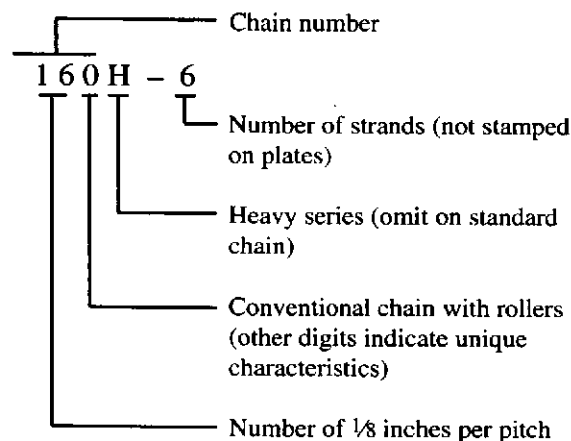
## 3 Roller Chain

### 3.1 CHAIN DESIGNATION

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

<sup>1</sup>American Chain Association, 932 Hungerford Drive #36, Rockville, Maryland 20850.

<sup>2</sup>American National Standards Institute, 11 West 42nd Street, New York, New York 10036.



### 3.2 HEAVY SERIES CHAINS

Heavy series chains are made in 3/4 inch (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 ANSI B29.1.

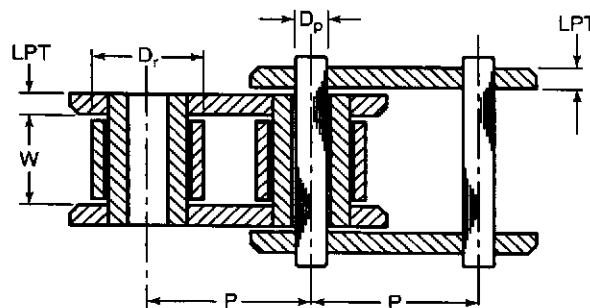


Figure 1—Chain Assembly

### 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.

Chain No.	Overlength Tolerance	
	in./ft	mm/m
40	0.019	1.58
50	0.018	1.50
60	0.017	1.42
80	0.016	1.33
100	0.016	1.33
120	0.015	1.25
140	0.015	1.25
160	0.015	1.25
180	0.015	1.25
200	0.015	1.25
240	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, as defined for chains covered by this specification, is the minimum load at which an unused, undamaged chain may be expected to fail when subjected to a single tensile load cycle (Table 1). Minimum ultimate tensile strength 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 minimum ultimate tensile strength 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 MINIMUM PRESS-OUT FORCE (TABLE 1)

These values represent the minimum force, in pounds (or newtons), required to move 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.

#### 3.6.1 Pin and Pin Link Plates

Chain link assemblies that are assembled with riveted pin-heads 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.

