

ASME B29.21M

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**ASME B29.21M-1996**  
(Revision of ANSI B29.21M-1981)

# **700 CLASS WELDED STEEL AND CAST CHAINS, ATTACHMENTS AND SPROCKETS FOR WATER AND SEWAGE TREATMENT PLANTS**

**AN AMERICAN NATIONAL STANDARD**



The American Society of  
Mechanical Engineers



The American Society of  
Mechanical Engineers

A N A M E R I C A N N A T I O N A L S T A N D A R D

# **700 CLASS WELDED STEEL A/ CAST CHAINS, ATTACHMENTS AND SPROCKETS FOR WATER AND SEWAGE TREATMENT PLANTS**

**ASME B29.21M-1996**  
(Revision of ANSI B29.21M-1981)

Date of Issuance: May 3, 1996

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## FOREWORD

(This Foreword is not part of ASME B29.21M-1996.)

An ANSI B29 Subcommittee was established in 1975 to develop a standard which would aid municipalities and others in specifying chains for water and sewage treatment plants. This Standard is the result of that effort.

Previous ANSI chain standards have covered dimensions which assured interchangeability and listed ultimate strengths. This Standard serves a dual purpose. It was developed to assure consistency with previous standards and does replace ANSI B29.13-1972. However, it also contains a supplementary section which is unique to ANSI B29 standards. The supplement identifies “*Engineering Characteristics*” of 700 Class Welded Steel and Cast Chain including attachments and sprockets in common use for rectangular straight line collectors in water and sewage treatment tanks. “*Engineering Characteristics*” as used in this Standard identify those properties of the chains, attachments and sprockets which are required to assure that they will operate successfully.

Use of this Standard and supplement offers sufficient information to use as a minimum or base requirement when specifying chain attachments and sprockets for water and sewage treatment plants. The Standard specifies a minimum chain “quality”. The user must identify those options, not affecting chain “quality”, but which do describe the chain features for a specific application. User specifications should include the following:

- Chain type and number
- Attachment and spacing
- Pin and cotter or riveted
- Pearlitic malleable—cast chain
- Heat treated or nonheat treated (welded steel chain only)
- Destructive tests, if any
- Sprocket construction details
- Special materials or plating
- Shipping Instructions

In the event that any chain, attachment or sprocket produced in accordance with this Standard does not comply with the listed “*Engineering Characteristics*” of the supplement for new and unused chain, it would be anticipated that the supplier would like an appropriate corrective action.

The function of the chains in a collector tank is to remove the separated solids from the tank by means of moving scraper flights. The operating conditions are both corrosive and abrasive to varying degrees. Successful past operation suggests that adherence to the “*Engineering Characteristic*” will provide satisfactory operation of chains in this application. Further, it provides for similar operating results with chains from various manufacturers.

Historically, small amounts of copper have been added to materials used in cast and fabricated steel chains for this application. While it is reported in scientific literature that small additions of copper enhance resistance to atmospheric corrosion, it is as yet undetermined whether the benefits of this practice apply to this application, and therefore, no requirement for copper is included.



The subcommittee encourages comparison testing where additional data is desired to confirm the advantage, non-advantage or disadvantage of copper addition. Additional consideration was also given to the commercial problem of the unavailability of copper in wrought steel materials except for very large orders.

This Standard was approved by the B29 Standards Committee and was subsequently approved by the secretariat and submitted to the American National Standards Institute for designation as an American National Standard. This was granted on April 3, 1981.

The current revision was approved as an American National Standard on March 8, 1996.

**ASME STANDARDS COMMITTEE B29**  
**Chains, Attachments, and Sprockets for Power Transmission and Conveying**

(The following is the roster of the Committee at the time of approval of the Standard.)

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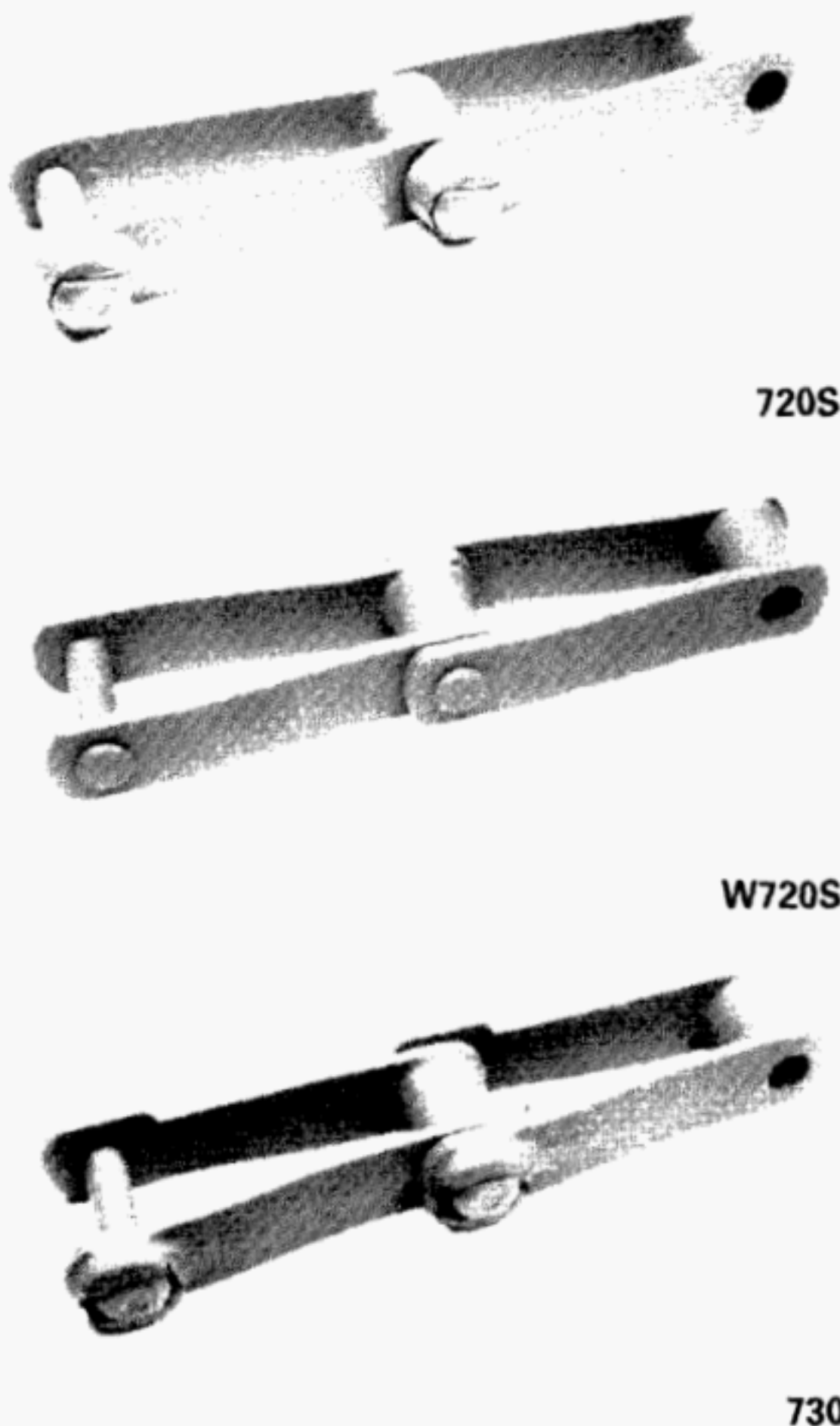
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## 700 CLASS WELDED STEEL AND CAST CHAINS, ATTACHMENTS AND SPROCKETS FOR WATER AND SEWAGE TREATMENT PLANTS

### 1 NOMENCLATURE

#### 1.1 Straight Sidebar Type



**FIG. 1 STRAIGHT SIDEBAR TYPE**

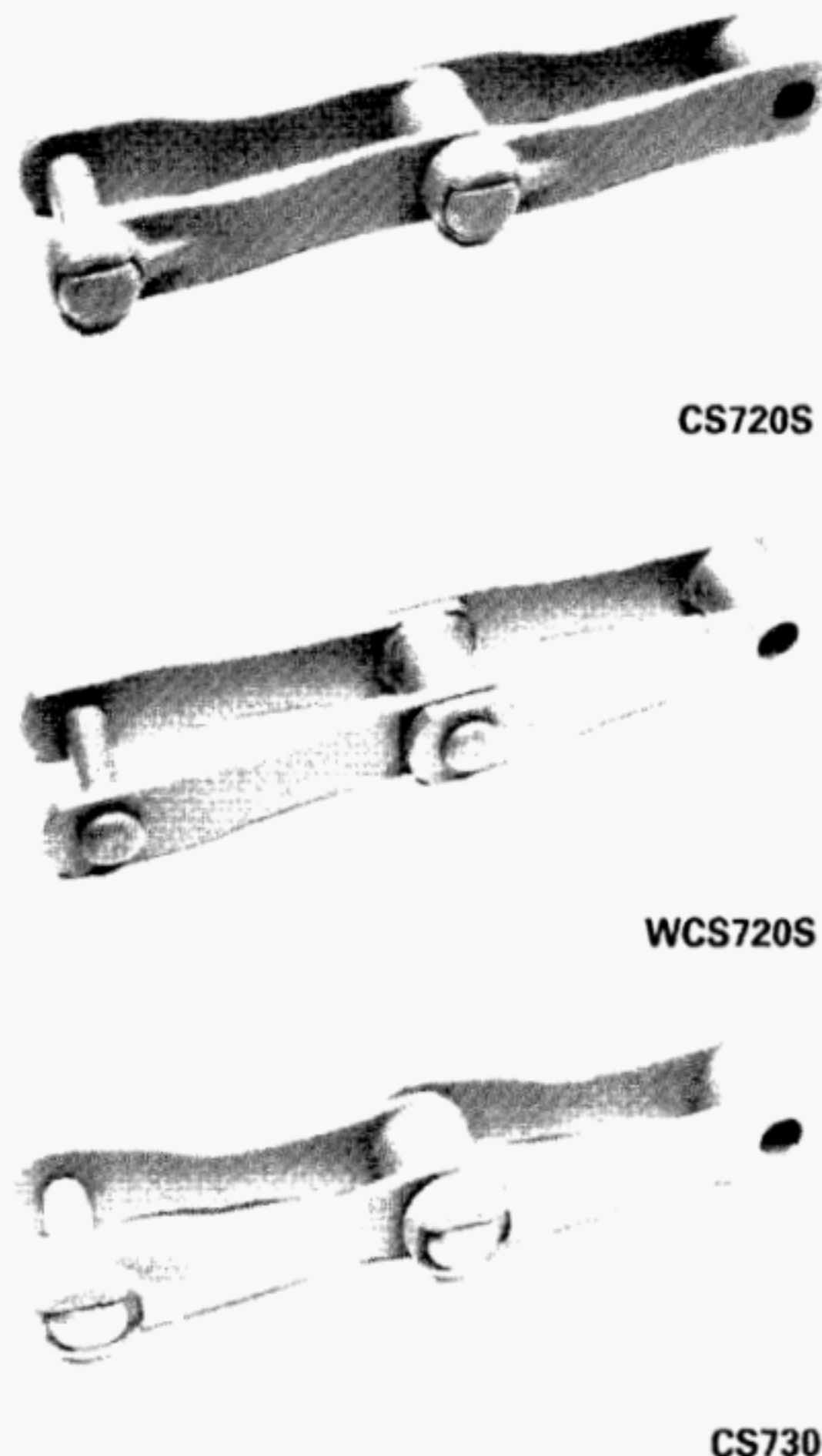
A series of identical offset links having barrels to contact the sprocket teeth and pins which articulate in the barrels of links.

