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All figures given are as a guide only and no responsibility is taken by HPC Gears Ltd for the use thereof.  
For confirmation of any values please refer to British Standards.



# TAPPED HOLES & THREADS

## METRIC

BORE or SHAFT Ø	KEYWAY	PIN HOLE Ø	GRUB SCREW
OVER UPTO			
4 - 6	-	1.50	M3
6 - 8	K2	2.00	M3
8 - 10	K3	3.00	M3
10 - 12	K4	4.00	M4
12 - 17	K5	5.00	M5
17 - 22	K6	6.00	M6
22 - 30	K8	8.00	M8
30 - 38	K10	10.00	M10
38 - 44	K12	10.00	M10
44 - 50	K14	10.00	M12
50 - 58	K16	10.00	M12

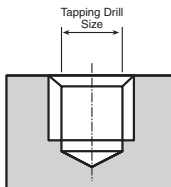
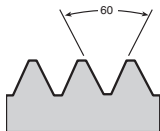
## IMPERIAL

BORE or SHAFT Ø (inches)	PIN HOLE Ø (inches)	GRUB SCREW
OVER UP TO		
0.156 - 0.312	0.031	M2.5
0.313 - 0.437	0.062	M3
0.438 - 0.562	0.125	M4
0.563 - 0.875	0.187	M5
0.876 - 1.250	0.250	M6
1.251 - 1.375	0.250	M8
1.376 - 1.750	0.375	M10
1.751 - 2.250	0.500	M12







Diameter of Shaft		Key size
Over	Up to and including	W x T
1/4	1/2	1/8 x 1/8
1/2	3/4	3/16 x 3/16
3/4	1	1/4 x 1/4
1	1 1/4	5/16 x 5/16
1 1/4	1 1/2	3/8 x 3/8
1 1/2	1 3/4	7/16 x 7/16
1 3/4	2	1/2 x 1/2
2	2 1/2	5/8 x 5/8
2 1/2	3	3/4 x 3/4

## METRIC THREAD

TAPPING DRILL Ø (mm)	THREAD	PITCH (mm)	OUTSIDE Ø (mm)
1.60	M2	0.40	2.00
2.05	M2.5	0.45	2.50
2.50	M3	0.50	3.00
3.30	M4	0.70	4.00
4.20	M5	0.80	5.00
5.00	M6	1.00	6.00
6.00	M7	1.00	7.00
6.80	M8	1.25	8.00
8.50	M10	1.50	10.00
10.20	M12	1.75	12.00
12.00	M14	2.00	14.00
14.00	M16	2.00	16.00
15.50	M18	2.50	18.00
17.50	M20	2.50	20.00
19.50	M22	2.50	22.00
21.00	M24	3.00	24.00



# THREADS IMPERIAL

THREAD	Ø Hole for Tapping	Pitch mm	(TPI)	ØD mm	THREAD	Ø Hole for Tapping	Pitch mm	(TPI)	ØD mm
<b>UNF</b> 60° 					<b>BSP</b> 55° 				
2-64 UNF	1.90	0.40	64	2.18	1/8 BSP	8.75	0.91	28	9.73
3-56 UNF	2.15	0.45	56	2.51	1/4 BSP	11.80	1.34	19	13.16
4-48 UNF	2.40	0.53	48	2.84	3/8 BSP	15.25	1.34	19	16.66
6-40 UNF	2.95	0.64	40	3.51	1/2 BSP	19.05	1.81	14	20.96
8-36 UNF	3.55	0.71	36	4.17	5/8 BSP	21.03	1.81	14	22.91
10-32 UNF	4.10	0.79	32	4.83	3/4 BSP	24.50	1.81	14	26.44
12-28 UNF	4.65	0.91	28	5.49	7/8 BSP	28.25	1.81	14	30.20
1/4-28 UNF	5.50	0.91	28	6.35	1 BSP	30.75	2.31	11	33.25
5/16-24 UNF	6.90	1.06	24	7.94	1 1/4 BSP	39.50	2.31	11	41.91
3/8-24 UNF	8.50	1.06	24	9.53	1 1/2 BSP	45.24	2.31	11	47.80
7/16-20 UNF	9.90	1.27	20	11.11	1 3/4 BSP	51.00	2.31	11	53.75
1/2-20 UNF	11.50	1.27	20	12.70	2 BSP	57.00	2.31	11	59.61
9/16-18 UNF	12.90	1.41	18	14.29					
5/8-18 UNF	14.50	1.41	18	15.88	<b>BSF</b> 55° 				
3/4-16 UNF	17.46	1.59	16	19.05	3/16 BSF	4.00	0.79	32	4.76
7/8-14 UNF	20.42	1.81	14	22.23	1/4 BSF	5.30	0.98	26	6.35
1-12 UNF	23.25	2.12	12	25.40	5/16 BSF	6.80	1.15	22	7.94
					3/8 BSF	8.25	1.27	20	9.53
<b>UNC</b> 60° 					7/16 BSF	9.70	1.41	18	11.11
2-56 UNC	1.85	0.45	56	2.18	1/2 BSF	11.11	1.59	16	12.70
3-48 UNC	2.10	0.53	48	2.51	9/16 BSF	12.70	1.59	16	14.29
4-40 UNC	2.35	0.64	40	2.84	5/8 BSF	14.00	1.84	14	15.88
6-32 UNC	2.84	0.79	32	3.51	3/4 BSF	16.75	2.12	12	19.05
8-32 UNC	3.50	0.79	32	4.17	7/8 BSF	19.75	2.31	11	22.23
10-24 UNC	3.90	1.06	24	4.83	1 BSF	22.75	2.54	10	25.40
12-24 UNC	4.55	1.06	24	5.49					
1/4-20 UNC	5.10	1.27	20	6.35	<b>BSW</b> 55° 				
5/16-18 UNC	6.60	1.41	18	7.94	1/8 BSW	2.55	0.64	40	3.18
3/8-16 UNC	8.00	1.59	16	9.53	3/16 BSW	3.70	1.06	24	4.76
7/16-14 UNC	9.40	1.81	14	11.11	1/4 BSW	5.10	1.27	20	6.35
1/2-13 UNC	10.80	1.95	13	12.70	5/16 BSW	6.50	1.41	18	7.94
9/16-12 UNC	12.20	2.12	12	14.29	3/8 BSW	7.94	1.59	16	9.53
5/8-11 UNC	13.50	2.31	11	15.88	7/16 BSW	9.36	1.81	14	11.11
3/4-10 UNC	16.50	2.54	10	19.05	1/2 BSW	10.50	2.12	12	12.70
7/8-9 UNC	19.50	2.82	9	22.23	9/16 BSW	12.10	2.12	12	14.29
1-8 UNC	22.25	3.18	8	25.40	5/8 BSW	13.50	2.31	11	15.88
					3/4 BSW	16.27	2.54	10	19.05
<b>BA</b> 47.5° 					7/8 BSW	19.25	2.82	9	22.23
0-BA	5.10	1.00	25.38	6.00	1 BSW	22.00	3.18	8	25.40
1-BA	4.50	0.90	28.25	5.30					
2-BA	4.00	0.81	31.35	4.70					
3-BA	3.40	0.73	34.84	4.10					
4-BA	3.00	0.66	38.46	3.60					
5-BA	2.65	0.59	43.10	3.20					
6-BA	2.30	0.53	47.85	2.80					
7-BA	2.05	0.48	52.91	2.50					
8-BA	1.80	0.43	59.71	2.20					