#### 3.6.2 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.

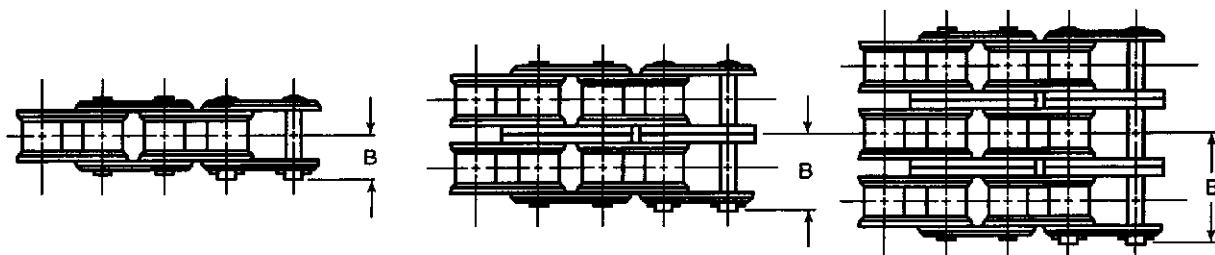


Figure 2—Single and Multiple Chain Assemblies

Table 1—Table of Standard Chain Capacities

ANSI Number	Minimum Ult. Tensile Strength	Minimum Press-Out Force lb		Dynamic Test Loads lb	
	lb	Pin	Bush	Maximum	Minimum
40	3125	180	108	690	69
50	4880	300	180	1080	108
60	7030	412	247	1550	155
80	12500	728	437	2710	271
100	19500	1060	635	4150	415
120	28100	1430	859	5840	584
140	38300	1880	1120	7720	772
160	50000	2370	1420	9840	984
180	63300	3540	2120	12100	1210
200	78100	4580	2740	14500	1450
240	112500	5380	3540	19400	1940
	(N)	(N)		(N)	
40	13900	800	480	3069	307
50	21710	1334	801	4804	480
60	31270	1833	1099	6895	690
80	55600	3238	1944	12055	1206
100	86870	4715	2825	18460	1846
120	125100	6361	3821	25978	2598
140	170270	8363	4982	34340	3434
160	222400	10542	6316	43771	4377
180	281470	15747	9430	53823	5382
200	347500	20373	12188	64499	6450
240	529400	23931	15747	86296	8630

### 3.7 MINIMUM DYNAMIC STRENGTH

Standard series single strand chain, conforming to this specification shall be capable of withstanding a minimum of 3 million cycles at the dynamic test loads shown in Table 1 without failure.

#### 3.7.1 Dynamic Test

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

The dynamic 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.

#### 3.7.2 Dynamic Test Procedure

An unused, undamaged, length of chain, containing at least five free pitches, shall be mounted in the test machine by

means of fixtures that permit free movement on both sides of the chain centerline in the normal plane of articulation. Any links that are enclosed by, or are in contact with, the fixtures shall be excluded from the count of free pitches.

An axial force shall be applied, varying sinusoidally between the maximum and minimum loads listed in Table 1, for a 3-million-cycle period.

Fracture of any component in less than 3 million cycles constitutes failure of this test.

Failures in the links that are in contact with the fixtures (not one of the free pitches) shall be disregarded, and an additional sample shall be tested.

### 3.8 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 packaging.



## 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 inches, or mm,  
 $P$  = chain pitch, in inches, or mm,  
 $n$  = number of chain strands.

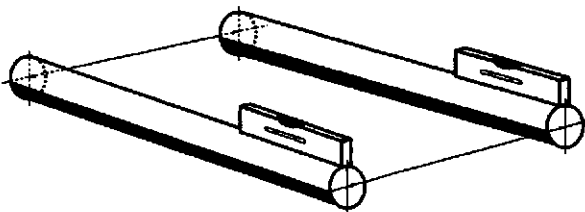


Figure A-1—Align Shafts

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

$$P = \text{chain pitch, in inches, or (mm).}$$

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 ANSI 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

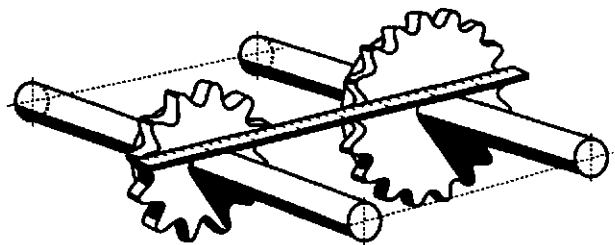


Figure A-2—Align Sprockets

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 ANSI 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 ANSI 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 inches (mm)						
Drive Center-Line	Tangent Length Between Sprockets, in inches (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)

