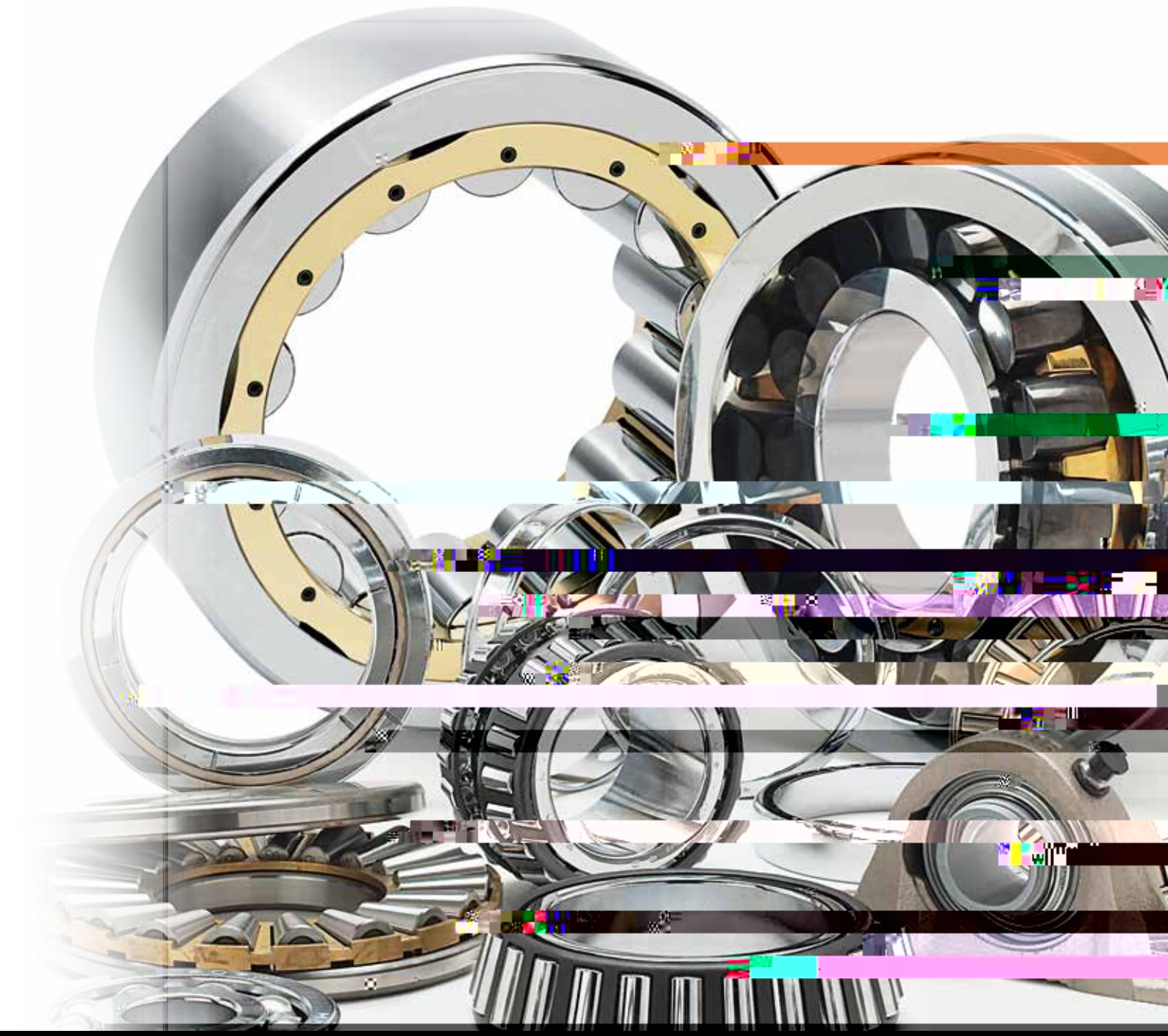
TIMKEN





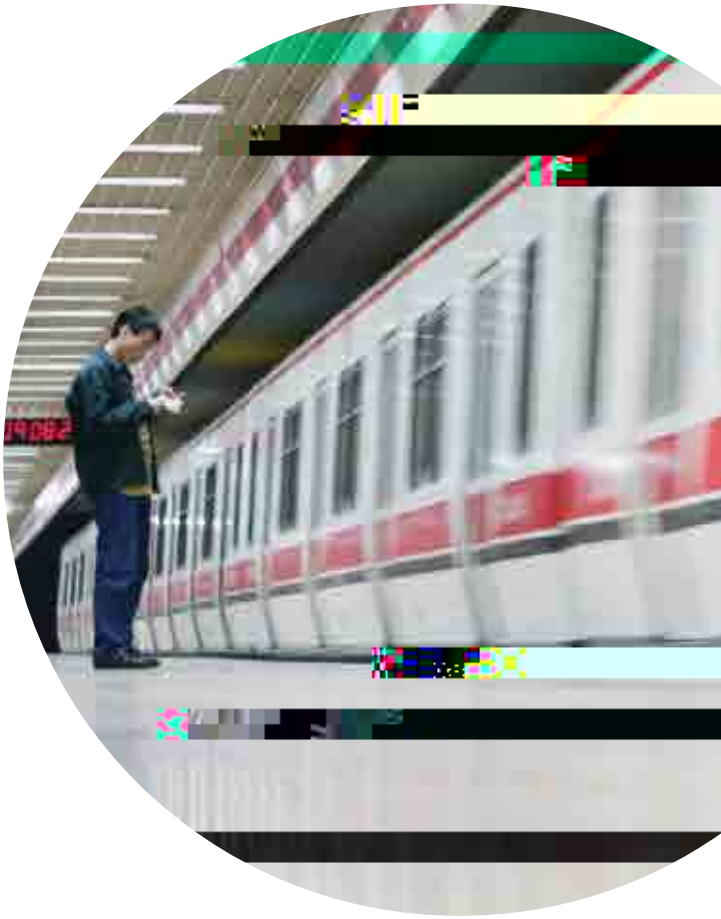


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ISO ANSI/ABMA

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ISO ABEC

ISO/ABMA

TS TSF

4 ISO

16

TSHR- Hydra - Rib™

- ISO 19 9300WI 9300HX
- ISO 10 9100WI 9100HX 99100WN
- ISO 02 200WI
- ISO 03 300WI

Hydra-Rib™

WI,WN,HX K WI

HX

TXR –

WN WI HX

WI HX

15 2MM 25

3MM .

K

TXRDO

TS –

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2S SR



21.

TNA TNASW TNASWE

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2S

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SR - SET - RIGHT™

SET-RIGHT™

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- 2TS -TM ض ن



2TS-IM



2TS-DM



2TS-TM



PAC™

PAC™

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UNIPAC™

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UNIPAC™

UNIPAC-PLUS™

UNIPAC- PLUS™

UNIPAC- PLUS™

AP™

AP™

AP™

SP™

AP™ **SP™**

SP™

TSMA – – 4 ẽ
TSMR – – 4 ẽ

TVL DTVL TTHD TSR

TVB

TVL

TVL

TVL **ABEC 1**

TVL

TVL

DTVL **TVL** **DTVL**

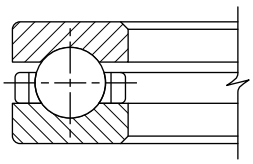
TVB	– –	
TVL	– –	
DTVL	– –	
TP	– –	
TPS	– –	
TTHD	– –	
TSR	– –	
TTHDFL	– –	**V**
TTVS	– –	**V**
TTSP	– –	

30 TVB TVL DTVL

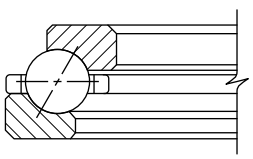
TVB

TVB

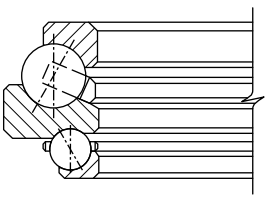
ABEC 1



TVB



TVL



DTVL

30.

TSR

15m/s(3000fpm) **TSR**

2.5

32.TSR

TTHD

TTHD

TTHD

TTHD

TTHD

33. TTHD

TTC

TTSP

TTC TTSP TTC
TTSP

TTHDFL **TTVS**

TTHDSX **TTHDSV**

V **TTHDFL TTVS**

- **≤400 mm** **EJ EM EMB**
- **>400 mm** **YM YMB YMD YP**

Timken®

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5200

EP 107 225 F



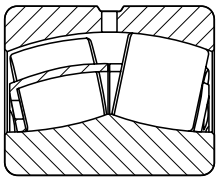
39.

400mm

20m/s

Timken® EJ

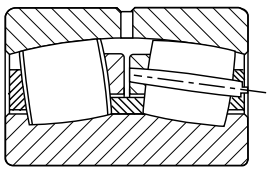
EJ



EJ
40. EJ

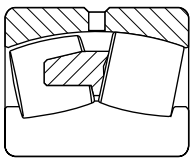


EJ
41. EJ

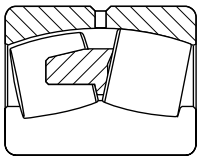


42.

EM EMB YM YMB YMD
44 - 46

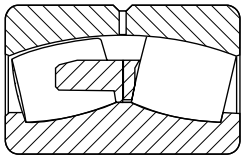


EM/YM



YMD

43.



EMB/YMB

EM EMB YM YMB

EM YM

EMB YMB

YMD YMB



44.



45.

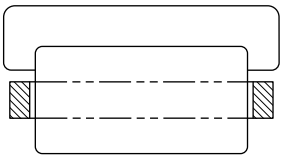


46.

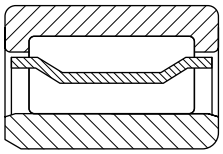
5200

S

48.



47. S





49

49.

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50.

51 **EMA**



51.

(/)

a ″H Ă ▒ ē ٢٫٤ ٢ ى mm, in.

a_1 ڠ ث

		(/)
HFS		
i		
i_B		
k		lbf/RPM^2
k_1		
k_4, k_5, k_6		
K		
K		
K_1, K_2		
K_{ea}		mm, in.
K_o		
K_i		
Kia		mm, in.
K_N		
K_T		
L_H		mm, in.
L		mm, in.
L_{10}		/
L_f		
m		
M		N-m, N-mm, lb.-in.
M_O		N-m, N-mm, lb.-in.
n		rot/min, RPM
n_1, n_2, ... , n_n		rot/min, RPM
N_A		rot/min, RPM
n_G		rot/min, RPM
n_P		rot/min, RPM
n_W		rot/min, RPM
N_c		
N_i		
N_G		
N_P		
N_S		
N_f		
P		
P_o		N, lbf
P_{oa}		N, lbf
P_{or}		N, lbf
P_a		N, lbf
P_r		N, lbf
P_{eq}		N, lbf
Q		W, BTU/min
Q_{gen}		W, BTU/min
Q_{oil}		W, BTU/min
r		mm, in.
R		a_1

		(/)
RIC		mm, in.
S		mm, in.
s		
S_D		mm, in.
S_D		mm, in.
S_{ea}		mm, in.
S_{ia}		mm, in.
t_1, t_2, ..., t_N		
T		N, lbf
T_E		N, lbf
v		
V		km/h, mph
V_{BS}		mm, in.
V_{CS}		mm, in.
Vr		m/s, fpm
W		
X		
X_0		
Y, Y_1, Y_2, ...		
Y_0		
G		°
		°
P		°
		°
Z		

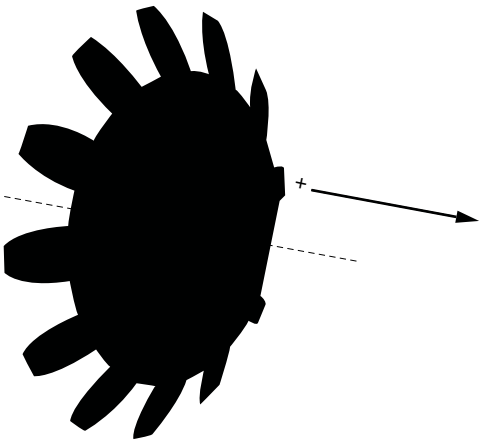
59 F_{tP} F_{tG}

D_{mP}

D_{mG} D_{pP} D_{pG}

$$Dm_G = Dp_G - b \sin \quad _G \quad \mathbf{J} \qquad Dm_P = Dp_P - b \sin \quad _P$$

$$F_{tP} = F_{tG}$$



م

$$F_{tP} = \frac{(1.91 \times 10^7)\, H}{Dm_P\, n_P} \quad ^6$$

$$= \frac{(1.26 \times 10^5)\, H}{Dm_P\, n_P}$$

م

$$F_{aP} = F_{tP} \tan \quad _P \sin \quad _P$$

ًHظم

$$F_{SP} = F_{tP} \tan \quad _P \cos \quad _P$$

$$F_{tW} = \frac{(1.91 \times 10^7)\, H}{D_{PW}\, n_W} \quad \text{lb}$$

$$= \frac{(1.26 \times 10^5)\, H}{D_{pW}\, n_W}$$

$$F_{aW} = \frac{(1.91 \times 10^7)\, H}{D_{pG}\, n_G} \quad \text{lb}$$

$$= \frac{(1.26 \times 10^5)\, H}{D_{pG}\, n_G}$$

م

$$F_{tG} = \frac{(1.91 \times 10^7)\ H}{Dp_G\ n_G}$$ 6

$$= \frac{(1.26 \times 10^5)\ H}{Dp_G\ n_G}$$

$$F_{tG} = \frac{F_{tW}}{\tan}$$

م

$$F_{aG} = \frac{(1.91 \times 10^7)\ H}{Dp_W\ n_W}$$ 6

$$= \frac{(1.26 \times 10^5)\ H}{Dp_W\ n_W}$$

ّ ط م

$$F_{sG} = \frac{F_{tW} \sin}{\cos \quad \sin \quad \mu \cos}$$

$$= \tan^{-1} \left(\frac{Dp_G}{m\ Dp_W} \right)$$

$$= \tan^{-1} \left(\frac{L_H}{\pi\ Dp_W} \right)$$

$$= \frac{\cos \quad - \mu \tan}{\cos \quad + \mu \cot}$$

6

$$\mu^{(1)} = (5.34 \times 10^{-7})\ V_r^3 + \frac{0.146}{V_r^{0.09}} - 0.103$$

$$V_r = \frac{Dp_W\ n_W}{(1.91 \times 10^4) \cos}$$

$$\mu^{(1)} = (7 \times 10^{-14})\ V_r^3 + \frac{0.235}{V_r^{0.09}} - 0.103$$

$$V_r = \frac{Dp_W\ n_W}{3.82 \cos} \qquad /ّ$$

(1) 0.015 15 m/s(3 3000ft/min)

م

$$F_{tW} = \frac{(1.91 \times 10^7)\ H}{Dm_W\ n_W}$$ 6

$$= \frac{(1.26 \times 10^5)\ H}{Dm_W\ n_W}$$

م

$$F_{aW} = 0.98\ F_{tG}$$

ّ ط م

$$F_{sW} = \frac{0.98\ F_{tG} \tan}{\cos}$$

م

$$F_{tG} = \frac{(1.91 \times 10^7)\ H\ m}{Dp_G\ n_W}$$ 6

$$= \frac{(1.26 \times 10^5)\ H\ m}{Dp_G\ n_W}$$

$$F_{tG} = \frac{(1.91 \times 10^7)\ H}{Dp_G\ n_G}$$ 6

$$= \frac{(1.26 \times 10^5)\ H}{Dp_G\ n_G}$$

م

$$F_{aG} = \frac{(1.91 \times 10^7)\ H}{Dm_W\ n_W}$$ 6

$$= \frac{(1.26 \times 10^5)\ H}{Dm_W\ n_W}$$

ّ ط م

$$F_{sG} = \frac{0.98\ F_{tG} \tan}{\cos}$$

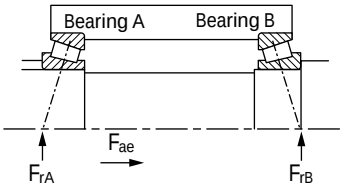
$$= \quad (\qquad)$$

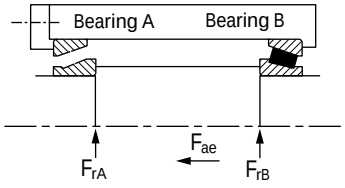
$$Dm_W = 2d_c - 0.98\ Dp_G$$

$$= \tan^{-1} \frac{Dp_G}{m\ Dp_W} = \tan^{-1} \frac{L_H}{\pi\ Dp_W}$$

(P_r)

L_{10} P


Bearing A
Bearing B
F_{ae}
F_{rA}
F_{rB}


Bearing A
Bearing B
F_{ae}
F_{rA}
F_{rB}

F_{ae}

A B P_r F_{rAB} F_{rC} F_{rAB} F_{rC}

A B $C_{90(2)}$

(P_a)

:

$$P_a = X_r F + Y F_a$$

(F_a / F_r) X Y

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:

$$P_a = 1.2 F_r + F_a$$

F_r

$F_r \leq 0.55\, F_a$

($F_{ai} = 1.2 F_r$)

F_{ai}

:

$$_0 = 4000 \left(\frac{P_0}{C_0}\right)^{1/2} \text{ MPa}$$

$$_0 = 580 \left(\frac{P_0}{C_0}\right)^{1/2} \text{ ksi}$$

:

$$_0 = 4200 \left(\frac{P_0}{C_0}\right)^{1/3} \text{ MPa}$$

$$_0 = 607 \left(\frac{P_0}{C_0}\right)^{1/3} \text{ ksi}$$

9 **X_0 Y_0**

$$P_{0r} = X_0 F_r + Y_0 F_a$$

$$P_{0a} = X_0 F_r + Y_0 F_a$$

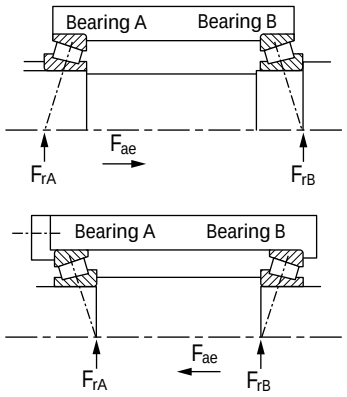
www.timken.com **X_0 Y_0**

$$P_{0a} = F_a + 2.7 F_r$$

P_{0a} **$0.5C_{0a}$.**

9.

10.