# KEYWAYS

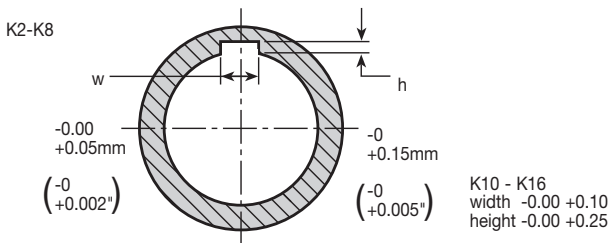
## METRIC

REF	w mm	h mm	P mm
K2	2	1.07	1.25
K3	3	1.50	1.85
K4	4	1.86	2.55
K5	5	2.35	3.05
K6	6	2.83	3.55
K8	8	3.34	4.10
K10	10	3.34	5.10
K12	12	3.35	5.10
K14	14	3.80	5.50
K16	16	4.30	6.00

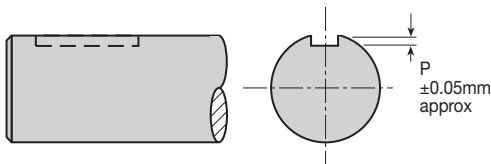
## IMPERIAL

REF	w inches	h inches	P inches
K3/32	0.0937	0.062	0.070
K1/8	0.1250	0.065	0.075
K5/32	0.1562	0.075	0.090
K3/16	0.1875	0.094	0.110
K1/4	0.2500	0.120	0.145
K5/16	0.3125	0.145	0.180
K3/8	0.3750	0.178	0.216
K1/2	0.5000	0.229	0.286

## HOLE KEY



## SHAFT KEY

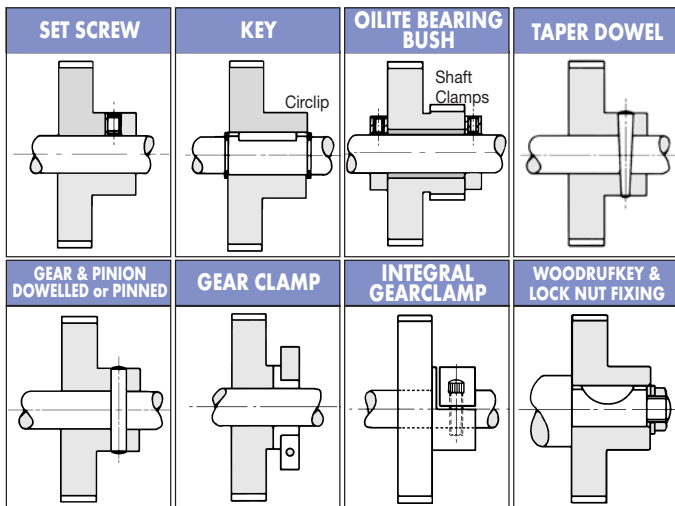


# SHAFTS

## FIXATIONS - SECURING OF GEARS TO SHAFTS

BORE or SHAFT DIAMETER		KEYWAY	PIN HOLE DIAMETER	SET SCREW SIZE
over Ø4	up to Ø6	-	1.50	M3
Ø6	Ø8	K2	2.00	M3
Ø8	Ø10	K3	3.00	M3
Ø10	Ø12	K4	4.00	M4
Ø12	Ø17	K5	5.00	M5
Ø17	Ø22	K6	6.00	M6
Ø22	Ø30	K8	8.00	M8
Ø30	Ø38	K10	10.00	M10
Ø38	Ø44	K12	10.00	M10
Ø44	Ø50	K14	10.00	M12
Ø50	Ø58	K16	10.00	M12

## SAMPLES OF ALTERNATIVE FIXINGS



# SHAFT POWER

## SHAFT DIAMETERS

APPROX TORQUE TRANSMITTED N/M

MATERIAL	SHAFT DIAMETER (mm)											
	Ø6	Ø10	Ø12	Ø15	Ø17	Ø20	Ø25	Ø30	Ø40	Ø50	Ø75	Ø100
N.m. MILD STEEL EN1A EN3 35000 N/m <sup>2</sup>	1,50	6,60	11,50	23	34	55	105	180	440	840	2800	6600
N.m. EN8 EN32 EN58 45000 N/m <sup>2</sup>	1,90	8,50	15	28	43	70	135	230	550	1000	3600	8500
N.m. EN16 EN19 EN24 EN36 60000 N/m <sup>2</sup>	2,50	12,00	20	39	56	95	180	310	750	1500	4800	12000