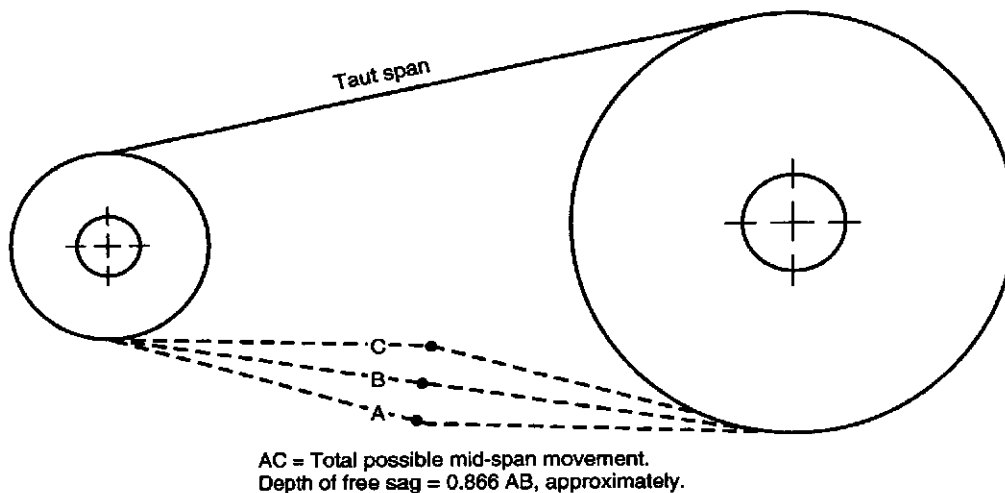


Figure A-3—Mid-Span Movement

## 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:

- Sufficiently low viscosity to penetrate into the critical internal surfaces.
- Sufficiently high viscosity, or appropriate additives, to maintain the lubricating film under the prevailing bearing pressures.
- Clean and free of corrodents.
- 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 ANSI 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.

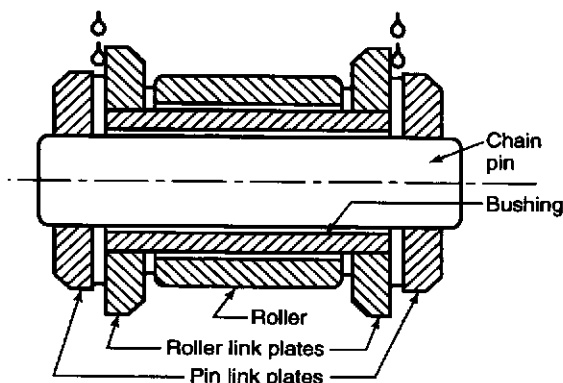


Figure A-4—Lubricant Flow Into the Chain Joint

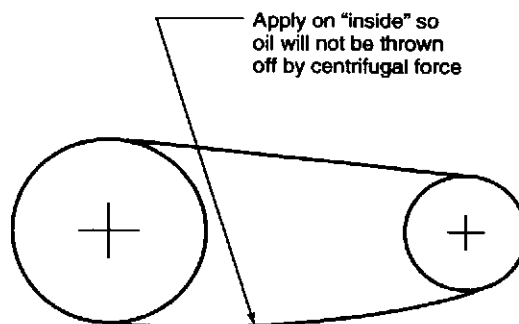


Figure A-5—Application of Lubricant to Chain

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)	Chain Speed, ft/min (m/min)		
	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)