Pins are fixed in the sidebar pitch holes by pressfits and/or mechanical locks, such as flats, to prevent rotation of the pins in the sidebar pitch holes.

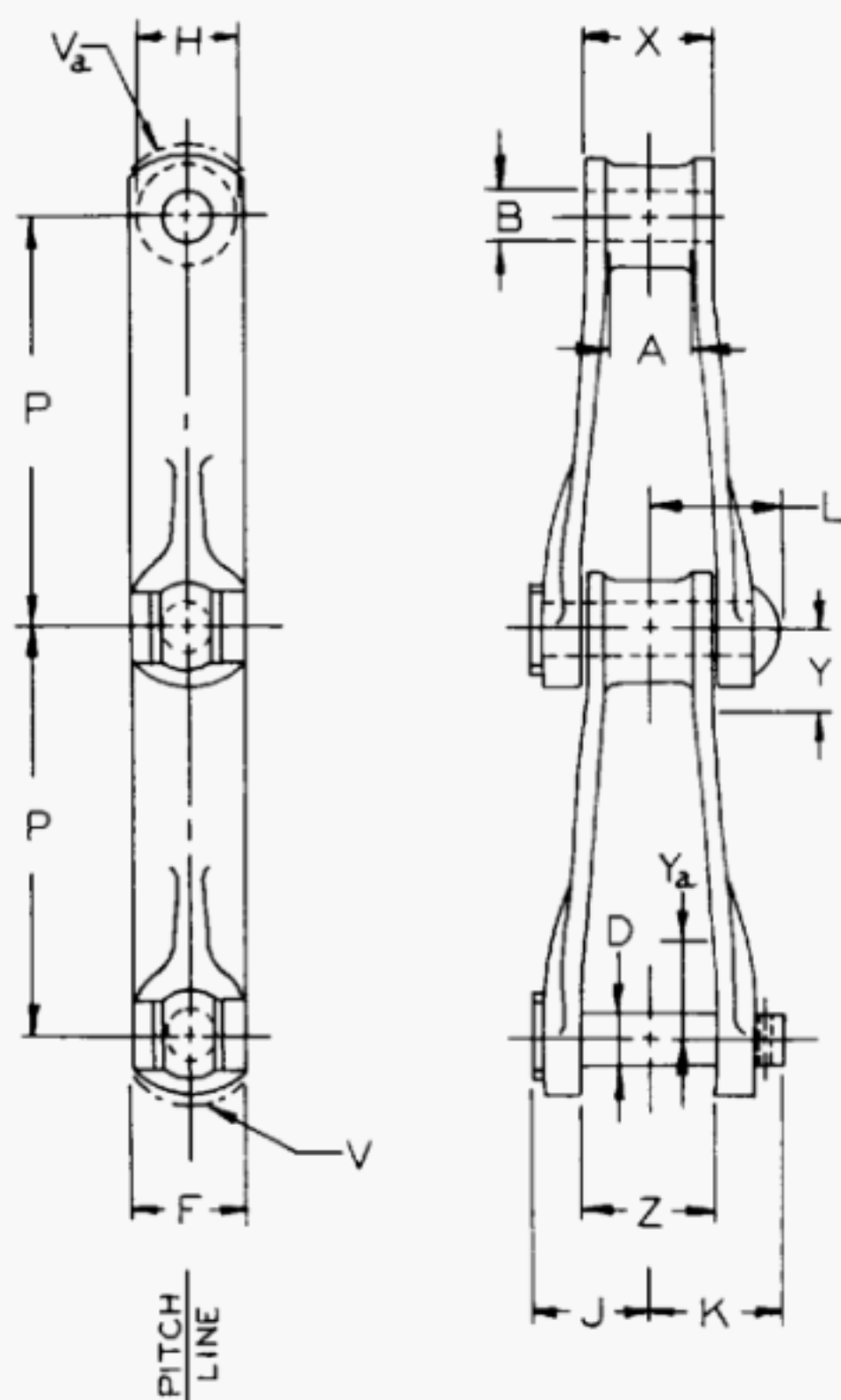
#### 1.2 Curved Sidebar Type

A series of identical offset links having barrels to contact the sprocket teeth, curved sidebars which contact sprocket flanges to provide additional link support and wearing surfaces, and pins which articulated in the barrels of the links.

Pins are fixed in the sidebar pitch holes by pressfits and/or mechanical locks, such as flats, to prevent rotation of the pins in the sidebar pitch holes.

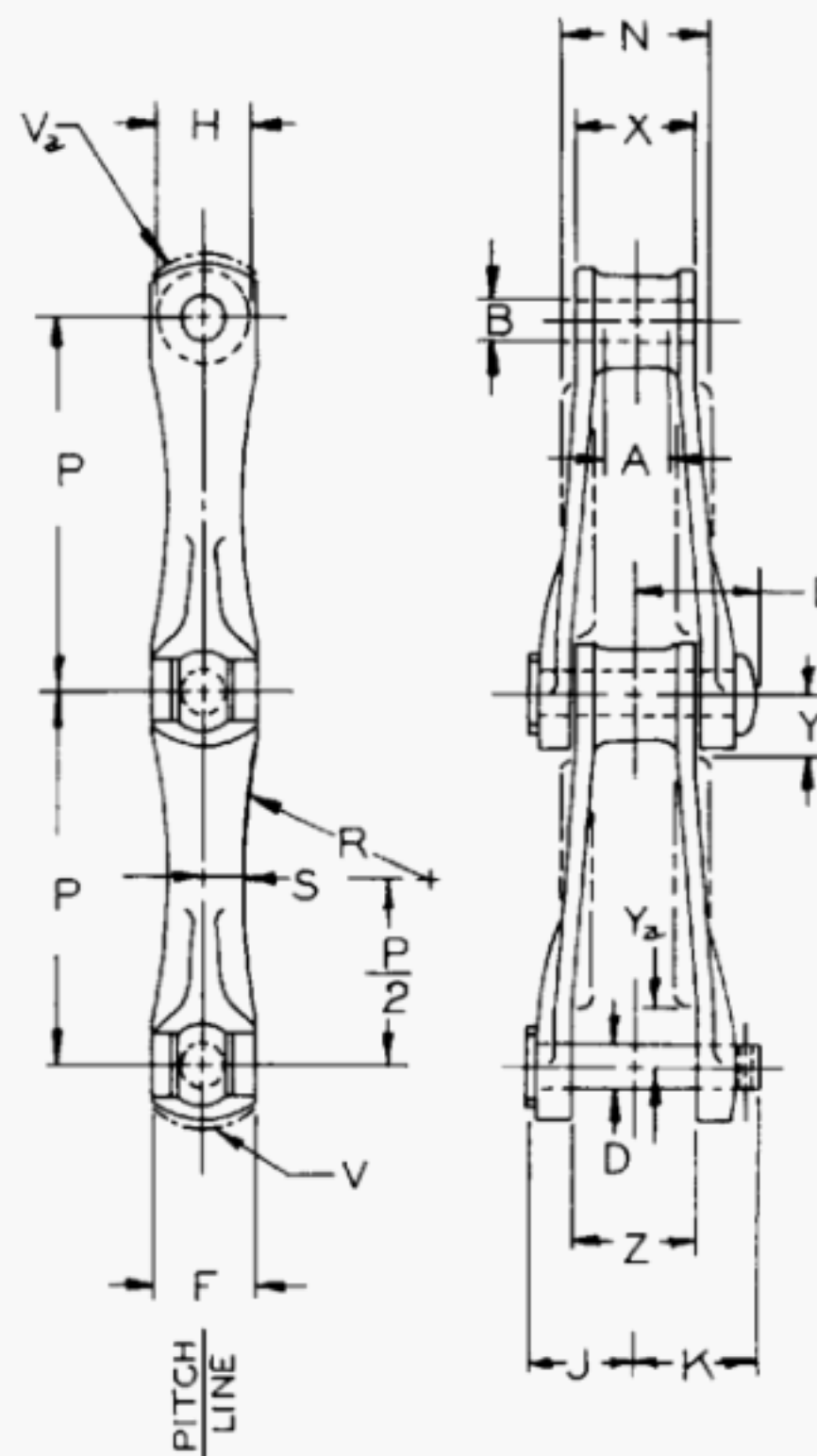


**FIG. 2 CURVED SIDEBAR TYPE**



- A** = Inside Width for Sprocket Contact  
**B** = Diameter of Hole at Barrel End  
**D** = Pin Diameter  
**F** = Chain Height  
**H** = Barrel Outside Diameter  
**J** = Pin Head to Centerline  
**K** = Pin End to Centerline  
**L** = Riveted Head to Centerline  
**N** = Width of Chain at Sprocket Contact Points  
**P** = Chain Pitch (This is theoretical reference dimension used for basic calculation)  
**R** = Radius of Curvature of Sidebar  
**S** = Sidebar Height at Waist, from Pitch Line  
**V** = Sidebar End Clearance Radius, Pin End of Link

**FIG. 3 STRAIGHT SIDEBAR TYPE CHAIN 720, 720S, W720S, 730, AND W730**



- V<sub>a</sub>** = Sidebar End Clearance Radius, Barrel End of Link  
**X** = Width of Link at Barrel End, Extending to a Point of the Pitch Line,  $Y$  in. from the Centerline as Shown  
**Y** = Straight Before Bend, Barrel End of Link  
**Y<sub>a</sub>** = Straight Before Bend, Pin End of Link  
**Z** = Width Between Sidebars, at Pin End of Link, Extending to a Point on the Pitch Line,  $Y_a$  in. from the Centerline as Shown

**NOTE:** (W) prefix on chain number indicates Welded Steel chain. All others are cast chain.

**FIG. 4 CURVED SIDEBAR TYPE CHAIN CS720S, WCS720S, CS730, AND WCS730**

### 1.3 Dimensions for Chain Links

To assure interchangeability of links as produced by different makers of chain, standard maximum and minimum dimensions are adopted. They are not actual dimensions used in manufacturing, but limiting dimensions—maximum or minimum—required to assure the desired interchangeability.

All dimensions are given in a decimal-inch system in accordance with ANSI B87.1-1965. The metric equivalent dimensions are for reference only, per ANSI Z210.1-1976.

## 2 DEFINITIONS

### 2.1 Minimum Ultimate Strength (M.U.S.)

The minimum ultimate strength (M.U.S.) is a factored statistical value for standards, which does not necessarily reflect the typical ultimate strength of the chain. Manufacturer should be consulted for additional information.

#### CAUTION

THIS LOAD IS BEYOND THE YIELD STRENGTH OF THE CHAIN AND WOULD RENDER THE CHAIN UNSUITABLE FOR APPLICATION. FOR APPLICATION GUIDANCE, CONSULT MANUFACTURERS' CATALOGS OR THE AMERICAN CHAIN ASSOCIATION HANDBOOK, "ENGINEERING STEEL CHAINS FOR CONVEYORS, ELEVATORS AND DRIVES."

### 2.2 Proof Load for Cast Chains

Nondestructive testing of each chain strand at the proof load, a load which is greater than the load expected to be applied to the chain in service, gives the user assurance that the chain meets the requirements of this Standard. All cast chains must be subjected to this test.

### 2.3 Working Load Capacities of Chains

For working load capacities of each chain, consult the individual chain manufacturer.

### 2.4 Strand Length Tolerance

**2.4.1 Welded Steel Chains.** New chains under a measuring load may be over minimum length up to 0.38 in. in 120 in. (9.7 mm in 3048 mm), but must not be less than minimum length.