0.47 F_{rA}

P_0 (C_0) P_0 F_r

($F_{a\ min}$)

$$F_{a\,min} = 1.2\,F_r + F_{ac} \geq \frac{C_{0a}}{1000} \quad (N)$$

($F_{a\ min}$) **(C_{0a})**

(a_{3k}) (a_{3l})

-

L_{10a}

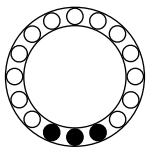
$a_{3l} = C_g C_l C_j C_s C_v C_{gr}$

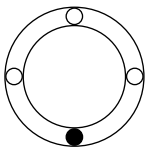
L_{10a}

Pr (Fr) a_{3l} 2.88 a_{3l}

0.200 a_{3l} 0.126

40 m





ť ▪ (C_g)

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(Cg)

a_{3k}

C_g DuraSpexx™

DuraSpexx™

(Cl)

70 Cl

Pr



70. Cl Pr

(Cj)

1

71

(C_{gr})

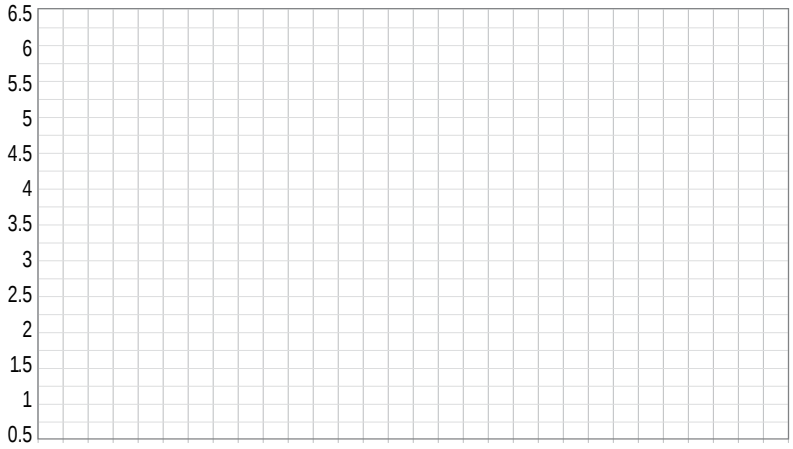
C_{gr}

$C_{gr} = 0.79$

(a_{3p})

75

a_{3p} **a_{3l}**



75.

(a_{3m})

76

76.

$$R_{(\quad)} = R_A R_B R_C \cdots . R_n$$

$$L_{10(\quad)} = [(1/L_{10A})^{3/2} + (1/L_{10B})^{3/2} + \cdots .(1/L_{10n})^{3/2}]^{-2/3}$$

$$F_{wt} = [(n_1 t_1 F_1{}^{10/3} + \cdots .n_n t_n F_n{}^{10/3}) / n_a]^{0.3}$$

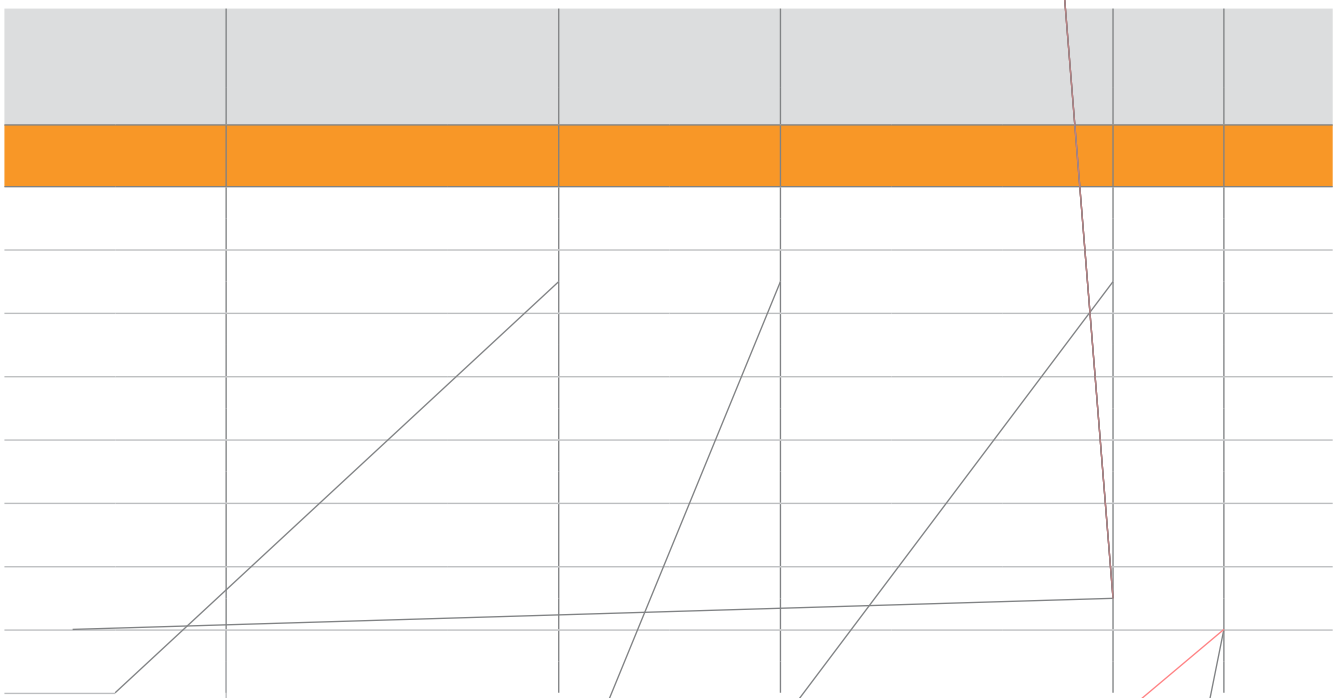
$$F_{wt} = [(3/13) (F_{max}{}^{13/3} - F_{min}{}^{13/3}) / (F_{max} - F_{min})]^{0.3}$$

$$\mathbf{a_{3I}}$$

$$L_{nwt} = 1/\left\{[t_1 / (L_n)_1] + [t_2 / (L_n)_2] + \cdots [t_n / (L_n)_n]\right\}$$

15. — —

ت		ت (1) Δ_{dmp}			ـ H إ V_{BS}			ت A K_{ia}			H A S_d	A S_{ia}	ـ H (1) Δ_{Bs} □ Δ_{Cs}	
ؤ		P0	P6	P5	P0	P6	P5	P0	P6	P5	P5	P5	P0, P6	P5
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
2.5000 0.0984	**10.000** 0.3937	**-0.008** -0.0003	**-0.007** -0.0003	**-0.005** -0.0002	**0.015** 0.0006	**0.015** 0.0006	**0.005** 0.0002	**0.010** 0.0004	**0.006** 0.0002	**0.004** 0.0002	**0.007** 0.0003	**0.007** 0.0003	**-0.120** -0.0047	**-0.040** -0.0157
10.000 0.3937	**18.000** 0.7087	**-0.008** -0.0003	**-0.007** -0.0003	**-0.005** -0.0002	**0.020** 0.0008	**0.020** 0.0008	**0.005** 0.0002	**0.010** 0.0004	**0.007** 0.0003	**0.004** 0.0002	**0.007** 0.0003	**0.007** 0.0003	**-0.120** -0.0047	**-0.080** -0.0031
18.000 0.7087	**30.000** 11811	**-0.010** -0.0004	**-0.008** -0.0003	**-0.006** -0.0002	**0.020** 0.0008	**0.020** 0.0008	**0.005** 0.0002	**0.013** 0.0005	**0.008** 0.0003	**0.004** 0.0002	**0.008** 0.0003	**0.008** 0.0003	**-0.120** -0.0047	**-0.120** -0.0047
30.000	**50.000**	**-0.012**	**-0.010**	**-0.008**	**0.020**	**0.020**	**0.005mm**20	0.020		0.029(-)-60(.0026(.)6.00232-)-62.9883(0)12.001.0221(1)51.9922(2)12.0052(51.941(				



17. — — TVB

ت			ت			"H			
	ت ؤ	6 (1)		ت ؤ	6 (1)		ت ؤ	6	
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
0.000 0.0000	**171.450** 6.7500	**+0.127** +0.0050	**0.000** 0.0000	**134.938** 5.3125	**-0.051** -0.0020	**0.000** 0.0000	**46.038** 1.8125	**+0.127** +0.0050	**-0.127** -0.0050
171.450 6.7500	**508.000** 20.0000	**+0.178** +0.0070	**134.938** 5.3125	**441.325** 17.3750	**-0.076** -0.0030	**46.038** 1.8125	**304.800** 12.0000	**+0.254** +0.0100	**-0.254** -0.0100
– –	**–** –	**–** –	**441.325** 17.3750	**1000.000** 39.3701	**-0.102** -0.0040	**304.800** 12.0000	**508.000** 20.0000	**+0.381** +0.0150	**-0.381** -0.0150

(1) **ABMA 21.2**

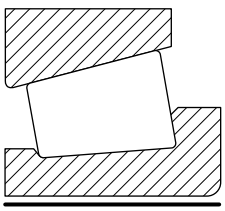
18. — — TVL DTVL

ت ؤ		6 (1)	ت ؤ		6 (1)	″ Ḥ ت ؤ		6
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
0.000 0.0000	504.825 19.8750	-0.076 -0.0030	0.000 0.0000	584.000 23.0000	-0.076 -0.0030			± 0.381 ± 0.0150
504.825 19.8750	1524.000 60.0000	-0.127 -0.0050	584.000 23.0000	1778.000 70.0000	-0.127 -0.0050			– –

(1) ABMA 21.2

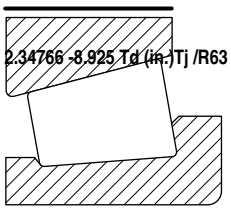
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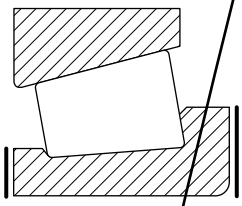
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80.000 3.1496	120.000 4.7244	-0.020 -0.0008	0.025 0.0010	120.000 4.7244	150.000 5.9055	-0.020 -0.0080	0.041 0.0016	80.000 3.1496	120.000 4.7244	+0.094 +0.0037	-0.254 -0.0100
120.000 4.7244	180.000 7.0866	-0.025 -0.0010	0.030 0.0012	150.000 5.9055	180.000 7.0866	-0.025 -0.0010	0.046 0.0018	120.000 4.7244	180.000 7.0866	+0.109 +0.0043	-0.300 -0.0118
180.000 7.0866	250.000 9.8425	-0.030 -0.0012	0.041 0.0016	180.000 7.0866	250.000 9.8425	-0.030 -0.0012	0.051 0.0020	180.000 7.0866	250.000 9.8425	+0.130 +0.0051	-0.366 -0.0144
250.000 9.8425	315.000 12.4016	-0.036 -0.0014	0.051 0.0020	250.000 9.8425	315.000 12.4016	-0.036 -0.0014	0.061 0.0024	250.000 9.8425	315.000 12.4016	+0.155 +0.0061	-0.434 -0.0171
315.000	400.000	400.000									



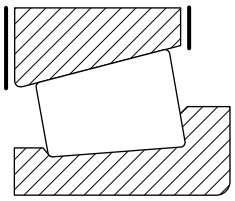
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			K (1)		N		C		B		A		AA	
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	10.000 0.3937	**80.000** 3.1496	**0.000** 0.0000	**-0.150** -0.0059	**0.000** 0.0000	**-0.100** -0.0040	**0.000** 0.0000	**-0.150** -0.0059	**0.000** 0.0000	**-0.150** -0.0059	**0.000** 0.0000	**-0.150** -0.0059	**0.000** 0.0000	**-0.150** -0.0059
	80.000 3.1496	**150.000** 5.9055	**0.000** 0.0000	**-0.200** -0.0079	**0.000** 0.0000	**-0.100** -0.0040	**0.000** 0.0000	**-0.200** -0.0079	**0.000** 0.0000	**-0.200** -0.0079	**0.000** 0.0000	**-0.200** -0.0079	**0.000** 0.0000	**-0.200** -0.0079
	150.000 5.9055	**180.000** 7.0866	**0.000** 0.0000	**-0.200** -0.0079	**0.000** 0.0000	**-0.100** -0.0040	**0.000** 0.0000	**-0.250** -0.0098	**0.000** 0.0000	**-0.250** -0.0098	**0.000** 0.0000	**-0.250** -0.0098	**0.000** 0.0000	**-0.250** -0.0098

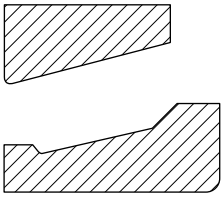
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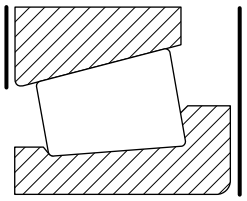
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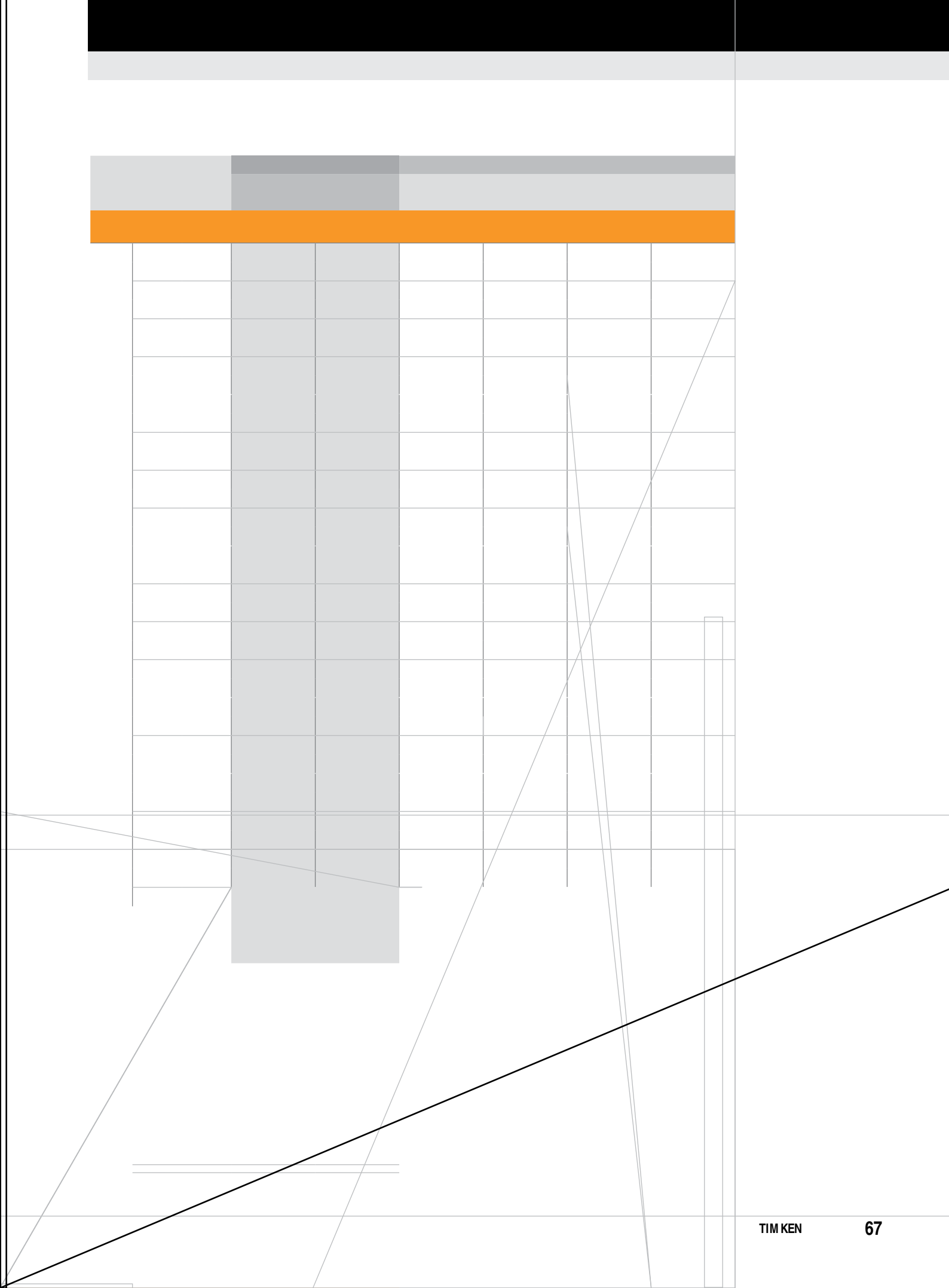
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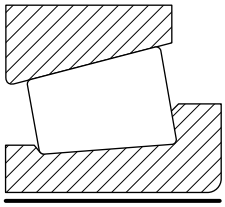




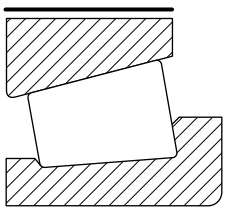
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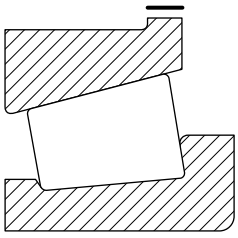
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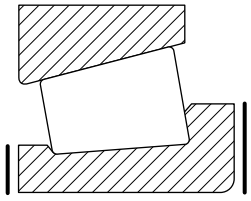
28.