## SHAFT ROTATION

KW = HP x 0,746

SHAFT ROTATION - H.P. TRANSMITTED FOR GIVEN R.P.M. AND Nm

Nm	0,1	0,5	1	2	5	8	10	15	20	25	30	50	100	200	500	1000
RPM 5								0,01	0,014	0,017	0,002	0,035	0,07	0,15	0,35	0,70
10						0,011	0,014	0,02	0,028	0,038	0,041	0,07	0,15	0,28	0,70	1,40
20				0,014	0,023	0,028	0,04	0,056	0,07	0,085	0,14	0,28	0,55	1,40	2,80	
50			0,014	0,038	0,055	0,007	0,10	0,14	0,17	0,21	0,35	0,70	1,40	3,50	7	
100		0,014	0,028	0,07	0,115	0,14	0,21	0,28	0,35	0,41	0,70	1,45	2,80	7	14	
200	0,014	0,028	0,055	0,14	0,23	0,28	0,42	0,57	0,70	0,85	1,50	2,90	5,60	14	28	
300	0,021	0,420	0,82	0,21	0,35	0,41	0,62	0,85	1,05	1,25	2,10	4,20	8,50	21	42	
400	0,028	0,055	0,11	0,28	0,45	0,55	0,85	1,10	1,40	1,70	2,80	5,60	11	28	56	
500	0,035	0,07	0,14	0,35	0,56	0,70	1,05	1,40	1,75	2,10	3,50	7,00	14	35	70	
750	0,010	0,051	0,10	0,21	0,52	0,85	1,05	1,60	2,10	2,70	3,10	5,20	10,40	21	52	107
1000	0,015	0,07	0,14	0,28	0,70	1,15	1,40	2,10	2,80	3,50	4,20	7,00	14	28	70	140
1500	0,022	0,10	0,21	0,40	1,00	1,70	2,10	3,10	4,20	5,10	6,20	10,50	21	41	100	210
2000	0,029	0,16	0,28	0,55	1,40	2,30	2,80	4,10	5,50	7	8,40	14	28	56	140	280
3000	0,044	0,24	0,42	0,82	2,10	3,50	4,20	6,20	8,50	10	12,50	21	43	85	210	420
4000	0,060	0,27	0,56	1,10	2,80	4,50	5,50	8,50	11	14	18	28	58	110	280	560
5000	0,072	0,35	0,70	1,40	3,50	5,60	7	10,50	14	17	21	35	70	140	350	700
8000	0,120	0,55	1,10	2,30	5,50	9,20	11	17	23	28	34	56	115	230	550	1150
10000	0,150	0,70	1,40	2,80	7,00	11,50	14	21	29	35	42	71	140	280	700	1400

760



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# TOLERANCES

Gear tooth shape is an involute curve. Module BS4582 Pt 1 Fig 1 DIN867.  
DP BS978 Pt 1 Fig 1 DIN 867.

## METRIC

## IMPERIAL

BLANKS	mm	inches
<b>GENERAL</b>	±0.15	±0.006
<b>BORES TO</b>	H8 LIMITS	H8 LIMITS
<b>GEAR ØD (nominal)</b>	-0.15	-0.006
GEAR	mm	inches
<b>PCD (nominal)</b>	-0.15	-0.006
<b>BACKLASH (nominal)</b>	-0.11	-0.0043
<b>TCE (0-60Ø)</b>	0.04	0.0015
<b>(TCE DELRIN)</b>	0.05	0.0020
<b>TCE (60-125Ø)</b>	0.06	0.0023
<b>(TCE DELRIN)</b>	0.07	0.0028
<b>TCE (125+Ø)</b>	0.08	0.0032
RACKS	mm	inches
<b>TCE</b>	±0.10	±0.004
(300mm length)		

*TCE = Total Composite Error*

## BORE AND SHAFT TOLERANCES

mm	BORE TOLERANCES		SHAFT TOLERANCES													
			CLEARANCE FIT				TRANSITION FIT				INTERFERENCE FIT					
			H7		H8		f7		g6		k6		n6		p6	
Ø RANGE	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high
0 3	0	+0.010	0	+0.014	-0.006	-0.016	-0.002	-0.008	+0.006	0	+0.010	+0.004	+0.012	+0.006	+0.020	+0.014
3 6	0	+0.012	0	+0.018	-0.010	-0.022	-0.004	-0.012	+0.009	+0.001	+0.016	+0.008	+0.020	+0.012	+0.027	+0.019
6 10	0	+0.015	0	+0.022	-0.013	-0.028	-0.005	-0.014	+0.010	+0.001	+0.019	+0.010	+0.024	+0.015	+0.032	+0.023
10 18	0	+0.018	0	+0.027	-0.016	-0.034	-0.006	-0.017	+0.012	+0.001	+0.023	+0.012	+0.029	+0.018	+0.039	+0.028
18 30	0	+0.021	0	+0.033	-0.020	-0.041	-0.007	-0.020	+0.015	+0.002	+0.028	+0.015	+0.035	+0.022	+0.048	+0.035
30 50	0	+0.025	0	+0.039	-0.025	-0.050	-0.009	-0.025	+0.018	+0.002	+0.033	+0.017	+0.042	+0.026	+0.059	+0.043
50 80	0	+0.030	0	+0.046	-0.030	-0.060	-0.010	-0.029	+0.021	+0.002	+0.039	+0.020	+0.051	+0.032	+0.072	+0.053
80 120	0	+0.035	0	+0.054	-0.036	-0.071	-0.012	-0.034	+0.025	+0.003	+0.045	+0.023	+0.059	+0.037	+0.093	+0.071



# GENERAL CAPACITY SIZE LIMITATIONS

Most of the cutting limitations are dependent on the required pitch.