**2.4.2 Cast Chains.** New chains under a measuring load may be over minimum length up to 0.75 in. in 120 in. (19.05 mm in 3048 mm), but must not be less than minimum length.

### 2.5 Weights

Chain weights are listed in manufacturer's catalogs.

**TABLE 1 GENERAL CHAIN DIMENSIONS, ULTIMATE STRENGTHS, STRAND  
LENGTH, AND MEASURING LOAD FOR CHECKING CHAIN LENGTH****CAUTION**

THE NUMERICAL VALUES SET FORTH IN THIS TABLE MUST BE READ IN CONJUNCTION WITH THE DEFINITION AND EXPLANATORY NOTE APPEARING ON PAGE 3 AND TABLES 2 AND 3. THE M.U.S. VALUES DO NOT AFFORD A SUFFICIENT OR APPROPRIATE BASIS FOR DETERMINING CHAIN APPLICATION.

**Nominal Dimensions in Inches**

Chain No.	720	720S CS720S	W720S WCS720S	730 CS730	W730 WCS730
P	6.000	6.000	6.000	6.000	6.000
D	0.69	0.75	0.75	0.75	0.75
F	1.50	1.56	1.56	1.75	1.75
H	1.38	1.44	1.44	1.50	1.50
M.U.S. (lb) — See Page 3					
Welded — Not Heat Treated			30,000		36,000
Welded — Heat Treated			42,000		50,000
Proof Load (lb) — See Page 3					
Cast	13,750	18,000		20,000	
No. of Pitches In Standard Measuring Length	20	20	20	20	20
Minimum Length of Standard Measuring Length	120.00	120.00	120.00	120.00	120.00
Measuring Load (lb)	300	300	300	300	300

**Nominal Dimensions in Millimeters**

Chain No.	720	720S CS720S	W720S WCS720S	730 CS730	W730 WCS730
P	152.4	152.4	152.4	152.4	152.4
D	17.5	19.0	19.0	19.0	19.0
F	38.1	39.6	39.6	44.5	44.5
H	35.0	36.6	36.6	38.1	38.1
M.U.S. (kn) — See Page 3					
Welded — Not Heat Treated			133.5		160.2
Welded — Heat Treated			186.9		222.5
Proof Load (kN) — See Page 3					
Cast	61.2	80.1		89.0	
No. of Pitches In Standard Measuring Length	20	20	20	20	20
Minimum Length of Standard Measuring Length	3048.0	3048.0	3048.0	3048.0	3048.0
Measuring Load (kN)	1.3	1.3	1.3	1.3	1.3



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**TABLE 2 MAXIMUM AND MINIMUM CONTROLLING DIMENSIONS  
FOR INTERCHANGEABLE CHAIN LINKS**

Dimensions in Inches									
Chain No.	720	720S	CS720S	730	CS730	W720S	WCS720S	W730	WCS730
(P) Chain pitch	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
Strand length maximum	120.75	120.75	120.75	120.75	120.75	120.38	120.38	120.38	120.38
(A) Inside width for sprocket contact minimum	1.00	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
(B) Diameter of hole at barrel end minimum	0.70	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
(D) Pin diameter maximum	0.69	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
(H) Barrel outside diameter maximum	1.42	1.48	1.48	1.54	1.54	1.48	1.48	1.54	1.54
(R) Radius curvature of sidebar minimum	—	—	10.00	—	10.00	—	10.00	—	10.00
(S) Sidebar height at waist from pitch line maximum	—	—	0.66	—	0.57	—	0.66	—	0.57
(V & V <sub>a</sub> ) Sidebar end clear ance radius maxi- mum	0.78	0.80	0.80	0.90	0.90	1.12	1.12	1.12	1.12
(X) Width of link at barrel end maximum	1.88	1.94	1.94	2.00	2.00	2.16	2.16	2.16	2.16
(Y & Y <sub>a</sub> ) Straight before bend minimum	0.80	0.82	0.82	0.92	0.92	1.13	1.13	1.13	1.13
(Z) Width between sidebar at pin end minimum	1.90	1.96	1.96	2.02	2.02	2.18	2.18	2.18	2.18

**TABLE 2 MAXIMUM AND MINIMUM CONTROLLING DIMENSIONS  
FOR INTERCHANGEABLE CHAIN LINKS (CONT'D.)**

Dimensions in Millimeters									
Chain No.	720	720S	CS720S	730	CS730	W720S	WCS720S	W730	WCS730
(P) Chain pitch	152.4	152.4	152.4	152.4	152.4	152.4	152.4	152.4	152.4
Strand length maximum	3067.0	3067.0	3067.0	3067.0	3067.0	3057.0	3057.0	3057.0	3057.0
(A) Inside width for sprocket contact minimum	25.4	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
(B) Diameter of hole at barrel end minimum	17.7	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
(D) Pin diameter maximum	17.6	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
(H) Barrel outside diameter maximum	36.1	37.6	37.6	39.1	39.1	37.6	37.6	39.1	39.1
(R) Radius curvature of sidebar minimum	—	—	254.0	—	254.0	—	254.0	—	254.0
(S) Sidebar height at waist from pitch line maximum	—	—	16.8	—	14.5	—	16.8	—	14.5
(V & V <sub>a</sub> ) Sidebar end clearance radius maximum	19.8	20.3	20.3	22.9	22.9	28.5	28.5	28.5	28.5
(X) Width of link at barrel end maximum	47.8	49.3	49.3	50.8	50.8	54.8	54.8	54.8	54.8
(Y & Y <sub>a</sub> ) Straight before bend minimum	20.3	20.8	20.8	23.4	23.4	28.7	28.7	28.7	28.7
(Z) Width between sidebar at pin end minimum	48.3	49.8	49.8	51.3	51.3	55.4	55.4	55.4	55.4



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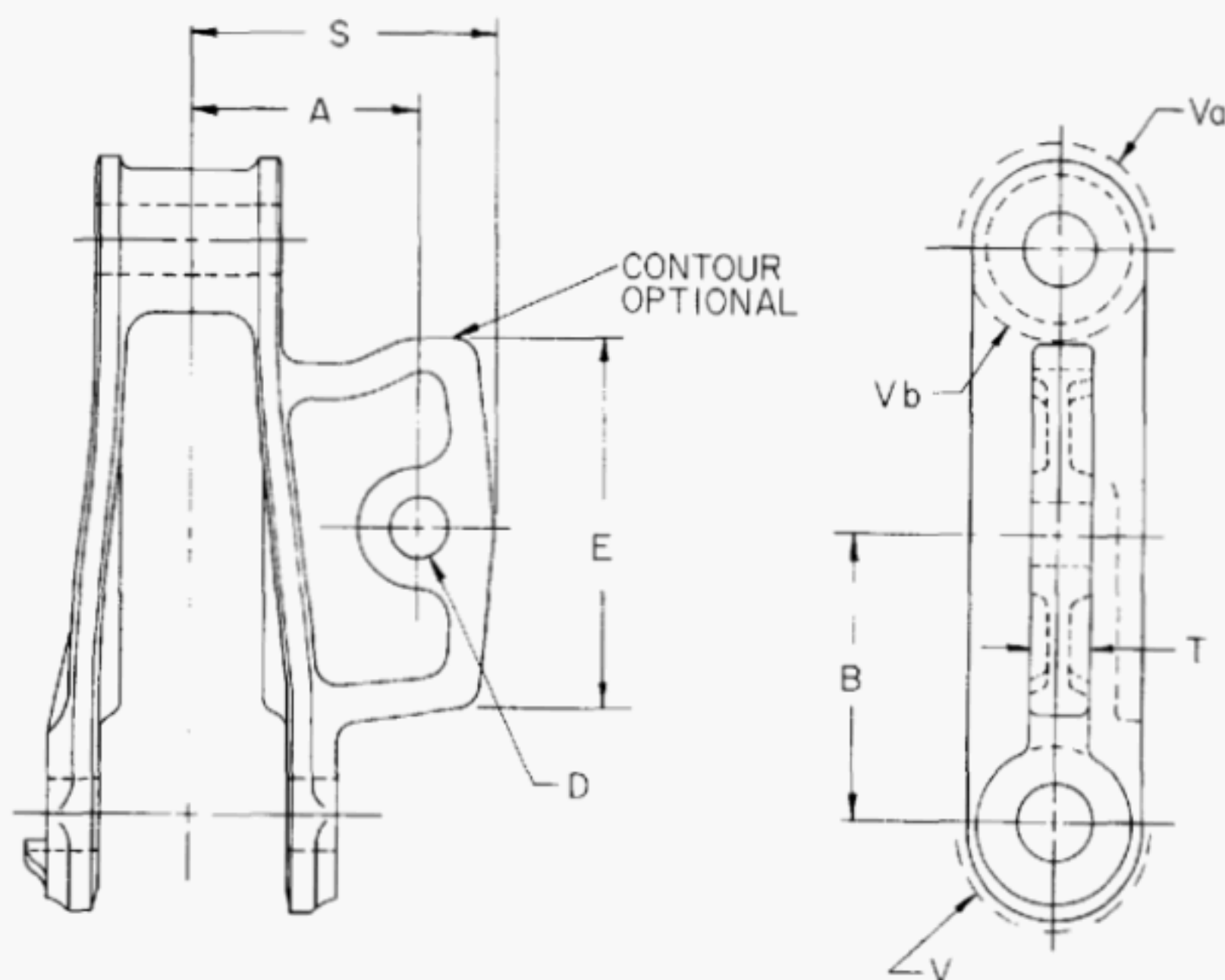
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**TABLE 3 CHAIN CLEARANCE DIMENSIONS****Dimensions in Inches**

Chain No.	720	720S	CS720S	730	CS730	W720S	WCS720S	W730	WCS730
(F) Chain height maximum	1.54	1.60	1.60	1.80	1.80	1.63	1.63	1.82	1.82
(J) Pin head to center-line of chain maximum	1.75	1.82	1.82	1.88	1.88	1.70	1.70	1.70	1.70
(K) Pin end to center-line of chain maximum	2.00	2.25	2.25	2.13	2.13	2.00	2.00	2.00	2.00
(L) Riveted head to centerline of chain maximum	1.88	2.09	2.09	1.89	1.89	2.00	2.00	2.00	2.00
(N) Width of chain at sprocket flange contact point maximum	—	—	2.54	—	2.60	—	—	—	—

**Dimensions in Millimeters**

Chain No.	720	720S	CS720S	730	CS730	W720S	WCS720S	W730	WCS730
(F) Chain height maximum	39.1	40.6	40.6	45.7	45.7	41.4	41.4	46.2	46.2
(J) Pin head to center-line of chain maximum	44.5	46.2	46.2	47.8	47.8	43.2	43.2	43.2	43.2
(K) Pin end to center-line of chain maximum	50.8	57.2	57.2	54.1	54.1	50.8	50.8	50.8	50.8
(L) Riveted head to centerline of chain maximum	47.8	53.1	53.1	48.0	48.0	50.8	50.8	50.8	50.8
(N) Width of chain at sprocket flange contact point maximum	—	—	64.5	—	66.0	—	—	—	—



**TABLE 4 A42 ATTACHMENT**  
**Dimensions in Inches**

Chain No.	A	B	E Max	S Max	T Max	D* Bolt Size	D Min Hole
730 W730	2.44	3.00	3.88	3.28	0.66	0.63	0.66

**Dimensions in Millimeters**

Chain No.	A	B	E Max	S Max	T Max	D* Bolt Size	D Min Hole
730 W730	62.0	76.2	98.6	83.3	16.8	16.0	16.8

\*Hole size must be large enough to accept the nominal bolts in the position specified.