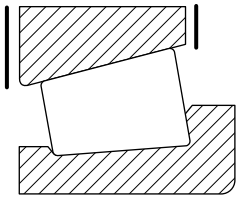


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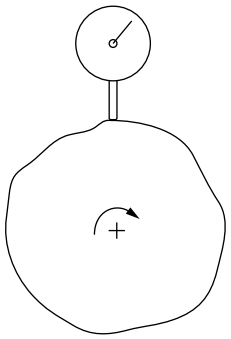




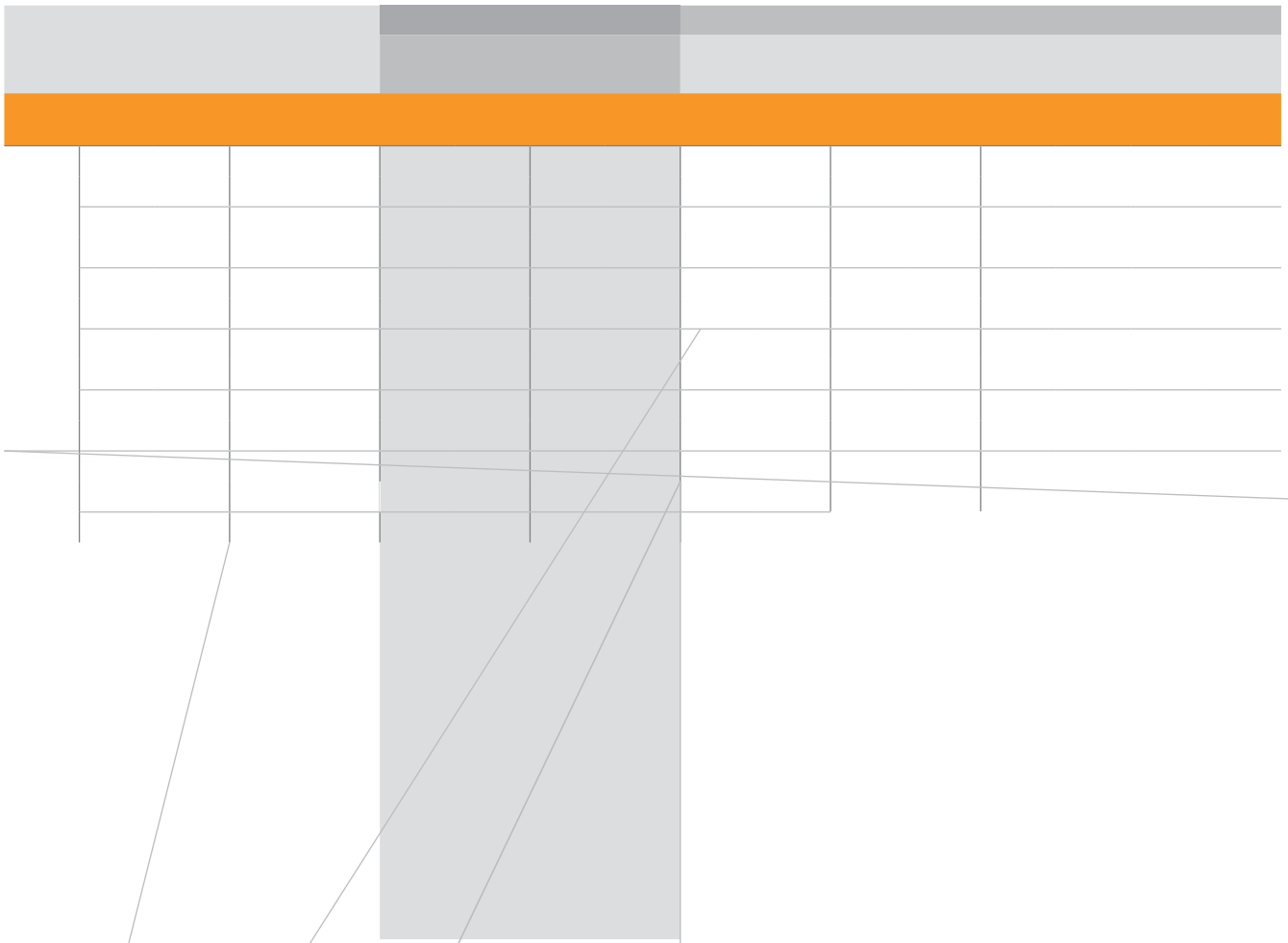


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TS TSF TSL 2S TDI TDIT TDO TNA TNASW TNASWE	**0.000** 0.0000	**266.700** 10.5000	**0.051** 0.0020	**0.038** 0.0015	**0.008** 0.0003	**0.004** 0.00015	**0.002** 0.00075	**0.001** 0.00040
	266.700 10.5000	**304.800** 12.0000	**0.051** 0.0020	**0.038** 0.0015	**0.008** 0.0003	**0.004** 0.00015	**0.002** 0200075	**0.001** 0.00040
	304.800 12.0000	**609.600** 24.0000	**0.051** 0.0020	**0.038** 0.0015	**0.018** 0.0007	– –	– –	– –
	609.600 24.0000	**914.400** 36.0000	**0.076** 0.0030	**0.051** 0.0020	**0.051** 0.0020	– –	– –	– –
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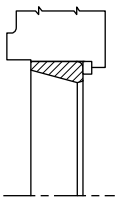


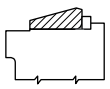
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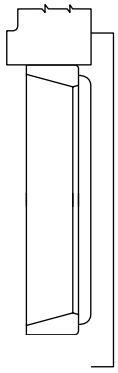
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$= \left(\frac{d}{d_o}\right)\delta_S$ = 0.

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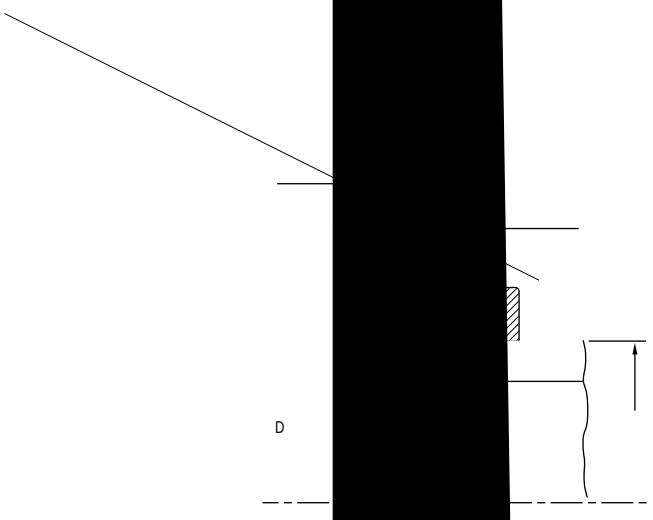
$= \left(\frac{D_o}{D}\right)\delta_H$

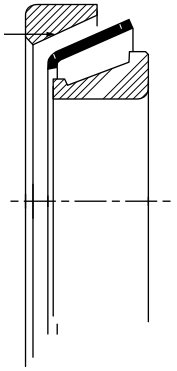
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		C2		C3		C5				
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450	**500**	**0.14** 0.0055	**0.26** 0.0102	**0.41** 0.0161	**0.55** 0.0217	**0.72** 0.0283	**0.9** 0.0354	**0.178** 0.007	**0.229** 0.009	**0.165** 0.0065
500	**560**	**0.15** 0.0059	**0.28** 0.011	**0.44** 0.0173	**0.6** 0.0236	**0.78** 0.0307	**1** 0.0394	**0.203** 0.008	**0.254** 0.01	**0.178** 0.007
560	**630**	**0.17** 0.0067	**0.31** 0.0122	**0.48** 0.0189	**0.65** 0.0256	**0.85** 0.0335	**1.1** 0.0433	**0.229** 0.009	**0.279** 0.011	**0.203** 0.008
630	**710**	**0.19** 0.0075	**0.35** 0.0138	**0.53** 0.0209	**0.7** 0.0276	**0.92** 0.0362	**1.19** 0.0469	**0.254** 0.01	**0.305** 0.012	**0.203** 0.008
710	**800**	**0.21** 0.0083	**0.39** 0.0154	**0.58** 0.0228	**0.77** 0.0303	**1.01** 0.0398	**1.3** 0.0512	**0.279** 0.011	**0.356** 0.014	**0.229** 0.009
800	**900**	**0.23** 0.0091	**0.43** 0.0169	**0.65** 0.0256	**0.86** 0.0339	**1.12** 0.0441	**1.44** 0.0567	**0.305** 0.012	**0.381** 0.015	**0.252** 0.01
900	**1000**	**0.26** 0.0102	**0.48** 0.0189	**0.71** 0.028	**0.93** 0.0366	**1.22** 0.048	**1.57** 0.0618	**0.356** 0.014	**0.432** 0.017	**0.279** 0.011

42. — —

ت – RIC											
ت	ؤ	C2		C0		C3		C4		C5	
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
– –	**10** 0.3937	**0.000** 0.0000	**0.025** 0.0010	**0.020** 0.0008	**0.0045** 0.0018	**0.035** 0.0014	**0.060** 0.0024	**0.050** 0.0020	**0.075** 0.0030	– –	– –
10 0.3937	**24** 0.9449	**0.000**	**0.025**	**0.020**	**0.0045**	**0.035**	**0.060**	**0.050**	**0.075**	**0.065**	**0.090**

22328K C3 140 mm C3

RIC

RIC = 0.178 mm (0.007 in.)

RIC =

0.064 0.089 mm 0.0025 in. 0.0035 in.

86

0.178 mm - 0.076 mm = 0.102 mm

0.007 in. - 0.003 in. = 0.004 in.

86 88

0.076 mm 0.003 in.

RIC 0.102mm 0.004 in.

RIC

0.056 mm 0.0022 in.

150 mm 124 ISO p6

150mm p6 136

+0.043 +0.068mm +0.0017 +0.0027 in.

= 150.068 mm 5.0955 in.

= 150.043 mm 5.0945 in.

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= 150.068 - 149.075

= 0.093mm 0.0037 in.

=

= 150.043 - 150.000

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RIC
2

0.043 mm 0.0017 in.

0.093 mm 0.0037 in.

0 mm 0.116 mm 0.0046 in.

1200 RPM 60%

70%

60%

ISO C0

84 RIC C_0 150 mm

RIC 0.110 mm 0.170 mm 0.0043 in.

0.0067 in. RIC

0.056 mm 0.0022 in.

83 RIC

80%

60%

RIC

- RIC

0.043 mm 0.0017 in. 0.034 mm 0.0014 in. RIC

0.093 mm (0.0037 in.) 0.074 mm (0.0030 in.) RIC

= RIC -

= 0.170 - 0.034 = 0.136 mm (0.0054 in.)

= RIC -

= 0.110 - 0.074 = 0.036 mm (0.0014 in.)

RIC 0.056 mm

0.0022 in. C0 RIC

150 mm C3 0.170

0.220 mm 0.0067 0.0087 in. RIC

= RIC -

= 0.220 - 0.034 = 0.186 mm (0.0073 in.)

= RIC -

= 0.170 - 0.074 = 0.096 mm (0.0038 in.)

RIC 0.056 mm

0.0022 in. C3 RIC

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- 121 C (250 F) 93 C (200 F)
- 20 30
- 93 C (200 F)
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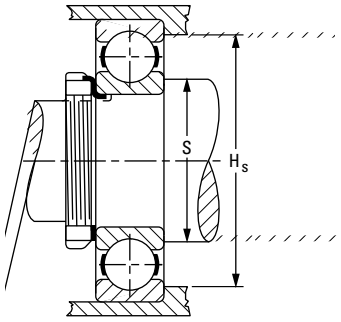


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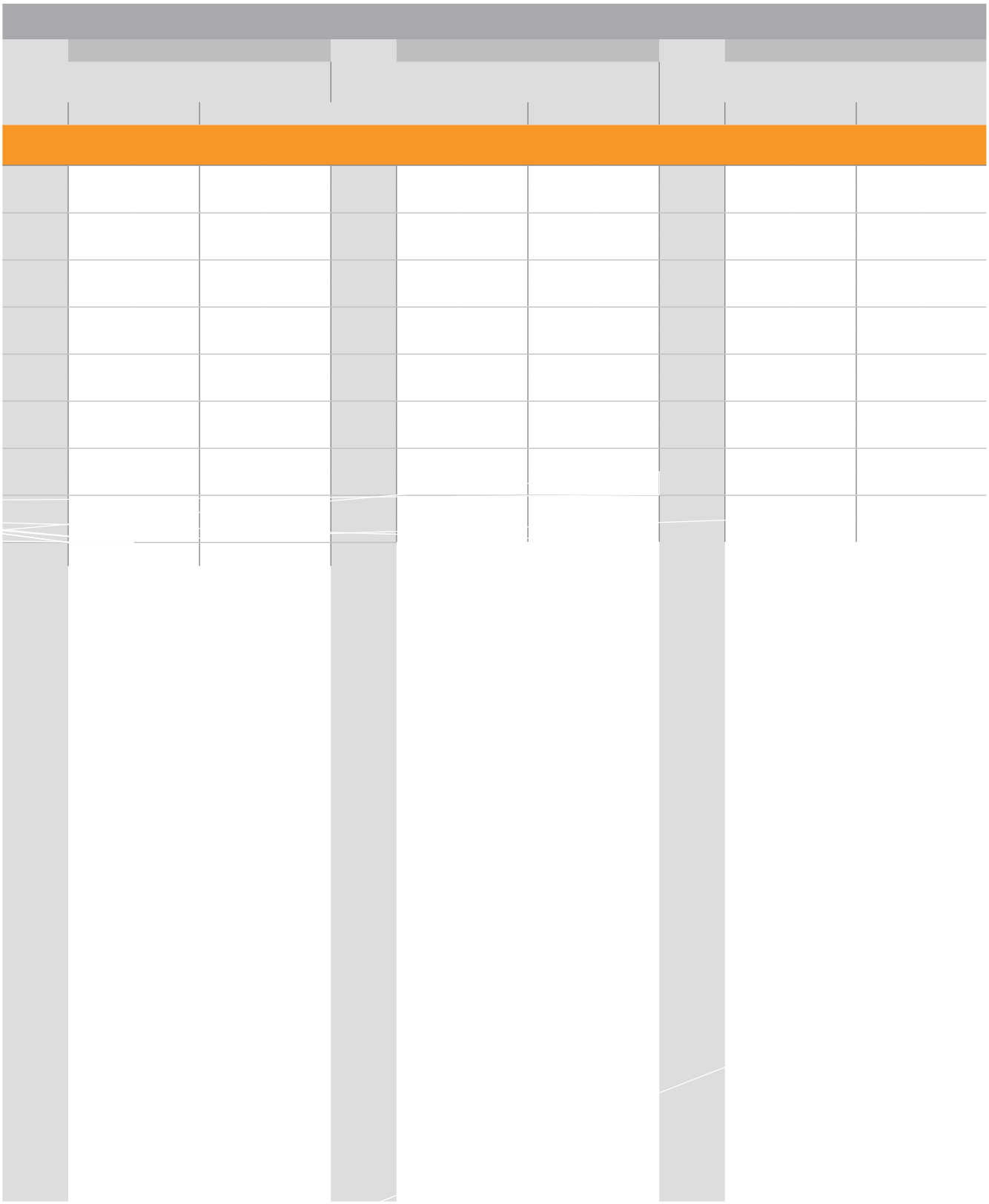
44 - 48

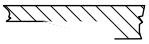


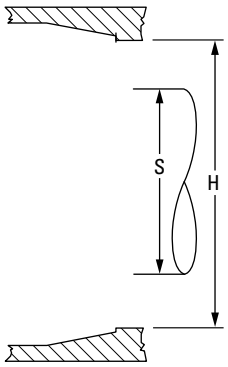
106.

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■	S		H_s	
	mm in.	**mm** in.	**mm** in.	**mm** in.
33K3	**5.1** 0.20	**4.8** 0.19	**8.1** 0.32	**7.9** 0.31
33K4	**6.1** 0.24	**5.8** 0.23	**11.2** 0.44	**10.9** 0.43
33K5	**6.6** 0.26	**6.4** 0.25	**11.2** 0.44	**10.9** 0.43
34K	**6.6** 0.26	**6.4** 0.25	**14.2** 0.56	**14.0** 0.55
35K	**9.4** 0.37	**9.1** 0.36	**17.0** 0.67	**16.8** 0.66
36K	**9.4** 0.37	**9.1** 0.36	**17.0** 0.67	**16.8** 0.66
37K	**11.2** 0.44	**10.7** 0.42	**20.1** 0.79	**19.6** 0.77
38K	**11.4** 0.45	**10.9** 0.43	**20.1** 0.79	**19.6** 0.77
38KV	**11.4** 0.45	**10.9** 0.43	**20.1** 0.79	**19.6** 0.77
39K	**13.0** 0.51	**12.5** 0.49	**23.1** 0.91	**22.6** 0.89
S1K7	**8.6** 0.34	**8.1** 0.32	**14.2** 0.56	**13.7** 0.54
S1K	**9.4** 0.37	**8.9** 0.35	**17.5** 0.69	**17.0** 0.67
S3K	**12.7** 0.50	**12.2** 0.48	**20.3** 0.80	**19.8** 0.78
S5K	**16.0** 0.63	**15.5** 0.61	**25.1** 0.99	**24.6** 0.97
S7K	**21.3** 0.84	**20.3** 0.80	**31.5** 1.24	**30.5** 1.20
S8K	**24.6** 0.97	**23.6** 0.93	**37.1** 1.46	**35.6** 1.40
S9K	**28.9** 114	**27.9** 110	**41.9** 1.65	**40.9** 1.61
S10K	**31.5** 1.24	**30.5** 1.20	**46.7** 1.84	**45.7** 1.80
S11K	**34.0** 1.34	**33.0** 1.30	**49.5** 1.95	**48.5** 1.91
S12K	**39.4** 1.55	**38.4** 1.51	**55.9** 2.20	**50.8** 2.00






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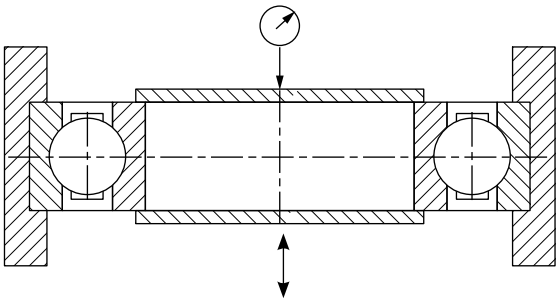
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R	0	RMM204K.
P	3	: P204k.
J	4	: J204k.
JJ	5	

Endplay)

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110.