## GEARS

GEAR TYPE	RANGE	CAPACITY (mm)
<b>SPUR GEARS</b> <b>HELICAL GEARS</b>	120 - 1 DP 0.2 - 25 MOD	Ø5 - Ø1800 (0.200" - 72") Ø5 - Ø1000 (0.200" - 40")
<b>SPROCKETS</b>	1/4", 3/8", 1/2", 5/8", 3/4", 1", 1 1/4" CP 4,6,8 mm pitch	Ø14 - Ø400 (0.550" - 16")
<b>INTERNAL GEARS</b>	96 DP - 12 DP 1 - 7 mm pitch 0.2 - 2 MOD	Up to Ø200 internal (8") Max component Ø298 (12")
<b>WORM WHEELS</b>	0.2 - 4 MOD 1 - 7 mm pitch 96 - 6 DP	Ø15 - Ø250 (0.600" - 10")
<b>WORMS</b>	0.5 - 7 mm pitch 0.2 - 4 MOD 100 - 6DP	From Ø10 x 10 long up to Ø60 x 500 long depending on cutter and pitch
<b>RACKS</b>	96 - 4 DP (Up to 25 MOD 0.25 - 8 MOD on specials)	Up to 3000 long (120") in one piece
<b>BEVELS</b>	64 - 6 DP 0.4 - 6 MOD	Up to Ø120 (4.720")
<b>TIMING PULLEYS</b>	5 - 20mm AT 2.5 - 20mm T 3 - 14mm HTD	MXL XL L H Ø10 - Ø500 (0.400" - 20")
<b>PINION GEARS</b>	2mm - 13mm	Ø5 - Ø600 (0.200" - 24")

## COMPONENTS

TYPE	ASSEMBLY	GEARBOX (mm)
<b>BORING</b>	- Jig boring 0.008mm of size at 25mm dia - Horizontal boring - light - Vertical boring	Max. area of 610 x 155 (24" x 6")
<b>CUT OFF DRILLING</b>		Up to Ø150 Up to Ø40
<b>MILLING</b>	- CNC - Co-ordinate milling and boring	Max. area of 610 x 155 (24" x 6")
<b>SLOTING</b>	- Up to 152-4mm (6") stroke	
<b>TURNING</b>	- CNC - Precision turning and boring	Max. Ø600 x 1000 long
<b>GRINDING</b>	- Precision diameter grinding - Bore honing	Ø1 - Ø200 x 500 between centres Ø3 - Ø25

# HPC CAPACITY AND BACKLASH

## STANDARD PITCHES

*Other pitches available on request.*

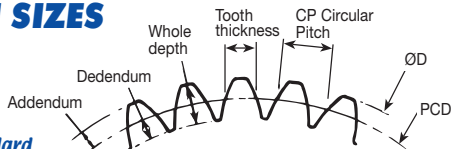
<b>BEVELS</b>	0.8 - 6 mod 48 - 5 DP	<b>WORMS &amp; WHEELS</b>	0.4 - 4 mod 64 - 6 DP
<b>SPROCKET</b>	1/4": 3/8": 1/2": 5/8": 3/4": 1": 1 1/4" 4mm : 6mm : 8mm	<b>RACKS</b>	0.25 - 8 mod 96 - 4 DP
<b>PULLEYS</b> (PITCH)	0.08" : 0.2" : 0.375" : 0.5" T2.5 : T5 : T10 : T20 HTD3 : HTD5 : HTD8 : HTD14 AT5 : AT10 : AT20	<b>PRESSURE ANGLES</b>	
		Standard	20° P.A.
		Special	14 1/2 P.A.

## BACKLASH CORRESPONDING TO PITCH

GEARS	BACKLASH (mm)	METRIC		IMPERIAL
		Module	(mm) CP	DP (Inches) CP
FINE PITCH	APPROX. BACKLASH = 0.07 - 0.12 @ STD CNTRES	0.25	1mm	100
		0.3		96
		0.4		82
				80
				72
	APPROX. BACKLASH = 0.1 - 0.15 @ STD CNTRS	0.5	2mm	64
		0.6		60
		0.7		56
		0.75		50
		0.8		48
MEDIUM PITCH	APPROX. BACKLASH = 0.13 - 0.2 @ STD CNTRS	0.9	1/20	46
		1		44
		1.25		40
		1.5		38
		1.75		36
		2		34
				32
				30
				28
				26
HEAVY PITCH	APPROX. BACKLASH = 0.15 - 0.3 @ STD CNTRS	2.25	1/8	24
		2.5		22
		2.75		20
		3		19
		3.5		18
		4		16
		5		15
		6		14
		6		13
		8		12
	11			
	10			
	9			
	8			
	7			
	6			
	5			
	4.5			
	4			