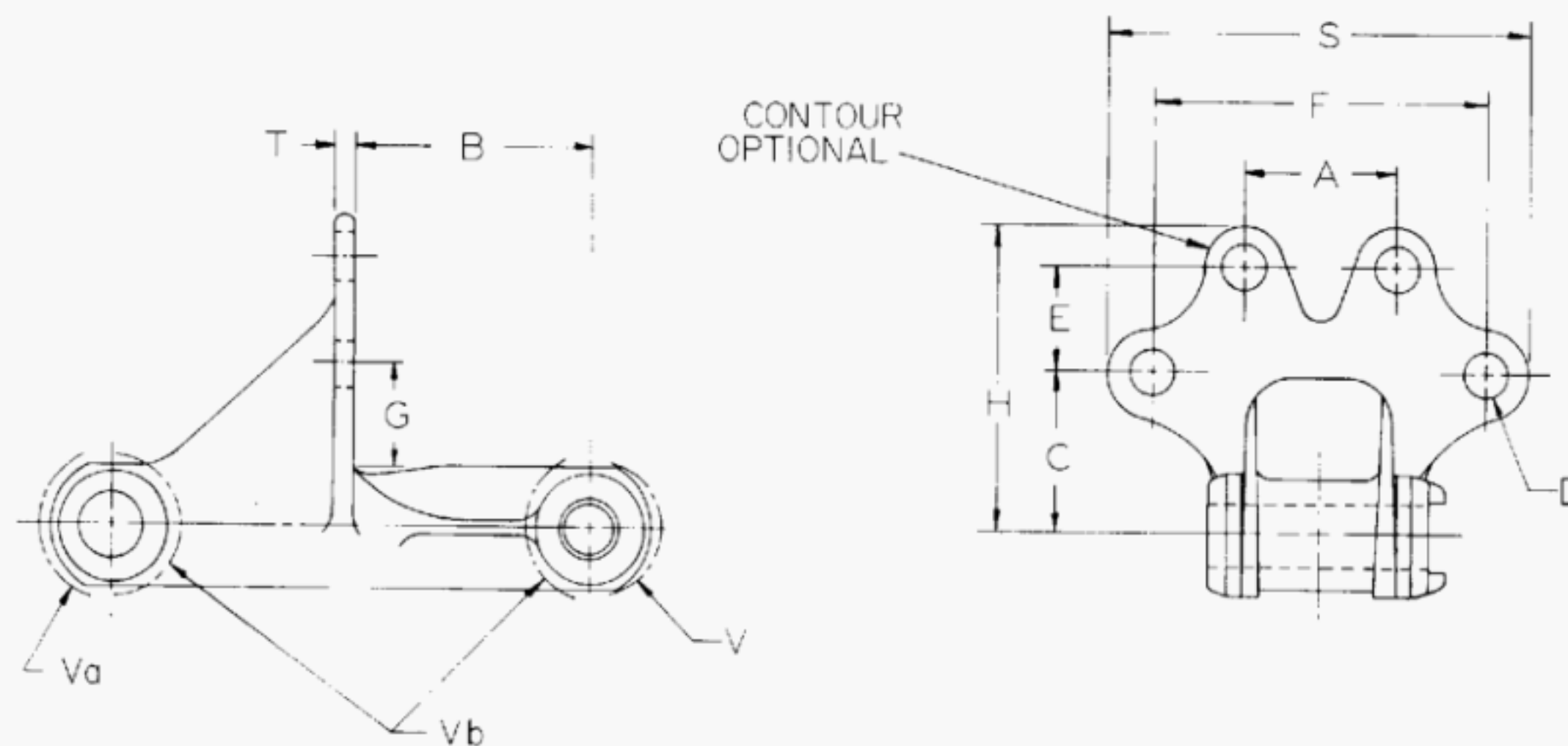
Pin head side location must be opposite the attachment.

For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.

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**TABLE 5 F2 ATTACHMENT****Dimensions in Inches**

Chain No.	A	B	C	E	F	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720	1.94	3.00	2.00	1.31	4.25	1.09	3.94	5.44	0.25	0.50	0.53
720S CS720S	1.94	3.00	2.00	1.31	4.25	1.06	3.94	5.44	0.25	0.38	0.40
730 CS730	1.94	3.00	2.00	1.31	4.25	1.06	4.06	5.70	0.38	0.38	0.40
W720S WCS720S	1.94	3.00	2.00	1.31	4.25	1.06	4.10	5.70	0.25	0.38	0.40
W730 WCS730	1.94	3.00	2.00	1.31	4.25	1.06	4.10	5.70	0.31	0.38	0.40

**Dimensions in Millimeters**

Chain No.	A	B	C	E	F	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720	49.3	76.2	50.8	33.3	108.0	27.7	100.1	133.2	6.4	12.7	13.5
720S CS720S	49.3	76.2	50.8	33.3	108.0	26.9	100.1	138.2	6.4	9.7	10.2
730 CS730	49.3	76.2	50.8	33.3	108.0	26.9	103.1	144.8	9.7	9.7	10.2
W720S WCS720S	49.3	76.2	50.8	33.3	108.0	26.9	104.1	144.8	6.4	9.7	10.2
W730 WCS730	49.3	76.2	50.8	33.3	108.0	26.9	104.1	144.8	7.9	9.7	10.2

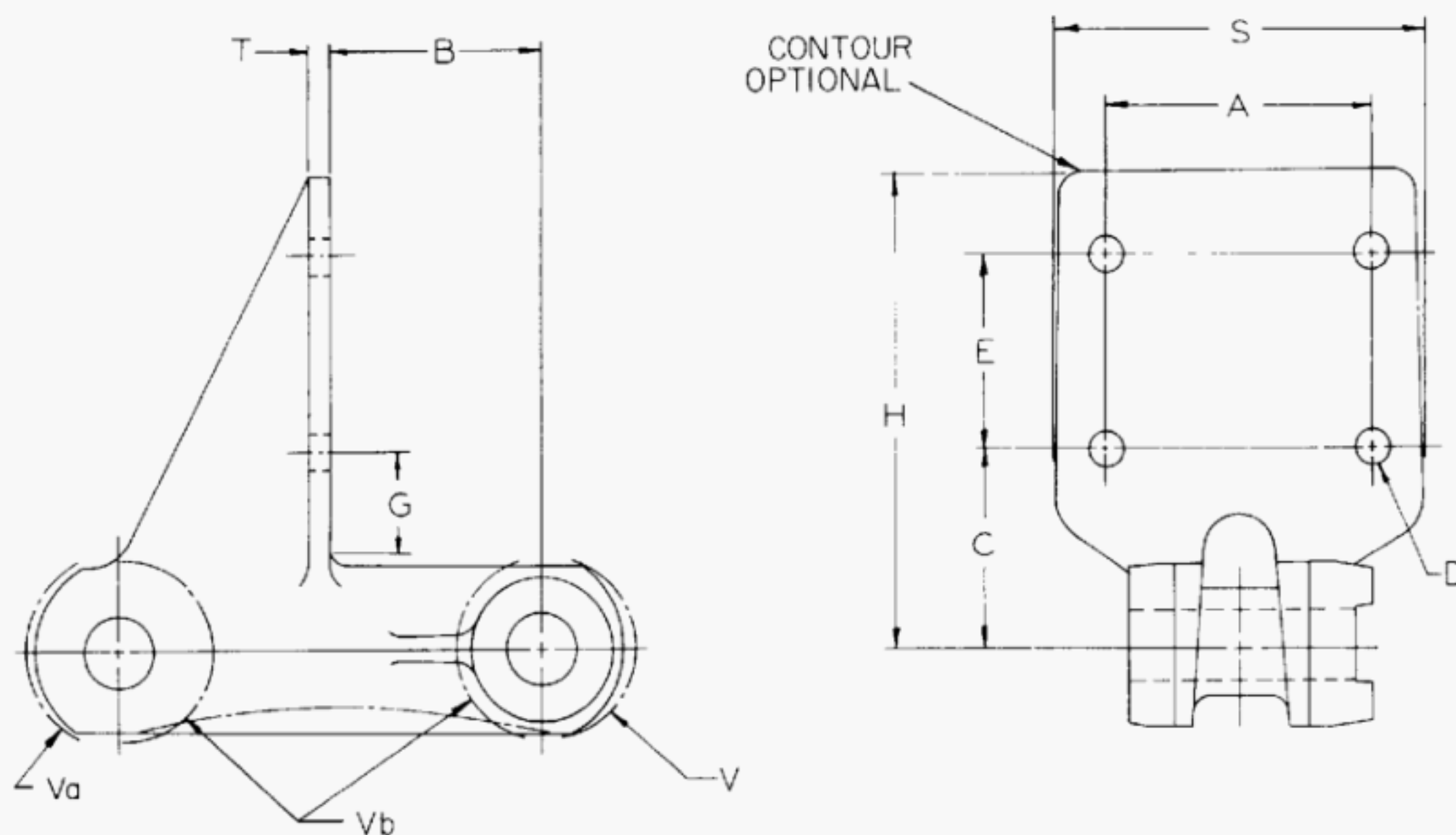
\*Hole size must be large enough to accept the nominal bolts in the position specified.

Pin head side location at manufacturer's option.

For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.

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700 CLASS WELDED STEEL AND CAST CHAINS,  
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Chain No.	A	B	C	E	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720 720S CS720S	3.75	3.00	2.38	2.63	1.47	6.14	5.64	0.25	0.38	0.40
730 CS730	3.75	3.00	2.38	2.63	1.44	6.14	5.64	0.31	0.38	0.40
W720S WCS720S	3.75	3.00	2.38	2.63	1.44	6.1	5.1	0.25	0.38	0.40
W730 WCS730	3.75	3.00	2.38	2.63	1.44	6.1	5.1	0.31	0.38	0.40

**Dimensions in Millimeters**

Chain No.	A	B	C	E	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720 720S CS720S	95.3	76.2	60.5	66.8	37.3	156.0	143.3	6.4	9.7	10.2
730 CS730	95.3	76.2	60.5	66.8	36.6	156.0	143.3	7.9	9.7	10.2
W720S WCS720S	95.3	76.2	60.5	66.8	36.6	154.9	129.5	6.4	9.7	10.2
W730 WCS730	95.3	76.2	60.5	66.8	36.6	154.9	129.5	7.9	9.7	10.2

\*Hole size must be large enough to accept the nominal bolts in the position specified.