Endplay

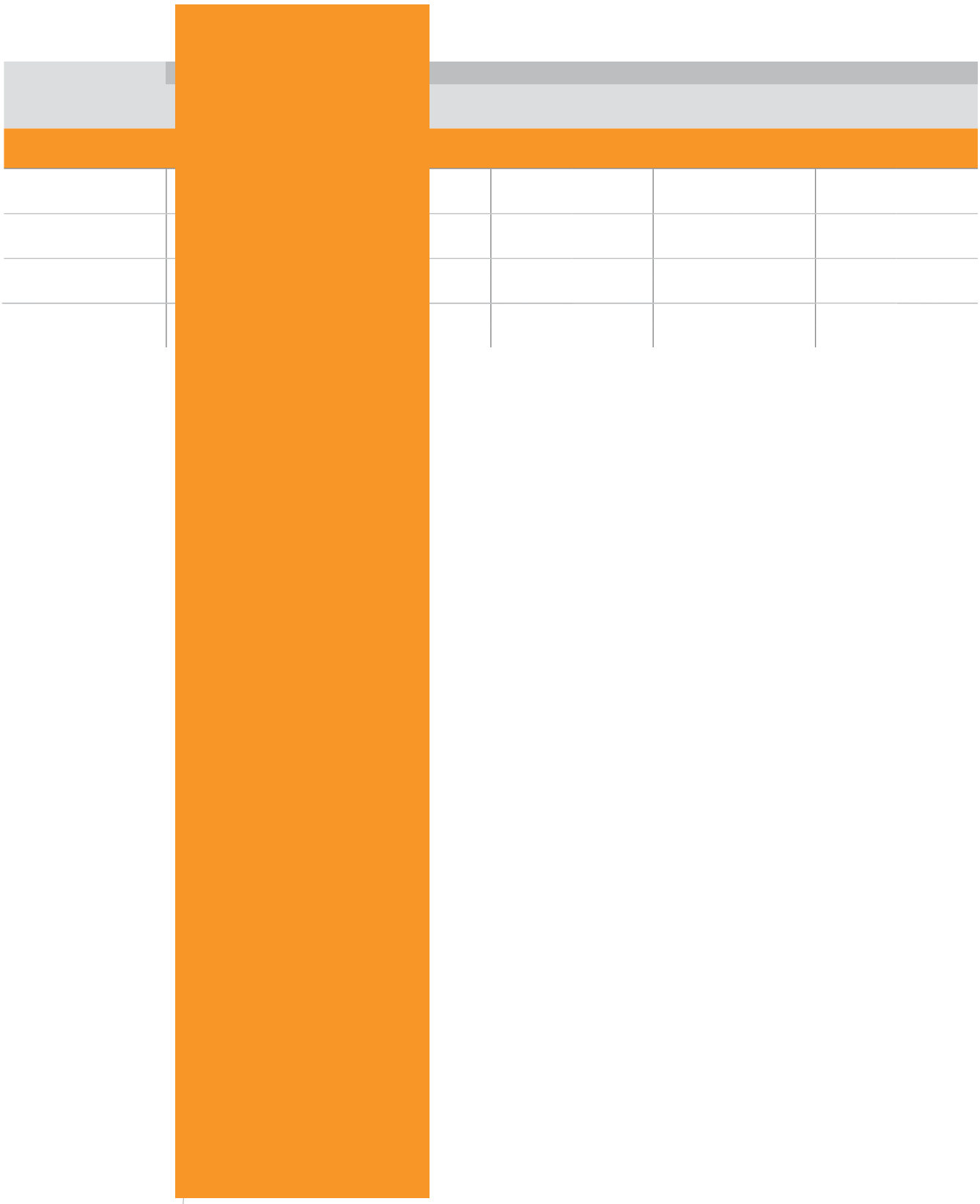
$$E = \sqrt{4d[RIC](K_O + K_i - 1) - RIC^2} \text{ or} \cong \sqrt{4d[RIC](K_O + K_i - 1)}$$

(: RIC^2)

:

$$\alpha = \sin^{-1} \frac{E}{2 (K_0 + K_i - 1) d}$$

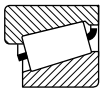
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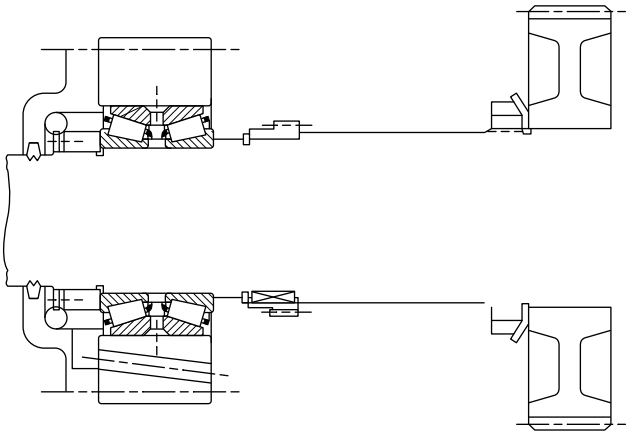


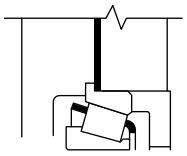
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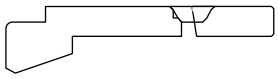
R C0 P C3 52mm 2.0472in. P(C3)





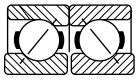


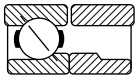




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DB

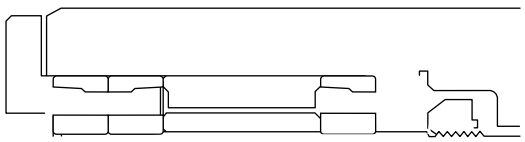




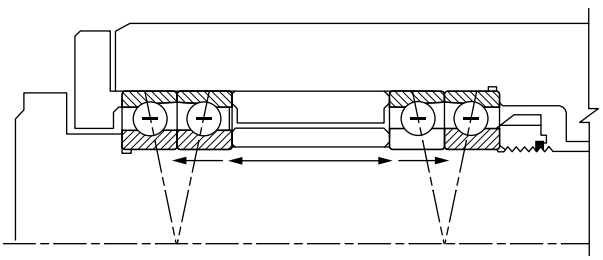
DF

127. DF

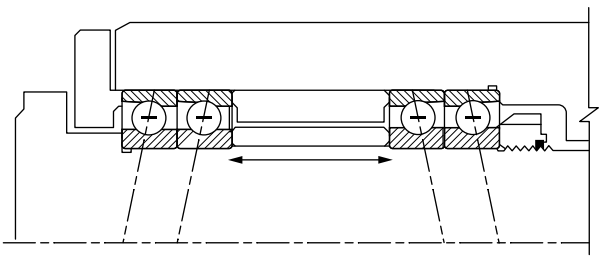
128. DB



129. DB - DB



. 130. DF - DF



131. DT - DB

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	C 3	B 0	A 00	AA 000
	µm µin	**µm** µin	**µm** µin	**µm** µin
- Ra	**0.8** 32	**0.6** 24	**0.4** 16	**0.2** 8
- Ra	**1.6** 63	**0.8** 32	**0.6** 24	**0.4** 16

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ISO P4/ABEC 7 ISO P2/ ABEC 9

16kg 35lbs. 2MM9111WI DUL
0.010 mm 0.0004 in.
86 Kg 180 lbs.

53. M M V (ISO P4/ABEC 7)

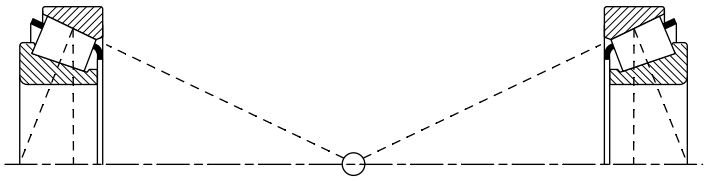
ت		ت		▫ ع	
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.

	ñ ■	₆	MV ABEC 7 (ISO P4)	MMV/MM ABEC 7/9 (ISO P4S)	MMX ABEC 9 (ISO P2)
¦H		t1	IT2	IT1	IT0 251.25 2.52 3049.s /Td

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TS TSF

133



133.

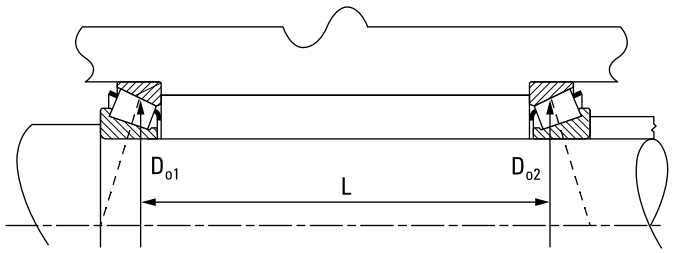
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134

$$\tilde{e} = 12 \times 10^{-6}\ \Delta T \left[\left(\frac{K_1}{0.39} \right) \left(\frac{D_{o1}}{2} \right) + \left(\frac{K_2}{0.39} \right) \left(\frac{D_{o2}}{2} \right) - L \right]$$

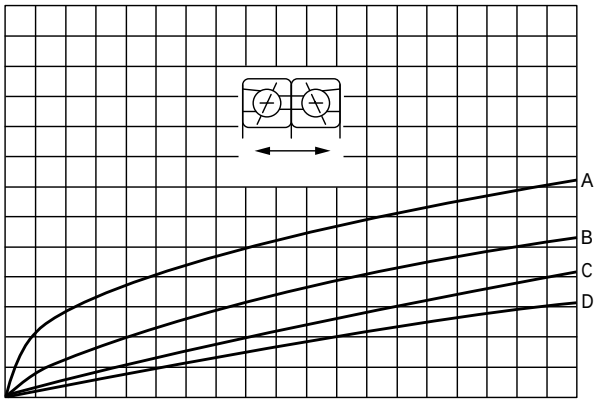
2 C 5 C (4 F

9 F)



134.

113 **123-126**



A
B
C
D

137.

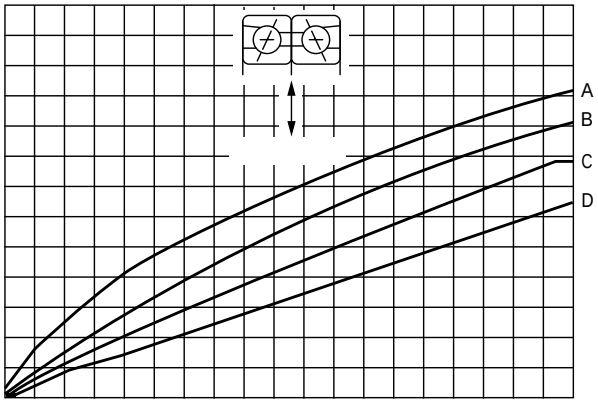
TIMKEN

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TIMKEN **www.timken.com**

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137 **138**



A
B
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138.

55.

				(1)	
			mm in.		
			57	s4	57
				g6	
				h6	
				k6	
	P ≤ 0.07C		**18** **100** 0.7087 3.9370		k5 m5
			100 **200** 3.9370 7.8740	m6	k6 m6 .
	P > 0.07C ≤ 0.25C		**18** **65** 0.7087 2.5590	m5	
			65 **100** 2.5590 3.9370	m6	
			100 **140** 3.9370 5.5118	n6	
			140 **280** 5.5118 11.0236	p6	
			280 **500** 11.0236 19.6850	r6	
			500 19.6850	r7	
	P > 0.25C		**18** **65** 0.7087 2.5590	m6	
			65 **100** 2.5590 3.9370	n6	
			100 **140** 3.9370 5.5118	p6	
			140 **200** 5.5118 7.8740	r6	
			200 **500** 7.8740 19.6850	r7	
					86 87 RIC

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73 **P6** **57**
s4 **W33**

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ISO **s4**

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ف		₆ (1)	ت		▫
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
50.000 1.9685	**80.000** 3.1496	**-0.015** -0.0006	**-0.025** -0.0010	**-0.036** -0.0014	**0.010L** **0.036L** 0.0004L 0.0014L
80.000 3.4196	**120.000** 4.7244	**-0.020** -0.0008	**-0.033** -0.0013	**-0.043** -0.0017	**0.013L** **0.043L** 0.0005L 0.0017L
120.000 4.7244	**180.000** 7.0866	**-0.025** -0.0010	**-0.041** -0.0016	**-0.053** -0.0021	**0.015L** **0.053L** 0.0006L 0.0021L
180.000 7.0866	**250.000** 9.8425	**-0.030** -0.0012	**-0.048** -0.0019	**-0.064** -0.0025	**0.018L** **0.064L** 0.0007L 0.0025L

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ت		6 (2)	ت	▫	ت	▫				
.0199(0)20.0247(1)9.99178.03(0445.0199(027L)ؤ		8637.4.778 c 238.763 3-60.0(0)65.9885(027L)10 39970000) 46.4626 0 T3)-3-009			-561-55.0199(0)20..9753(04L)047/(-0.0633-55.0199(0)-54.9753(04L)TJ /8T3 Tc /R63 7.5					
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
80	120	-0.020	+0.048	+0.025	0.025T	0.069T	0.000	-0.02in.		

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ت			ر "H ▫ ئ				ر ▫			
ت ؤ		6 (1)	ت	▫			ت	▫		
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
– –	180 7.0866	-0.025 -0.0010	+0.022 +0.0008	-0.015 -0.0006	0.015T 0.0006T	0.046L 0.0018L	-0.025 -0.0010	-0.056 -0.0022	0.056T 0.0022T	0.000L 0.0000L
180 7.0866	200 7.8740	-0.030 -0.0012	+0.018 +0.0007	-0.018 -0.0007	0.018T 0.0007T	0.048L 0.0019L	-0.030 -0.0012	-0.066 -0.0026	0.066T 0.0026T	0.000L 0.0000L
200 7.874	230 9.0551	-0.030 -0.0012	+0.023 +0.0009	-0.018 -0.0007	0.018T 0.0007T	0.053L 0.0021L	-0.030 -0.0012	-0.066 -0.0026	0.066T 0.0026T	0.000L 0.0000L
230 9.0551	250 9.8425	-0.030 -0.0012	+0.028 +0.0011	-0.018 -0.0007	0.018T 0.0007T	0.058L 0.0023L	-0.030 -0.0012	-0.066 -0.0026	0.066T 0.0026T	0.000L 0.0000L
250 9.8425	270 10.6299	-0.036 -0.0014	+0.028 +0.0011	-0.018 -0.0007	0.018T 0.0007T	0.064L 0.0025L	-0.030 -0.0012	-0.071 -0.0028	0.071T 0.0028T	0.005L 0.0002L
270 10.6299	310 12.2047	-0.036 -0.0014	+0.033 +0.0013	-0.018 -0.0007	0.018T 0.0007T	0.069L 0.0027L	-0.036 -0.0014	-0.071 -0.0028	0.071T 0.0028T	0.005L 0.0002L
310 12.2047	400 15.7480	-0.041 -0.0016	+0.038 +0.0015	-0.018 -0.0007	0.018T 0.0007T	0.079L 0.0031L	-0.036 -0.0014	-0.076 -0.0030	0.079T 0.0030T	0.005L 0.0002L
400 15.748	440 17.3228	-0.046 -0.0018	+0.041 +0.0016	-0.023 -0.0009	0.023T 0.0009T	0.086L 0.0034L	-0.036 -0.0014	-0.086 -0.0034	0.086T 0.0034T	0.010L 0.0004L

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65. 5200

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	mm in.	**mm** in.	**mm** in.	**mm** in.
5220 WS	**121.064** 4.7663	**121.044** 4.7655	**121.036** 4.7652	**121.016** 4.7644
5222 WS	**133.007** 5.2365	**132.987** 5.2357	**132.969** 5.235	**132.949** 5.2343
5224 WS	**145.194** 5.7163	**145.174** 5.7155	**145.156** 5.7148	**145.136** 5.714
5226 WS	**155.042** 6.104	**155.016** 6.103	**155.004** 6.1025	**154.978** 6.1015
5228 WS				

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			g6			h6			h5			j5		
		(1)												
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
315.000 12.4016	**355.000** 13.9764	**-0.040** -0.0016	**-0.018** -0.0007	**-0.054** -0.0021	**0.054L** **0.022T** 0.0021L 0.0009T	**0.000** 0.0000	**-0.036** -0.0014	**0.036L** **0.040T** 0.0014L 0.0016T	–	–	–	**+0.007** +0.0003	**-0.018** -0.0007	**0.018L** **0.047T** 0.0007L 0.0019T
355.000 13.9764	**400.000** 15.7480	**-0.040** -0.0016	**-0.018** -0.0007	**-0.054** -0.0021	**0.054L** **0.022T** 0.0021L 0.0009T	**0.000** 0.0000	**-0.036** -0.0014	**0.036L** **0.040T** 0.0014L 0.0016T	–	–	–	**+0.007** +0.0003	**-0.018** -0.0007	**0.018L** **0.047T** 0.0007L 0.0019T
400.000 15.7480	**450.000** 17.7165	**-0.045** -0.0018	**-0.020** -0.0008	**-0.060** -0.0024	**0.060L** **0.025T** 0.0024L 0.0010T	**0.000** 0.0000	**-0.040** -0.0016	**0.040L** **0.045T** 0.0016L 0.0018T	–	–	–	**+0.007** +0.0003	**-0.020** -0.0008	**0.020L** **0.052T** 0.0008L 0.0021T
450.000 17.7165	**500.000** 19.6850	**-0.045** -0.0018	**-0.020** -0.0008	**-0.060** -0.0024	**0.060L** **0.025T** 0.0024L 0.0010T	**0.000** 0.0000	**-0.040** -0.0016	**0.040L** **0.045T** 0.0016L 0.0018T	–	–	–	**+0.007** +0.0003	**-0.020** -0.0008	**0.020L** **0.052T** 0.0008L 0.0020T
500.000 19.6850	**560.000** 22.0472	**-0.050** -0.0020	**-0.022** -0.0009	**-0.066** -0.0026	**0.066L** **0.028T** 0.0026L 0.0011T	**0.000** 0.0000	**-0.044** -0.0017	**0.044L** **0.050T** 0.0017L 0.0020T	–	–	–	**+0.008** 0.0003	**-0.022** -0.0009	**0.022L** **0.058T** 0.0009L 0.0023T
560.000 22.0472	**630.000** 24.8032	**-0.050** -0.0020	**-0.022** -0.0009	**-0.066** -0.0026	**0.066L** **0.028T** 0.0026L 0.0011T	**0.000** 0.0000	**-0.044** -0.0017	**0.044L** **0.050T** 0.0017L 0.0020T	–	–	–	**+0.008** +0.0003	**-0.022** -0.0009	**0.022L** **0.058T** 0.0009L 0.0023T
630.000 24.8032	**710.000** 27.9528	**-0.075** -0.0030	**-0.024** -0.0009	**-0.074** -0.0029	**0.074L** **0.051T** 0.0029L 0.0021T	**0.000** 0.0000	**-0.050** -0.0020	**0.050L** **0.075T** 0.0020L 0.0030T	–	–	–	**+0.010** +0.0004	**-0.025** -0.0010	**0.025L** **0.085T** 0.0010L 0.0035T
710.000 27.9528	**800.000** 31.4961	**-0.075** -0.0030	**-0.024** -0.0009	**-0.074** -0.0029	**0.074L** **0.051T** 0.0029L 0.0021T	**0.000** 0.0000	**-0.050** -0.0020	**0.050L** **0.075T** 0.0020L 0.0030T	–	–	–	**+0.010** +0.0004	**-0.025** -0.0010	**0.025L** **0.085T** 0.0010L 0.0035T
800.000 31.4961	**900.000** 35.4331	**-0.100** -0.0039	**-0.026** -0.0010	**-0.082** 0.0032	**0.082L** **0.074T** 0.0032L 0.0029T	**0.000** 0.0000	**-0.056** -0.0022	**0.056L** **0.100T** 0.0022L 0.0039T	–	–	–	**+0.012** +0.0005	**-0.028** -0.0011	**0.028L** **0.112T** 0.0011L 0.0044T
900.000 35.4331	**1000.000** 39.3701	**-0.100** -0.0039	**-0.026** -0.0010	**-0.082** 0.0032	**0.082L** **0.074T** 0.0032L 0.0029T	**0.000** 0.0000	**-0.056** -0.0022	**0.056L** **0.100T** 0.0022L 0.0039T	–	–	–	**+0.012** +0.0005	**-0.028** -0.0011	**0.028L** **0.112T** 0.0011L 0.0044T
1000.000 39.3701	**1120.000** 44.0945	**-0.125** -0.0049	**-0.028** -0.0011	**-0.094** -0.0037	**0.094L** **0.097T** 0.0037L 0.0038T	**0.000** 0.0000	**-0.066** -0.0026	**0.066L** **0.125T** 0.0022L 0.0039T	–	–	–	**+0.013** +0.0005	**-0.033** -0.0013	**0.033L** **0.138T** 0.0013L 0.0054T
1120.000 44.0945	**1250.000** 49.2126	**-0.125** -0.0049	**-0.028** -0.0011	**-0.094** -0.0037	**0.094L** **0.097T** 0.0037L 0.0038T	**0.000** 0.0000	**-0.066** -0.0026	**0.066L** **0.125T** 0.0022L 0.0039T	–	–	–	**+0.013** +0.0005	**-0.033** -0.0013	**0.033L** **0.138T** 0.0013L 0.0054T