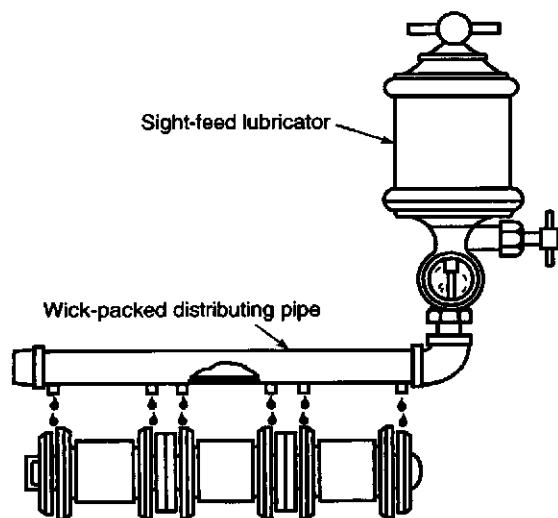


Figure A-6—Drip Feed Lubrication

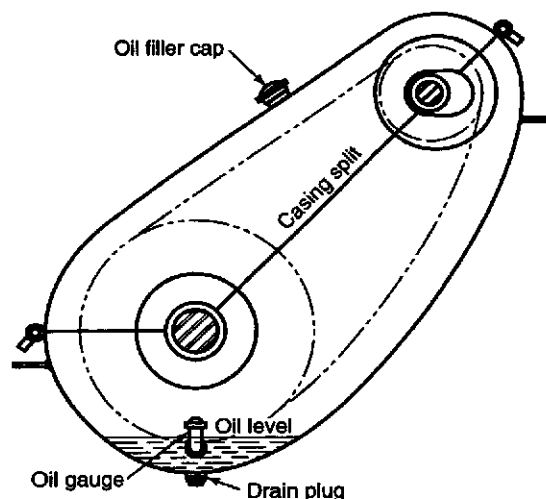


Figure A-7—Oil Bath Lubrication

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 usu-

ally 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

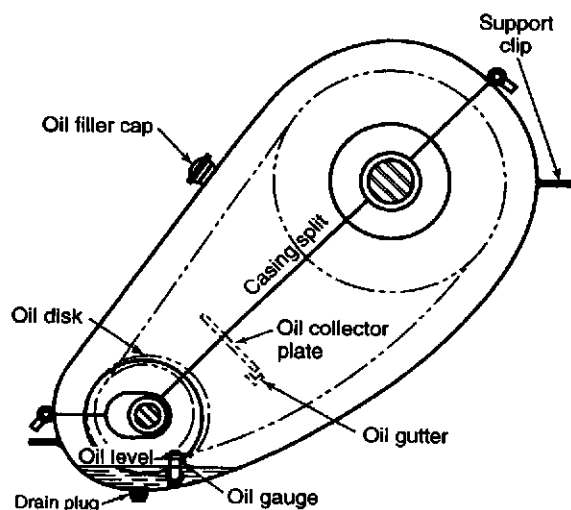


Figure A-8—Slinger Disc Lubrication

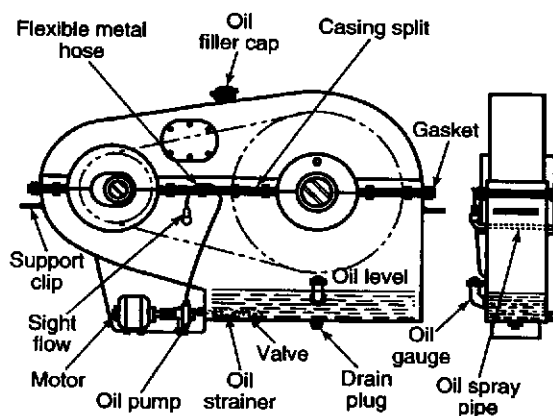


Figure A-9—Oil Stream Lubrication

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

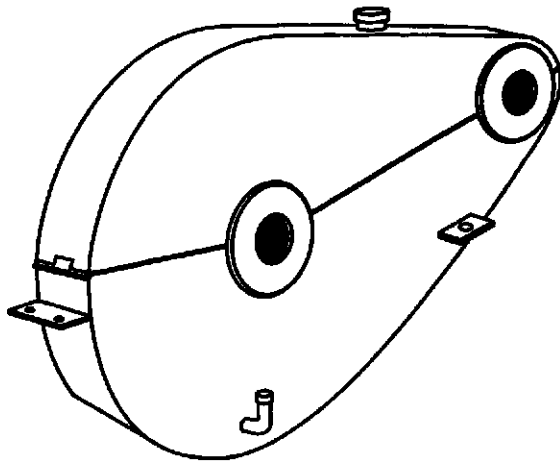


Figure A-10—Typical Oil Retaining Chain Casing

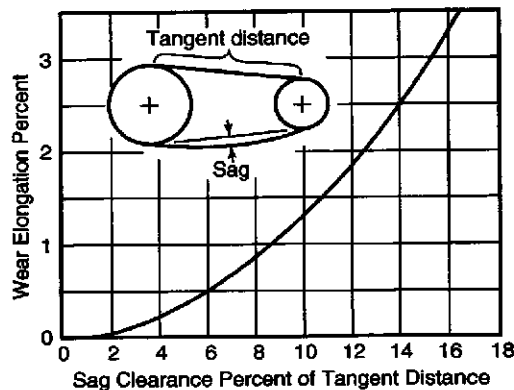


Figure A-11—Casing Clearance Wear Limit

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:

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

$T$  = Temperature rise,  $^\circ\text{F}$

where

$HP$  = Transmitted horsepower,

$A$  = Casing area exposed to air circulation in  $\text{ft}^2$ ,

$K$  = 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  $180^\circ\text{F}$  (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).

#### Values of $X$

Standard Casing

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

Oversize Casing

$$X = R_1 + R_2 + W$$

where

$P$  = Chain pitch, inches,

$t$  = No. teeth small sprocket,

$W_c$  = Chain width, inches,

$R_1$  = Casing rad., small end, inches,

$R_2$  = Casing rad., large end, inches,

$W$  = Casing width, inches,

$HP$  = Horsepower,

$T$  = No. teeth large sprocket,

$A$  = Area in  $\text{ft}^2$ .

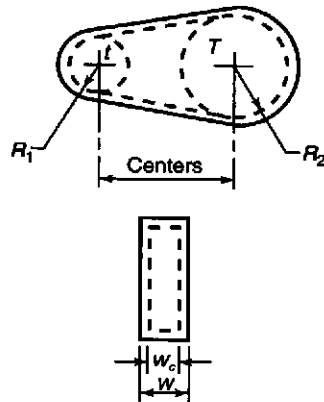


Figure A-12—Chain Casing Schematic

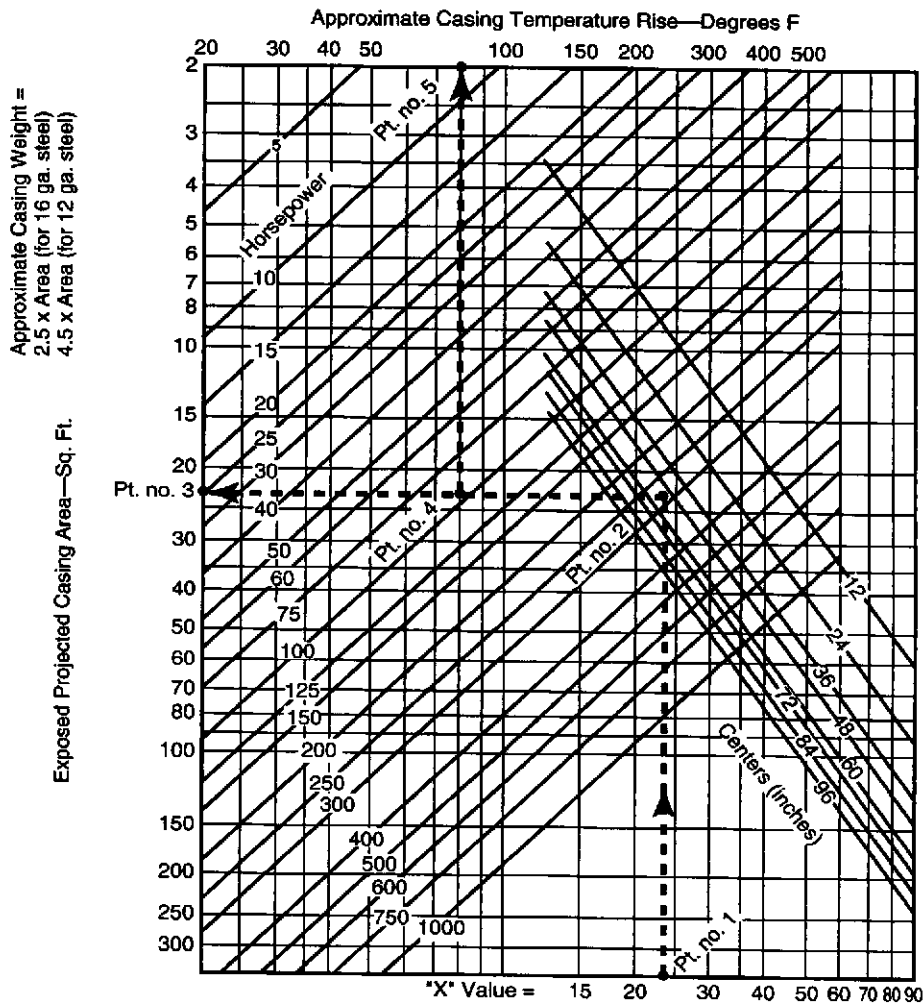


Figure A-13—Approximation of Temperature Rise of a Chain Casing

## 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 Number	Chain Pitch		No. of Pitches	Measured Length			
				Nominal		At 3% Wear	
	in.	mm		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	0.750	19.05	16	12.00	305	12.375	314
80	1.000	25.40	12	12.00	305	12.375	314
100	1.250	31.75	20	25.00	635	25.750	654
120	1.500	38.10	16	24.00	610	24.719	628
140	1.750	44.45	14	24.50	622	25.250	641
160	2.000	50.80	12	24.00	610	24.719	628
180	2.250	57.15	12	27.00	686	27.812	706
200	2.500	63.50	10	25.00	635	25.750	654
240	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.