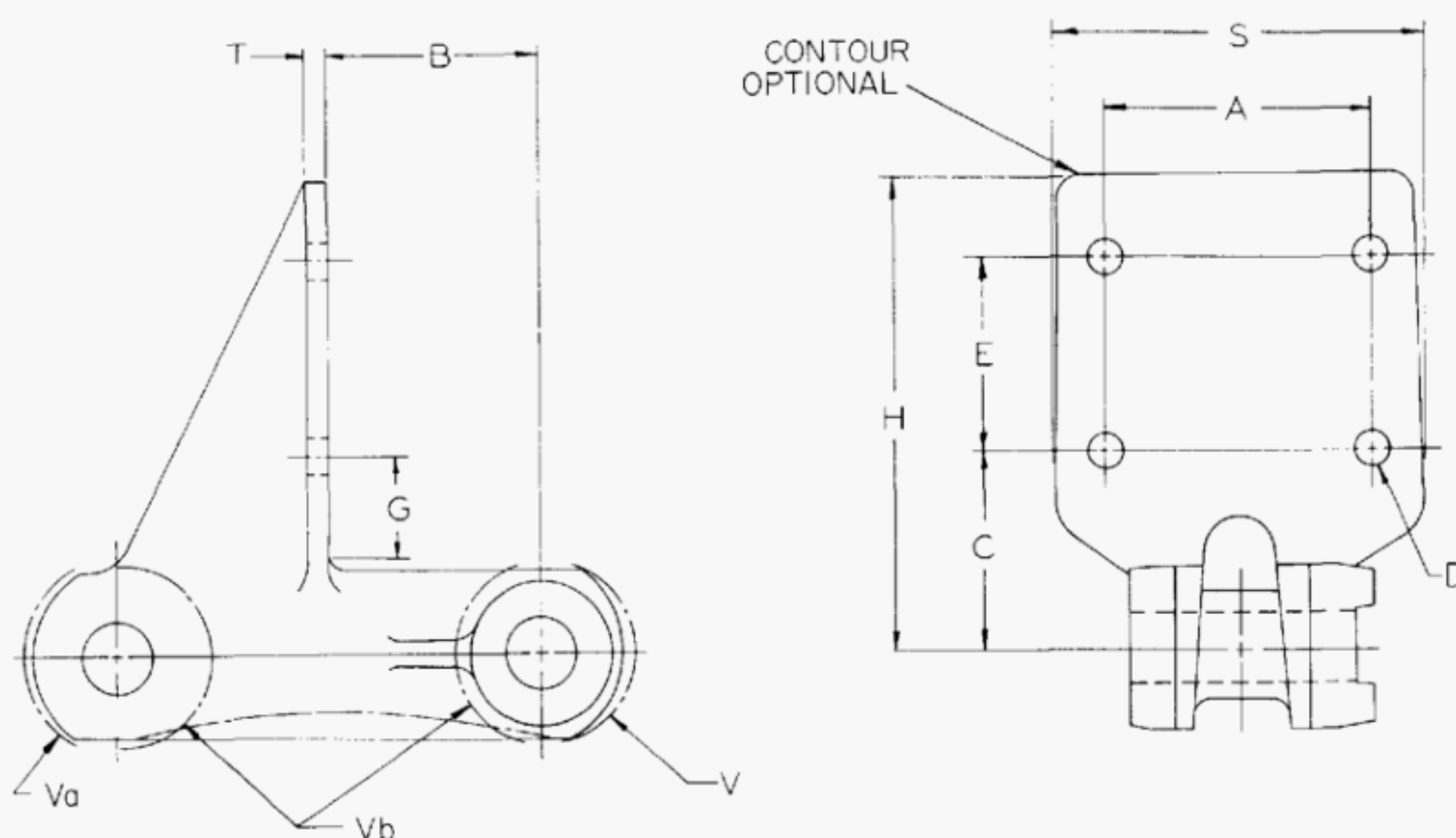
Pin head side location at manufacturer's option.

For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.

700 CLASS WELDED STEEL AND CAST CHAINS,  
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**TABLE 7 F22-8 ATTACHMENT****Dimensions in Inches**

Chain No.	A	B	C	E	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720 720S CS720S	3.75	3.00	2.38	4.50	1.47	8.14	5.64	0.25	0.38	0.40
730 CS730	3.75	3.00	2.38	4.50	1.44	8.14	5.64	0.31	0.38	0.40
W720S WCS720S	3.75	3.00	2.38	4.50	1.44	8.1	5.1	0.25	0.38	0.40
W730 WCS730	3.75	3.00	2.38	4.50	1.44	8.1	5.1	0.31	0.38	0.40

**Dimensions in Millimeters**

Chain No.	A	B	C	E	G Min	H Max	S Max	T Nom	D* Bolt Size	D Min Hole
720 720S CS720S	95.3	76.2	60.5	114.3	37.3	206.8	143.3	6.4	9.7	10.2
730 CS730	95.3	76.2	60.5	114.3	36.6	206.8	143.3	7.9	9.7	10.2
W720S WCS720S	95.3	76.2	60.5	114.3	36.6	205.7	129.5	6.4	9.7	10.2
W730 WCS730	95.3	76.2	60.5	114.3	36.6	205.7	129.5	7.9	9.7	10.2

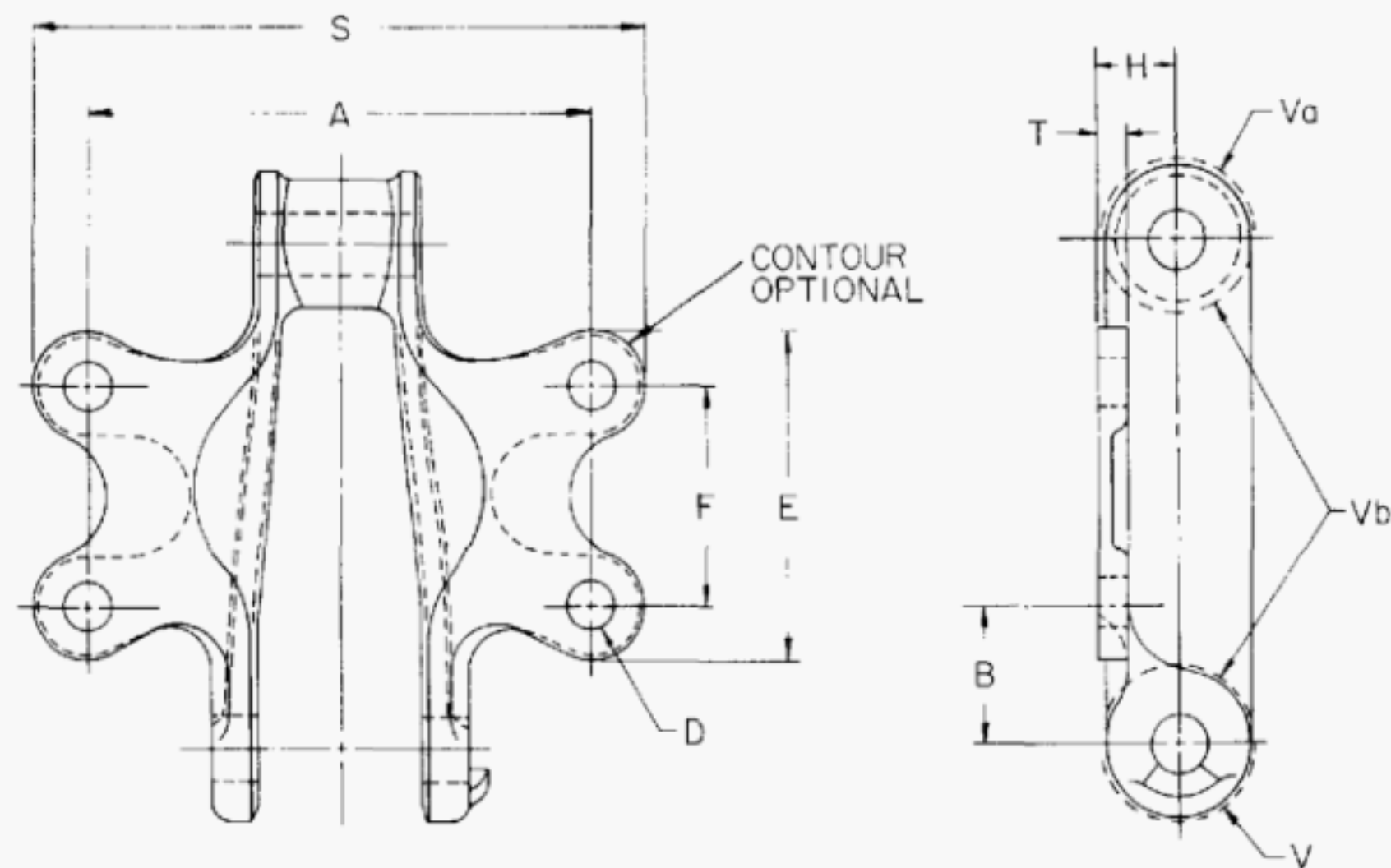
\*Hole size must be large enough to accept the nominal bolts in the position specified.

Pin head side location at manufacturer's option.

For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.





**TABLE 8 K2 ATTACHMENT**  
**Dimensions in Inches**

Chain No.	A	B	E Max	F	H Max	S Max	T	D* Bolt Size	D Min Hole
730 W730	6.00	1.69	4.14	2.62	1.02	7.50	0.31	0.50	0.53

**Dimensions in Millimeters**

Chain No.	A	B	E Max	F	H Max	S Max	T	D* Bolt Size	D Min Hole
730 W730	152.4	42.9	105.2	66.5	25.9	190.5	7.9	12.70	13.5

\*Hole size must be large enough to accept the nominal bolts in the position specified.

Pin head side location at manufacturer's option.

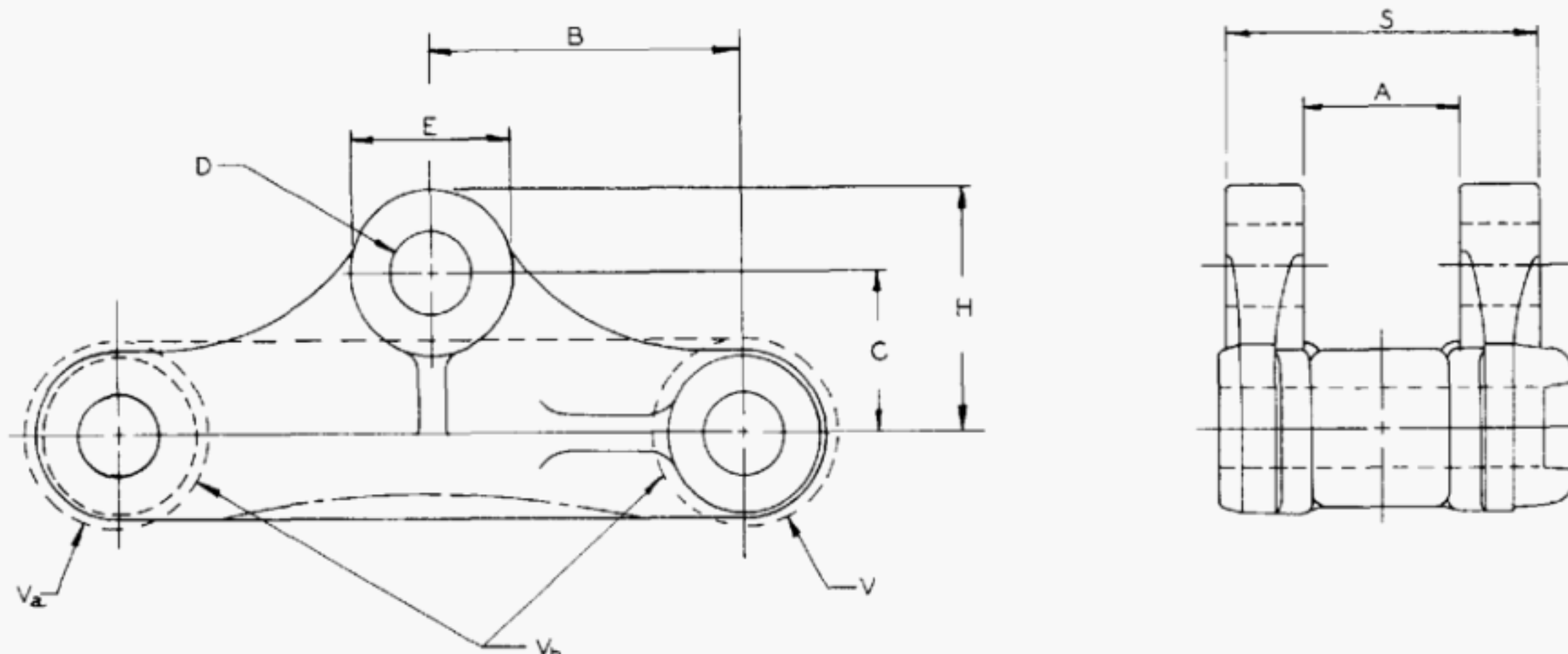
For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.