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j6			k5			k6			m5		
○		□	○		□	○		□	○		□
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
+0.018 +0.0007	**-0.018** -0.0007	**0.018L** **0.058T** 0.0007L 0.0023T	**+0.029** +0.0011	**+0.046** +0.0002	**0.004T** **0.069T** 0.0002T 0.0027T	–	–	–	**+0.046** +0.0018	**+0.021** +0.0008	**0.021T** **0.086T** 0.0008T 0.0034T
+0.018 +0.0007	**-0.018** -0.0007	**0.018L** **0.058T** 0.0007L 0.0023T	**+0.029** +0.0011	**+0.004** +0.0002	**0.004T** **0.069T** 0.0002T 0.0027T	–	–	–	**+0.046** +0.0018	**+0.021** +0.0008	**0.021T** **0.086T** 0.0008T 0.0034T
+0.020 +0.0008	**-0.020** -0.0008	**0.020L** **0.065T** 0.0008L 0.0026T	**+0.032** +0.0013	**+0.005** +0.0002	**0.005T** **0.077T** 0.0002T 0.0031T	–	–	–	**+0.050** +0.0020	**+0.023** +0.0009	**0.023T** **0.095T** 0.0009T 0.0037T
+0.020 +0.0008	**-0.020** -0.0008	**0.020L** **0.065T** 0.0008L 0.0026T	**+0.032** +0.0013	**+0.005** +0.0002	**0.005T** **0.077T** 0.0002T 0.0031T	–	–	–	**+0.050** +0.0020	**+0.023** +0.0009	**0.023T** **0.095T** 0.0009T 0.0037T
+0.022 +0.0009	**-0.022** -0.0009	**0.022L** **0.072T** 0.0009L 0.0029T	**+0.030** +0.0012	**0.000** 0.0000	**0.00T** **0.080T** 0.0000T 0.0032T	–	–	–	**+0.056** +0.0022	**+0.026** +0.0010	**0.026T** **0.106T** 0.0010T 0.0042T
+0.022 +0.0009	**-0.022** -0.0009	**0.022L** **0.072T** 0.0009L 0.0029T	**+0.030** +0.0012	**0.000** 0.0000	**0.00T** **0.080T** 0.0000T 0.0032T	–	–	–	**+0.056** +0.0022	**+0.026** +0.0010	**0.026T** **0.106T** 0.0010T 0.0042T
+0.025 +0.0010	**-0.025** -0.0010	**0.025L** **0.100T** 0.0010L 0.0040T	**+0.035** +0.0014	**0.000** 0.0000	**0.000T** **0.110T** 0.0000T 0.0044T	–	–	–	**+0.065** +0.0026	**+0.030** +0.0012	**0.030T** **0.140T** 0.0012T 0.0056T
+0.025 +0.0010	**-0.025** -0.0010	**0.025L** **0.100T** 0.0010L 0.0040T	**+0.035** +0.0014	**0.000** 0.0000	**0.000T** **0.110T** 0.0000T 0.0044T	–	–	–	**+0.065** +0.0026	**+0.030** +0.0012	**0.030T** **0.140T** 0.0012T 0.0056T
+0.025 +0.0010	**-0.025** -0.0010	**0.028L** **0.128T** 0.0011L 0.0050L	**+0.040** +0.0016	**0.000** 0.0000	**0.000T** **0.140T** 0.0000T 0.0055T	–	–	–	**+0.074** +0.0029	**+0.0030** +0.0012	**0.034T** **0.174T** 0.0012T 0.0056T
+0.028 +0.0011	**-0.028** -0.0011	**0.028L** **0.128T** 0.0011L 0.0050T	**+0.040** +0.0016	**0.000** 0.0000	**0.000T** **0.140T** 0.0000T 0.0055T	–	–	–	**+0.074** +0.0029	**+0.034** +0.0013	**0.034T** **0.174T** 0.0013T 0.0068T
+0.028 +0.0011	**-0.028** -0.0011	**0.033L** **0.158T** 0.0013L 0.0062T	**+0.046** +0.0018	**0.000** 0.0000	**0.000T** **0.171T** 0.0000T 0.0067T	–	–	–	**+0.086** +0.0034	**+0.040** +0.0016	**0.040T** **0.211T** 0.0016T 0.0083T
+0.033 +0.0013	**-0.033** -0.0013	**0.033L** **0.158T** 0.0013L 0.0062T	**+0.046** +0.0018	**0.000** 0.0000	**0.000T** **0.171T** 0.0000T 0.0067T	–	–	–	**+0.086** +0.0034	**+0.040** +0.0016	**0.040T** **0.211T** 0.0016T 0.0083T

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10.000 0.3937	**18.000** 0.7087	**-0.008** -0.0003	**+0.034** +0.0013	**+0.016** +0.0006	**0.016L** **0.042L** 0.0006L 0.0016L	**+0.024** +0.0009	**+0.002** +0.0002	**0.006L** **0.032L** 0.0002L 0.0012L	**+0.011** +0.0004	**0.000** 0.0000	**0.000L** **0.019L** 0.0000L 0.0007L	**+0.018** +0.0007	**0.000** 0.0000	**0.000L** **0.026L** 0.0000L 0.0010L
					0.020L			**0.007L**			**0.000L**			**0.000L**

H8			J6			J7			K6			K7		
⌀		▫	⌀		▫	⌀		▫	⌀		▫	⌀		▫
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
+0.027 +0.0011	**0.000** 0.0000	**0.000L** **0.035L**	**+0.006**	**-0.005**	**0.005T** **0.014L**	**+0.10**	**-0.008**	**0.008T** **0.018L**	**+0.002**	**-0.009**	**0.009T** **0.010L**	**+0.006**	**-0.012**	**0.012T** **0.014L**

P6			P7		
	○	□		○	□
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
-0.015 -0.0006	**-0.026** -0.0010	**0.026T** **0.007T** 0.0010T 0.0003T	**-0.011** -0.0004	**-0.029** -0.0011	**0.029T** **0.003T** 0.0011T 0.0001T
-0.018 -0.0007	**-0.031** -0.0012	**0.031T** **0.009T** 0.0012T 0.00035T	**-0.014** -0.0006	**-0.035** -0.0014	**0.035T** **0.005T** 0.0014T 0.0025T
-0.021 -0.0008	**-0.037** -0.0015	**0.037T** **0.010T** 0.0015T 0.00035T	**-0.017** -0.0007	**-0.042** -0.0017	**0.042T** **0.006T** 0.0017T 0.0025T
-0.026 -0.0010	**-0.045** -0.0018	**0.045T** **0.013T** 0.0018T 0.0005T	**-0.021** -0.0008	**-0.051** -0.0020	**0.051T** **0.008T** 0.0020T 0.0003T
-0.030 -0.0012	**-0.052** -0.0020	**0.052T** **0.015T** 0.0020T 0.0006T	**-0.024** -0.0009	**-0.059** -0.0023	**0.059T** **0.009T** 0.0023T 0.0003T
-0.036 -0.0014	**-0.061** -0.0024	**0.061T** **0.018T** 0.0024T 0.0007T	**-0.028** -0.0011	**-0.068** -0.0027	**0.068T** **0.010T** 0.0027T 0.0004T
-0.036 -0.0014	**-0.061** -0.0024	**0.061T** **0.011T** 0.0024T 0.0004T	**-0.028** -0.0011	**-0.068** -0.0027	**0.068T** **0.003T** 0.0027T 0.0001T
-0.041 -0.0016	**-0.070** -0.0028	**0.070T** **0.011T** 0.0028T 0.0004T	**-0.033** -0.0013	**-0.079** -0.0031	**0.079T** **0.003T** 0.0031T 0.0001T
-0.047 -0.0019	**-0.079** -0.0031	**0.079T** **0.012T** 0.0031T 0.0005T	**-0.036** -0.0014	**-0.088** -0.0035	**0.088T** **0.001T** 0.0035T 0.0000T
-0.051 -0.0020	**-0.087** -0.0034	**0.087T** **0.011T** 0.0034T 0.0004T	**-0.041** -0.0016	**-0.098** -0.0039	**0.098T** **0.001T** 0.0039T 0.0000T
-0.055 -0.0022	**-0.095** -0.0037	**0.095T** **0.010T** 0.0037T 0.0004T	**-0.045** -0.0018	**-0.108** -0.0043	**0.108T** **0.000T** 0.0043T 0.0000T
-0.078 -0.0031	**-0.122** -0.0048	**0.122T** **0.028T** 0.0048T 0.0011T	**-0.078** -0.0031	**-0.148** -0.0058	**0.148T** **0.028T** 0.0058T 0.0011T



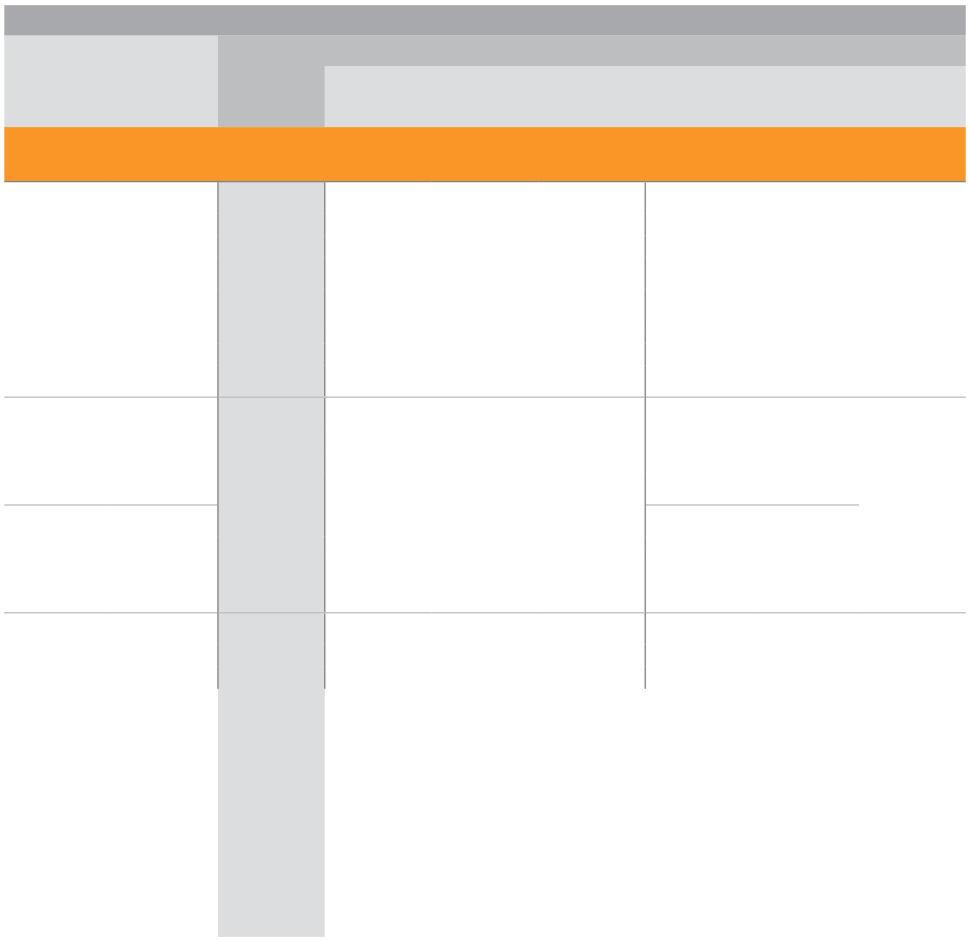
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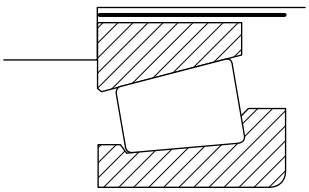
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10.000 0.3937	**18.000** 0.7087	**-0.012** **0.000** -0.0005 0.0000	**0.018** **0.007** 0.0007 0.0003	**0.030T** **0.007T** 0.0012T 0.0003T	m6	**+0.023** **+0.012** +0.0009 +0.0005	**0.035T** **0.012T** 0.0014T 0.0005T	n6
18.000 0.7087	**30.000** 11811	**-0.012** **0.000** -0.0005 0.0000	**0.021** **0.008** 0.0008 0.0003	**0.033T** **0.008T** 0.0013T 0.0003T	m6	**+0.028** **+0.015** +0.0011 0.0016T	**0.040T** **0.015T** 0.0016T 0.0016T	n6

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mm in.	mm in.		mm in.	mm in.		mm in.	mm in.		mm in.	mm in.	
0.000 **-0.011** 0.0000 -0.0004	**0.012T** **0.011L** 0.0005T 0.0004L	h6	**-0.006** **-0.017** -0.0002 -0.0007	**0.006T** **0.017L** 0.0002T 0.0007L	g6	**-0.006** **-0.017** -0.00025 -0.00065	**0.006T** **0.017L** -0.00025T 0.00065L	g6	**-0.016** **-0.027** -0.0006 -0.0011	**0.004L** **0.027L** 0.0002L 0.0011L	f6
0.000 **-0.013** 0.0000 -0.0005	**0.012T** **0.013L** 0.0005T 0.0005L	h6	**-0.007** **-0.020** -0.0003 -0.0008	**0.005T** **0.020L** 0.0002T 0.0008L	g6	**-0.007** **-0.020** -0.0003 -0.0008	**0.005T** **0.020L** 0.0002T 0.0008L	g6	**-0.020** **-0.033** -0.0008 -0.0013	**0.008L** **0.033L** 0.0003L 0.0013L	f6
0.000 **-0.016** 0.0000 -0.0006	**0.012T** **0.016L** 0.0005T 0.0006L	h6	**-0.009** **-0.025** -0.0004 -0.0010	**0.003T** **0.025L** 0.0001T 0.0010L	g6	**-0.009** **-0.025** -0.0004 -0.0010	**0.003T** **0.025L** 0.0001T 0.0010L	g6	**-0.025** **-0.041** -0.0010 -0.0016	**0.013L** **0.041L** 0.0005L 0.0016L	f6
0.000 **-0.019** 0.0000 -0.0007	**0.015T** **0.019L** 0.0006T 0.0007L	h6	**-0.010** **-0.029** -0.0004 -0.0011	**0.005T** **0.029L** 0.0002T 0.0011L	g6	**-0.010** **-0.029** -0.0004 -0.0011	**0.005T** **0.029L** 0.0002T 0.0011L	g6	**-0.030** **-0.049** -0.0012 -0.0019	**0.015L** **0.049L** 0.0006L 0.0019L	f6
0.000 **-0.022** 0.0000 -0.0009	**0.020T** **0.022L** 0.0008T 0.0009L	h6	**-0.012** **-0.034** -0.0005 -0.0014	**0.008T** **0.034L** 0.0003T 0.0014L	g6	**-0.012** **-0.034** -0.0005 -0.0014	**0.008T** **0.034L** 0.0003T 0.0014L	g6	**-0.036** **-0.058** -0.0014 -0.0023	**0.016L** **0.058L** 0.0006L 0.0023L	f6
0.000 **-0.025** 0.0000 -0.0010	**0.025T** **0.025L** 0.0010T 0.0010L	h6	**-0.014** **-0.039** -0.0006 -0.0016	**0.011T** **0.039L** 0.0004T 0.0016L	g6	**-0.014** **-0.039** -0.0006 -0.0016	**0.011T** **0.039** 0.0004T 0.0016L	g6	**-0.043** **-0.068** -0.0016 -0.0026	**0.018L** **0.068L** 0.0006L 0.0026L	f6
0.000 **-0.029** 0.0000 -0.0011	**0.030T** **0.029L** 0.0012T 0.0011L	h6	**-0.015** **-0.044** -0.0006 -0.0017	**0.015T** **0.044L** 0.0006T 0.0017L	g6	**-0.015** **-0.044** -0.0006 -0.0017	**0.015T** **0.044L** 0.0006T 0.0017L	g6	**-0.050** **-0.079** -0.0020 -0.0031	**0.020L** **0.079L** 0.0008L 0.0031L	f6
0.000 **-0.032** 0.0000 -0.0012	**0.035T** **0.032L** 0.0014T 0.0012L	h6	**-0.017** **-0.049** -0.0007 -0.0019	**0.018T** **0.049L** 0.0007T 0.0019L	g6	**-0.017** **-0.049** -0.0007 -0.0019	**0.018T** **0.049L** 0.0007T 0.0019L	g6	**-0.056** **-0.068** -0.0022 -0.0027	**0.021L** **0.088L** 0.0008L 0.0035L	f6





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+0.025 +0.013 +0.0010 +0.0005	0.025T 0.000 0.0010T 0.0000	+0.030 +0.018 +0.0012 +0.0007	0.030T 0.005T 0.0012T 0.0002T	+0.051 +0.038 +0.0020 +0.0015	0.051T 0.025T 0.0020T 0.0010T	+0.102 +0.064 +0.0040 +0.0025	0.102T 0.051T 0.0040T 0.0020T	+0.038 +0.025 +0.0015 +0.0010	0.038T 0.012T 0.0015T 0.0005T
+0.038 +0.013 +0.0015 +0.0005	0.038T 0.012T 0.0015T 0.0005T	–	–	+0.076 +0.051 +0.0030 +0.0020	0.076T 0.026T 0.0030T 0.0010T	+0.102 +0.076 +0.0040 +0.0025	0.102T 0.051T 0.0040T 0.0020T	+0.064 +0.038 +0.0025 +0.0015	0.064T 0.013T 0.0025T 0.0005T