# GEAR TOOTH SIZES



**Bold numbers are standard.**  
**Dimensions in mm and inches.**

MOD	DP	CIRCULAR PITCH	TOOTH THICKNESS	ADDENDUM (= MODULE)	DEDENDUM	WHOLE DEPTH
<b>0.2 MOD</b>	127.00	0.628	0.314	0.20	0.28	0.48
<b>0.25 MOD</b>	101.60	0.785	0.392	0.25	0.35	0.60
0.254	<b>100 DP</b>	0.0314"	0.0157"	0.010"	0.014"	0.0240"
0.265	<b>96 DP</b>	0.0327"	0.0163"	0.0104"	0.0145"	0.0250"
<b>0.3 MOD</b>	84.67	0.942	0.471	0.30	0.42	0.72
0.318	<b>80 DP</b>	0.0392"	0.0196"	0.0125"	0.0175"	0.0300"
0.353	<b>72 DP</b>	0.0436"	0.0218"	0.0138"	0.0194"	0.0333"
0.397	<b>64 DP</b>	0.0490"	0.0245"	0.0156"	0.02187"	0.0375"
<b>0.4 MOD</b>	63.50	1.256	0.628	0.40	0.56	0.96
<b>0.5 MOD</b>	50.80	1.570	0.785	0.50	0.70	1.20
0.529	<b>48 DP</b>	0.0654"	0.0327"	0.0208"	0.02916"	0.0500"
<b>0.6 MOD</b>	42.33	1.884	0.942	0.60	0.84	1.44
0.635	<b>40 DP</b>	0.0785"	0.0392"	0.025"	0.0350"	0.0600"
<b>0.7 MOD</b>	36.29	2.199	1.099	0.70	0.98	1.68
0.706	<b>36 DP</b>	0.0872"	0.0436"	0.0277"	0.0388"	0.0666"
<b>0.75 MOD</b>	33.87	2.356	1.178	0.75	1.05	1.80
0.794	<b>32 DP</b>	0.0981"	0.04906"	0.0312"	0.0437"	0.0750"
<b>0.8 MOD</b>	31.75	2.513	1.256	0.80	1.12	1.92
0.847	<b>30 DP</b>	0.1047"	0.05235"	0.0333"	0.0466"	0.08"
<b>0.9 MOD</b>	28.22	2.827	1.413	0.90	1.26	2.16
0.907	<b>28 DP</b>	0.1121"	0.05605"	0.0357"	0.0500"	0.0857"
<b>1.00 MOD</b>	25.40	3.141	1.570	1.00	1.400	2.40
1.05	<b>24 DP</b>	0.1308"	0.0654"	0.0416"	0.0583"	0.1000"
1.15	<b>22 DP</b>	0.1427"	0.07135"	0.0454"	0.0636"	0.1090"
<b>1.25 MOD</b>	20.32	3.926	1.963	1.25	1.562	2.81
1.27	<b>20 DP</b>	0.1570"	0.0785"	0.050"	0.0625"	0.1125"
1.411	<b>18 DP</b>	0.1745"	0.08725"	0.0555"	0.0694"	0.1250"
<b>1.50 MOD</b>	16.93	4.712	2.356	1.50	1.875	3.37
1.588	<b>16 DP</b>	0.1963"	0.09815"	0.0625"	0.0781"	0.1406"
1.693	<b>15 DP</b>	0.2094"	0.1047	0.0666"	0.0833"	0.1500"
<b>1.75 MOD</b>	14.51	5.497	2.7485	1.75	2.187	3.93
1.814	<b>14 DP</b>	0.2243"	0.11215"	0.0714"	0.0892"	0.1607"
<b>2.0 MOD</b>	12.70	6.283	3.141	2.00	2.50	4.50
2.117	<b>12 DP</b>	0.2617"	0.13085"	0.0833"	0.1041"	0.1875"
<b>2.25 MOD</b>	11.29	7.068	3.534	2.25	2.812	5.06
<b>2.5 MOD</b>	10.16	7.853	3.926	2.50	3.125	5.62
2.54	<b>10 DP</b>	0.3141"	0.15705"	0.100"	0.1250"	0.2250"
<b>2.75 MOD</b>	9.24	8.639	4.319	2.75	3.437	6.18
<b>3 MOD</b>	8.47	9.424	4.712	3.00	3.75	6.75
3.175	<b>8 DP</b>	0.3926"	0.1963"	0.125"	0.15625"	0.28125"
<b>4 MOD</b>	6.35	12.566	6.283	4.00	5.00	9.00
4.233	<b>6 DP</b>	0.5235	0.26175"	0.1666"	0.20833"	0.3750"
<b>5 MOD</b>	5.08	15.707	7.853	5.00	6.25	11.25
5.08	<b>5 DP</b>	0.6283"	0.31415"	0.200"	0.2500"	0.4500"
<b>6 MOD</b>	4.23	18.849	9.4245	6.00	7.50	13.50
6.35	<b>4 DP</b>	0.7853"	0.39265"	0.250"	0.3125"	0.5625"
<b>8 MOD</b>	<b>3.175 DP</b>	25.132	12.566	8.00	10.00	18.00

# MATERIALS AVAILABLE

The materials below are supplied as standard. HPC Gears Ltd reserve the right to use higher grades of material.

## STANDARD MATERIALS

PRODUCT	STANDARD MATERIALS
<b>GEARS</b> <b>WORM WHEELS</b> <b>WORMS</b> <b>SPROCKETS</b> <b>PULLEYS</b> <b>BEVELS</b> <b>RACKS</b>	EN202, EN32A, EN24, EN36, EN58, DELRIN PHOSPHOR BRONZE, DELRIN EN202, DELRIN EN32B or EN 202, DELRIN, EN58 2011T3 ALUMINIUM, EN32, EN202 EN8, DELRIN EN8, EN32A, EN58, DELRIN

## OTHER MATERIALS

<b>EN8</b> <b>EN19</b> <b>EN24</b>	(EN8) INDUCTION/FLAME HARDENED ONLY CAN BE THROUGH/INDUCTION/NITRIDE HARDENED 50-55 ROCKWELL 'C' OR FLAME HARDENED
<b>EN202</b> <b>EN32B</b> <b>EN36</b>	CAN BE SKIN HARDENED OR CASE (CYANIDE) HARDENED
<b>EN40B</b> <b>EN41</b>	CAN BE NITRIDE HARDENED