700 CLASS WELDED STEEL AND CAST CHAINS,  
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**TABLE 9 M1 ATTACHMENT**

Dimensions in Inches

Chain No.	A Min	B	C	E Max	H Max	S Nom	D* Bolt Size	D Min Hole
720 720S CS720S	1.50	3.00	1.50	1.54	—	3.00	0.75	0.78
730 CS730	1.50	3.00	1.63	1.54	—	3.00	0.75	0.78
W720S WCS720S W730 WCS730	1.50	3.00	1.63	—	2.70	3.00	0.75	0.78

Dimensions in Millimeters

Chain No.	A	B	C	E Max	H Max	S Nom	D* Bolt Size	D Min Hole
720 720S CS720S	38.1	76.2	38.1	39.1	—	76.2	19.05	19.8
730 CS730	38.1	76.2	41.4	39.1	—	76.2	19.05	19.8
W720S WCS720S W730 WCS730	38.1	76.2	41.4	—	68.6	76.2	19.05	19.8

\*Hole size must be large enough to accept the nominal bolts in the position specified.

Pin head side location at manufacturer's option.

For "V" and "Va" dimension, see Table 2.

"Vb" (attachment clearance radius, minimum) dimensions are the same as "Y" and "Ya" dimensions, see Table 2.

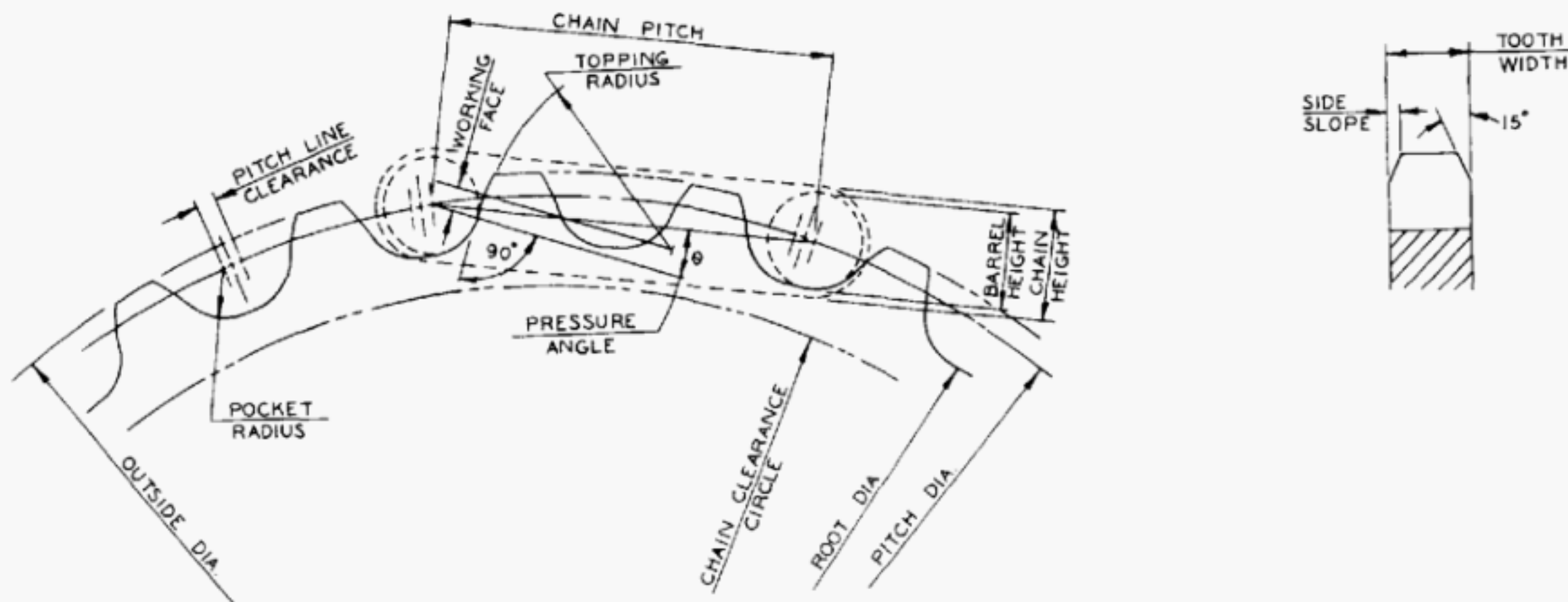


FIG. 5 SPROCKET TOOTH FORM

The elements of a chain sprocket and the tooth form may be determined by the following:

$$\text{Pitch diameter} = P \times \csc \frac{180}{N_p} \text{ (see Table 10)}$$

\* Root diameter (maximum) = Pitch diameter - H

\*\* Chain clearance circle =  $P(C - 0.05) - F$  (For curved sidebar chains, Figure 4, use the flange diameter.)

$$\text{Pitch line clearance} = 0.05 P$$

$$\text{Pressure angle} = \theta \text{ (see Table 10)}$$

\*\*\* Working face =  $0.01 P N_p$

$$\text{Pocket radius} = \frac{H}{2}$$

$$\text{Topping radius} = 0.5 P$$

$$\dagger \text{ Outside diameter} = (P \times C) + F$$

$$\text{Overall width flange} = 1.10 \times N \text{ maximum}$$

$$\text{Tooth width} = 0.9 \times A \text{ maximum}$$

$$\text{Side slope} = 0.12 \times W_t \text{ not to exceed } 0.38 \text{ in. (9.6 mm)}$$

$$\text{Flange diameter (see Table 12)}$$

The symbols represent:

$P$  = Chain pitch

$F$  = Chain height maximum (see Table 3)

$\dagger\dagger N_p$  = The number of pitches of chain required to wrap the pitch circumference of the sprocket

$H$  = Chain barrel height maximum (see Table 2)

$C$  = Clearance circle and outside diameter

$$\text{factor} = \cot \frac{180}{N_p} \text{ (see Table 10)}$$

$A$  = Inside width for sprocket contact minimum (see Table 2)

$N$  = Width of chain at sprocket flange contact point maximum (see Table 3)

$W_t$  = Tooth width

\* Root diameters must not exceed the maximums obtained from these formulae.

Oversize dimensions cause improper chain and sprocket action and excessive chain loads.

\*\* No portion of hub, beads, lugs, or fillets shall extend beyond this circle in the sidebar zone.

\*\*\* Limitation on length of working:

The working face shall not extend beyond the line through the adjacent pitch point which is perpendicular to the working face.

$\dagger$  Outside diameter may be increased to give a full height tooth when top of chain is clean of flights, pans, buckets, etc.

The idea that we are trying to express here is that full tooth height (pointed teeth) will be created by the intersections of the adjacent topping radii in this double-cut layout. The actual outside diameter that results would, of course, exceed that of the truncated tooth shown in the tooth form layout drawing. Since machine cut sprockets, and patterns for cast tooth sprockets, are usually produced by the use of space cutters, the pointed tooth is created automatically as the machine indexes to each succeeding tooth space. The customary use of the truncated form has the effect of requiring less raw material in manufacture, and also makes for easier (and safer, for the fingers) handling of the sprockets in shipping.

$\dagger\dagger$  Additional tooth pockets may be positioned on the same pitch circle midway between the pitch points. When " $N_p$ " is a fractional number, the additional tooth pockets automatically exist. Tooth working face length provides for approximately 6% chain pitch elongation.

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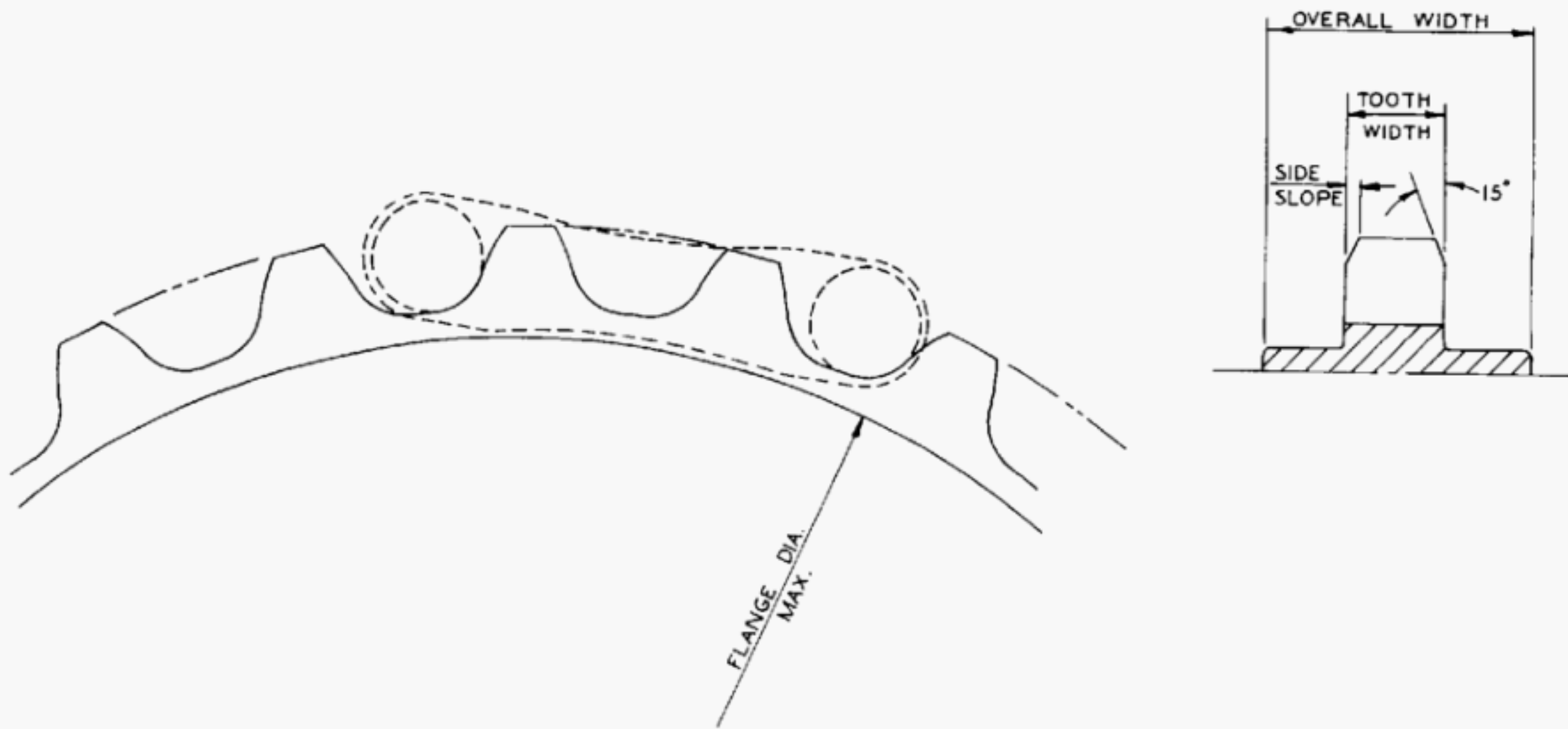
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**TABLE 10**  
**PRESSURE ANGLE, PITCH DIAMETER, AND**  
**CLEARANCE CIRCLE**