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+0.038 +0.076 +0.0015 +0.0030	0.013L 0.076L 0.0005L 0.0030L	+0.025 +0.051 +0.0010 +0.0020	0.000 0.051L 0.0000 0.0020L	0.000 +0.025 0.000 +0.0010	0.025T 0.025L 0.0010T 0.0010L	-0.038 -0.013 -0.0015 -0.0005	0.063T 0.013T 0.0025T 0.0005T
+0.038 +0.076 +0.0015 +0.0030	0.013L 0.076L 0.0005L 0.0030L	+0.025 +0.051 +0.0010 +0.0020	0.000 0.051L 0.0000 0.0020L	0.000 +0.025 0.0000 +0.0010	0.025T 0.025L 0.0010T 0.0010L	-0.051 -0.025 -0.0020 -0.0010	0.076T 0.025T 0.0030T 0.0010T
–	–	0.000 +0.051 0.0000 +0.0020	0.025T 0.051L 0.0010T 0.0020L	0.000 +0.051 0.0000 +0.0020	0.025T 0.051L 0.0010T 0.0020L	-0.077 -0.025 -0.0030 -0.0010	0.102T 0.025T 0.0040T 0.0010T

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18.000 0.7087	**30.000** 11811	**-0.012** **0.000** -0.0005 0.0000	**-0.020** **-0.033** -0.0008 -0.0013	**0.008L** **0.033L** 0.0003L 0.0013L	f6	**+0.035** **+0.022** +0.0013 +0.0008	**0.047T** **0.022T** 0.0018T 0.0008T	p6	**+0.035** **+0.022** +0.0013 +0.0008	**0.047T** **0.022T** 0.0018T 0.0008T	p6
		-0.012	**-0.025**	**0.013L**	f6	**+0.042**	**0.054T**	p6			

mm in.	mm in.		mm in.	mm in.		mm in.	mm in.		mm in.	mm in.	mm in.	mm in.	
+0.015 **+0.002** +0.0006 +0.0001	**0.027T** **0.002T** 0.0011T 0.0001T	k6	**+0.015** **+0.002** +0.0006 +0.0001	**0.027T** **0.002T** 0.0011T 0.0001T	k6	**+0.035** **+0.022** +0.0013 +0.0009	**0.047T** **0.022T** 0.0018T 0.0009T	p6	**+0.056** **+0.035** +0.0022 +0.0014	**0.068T** **0.035T** 0.0027T 0.0014T	**+0.021** **+0.008** +0.0008 +0.0003	**0.033T** **0.008T** 0.0013T 0.0003T	m6
+0.018 **+0.002** +0.0007 +0.0001	**0.030T** **0.002T** 0.0012T 0.0001T	k6	**+0.018** **+0.002** +0.0007 +0.0001	**0.030T** **0.002T** 0.0012T 0.0001T	k6	**+0.042** **+0.026** +0.0016 +0.0010	**0.054T** **0.026T** 0.0021T 0.0010T	p6	**+0.068** **+0.043** +0.0028 +0.0018	**0.080T** **0.043T** 0.0033T 0.0018T	**+0.025** **+0.009** +0.0010 +0.0004	**0.037T** **0.009T** 0.0015T 0.0004T	m6
+0.021 **+0.002** +0.0008 -0.0001	**0.036T** **0.002T** 0.0014T 0.0001L	k6	**+0.021** **+0.002** +0.0008 +0.0001	**0.036T** **0.002T** 0.0014T 0.0001L	k6	**+0.051** **+0.032** +0.021 +0.014	**0.066T** **0.032T** 0.0027T 0.0014T	p6	**+0.0089** **+0.059** +0.0034 +0.0022	**0.104T** **0.059T** 0.0040T 0.0022T	**+0.030** **+0.011** +0.0012 +0.0004	**0.045T** **0.011T** 0.0018T 0.0004T	m6
+0.013 **-0.009** +0.0005 -0.0004	**0.033T** **0.009L** 0.0013T 0.0004L	j6	–	–	–	**+0.045** **+0.023** +0.0019 +0.0010	**0.065T** **0.023T** 0.0027T 0.0010T	n6	**+0.114** **+0.079** +0.0044 +0.0030	**0.134T** **0.079T** 0.0052T 0.0030T	**+0.035** **+0.013** +0.0014 +0.0005	**0.055T** **0.013T** 0.0022T 0.0005T	m6
+0.014 **-0.011** +0.0006 -0.0004	**0.039T** **0.011L** 0.0016T 0.0004L	j6	–	–	–	**+0.052** **+0.028** +0.0022 +0.0012	**0.077T** **0.029T** 0.0032T 0.0012T	n6	**+0.140** **+0.100** +0.0056 +0.0040	**0.165T** **0.100T** 0.0066T 0.0040T	**+0.040** **+0.015** +0.0016 +0.0006	**0.066T** **0.015T** 0.0026T 0.0006T	–

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180.000 7.0866	200.000 7.8740	0.000 -0.030 0.0000 -0.0012	-0.106 -0.060 -0.0042 -0.0024	0.106T 0.030T 0.0042T 0.0012T											-0.106 -0.060 -0.0042 -0.0024	0.106T 0.030T 0.0042T 0.0012T	
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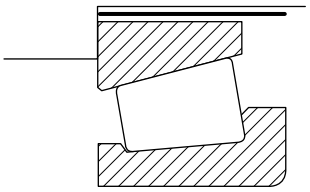
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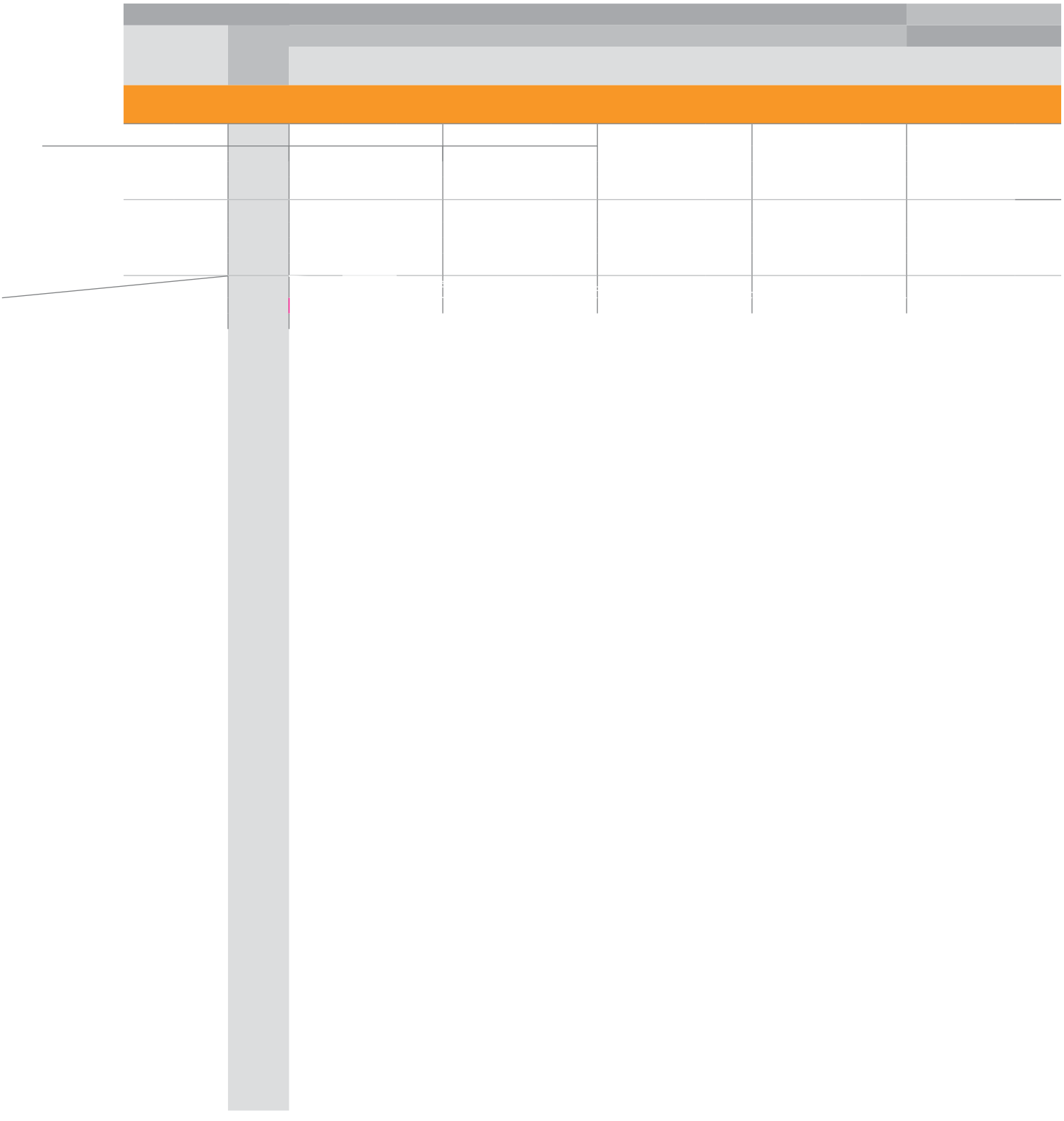
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80.000 3.1496	**120.000** 4.7244	**0.000** **-0.013** 0.0000 -0.0005	**-0.023** **-0.008** -0.0009 -0.0003	**0.023T** **0.005L** 0.0009T 0.0002L	M5	**0.000** **-0.010** 0.0000 -0.0004	**-0.023** **-0.008** -0.0009 -0.0003	**0.023T** **0.002L** 0.0009T 0.0001L	M5
120.000 4.7244	**180.000** 7.0866	**0.000** **-0.013** 0.0000 -0.0005	**-0.027** **-0.009** -0.0011 -0.0004	**0.027T** **0.004L** 0.0011T 0.0001L	M5	**0.000** **-0.010** 0.0000 -0.0004	**-0.027** **-0.009** -0.0011 -0.0004	**0.027T** **0.001L** 0.0011T 0.0000	M5
180.000 7.0866	**250.000** 9.8425	**0.000** **-0.015** 0.0000 -0.0006	**-0.031** **-0.011** -0.0012 -0.0004	**0.031T** **0.004L** 0.0012T 0.0002L	M5	**0.000** **-0.013** 0.0000 -0.0005	**-0.031** **-0.011** -0.0012 -0.0004	**0.031T** **0.002L** 0.0012T 0.0001L	M5
250.000 9.8425	**315.000** 12.4016	**0.000** **-0.020** 0.0000 -0.0008	**-0.036** **-0.013** -0.0014 -0.0005	**0.036T** **0.007L** 0.0014T 0.0003L	M5	**0.000** **-0.015** 0.0000 -0.0006	**-0.036** **-0.013** -0.0014 -0.0005	**0.036T** **0.002L** 0.0014T 0.0001L	M5
315.000 12.4016	**400.000** 15.7480	**0.000** **-0.020** 0.0000 -0.0008	**-0.039** **-0.014** -0.0015 -0.0006	**0.039T** **0.006L** 0.0015T 0.0002L	M5	–	–	–	–

ISO J

B ( )



T=
L =



86. — —

3 0( )

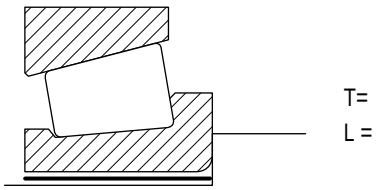
87.

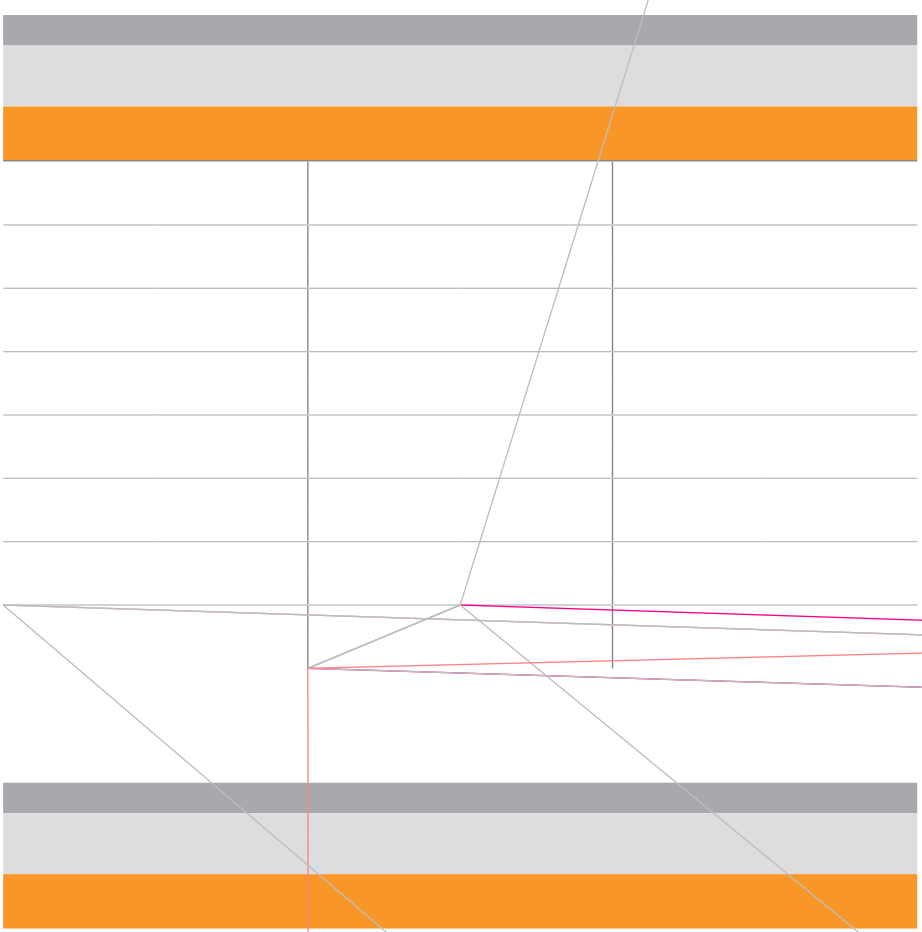
A AA ( )

mm in.	mm in.	mm in.	mm in.	mm in.			mm in.	mm in.			mm in.	mm in.			mm in.	mm in.			
		0.000	+0.008	0.008L		–	0.000	0.000		–	-0.008	0.008T		–	-0.016	0.016T			

ISO J

C

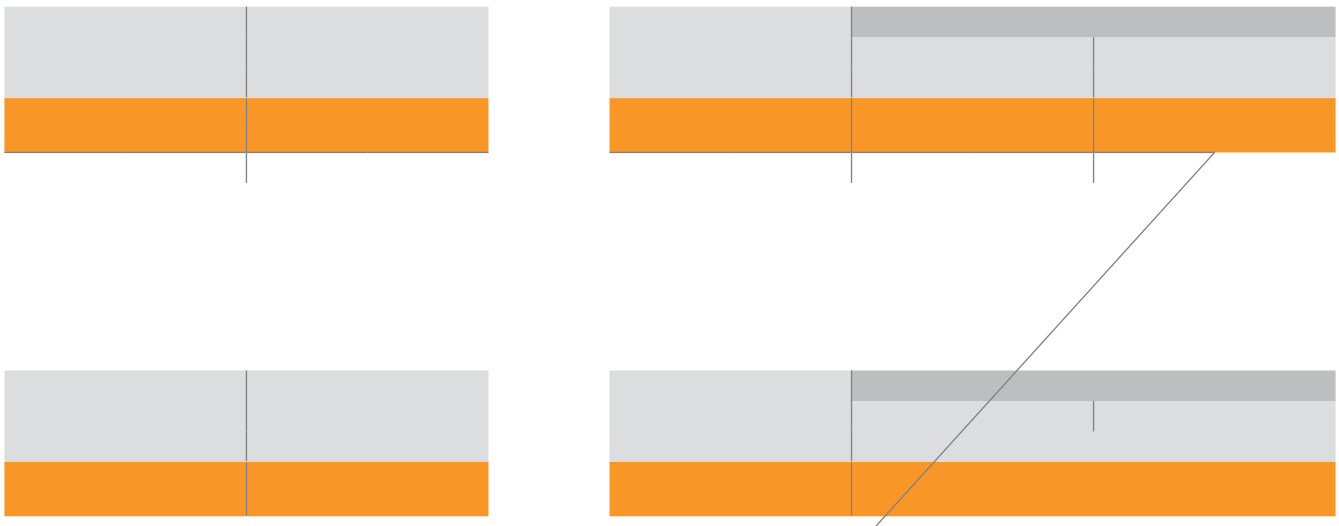




95. TXR – –

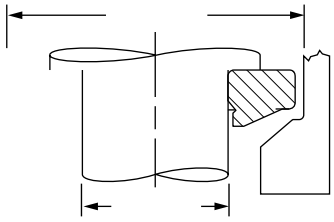
TXR 3 0( )

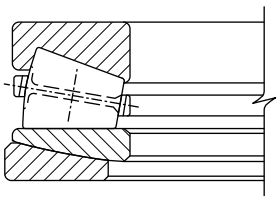
ت		è ă 3		è ă 0	
ώ ؤ					
mm in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.	**mm** in.
– –	**304.800** 12.0000	**0.037T** 0.0015T	**0.013T** 0.0005T	**0.020T** 0.0008T	**0.007T** 0.0003T
304.800 12.0000	**609.600** 24.0000	**0.077T** 0.0030T	**0.025T** 0.0010T	**0.037T** 0.0015T	**0.013T** 0.0005T
609.600	**914.400**	**0.114T**	**0.037T**	–	–



(1)

(2)





(1) 6 ώ +0 Ă ˘ ˇ

-
2.5mm 0.1 in.

- TTHD
0.25 0.37 mm (0.01
0.015 in.)

- TTHDFL
TTHD
0.025mm
0.076 mm

109

110

/

120 C

3 RC

Timken

111

Timken® -54 C 120 C

200 C

150 C

DIN 623

109.