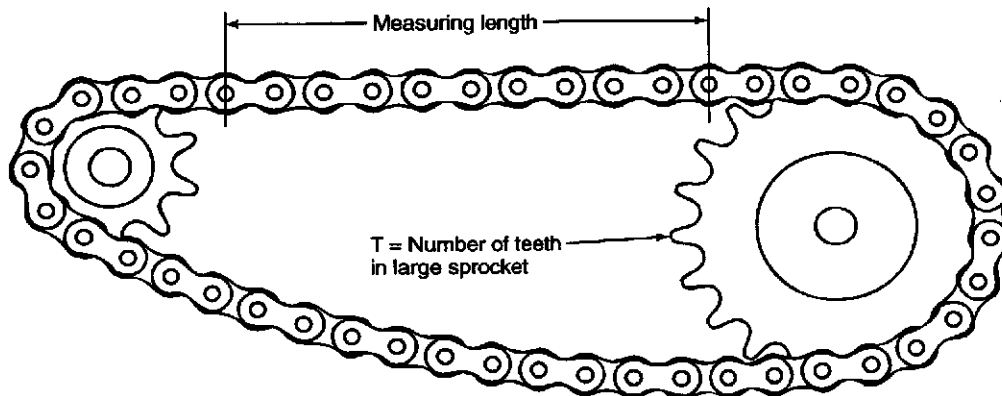


Figure A-14—Measurement of Chain for Wear Elongation

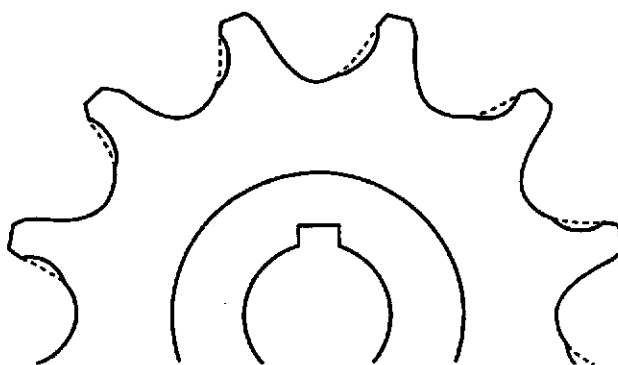


Figure A-15—Worn Sprocket

Table A-5—Roller Chain Drive Troubleshooting Guide

Condition/Symptom	Possible Cause	What To Do
Missing parts	<input type="checkbox"/> Missing at assembly. <input type="checkbox"/> Broken and lost.	Replace chain. Find and correct cause of damage. Replace chain.
Rusted chain	<input type="checkbox"/> Exposed to moisture. <input type="checkbox"/> Water in lubricant. <input type="checkbox"/> Inadequate lubrication.	Replace chain. Protect from moisture. Change lubricant. Protect lubrication system from water. Replace chain. Provide or re-establish proper lubrication. Replace chain, if needed.
Excessive noise	<input type="checkbox"/> Chain striking an obstruction. <input type="checkbox"/> Loose casing or shaft mounts. <input type="checkbox"/> Excess chain slack. <input type="checkbox"/> Excessive chain wear. <input type="checkbox"/> Excessive sprocket wear. <input type="checkbox"/> Sprocket misalignment. <input type="checkbox"/> Inadequate lubrication. <input type="checkbox"/> Chain pitch too large. <input type="checkbox"/> Too few sprocket teeth.	Replace chain. Eliminate interference. Tighten fasteners, mounts. Retension chain. Replace and retension chain. Replace sprockets and chain. Replace chain and sprockets, if needed. Realign sprockets. Replace chain if needed. Re-establish proper lubrication. Redesign drive for smaller pitch chain. 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	<input type="checkbox"/> Sprocket misalignment.	Replace sprockets and chain if needed. Realign drive. Retension chain.
Chain clings to sprocket	<input type="checkbox"/> Excessive sprocket wear. <input type="checkbox"/> Sprocket misalignment.	Replace sprockets and chain. Replace sprockets and chain if needed. Realign sprockets.