$N_p$	Pitch Dia.		Pressure	C
	in.	mm	Angle $\theta$ deg	
6½	12.91	327.9	10	1.90
7	13.82	351.0	10	2.07
7½	14.75	374.7	10	2.24
8	15.68	398.3	11	2.41
8½	16.61	421.9	11	2.58
9	17.54	445.5	12	2.74
9½	18.48	469.4	12	2.91
10	19.41	493.0	13	3.07
10½	20.35	516.9	13	3.24
11	21.29	540.8	14	3.40
11½	22.23	564.6	14	3.56
12	23.18	588.8	15	3.73
12½	24.12	612.6	15	3.89
13	25.07	636.8	16	4.05
13½	26.01	660.7	16	4.21
14	26.96	684.8	17	4.38
14½	27.91	708.9	17	4.54
15	28.85	732.8	18	4.70
15½	29.80	756.9	18	4.87

**TABLE 11**  
**MAXIMUM ECCENTRICITY AND FACE RUNOUT**  
**AT BOTTOM DIAMETER**

Pitch Diameter				Max. Face Runout		Max. Eccentricity	
in.		mm		TIR		TIR	
Over	Including	Over	Including	in.	mm	in.	mm
0 up to 12		0 up to 305		0.06	1.5	0.09	2.23
12 up to 24		305 up to 610		0.12	3.0	0.15	5.81
24 up to 36		610 up to 915		0.20	5.1	0.21	5.33

**TABLE 12 FLANGE DIAMETERS FOR CURVED SIDEBAR TYPE CHAIN**

Dimensions in Inches			Dimensions in Millimeters		
Flange Dia. Max.			Flange Dia. Max.		
$N_p$	CS720S WCS720S	CS730 WCS730	$N_p$	CS720S WCS720S	CS730 WCS730
6½	10.04	10.22	6½	255.0	259.6
7	11.06	11.24	7	281.0	285.5
7½	12.08	12.26	7½	306.8	311.4
8	13.10	13.28	8	332.7	337.3
8½	14.10	14.28	8½	358.1	362.7
9	15.10	15.28	9	383.5	388.1
9½	16.10	16.28	9½	408.9	413.5
10	17.08	17.26	10	433.8	438.4
10½	18.06	18.24	10½	458.7	463.3
11	19.04	19.22	11	483.7	488.2
11½	20.02	20.20	11½	508.5	513.1
12	21.00	21.16	12	533.4	537.5
12½	21.96	22.10	12½	557.8	561.3
13	22.94	23.06	13	582.7	585.7
13½	23.90	24.00	13½	607.1	609.6
14	24.86	24.96	14	631.4	634.0
14½	25.82	25.92	14½	655.8	658.4
15	26.78	26.86	15	680.2	682.2
15½	27.74	27.80	15½	704.6	706.1

Dimensions shown provide a minimum of 0.03 inch (0.8 mm) clearance,  
between the sprocket flange and the chain sidebar curvature.

ENGINEERING CHARACTERISTICS

SUPPLEMENT

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## ENGINEERING CHARACTERISTICS

### SUPPLEMENT

## 1 CHAIN STRENGTH

### 1.1 Chain Strength for Cast Chains

**1.1.1. Definition.** The standard for strength of cast chains shall be in terms of proof load. The proof load is a load applied to a cast chain at the factory which is greater than the load expected to be applied to the chain in service but less than the yield point of the chain or any of its components. The purpose of proof loading is to assure acceptable links.

**1.1.2 Standard.** Cast chains shall meet the proof load strength standards per ANSI B29.21M Table 1 for pearlitic malleable iron chains.

**1.1.3 Testing.** Proof load testing is a nondestructive test. It shall be performed on each strand of cast chain after assembly.

**1.1.4. Rationale for the Standard of Cast Chain Proof Load Strength.** The ability of a chain to carry the required tensile loading is one of its major basic engineering characteristics. Soundness of section is an important factor contributing to the strength of cast chains. Since proof loads are greater than expected to be applied to the chain in service, they are listed as the standard for strength of cast chains. Proof loads applied to cast chains provide maximum assurance of cast section soundness and that the chain will meet the requirements of this Standard.

### 1.2 Chain Strength for Welded Steel Chains

**1.2.1 Definition.** The standard for strength of welded steel chain shall be in terms of minimum ultimate strength. The minimum ultimate strength is the tensile

load in pounds at which a chain, in the condition at the time that it left the factory, may separate in a single load application.

**1.2.2 Standard.** Welded steel chains shall meet the minimum ultimate strength standards per ANSI B29.-21M Table 1 for heat treated chains.

**1.2.3 Testing.** Ultimate strength testing is a destructive test. When required, it is to be performed on lengths of chain assembled from components randomly selected from the same manufacturing lots as the production chain.

**1.2.4 Rationale for the Standard of Welded Steel Minimum Ultimate Strength.** The ability of a chain to carry the required tensile loading is one of its major basic engineering characteristics. The minimum ultimate strength is appropriate to use for a standard for strength in welded steel chain. However, it is beyond the yield strength of the chain and renders the chain unsuitable for application. Therefore, it must be performed on representative production samples only.

## 2 COMBINED WEAR AND CORROSION RESISTANCE OF CHAIN

### 2.1 Definition

The resistance to combined wear and corrosion of assembled chains is the result of the combined material and hardness properties of the individual chain components.

### 2.2 Standard for Combined Wear and Corrosion Resistance of Chain

The components of the chains shall have combined wear and corrosion resistance in this application equivalent to that of the materials on following list.



	Cast Chains	Welded Chains
<b>2.2.1</b> Chain, Pin or Rivet	AISI medium-carbon steel or equivalent, at 302 BHN min. hardness	AISI medium-carbon steel or equivalent, at 302 BHN min. hardness
<b>2.2.2</b> Chain Link Barrel	Pearlitic malleable iron ASTM A220 Grade 60004 or equivalent, at 179 BHN min. hardness	AISI medium-carbon steel or equivalent, at 229 BHN min. hardness.
<b>2.2.3</b> Chain Link Sidebar	Pearlitic malleable iron ASTM A220 Grade 60004 or equivalent, at 179 BHN min. hardness. Attachments shall be of the same material & strength as the chainlinks.	AISI medium-carbon steel or equivalent, at 229 BHN min. hardness
<b>2.2.4</b> Cotter	AISI 300 Series stainless steel, Recommendation only . . . Other materials with or without plating may be used.	AISI 300 Series stainless steel Recommendation only . . . Other materials with or without plating may be used.

## 2.3 Testing

Steel analysis shall be checked by chemical or spectrographic analysis. Cast material properties shall be checked according to the applicable ASTM specification.

Hardness testing is accomplished on the surface of the chain component using accepted sample preparation practices calling for a ground-flat surface free of decarburization and per ASTM testing procedures.

Material hardness checking, when specified, shall be performed on loose components randomly selected from the same manufacturing lots as the production chain.

## 2.4 Rationale for the Standard of Combined Chain Wear and Corrosion Resistance

The effective use of chain in this application is largely governed by the capability of their components to resist the effects of the abrasion and corrosion to which they are normally subject. The combined corrosion and wear resistance of the chain is determined by the materials and hardness of the components. The effect on chain components from abrasion and corrosion is essentially the same—reduction in material section. For this reason, a combined standard covering both properties is appropriate.

Historically, small amounts of copper have been added to materials used in cast and fabricated steel chains for this application. While it is reported in scientific literature that small additions of copper enhance resistance to atmospheric corrosion, evidence does not exist to substantiate the benefits of this practice in this application.

## 3 CHAIN AND ATTACHMENT DIMENSIONS

The 700 Class cast and welded steel water treatment chains in this supplement shall conform to the dimension per ANSI B29.21M.

## 4 CHAIN CAMBER

### 4.1 Definition

Camber is the measure of the ability of the chain to be flexed in a lateral direction.

### 4.2 Standard for Chain Camber

Each 20-pitch strand of chain shall meet the following standard.

	Cast Chains	Welded Chains
<b>4.2.1</b> Camber in each direction — Minimum	2 in.	2 in.
<b>4.2.2</b> Difference in camber from one direction to the other — (Maximum)	4 in.	4 in.

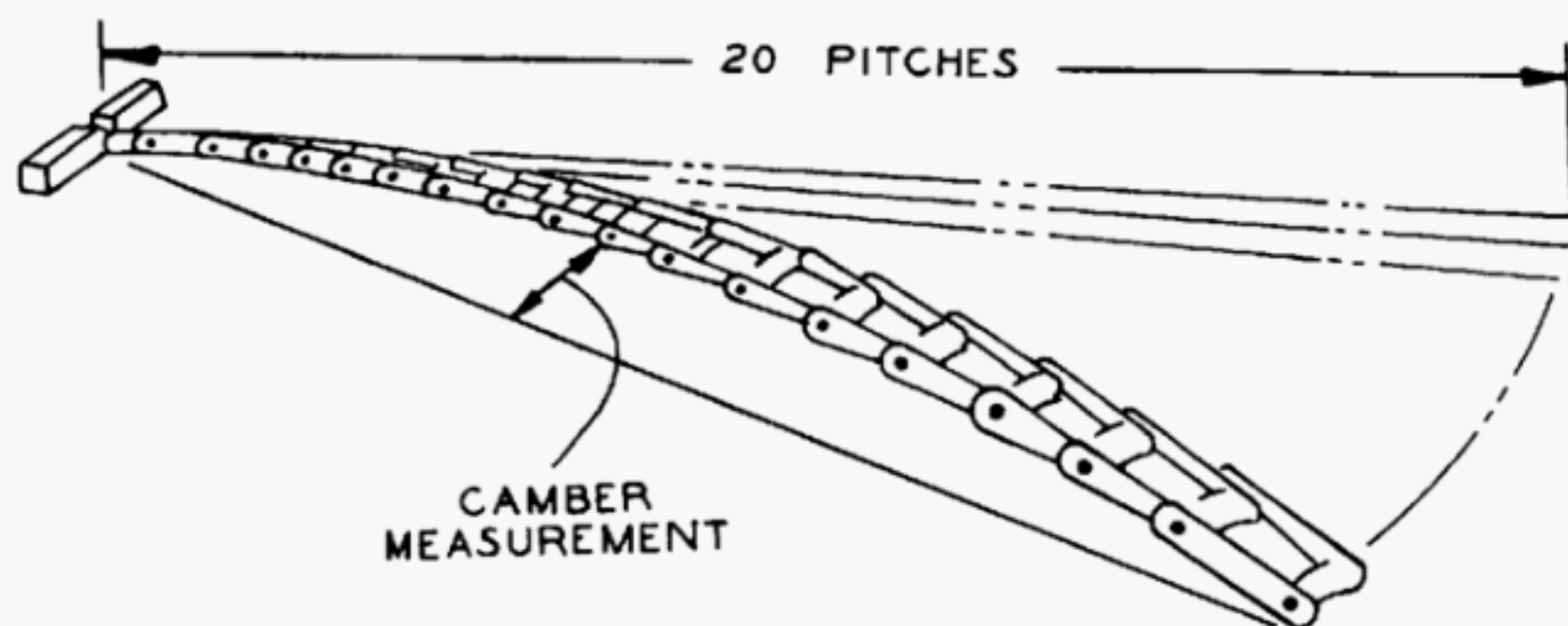
e.g., 3 in. left, 5 in. right, difference equals 2 in.; therefore acceptable.

e.g., 1 in. left, 4 in. right, difference equals 3 in.; however unacceptable (below minimum).

e.g., 5 in. left, 10 in. right, difference equals 5 in.; therefore unacceptable.