ă	“ n 'H	
	°C	°F
S0	150	302
S1	200	392
S2	250	482
S3	300	572
S4	350	662

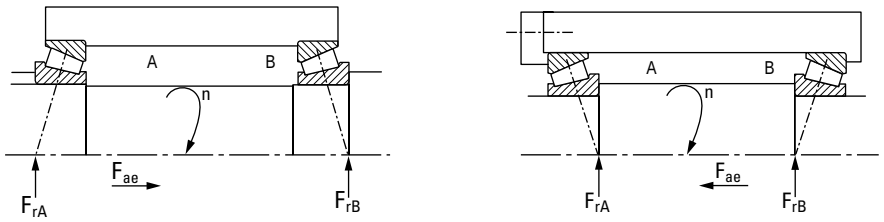
191

20 C 35 C

93 C 100 C

				-73° C -100° F	-54° C -65° F	-17° C 0° F	38° C 100° F	93° C 200° F	121° C 250° F	149° C 300° F	204° C 400° F	260° C 500° F	316° C 600° F	371° C 700° F	427° C 800° F
2 ASTM A295 52100	1C 0.5–1.5Cr 0.35Mn	70	60		100° C 2500 < 0.0001mm/mm										
2 ASTM A295 52100	1C 0.5–1.5Cr 0.35Mn	70 350 450	58 56 54	FS136 < 0.0001mm/mm A295 177 232 177 316 1 4 9 2500											
ASTM A485	1C 1–1.8Cr														

—— M



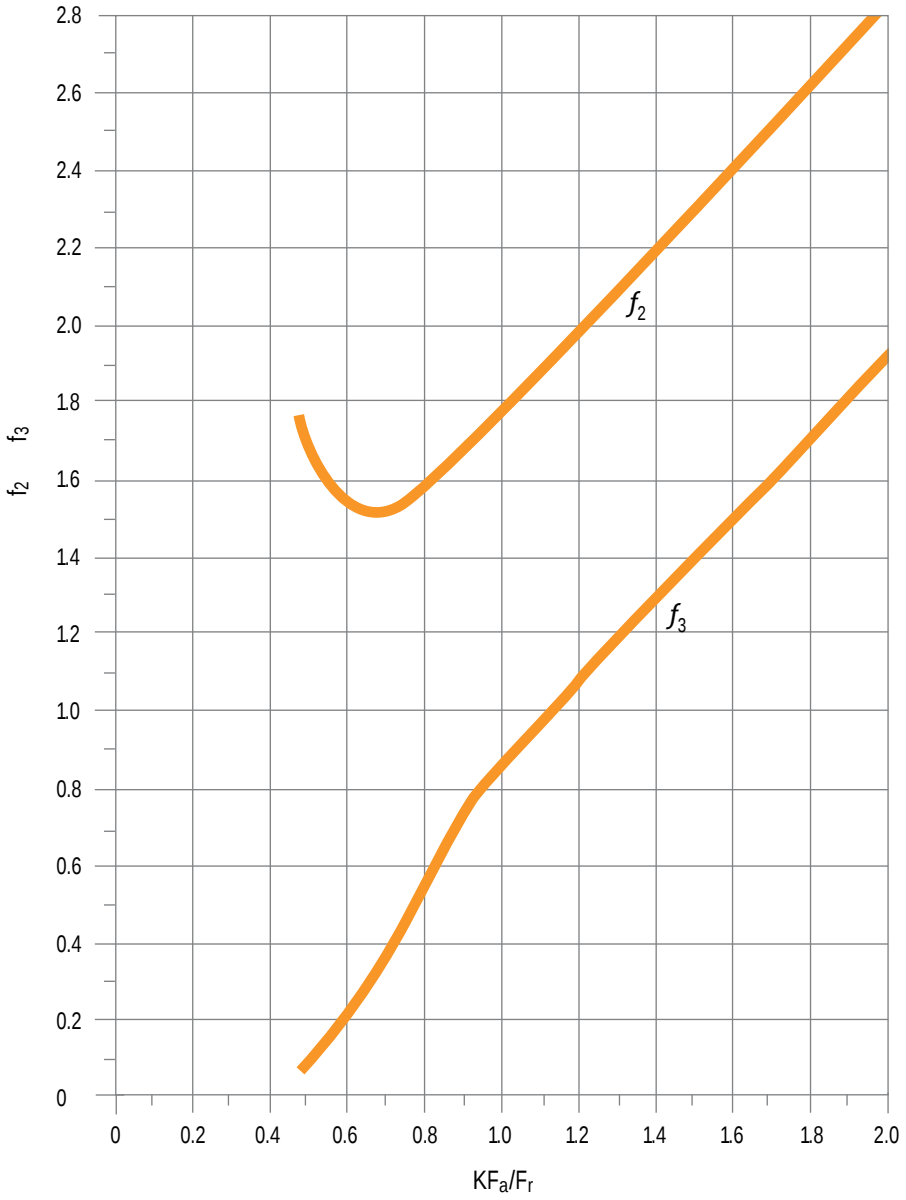
(Fae A)

139.

112.

▒ ℵ	ↄ ▒	
$\frac{0.47\,F_{rA}}{K_A} \le \frac{0.47\,F_{rB}}{K_B} + F_{ae}$	$F_{aA} = \frac{0.47\,F_{rB}}{K_B} + F_{ae}$ $F_{aB} = \frac{0.47\,F_{rB}}{K_B}$	$M = k_1 G_1 (n \mu)^{0.62} \left(\frac{f_3 F_r}{K}\right)^{0.3}$ $n_{min} = \frac{k_2}{G_2 \mu}\left(\frac{f_2 F_r}{K}\right)^{2/3}$
$\frac{0.47\,F_{rA}}{K_A} > \frac{0.47\,F_{rB}}{K_B} + F_{ae}$	$F_{aA} = \frac{0.47\,F_{rA}}{K_A}$ $F_{aB} = \frac{0.47\,F_{rA}}{K_A} - F_{ae}$	

n_{min} f_2 f_3 182 142



▒ x	f3 f2
KFa/Fr > 2.0	f3 = KFa/Fr f2 = f3 + 0.8
0.47 ≤ KFa/Fr ≤ 2.0	
KFa/Fr < 0.47	f3 = 0.06 f3 = 1.78

142. f_3 f_2

ISO/ASTM Ч è ě ď

$$M = \begin{Bmatrix} f_1 F_{\beta} dm + 10^{-7} f_0 (v \times n)^{2/3} dm^3 & | & (v \times n) \geq 2000 \\ f_1 F_{\beta} dm + 160 \times 10^{-7} f_0 dm^3 & | & (v \times n) < 2000 \end{Bmatrix}$$

FB

$$F_{\beta} = \max \begin{pmatrix} 0.9F_a \cot \alpha - 0.1F_r \\ \text{or} \\ F_r \end{pmatrix}$$

$$F_{\beta} = \max \begin{pmatrix} 0.8F_a \cot \alpha \\ \text{or} \\ F_r \end{pmatrix}$$

$F_{\beta} = F_a$

114.

		f_0	f_1
	18	1.7	0.00010
	28	1.7	0.00010
	38	1.7	0.00010
	39	1.7	0.00015
	00	1.7	0.00015
	02	2	0.00020
	03	2.3	0.00020
	04	2.3	0.00020
$22^\circ < \alpha \leq 45^\circ$	02	2	0.00025
	03	3	0.00035
	32	5	0.00035
	33	7	0.00035
	02	2	0.00037
	03	3	0.00037
	10	2	0.00020
	02	2	0.00030
	22	3	0.00040
	03	2	0.00035
	23	4	0.00040
	04	2	0.00040
	18	5	0.00055
	29	6	0.00055
	30	7	0.00055
	22	8	0.00055
	23	12	0.00055
	30	4.5	0.00017
	39	4.5	0.00017
	40	6.5	0.00027
	31	5.5	0.00027
	41	7	0.00049
	22	4	0.00019
	32	6	0.00036
	03	3.5	0.00019
	23	4.5	0.00030
	48	9	0.00055
	49	11	0.00055
	50	13	0.00055
	11	3	0.00150
	12	4	0.00150
	92	2.5	0.00023
	93	2.5	0.00023
	94	3	0.00030

ISO P0

ISO P5

115 **/ Timken®**

mm

mm

186 **116**

mm **RPM**

115.

30	□S	□	9100 □9300	1.3
200	5200	□7200		1.5
300	5300	□7300		1.7

- **70 12cSt ISOVG32**
  70 22 cSt 70
  20
-
-
-

116.
dm* X N (mm X RPM

■/ ᴗ	ᵍ	ISO P0		ISO P6			ISO P5 ☐ 4		
		▲	▲ (1)	▲	▲ (1)	Grease	▲	= (1)	
9300K, 9100K 200K,	⌂ ǎ ᵍ PRB	250000	300000	250000	300000	–	300000	300000	300000

* +
2

(1) 1/ 3-1/2
300,000 PDN

RR

144

$$V_r = \frac{\pi D_m n}{60000} \quad \text{(m/s)}$$

$$= \frac{\pi D_m n}{12} \quad \text{(ft/min)}$$

D_m = mm,in.

n = rev/min



99%

DN [mm rev/min

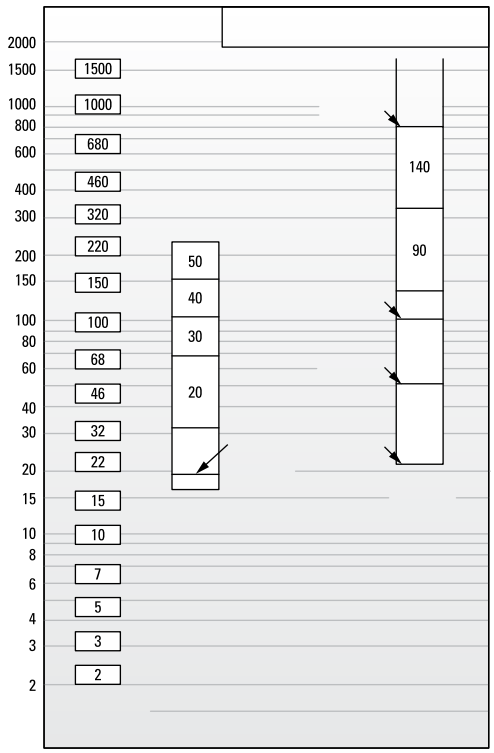
SUS	R ′	E	cSt
35	32.2	1.18	2.7
40	36.2	1.32	4.3
45	40.6	1.46	5.9
50	44.9	1.60	7.4
55	49.1	1.75	8.9
60	53.5	1.88	10.4
65	57.9	2.02	11.8
70	62.3	2.15	13.1
75	67.6	2.31	14.5
80	71.0	2.42	15.8
85	75.1	2.55	17.0
90	79.6	2.68	18.2
95	84.2	2.81	19.4
100	88.4	2.95	20.6
110	97.1	3.21	23.0
120	105.9	3.49	25.0
130	114.8	3.77	27.5
140	123.6	4.04	29.8
150	132.4	4.32	32.1
160	141.1	4.59	34.3
170	150.0	4.88	36.5
180	158.8	5.15	38.8
190	167.5	5.44	41.0
200	176.4	5.72	43.2
220	194.0	6.28	47.5
240	212	6.85	51.9
260	229	7.38	56.5
280	247	7.95	60.5
300	265	8.51	64.9
325	287	9.24	70.3
350	309	9.95	75.8
375	331	10.7	81.2
400	353	11.4	86.8
425	375	12.1	92.0

SUS	R ′	E	cSt
450	397	12.8	97.4
475	419	13.5	103
500	441	14.2	108
550	485	15.6	119
600	529	17.0	130
650	573	18.5	141
700	617	19.9	152
750	661	21.3	163
800	705	22.7	173
850	749	24.2	184
900	793	25.6	195
950	837	27.0	206
1000	882	28.4	217
1200	1058	34.1	260

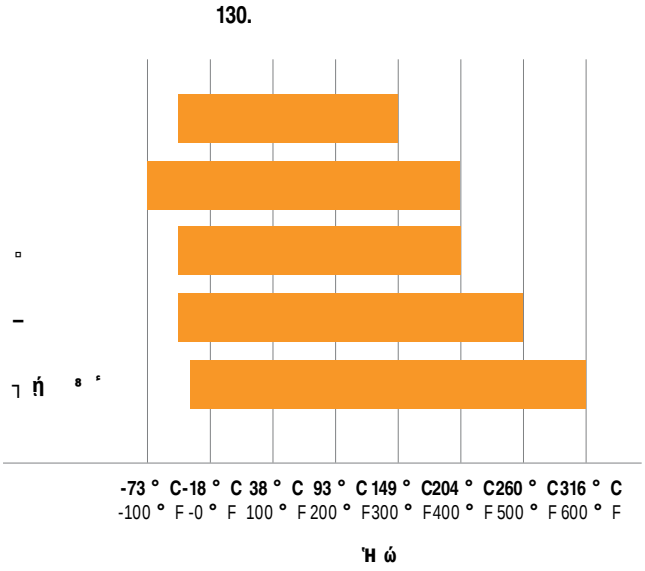


185-187

125.


2000
1500
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6
4
3
2
1500
1000
680
460
320
220
150
100
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90

121 C

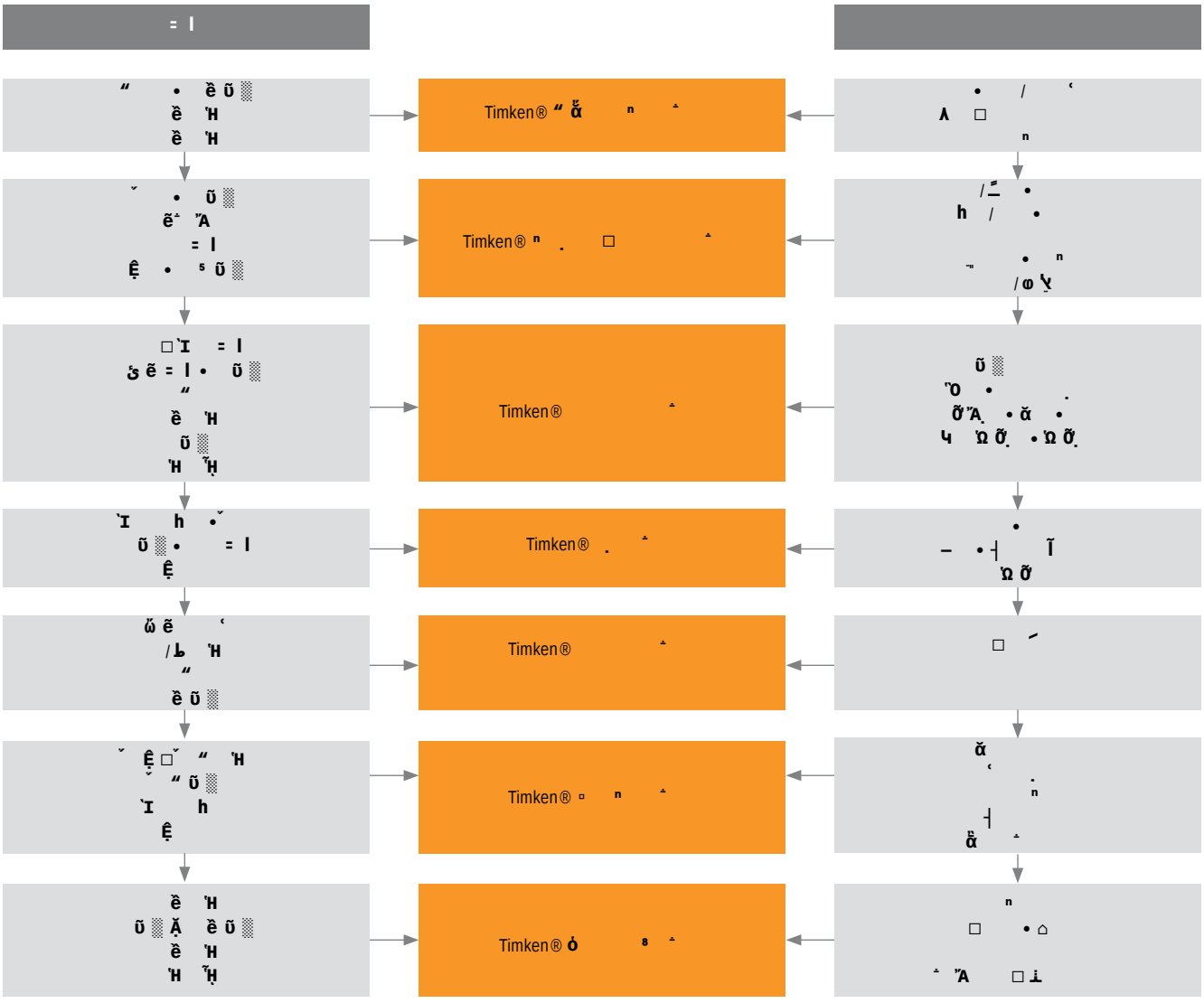

130.
▫
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ㄱ ṅ ⁸ ˢ
-73 ° C -18 ° C 38 ° C 93 ° C 149 ° C204 ° C260 ° C316 ° C
-100 ° F -0 ° F 100 ° F 200 ° F300 ° F400 ° F 500 ° F 600 ° F
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J.

Timken®

131 **Timken®** **Timken®**

131.



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-
-
- /
-



147.



148.

147

148

(NLGI)

133. NLGI

NLGI	
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

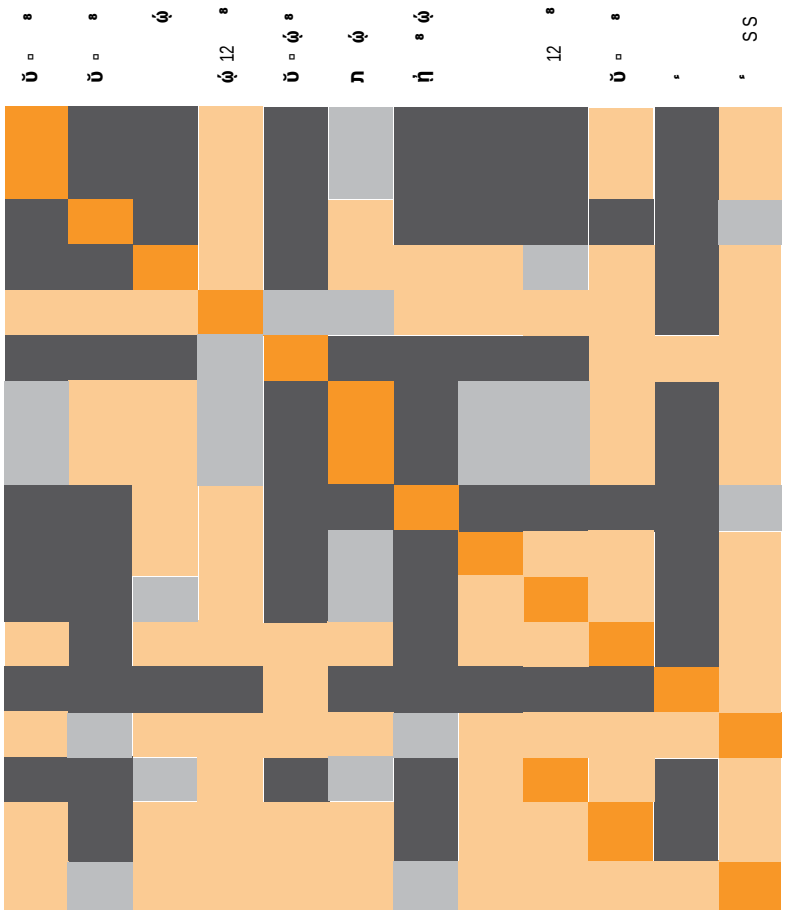
( )

132

132. TIM KEN

		-34 ° C to +135 ° C (-30 ° F to +275 ° F)
		-34 ° C to +135 ° C (-30 ° F to +275 ° F)
		-54 ° C to +163 ° C (-65 ° F to +325 ° F)

1/10mm





149

150

Timken®

0.5

-0.6mm 3mm

151 152

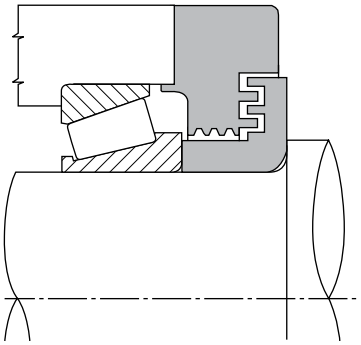
152

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154

153

135



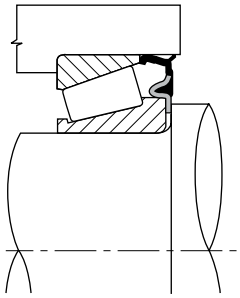
153.