BRITISH	GERMAN	FRENCH
<b>PHOSPHOR BRONZE</b> PB2 BS1400 1985	DIN1705 CUSN 12	AFNOR UE12
<b>COPPER</b> C101 HDHC BS2874		
<b>ALUMINIUM BRONZE</b> DTD 197A BS2874	DIN 17665 CuAl10Ni	ISO 428 CuAl10Fe5Ni5
<b>BRASS</b> CZ121 BS2874	CuZn39Pb3 DIN17660	CuZn40Pb3 NFA 51-105
<b>PLASTIC</b> DELRIN (Acetal 150) NYLON 66	DIN16979 DIN16985	
<b>ALUMINIUM</b> 2011T3 BS4300/5 HE15TF BS1474 HE30TF BS1474	DIN AlCuBiPb DIN AlCuSiMn DIN ALMgSiL	French Former NF A-U5PbBi French Former NF A-U4 SG French Former NF A-S G M 0.7
<b>TUFNOL</b> WHALE BS2572 Type 2 CARP BS2572 Type F1	DIN7735 HGW2082 DIN7735 HGW2083	

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**765**

# MATERIAL STRENGTHS

☐ Not heat treated

Note: 1N/mm<sup>2</sup> = 1 MPa

\* Estimated values

Material	Condition	Tensile Strength lbf/in <sup>2</sup>	Surface Stress Sc	Bending Stress S <sub>b</sub>	Tensile Strength N/mm <sup>2</sup>	Elongation After Fracture %	02% Proof Stress N/mm <sup>2</sup>
Nylon 66		9500	500*	3900	62 - 82	20% 200%	—
Delrin (Polyacetal)		10000	500*	3900*	69	60%	—
Tufnol	WHALE	9800	560	4500	68	—	—
Cast Iron	GR17 (260)	35800	1400	9000	260	—	—
Brass	—	—	700*	7000*	—	—	—
Aluminium Alloy	HE15		500	13000	295	6% - 8%	230
Aluminium Bronze	AB2		900	9000	420 - 720	18% - 40%	140 - 660
Phosphor Bronze	PB2 Sand Cast	26800	700	7000	360-500	6.25%	170 - 280
(EN32A) 045M10		71680	1400	17000	430	18%	—
(EN32A) 045M10	Case Hardened	71680	9200	40000	—	—	—
(EN8) 080M40		78400	1400	19000	510-550	16% - 17%	—
(EN8) 080M40	Induction	78400	2800	17000	—	—	—
(EN24) 817M40		112000	3000	32000	850 - 1550	5% - 13%	635 - 1125
(EN24) 817M40	Induction/through	112000	5000	26500	—	—	—
(EN36) 655M13	Case Hardened	123200	11000	50000	—	—	—
(EN58AM) 303S21	—	78400	1800	20000	480 - 510	35% - 40%	180 - 20

Material	Melt Point	Max. Service Temperature	
		Long Term	Short Term
NYLON 66	255°C	100°C	170°C
DELIRIN	175°C	90°C	150°C
TUFNOL WHALE	—	120°C	130°C

# MATERIAL HARDNESS VALUES

ROCKWELL 'C' SCALE 120°-150kg	ROCKWELL 'B' SCALE 1" BALL 100kg	FIRTH VICKERS 120kg	BRINELL 10mm Ø 3000kg	TONS PER -INS <sup>2</sup>	MATERIAL AND CONDITION THRU HDN VALUES DEPENDENT ON LIMITING RULING SECTIONS			
-20	67	114	114	26	EN1,3B			
-9	74	131	131	30	EN32			
1	83	156	156	36	EN8	EN56, 58		
10	90	187	187	41				
15	93	202	201	44	EN9, 16	EN19, 33	EN8R, 34	EN351, 40
20	97	223	223	49	EN24, 36 AS ROLLED			
25	101	256	255	55	EN16T, 19T, 24T	EN36T, 24T	EN57	
30	105	287	285	62				
35	109	339	334	72				
40	112	389	375	82				
45	115	454	429	94	EN24, 25, 26, 30	THRO. HDN Z CONDITION		
50	120	540	495	108	EN8 IND HDN	EN16 THR/HD	EN19 THR/HD	EN26 THR/HD
55		633	555	121	EN24 IND HDN			
57		675	578	126	EN40B, 41 GASEOUS NITRIDE			
60		765	627	137	EN36 CASE/HD	EN32C/H, 33C/H	EN34C/H	EN31 THR/HD
63		867	652	144				
65		940	682	150	EN56, 58 PLASMA NITRIDE			
67		1060	725	160				
70		1150	780	171				

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# MATERIALS DELRIN POLYACETAL 150