Chain climbs sprocket teeth	<input type="checkbox"/> Excess chain slack. <input type="checkbox"/> Excessive chain wear. <input type="checkbox"/> Excessive sprocket wear. <input type="checkbox"/> Extreme overload.	Retension chain. Replace and retension chain. Replace sprockets and chain. Replace chain. Eliminate cause of overload.
Missing or broken cotters	<input type="checkbox"/> Cotters installed improperly. <input type="checkbox"/> Striking obstruction. <input type="checkbox"/> Vibration. <input type="checkbox"/> Excessively high speed.	Install new cotters per manufacturer's instructions. Replace chain. Eliminate interference. Replace chain. Reduce vibration. Use larger sprockets. Replace chain. Reduce speed. Redesign drive for smaller pitch chain.
Exposed chain surfaces corroded or pitted	<input type="checkbox"/> Exposure to corrosive environment.	Replace chain. Protect from hostile environment.

Table A-5—Roller Chain Drive Troubleshooting Guide





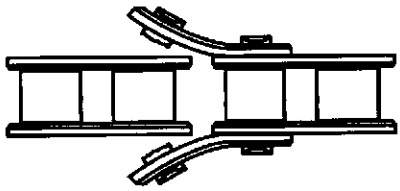



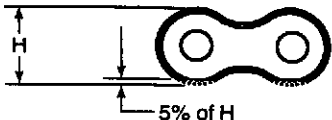

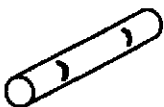
Condition/Symptom	Possible Cause	What To Do
Cracked link plates (stress corrosion) 	<input type="checkbox"/> Exposure to corrosive environment combined with stress from press fits.	Replace chain. Protect from hostile environment.
Tight joints 	<input type="checkbox"/> Dirt or foreign material in chain joints. <input type="checkbox"/> Inadequate lubrication. <input type="checkbox"/> Misalignment. <input type="checkbox"/> Internal corrosion or rust. <input type="checkbox"/> 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 	<input type="checkbox"/> Inadequate lubrication. <input type="checkbox"/> Overload.	Replace chain. Re-establish proper lubrication. Replace chain. Eliminate cause of overload.
Enlarged holes 	<input type="checkbox"/> Overload.	Replace chain. Eliminate cause of overload.
Broken pins   Broken link plates 	<input type="checkbox"/> Extreme overload.	Replace chain. Replace sprockets if indicated. Eliminate cause of overload or redesign drive for larger pitch chain.
Cracked link plates (Fatigue) 	<input type="checkbox"/> 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