" DUO- FACE® PLUS "

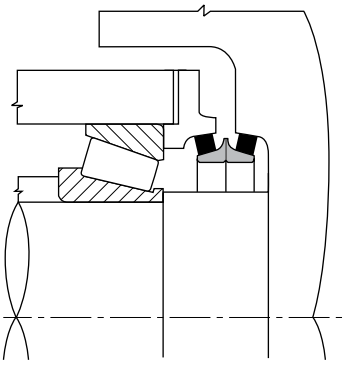
DUO -FACE®PLUS **156** **159**

DUO - FACE®PLUS

DUO - FACE®PLUS



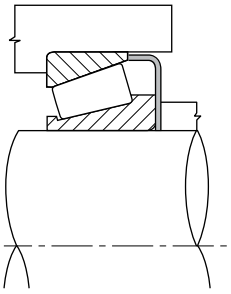
156. DUO FACE® -PLUS



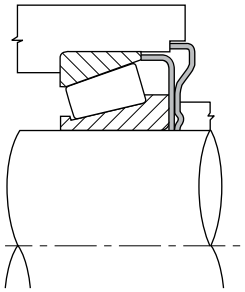
159.

157 **V**

158 **V**

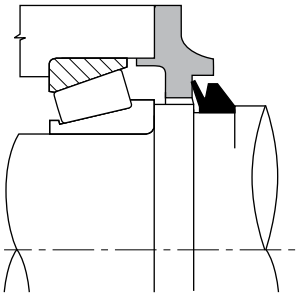


157.



158.

160 **V**



160. V

161. 1 — — D 162. 2 — — DD

T

1 **T**
TD **TT**

T **TD**

P

P **PP**

P

W- PP
W **PP**

171

168. **T.** **169.** **TD.**



PP **P** **PP**

170.



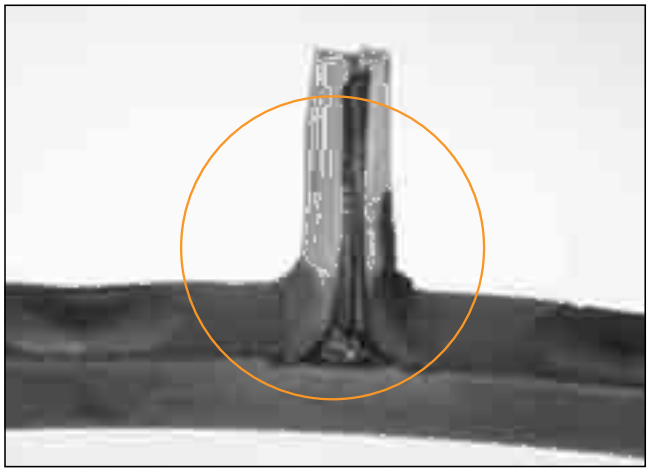
171. **W-PP**



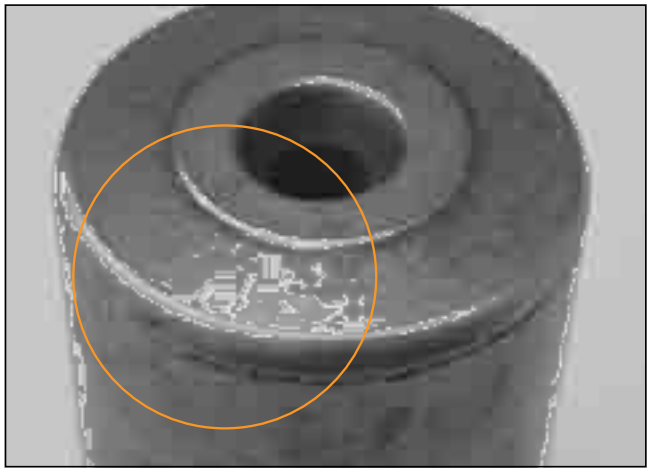
173. R R



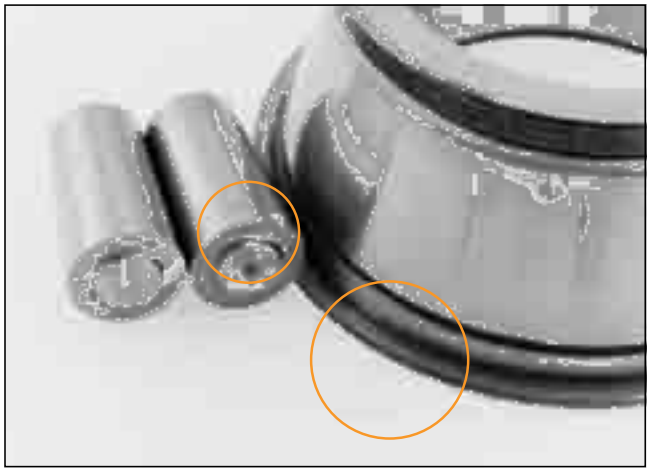
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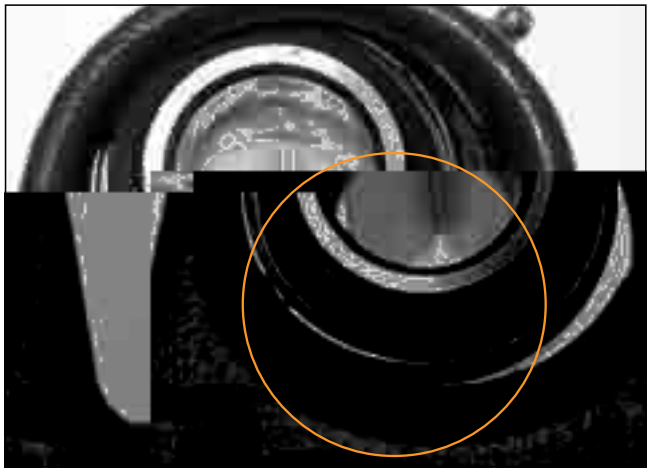
175.



176.



177.



178.



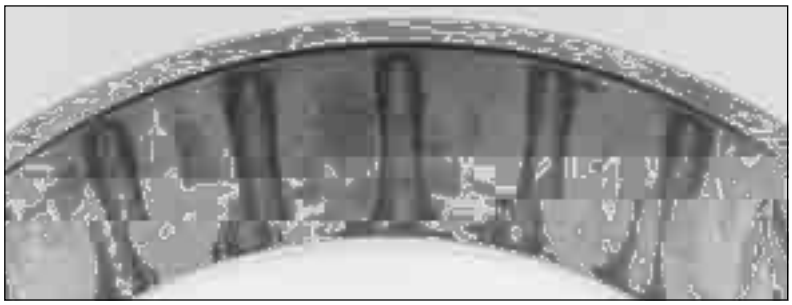
180.



182.

183

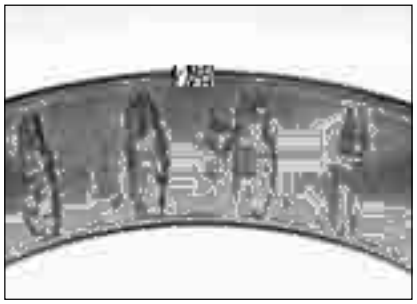
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186.



187.



188.



189.

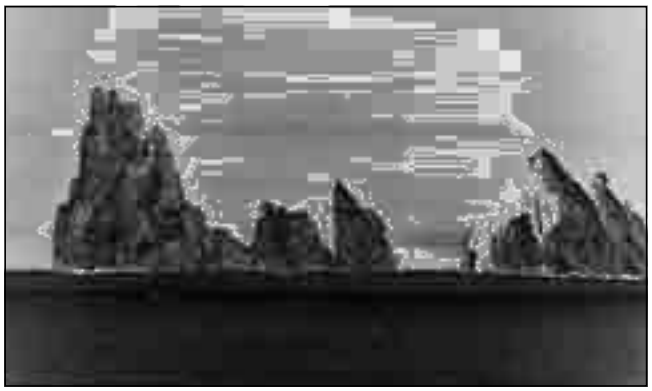


190.

(PSO)

(GSC)

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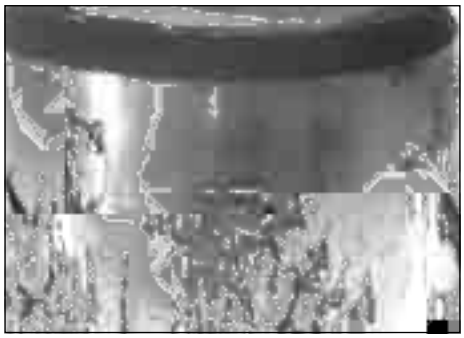


197.



198.

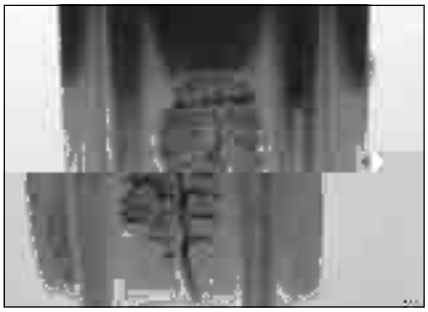
210



199.



200.



201.



202.



203.



204.



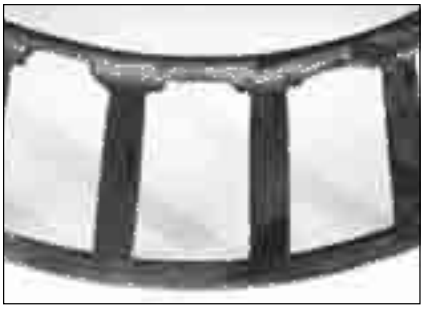
205.



206.



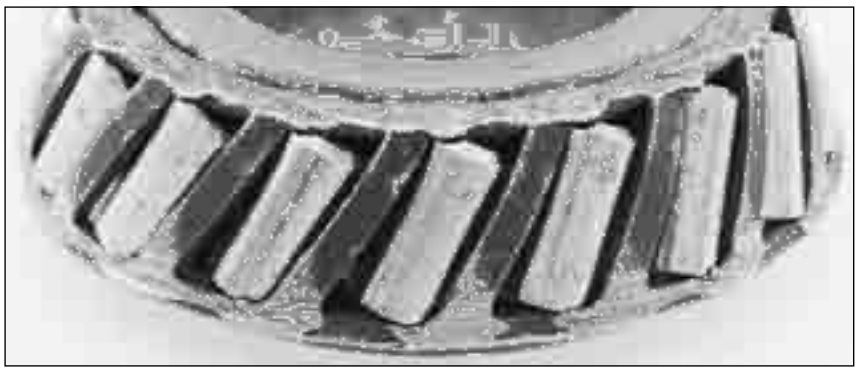
207.



208.



217.



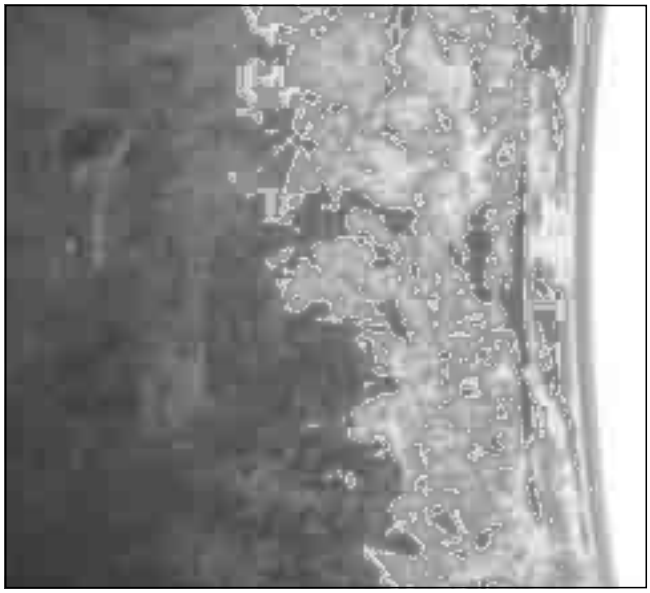
218.



219.



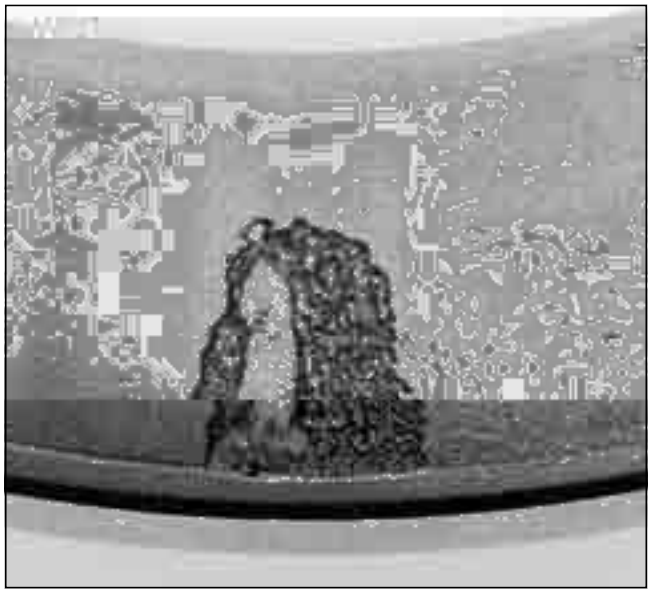
220.



221.



222.



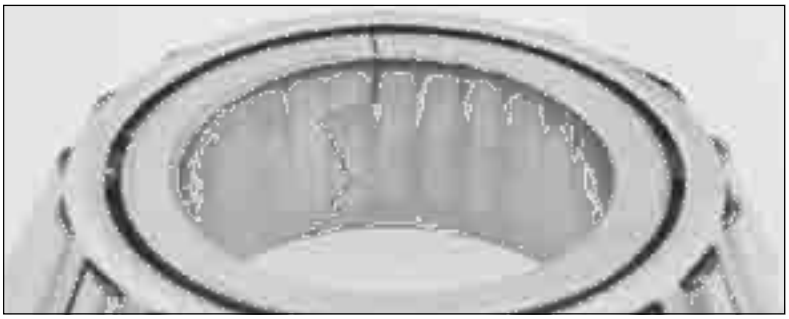
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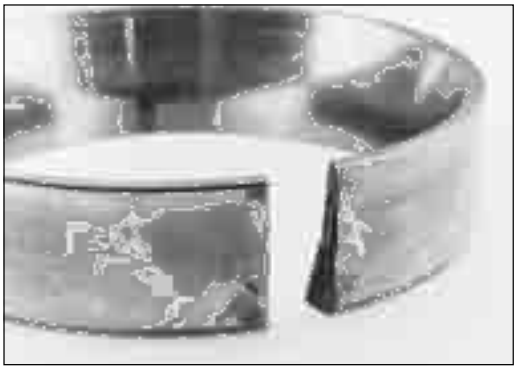
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225.



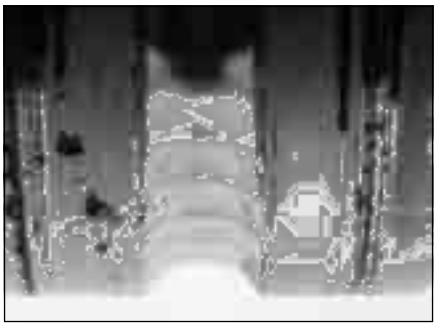
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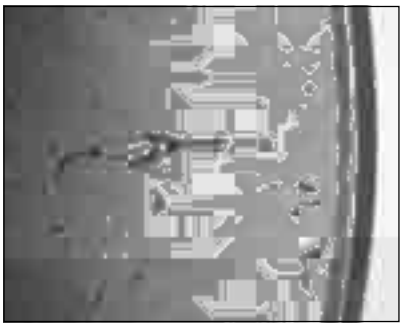


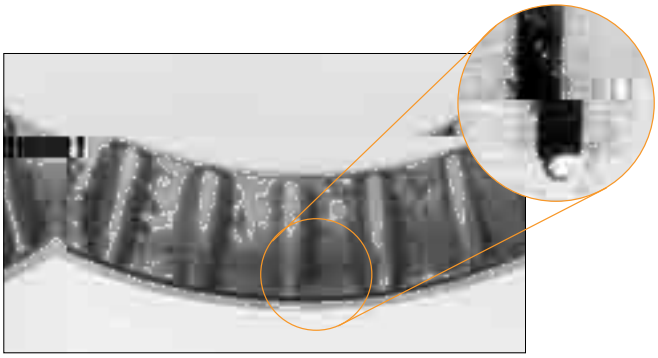
227.

229A **229B**

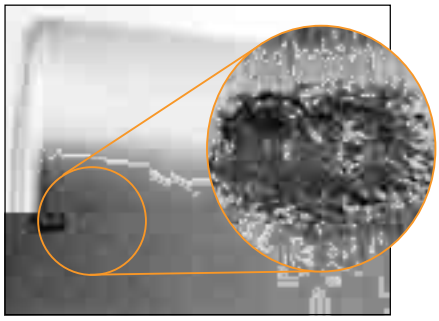








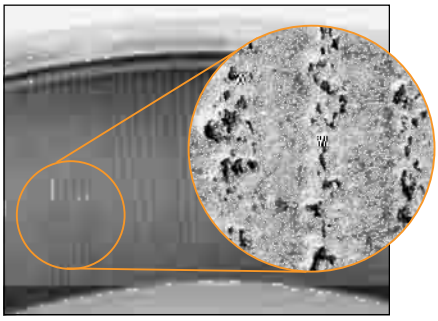
233.



234. 10



235.



236. 10