MECHANICAL PROPERTIES	ASTM TEST METHOD	VALUES	MECHANICAL PROPERTIES	ASTM TEST METHOD	VALUES
Density	D792	1.42 g/cm <sup>3</sup>	Coefficient of dynamic friction against Steel no lubricant water lubricated oil lubricated	D1894 -61T	0.10 - 0.30 0.10 - 0.20 0.05 - 0.10
Tensile strength @ yield	D628				
-55°C		101 N/mm <sup>2</sup>	against Brass		0.15
-40°C		- N/mm <sup>2</sup>	against Aluminium		0.15
12°C		69 N/mm <sup>2</sup>	against Polyacetal		0.35
70°C		48 N/mm <sup>2</sup>	<b>THERMAL PROPERTIES</b>		
100°C		36 N/mm <sup>2</sup>	Melting point	D2133	175 °C
122°C		26 N/mm <sup>2</sup>	Deflection temperature under flexural load	D648	
Elongation @ break			1.8 N/mm <sup>2</sup>		138 °C
-55°C	D638	.38 %	0.5 N/mm <sup>2</sup>		172 °C
-40°C		- %	Thermal conductivity		0.37 W/mK
12°C		75 %	Specific heat		1.47 kJ/kgK
70°C		230 %	Coefficient of linear thermal expansion		
100°C		>260 %	-40°C - 30 °C		10.4 x10 <sup>-5</sup> m/(m.K)
122°C		>260 %	30°C - 60 °C		12.2 x10 <sup>-5</sup> m/(m.K)
Tensile E Modulus			60°C - 105 °C		13.7 x10 <sup>-5</sup> m/(m.K)
	D638	3100 N/mm <sup>2</sup>	105°C - 150 °C	D696	14.9 x10 <sup>-5</sup> m/(m.K)
Shear Strength			Flamability	UL 94	HB
	D732	66 N/mm <sup>2</sup>	Maximum continuous use temperature		
Flexural Modulus			in air		90 °C
-55°C	D790	3650 N/mm <sup>2</sup>	in water		65 °C
-40°C		2620 N/mm <sup>2</sup>	Maximum intermittent use temperature		
-23°C		1550 N/mm <sup>2</sup>	in air		150 °C
-70°C		895 N/mm <sup>2</sup>	in water		80 °C
-100°C		620 N/mm <sup>2</sup>	Minimum continuous use temperature		-40 °C
Flexural fatigue endurance limit			<b>ELECTRICAL PROPERTIES</b>		
	D671	32 N/mm <sup>2</sup>	Volume resistivity	D257	10 <sup>15</sup> ohm cm
Compressive stress			Surface resistivity	D257	10 <sup>13</sup> ohm
1% deformation	D695	36 N/mm <sup>2</sup>	Dielectric strength short time (2.3mm sheet)	D149	20 kV/mm
10% deformation		124 N/mm <sup>2</sup>			
Izod impact strength			Dielectric constant 10-2HZ - 106HZ	D150 D150	3.7
unnotched	D256	no break J/m			
notched			Dissipation factor (1mm sheet)		
-40°C		96 J/m		100HZ	
23°C		123 J/m	1kHz		
Tensile impact strength			10kHz		
	D1822	350 kJ/m <sup>2</sup>	1MHz		0.005
Deformation under load (14N/mm <sup>2</sup> @ 50°C)					
	D621	0.5 %			
Hardness, Rockell					
	D785	M94 R120			
Water absorption					
24 hours immersion	D570	0.25 %			
equilibrium 50% R.H.		0.22 %			
equilibrium, continuous immersion		0.90 %			



# INTERNATIONAL MATERIAL EQUIVALENTS

CS- Carbon Steels. CCMFS- Carbon and Carbon Manganese free cutting steels. AS-Alloy steels.  
SHRS- Stainless and heat resistant steels.

En. No.	B.S. 970 : 1983	WERK-STOFF	AFNOR (France)	DIN (Germany)	KURZ-NAME	USA AISI/SAE	STEELS TYPE
1A	220M07	1.0711		9 S 20		1113	CCMFS
32C	080M15	1.1141	XC18	C 15		1016	CS
3B	070M20	1.0402	XC25	C 22		1020	CS
5C	080A32	1.1180	XC38	Cm 35		1035	CS
	070M26		50C30			1026	CS
6	080M30	1.1178		Ck 30		1030	CS
8	080M40	1.1186	60C40	Ck 40		1040	CS
8 A & B	080A35/37	1.1180	55C35	Cm 35		1035/1038	CS
8C	080A40	1.1186	XC42H1	Ck 40		1040	CS
8M	212M36	1.0726	35MF6	35 S 20		1140	CCMFS
	080M46	1.1191	XC48	Ck 45		1045	CS
9	070M55	1.0535	XC38	C 55		1055	CS
18B	530A32	1.7033	32C4	34 Cr 4		5130	AS
19	708M40	1.7225	42CD4	42 CrMo 4		4140	AS
19B	708A37	1.7220	35CD4	34 CrMo 4		4137	AS
24	817M40	1.6565	35NCD6	40 CrNiMo 6		4340	AS
26	826M40	1.6745	35NCD14	40 NiMoCr 10 5			AS
30B	835M30	1.6747	35NCD16	30 NiCrMo 16 6			AS
31	535A99	1.3505	100C6	100 Cr 6		52100	AS
202	214M15					1118	CCMFS
32A	045M10	1.0301	34C10	C 10		1010	CS
32M	210M15	1.0723		15 S 20		1117	CCMFS
36	655M13	1.5752	12NC15	14 NiCr 14		3415	AS
39B	835M15	1.6723	16NCD17	15 NiCrMo 16 5			AS
40B	722M24	1.7361	30CD12	32 CrMo 12			AS
43A	080M50		XC48H1			1049	AS
56AM	416S21	1.4005	Z12CF13	X 12 CrS 13		416	SHRS
58M	303S31	1.4305	Z10CNF18.9	X 10 CrNiS 18 9		303	SHRS
	316S33	1.4436	Z6CND17.12	X 5 CrNiMo 17 13 3		316	SHRS



# PRIME NUMBER & FACTOR TABLE

From the table to find the lowest prime factor for 645, look along the top row for 600. Then look down the first column to find 45. Find where this column and line meet and this is the lowest prime factor, e.g. in this example for 645, 3 is the lowest prime factor. If a **P** appears in the square then the chosen figure is a prime number, e.g. 919.