Condition/Symptom	Possible Cause	What To Do
Battered link plate edges 	<input type="checkbox"/> Chain striking an obstruction.	Replace chain. Eliminate interference.
Worn link plate contours 	<input type="checkbox"/> 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 	<input type="checkbox"/> Speed too high. <input type="checkbox"/> Sprockets too small.  <input type="checkbox"/> 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 	<input type="checkbox"/> Speed or load too high.  <input type="checkbox"/> 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:

- Type A—plain plate.
- Type B—hub on one side only.
- Type C—hub on both sides.
- 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  $0.04 \times$  pitch for maximum hub diameter.

Other dimensions indicated in Figure B-2 are as specified in ANSI B29.1 for precision sprockets.

### B.3 Tooth Form

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

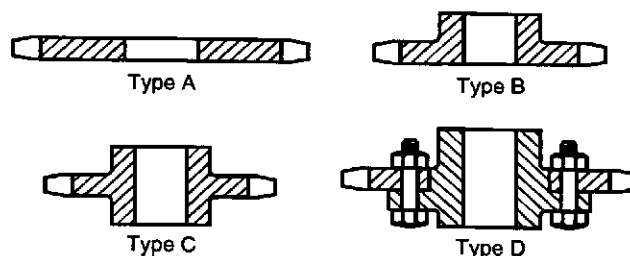


Figure B-1—Sprocket Types

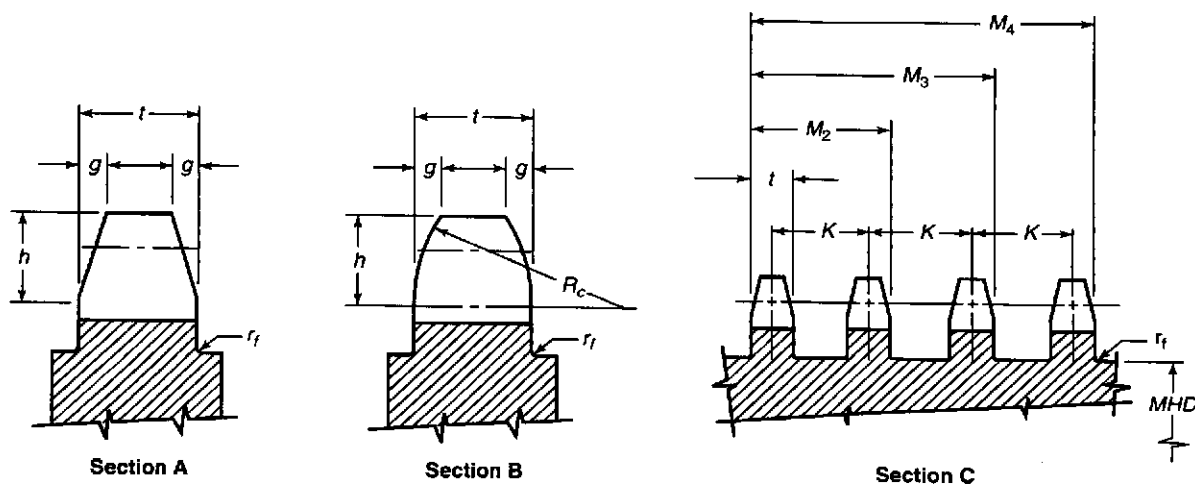


Figure B-2—Sprocket Tooth Profile

## 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, 3.6, and 3.7 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 3.8 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.

Additional copies available from API Publications and Distribution:  
(202) 682-8375

Information about API Publications, Programs and Services is  
available on the World Wide Web at: <http://www.api.org>



**American  
Petroleum  
Institute**

1220 L Street, Northwest  
Washington, D.C. 20005-4070  
202-682-8000

Order No. G07F06