### 4.3 Measurement

With the chain laid out flat, one end is held firmly while the other end is moved laterally as far as it will go. Camber is measured at the center of the strand as the height of the arc from the chord connecting the ends of the 20-pitch strand. No load is specified because the chain is forced manually to camber on a normal work surface



and allowed to assume the cambered position. The measurement is made when the load is removed.

#### 4.4 Rationale for the Standard for Chain Camber

The ability for the chain to camber to the specified amount provides for the ability of the conveyor to track and operate properly with the scraper flights and sprockets.

It is important that chains possess both minimum and uniform camber capabilities in both directions to prevent lateral binding.

### 5 CHAIN TWIST

#### 5.1 Definition

Twist is the measure of the ability of the chain to be flexed torsionally.

#### 5.2 Standard for Chain Twist

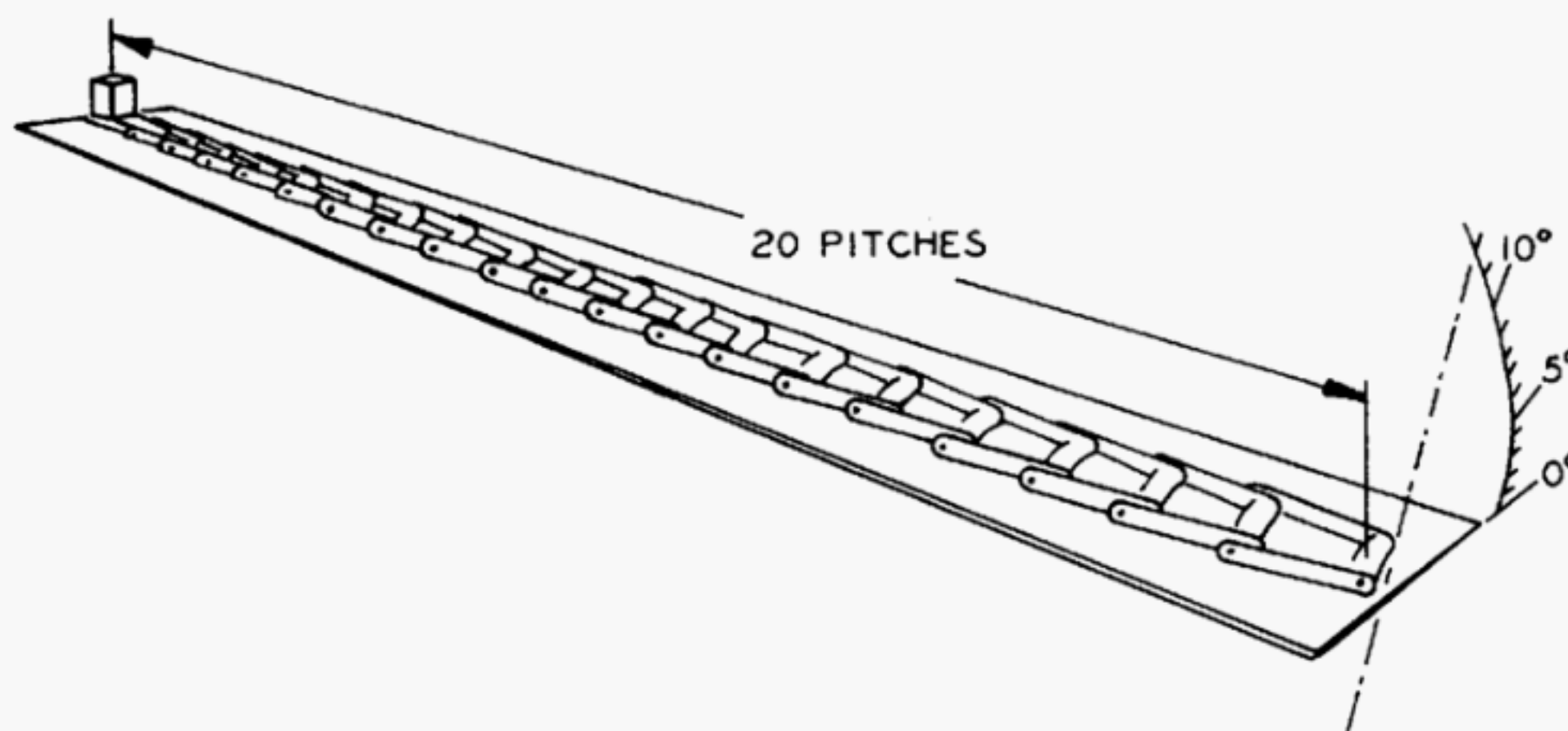
Each 20-pitch strand of chain shall meet the following standard.

	Cast Chains	Welded Chains
<b>5.2.1</b> Twist in each direction Minimum	4°	4°
<b>5.2.2</b> Difference in twist from one direction to the other (maximum)	12°	12°

e.g., 5 deg clockwise, 16 deg counterclockwise, difference equals 11 deg; therefore acceptable.

e.g., 3 deg clockwise, 10 deg counterclockwise, difference equals 7 deg; however unacceptable (below minimum).

e.g., 5 deg clockwise, 22 deg counterclockwise, difference equals 17 deg; therefore unacceptable.



### 5.3 Measurement

With the chain laid out flat, one end is held firmly while the other end is twisted as far as it will go. Twist is measured in degrees between a line laterally through the end pitch hole when the chain is flat and when it is in the twisted condition. No load is specified because the chain is forced manually to twist on a normal work surface and allowed to assume the twisted position. The measurement is made while the load is applied.

### 5.4 Rationale for the Standard for Chain Twist

The ability of the chain to twist to the specified amount provides for the ability of the conveyor to track and operate properly with the scraper flights and sprockets.

It is important that chains possess both minimum and uniform twist capabilities in both directions.

## 6 CHAIN STRAND MATCHING

### 6.1 Definition

Chain strand matching is that property of two chains intended to operate side-by-side which assures that they will have uniform length.

### 6.2 Standard for Matching Chain Strands

The length of each 20-pitch strand of a matched pair of chains shall measure within .19 inch of each other. Matched pairs of chain shall be properly identified.

### 6.3 Measurement

Measurement shall be made between corresponding points on the end links of each 10-foot strand using measuring loads per ANSI B29.21 M.

### 6.4 Rationale for the Standard for Chain Strand Matching

For the successful operation of two strands of chain operating together side-by-side rigidly connected by scraper flights, it is important that the length spacing between the flights be as uniform as practical on each side of the conveyor. This uniformity is to insure proper operation as the two chains flex over the sprockets together and help insure that the chains will track uniformly through the conveyor system.

Matching pairs of 20-pitch chain lengths is sufficient to provide satisfactory matching of attachments throughout the entire length of the chain.

## 7 WORKING LOAD CAPACITIES OF CHAINS

For working load capacities of each chain, consult the individual chain manufacturer.

## 8 SPROCKET WEAR AND CORROSION RESISTANCE

### 8.1 Definition

The resistance to combined wear and corrosion of sprockets operating in this application is the result of the combined material and hardness properties.

### 8.2 Standard for Combined Wear and Corrosion Resistance of Sprockets

Sprockets for both Cast and Welded Steel chains shall have combined wear and corrosion resistance in this application equivalent to:

- High strength cast gray iron
- Per ASTM A48 Class 30 minimum
- Chill-hardened surface in the tooth contact area 363 BHN minimum to a 3/16-inch depth minimum

### 8.2 Testing

Sprocket cast materials shall be checked according to ASTM A48.

Checking for both hardness and hardness depth, when specified, shall be performed on sprocket samples according to sampling procedures agreed upon between the user and manufacturer.

Hardness testing is accomplished on the surface of the sprocket at the bottom of the tooth space using accepted sample preparation practices calling for a ground-flat surface free of all decarburization and per ASTM hardness testing procedures.

### 8.4 Rationale for the Standard of Combined Wear and Corrosion Resistance of Sprockets

The effective life of a sprocket used in water and sewage treatment tanks is largely governed by its capability to resist the combined effects of the abrasion and corrosion to which it is normally subjected. The corrosion and wear resistance of the sprocket is determined by the material, hardness and hardness pattern. The effect on sprockets from abrasion and corrosion is essentially the same — reduction in material section. For this reason, a combined standard covering both properties is appropriate.



Occasionally, small amounts of nickel and chromium additives have been used in materials for sprockets in this application. While it is reported in scientific literature that small additions of these elements enhance the resistance to atmospheric corrosion, evidence does not exist to substantiate the benefits of this practice in sprockets used in water and sewage treatment plants.

## **9 SPROCKET DIMENSIONS**

The sprockets for use with the 700 Class cast and welded steel water treatment chains in this supplement shall conform to the dimensions per ANSI B29.21M Section 3.0.

## **10 CHAIN AND SPROCKET QUALITY AND WORKMANSHIP**

Chains and sprockets for use in water and sewage treatment plants shall be manufactured according to practices affording generally accepted levels of quality and workmanship including the following:

### **10.1 Chain Link Squareness**

### **10.2 Cast Chain Link Gate Removal**

### **10.3 Welds**

To be continuous and of sufficient size and have adequate fusion, penetration, hardness and toughness to assure meeting the minimum requirements of this supplement.

### **10.4 Squareness of Sprocket Working Surfaces**

### **10.5 Accuracy of Sprocket Tooth Spacing**

### **10.6 Cleanliness of Sprocket Castings**

### **10.7 Accuracy of Keying Sprockets in Pairs**

# **AMERICAN NATIONAL STANDARDS — CHAINS, ATTACHMENTS, AND SPROCKETS FOR POWER TRANSMISSION AND CONVEYING**

Precision Power Transmission Roller Chains, Attachments, and Sprockets . . .	B29.1M-1993
Inverted Tooth (Silent) Chains and Sprockets . . . . .	B29.2M-1982(R1994)
Double-Pitch Power Transmission Roller Chains and Sprockets . . . . .	B29.3M-1994
Double-Pitch Conveyor Roller Chains, Attachments, and Sprockets . . . . .	B29.4M-1994
Steel Detachable Link Chains, Attachments, and Sprockets . . . . .	B29.6M-1993
Leaf Chains, Clevises, and Sheaves . . . . .	B29.8M-1993
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"H" Type Mill Chains, Attachments, and Sprocket Teeth . . . . .	B29.14-1984(R1994)
Steel Roller Type Conveyor Chains, Attachments, and Sprocket Teeth . . . . .	B29.15M-1995
Welded Steel Type Mill Chains, Attachments, and Sprocket Teeth . . . . .	B29.16M-1995
Hinge Type Flat Top Conveyor Chains and Sprocket Teeth . . . . .	B29.17M-1983(R1995)
Welded Steel-Type Drag Chains, Attachments, and Sprocket Teeth . . . . .	B29.18M-1993
A and CA550 and 620 Roller Chains, Attachments, and Sprockets . . . . .	B29.19-1993
700 Class Welded Steel and Cast Chains, Attachments, and Sprockets for Water and Sewage Treatment Plants . . . . .	B29.21M-1981(R1996)
Drop Forged Rivetless Chains, Sprocket Teeth Drive Chain/Drive Dogs . . . . .	B29.22M-1995
Flexible Chain Couplings . . . . .	B29.23M-1985(R1995)
Roller Load Chains for Overhead Hoists . . . . .	B29.24M-1995
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### How can you reach us? It's easier than ever!

There are four options for making inquiries\* or placing orders. Simply mail, phone, fax, or E-mail us and an Information Central representative will handle your request.

#### *Mail*

**ASME**  
22 Law Drive, Box 2900  
Fairfield, New Jersey  
07007-2900

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#### *Fax-24 hours*

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