From to	0 100	100 200	200 300	300 400	400 500	500 600	600 700	700 800	800 900	900 1000	1000 1100	1100 1200
1	P	P	3	7	P	3	P	P	3	17	7	3
3	P	P	7	3	13	P	3	19	11	3	17	P
5	P	3	5	5	3	5	5	3	5	5	3	5
7	P	P	3	P	11	3	P	7	3	P	19	3
9	3	P	11	3	P	P	3	P	P	3	P	P
11	P	3	P	P	3	7	13	3	P	P	3	11
13	P	P	3	P	7	3	P	23	3	11	P	3
15	3	5	5	3	5	5	3	5	5	3	5	5
17	P	3	7	P	3	11	P	3	19	7	3	P
19	P	7	5	11	P	3	P	P	3	P	P	3
21	3	11	13	3	P	P	3	7	P	3	P	19
23	P	3	P	17	3	P	7	3	P	13	3	P
25	5	5	3	5	5	3	5	5	3	5	5	3
27	3	P	P	3	7	17	3	P	P	13	3	7
29	P	3	P	7	3	23	17	3	P	P	3	P
31	P	P	3	P	P	3	P	17	3	7	P	3
33	3	7	P	3	P	13	3	P	7	3	P	11
35	5	3	5	5	3	5	5	3	5	5	3	5
37	P	P	3	P	19	3	7	11	3	P	17	3
39	3	P	P	3	P	7	3	P	P	3	P	17
41	P	3	P	11	3	P	P	3	29	P	3	7
43	P	11	3	7	P	3	P	P	3	23	7	3
45	3	5	5	3	5	5	3	5	5	3	5	5
47	P	3	13	P	3	P	P	3	7	P	3	31
49	7	P	3	P	P	3	11	7	3	13	P	3
51	3	P	P	3	11	19	3	P	23	3	P	P
53	P	3	11	P	3	7	P	3	P	P	3	P
55	5	5	3	5	5	3	5	5	3	5	5	3
57	3	P	P	3	P	P	3	P	P	3	7	13
59	P	3	7	P	3	13	P	3	P	7	3	19
61	P	7	3	19	P	3	P	P	3	31	P	3
63	3	P	P	3	P	P	3	7	P	3	P	P
65	5	3	5	5	3	5	5	3	5	5	3	5
67	P	P	3	P	P	3	23	13	3	P	11	3
69	3	13	P	3	7	P	3	P	11	3	P	7
71	P	3	P	7	3	P	11	3	13	P	3	P
73	P	P	3	P	11	3	P	P	3	7	29	3
75	3	5	5	3	5	5	3	5	5	3	5	5
77	7	3	P	13	3	P	P	3	P	P	3	11
79	P	P	3	P	P	3	7	19	3	11	13	3
81	3	P	P	3	13	7	3	11	P	3	23	P
83	P	3	P	P	3	11	P	3	P	P	3	7
85	5	5	3	5	5	3	5	5	3	5	5	3
87	3	11	7	3	P	P	3	P	P	3	P	P
89	P	3	17	P	3	19	13	3	7	23	3	29
91	7	P	3	17	P	3	P	7	3	P	P	3
93	3	P	P	3	17	P	3	13	19	3	P	P
95	5	3	5	5	3	5	5	3	5	5	3	5
97	P	P	3	P	7	3	17	P	3	P	P	3
99	3	P	13	3	P	P	3	17	29	3	7	11



# GENERAL UNIT CONVERSIONS

INTERNATIONAL to BRITISH units	BRITISH to INTERNATIONAL units	
<b>Length</b> 1 km = 0.621 371 mile 1 m = 1.09361 yd 1 dm = 0.328 084 ft 1 cm = 0.393 701 in 1 $\mu$ m = 0.039 370 $\mu$ in	<b>Length</b> 1 mile = 1.609 34 km 1 furlong = 0.201 168 km 1 chain = 20.1168 m 1 yd = 0.914 4 m 1 ft = 0.304 8 1 in = 2.54 cm = 25.4mm 1 milli-inch ('thou') = 25.4 $\mu$	<b>Acceleration</b> 1 ft/s <sup>2</sup> = 0.304 8 m/s <sup>2</sup> (foot per second per second)
<b>Area</b> 1 km <sup>2</sup> = 247.105 acres 1 m <sup>2</sup> = 1.195 99 yd <sup>2</sup> 1 cm <sup>2</sup> = 0.155 000 in <sup>2</sup>	<b>Area</b> 1 Yd <sup>2</sup> (square yard) = 0.836 127 m <sup>2</sup> a ft <sup>2</sup> (square foot) = 0.092 9030 m <sup>2</sup> 1 in <sup>2</sup> (square inch) = 6.451 6 cm <sup>2</sup>	<b>Mass</b> 1 ton = 1016.047 kg 1 stone = 6.350 29kg 1 lb = 0.453 592 37 kg 1 oz = 28.349 5 g 1 slug = 14.593 9 g
<b>Volume</b> 1 m <sup>3</sup> = 1.307 95 yd <sup>3</sup> 1 dm <sup>3</sup> = 0.035 314 7 ft <sup>3</sup> 1 cm <sup>3</sup> = 0.051 023 7 in <sup>3</sup> 1 l (litre) = 0.2200 gals.	<b>Volume</b> 1 yd <sup>3</sup> (cubic yard) = 0.764 555 m <sup>3</sup> 1 ft <sup>3</sup> (cubic foot) = 28.316 8 dm <sup>3</sup> 1 in <sup>3</sup> (cubic inch) = 16.387 1 cm <sup>3</sup>	<b>Mass per unit length</b> 1 lb/ft = 1.488 16 kg/m 1 lb/in = 17.858 0 kg/m 1 oz/in = 11.161 2 g/cm
<b>Velocity</b> 1 km/H = 0.621 731 mile/h 1 m/s = 3.280 84 ft/s	<b>Capacity</b> 1 gal = 4.546 09 dm <sup>3</sup> 1 qt (quart) = 1.136 51 dm <sup>3</sup> 1 pt (pint) = 0.568 261 dm <sup>3</sup> 1 gill = 0.142 065 dm <sup>3</sup> 1 fl oz = 28.413 1 cm <sup>3</sup>	<b>Density</b> 1 ton/yd <sup>3</sup> = 1328.94 kg/m <sup>3</sup> (1.328 94 t/m <sup>3</sup> ) 1 lb/ft <sup>3</sup> = 16.018 5 kg/m <sup>3</sup> 1 lb/in <sup>3</sup> = 27.679 9 g/cm <sup>3</sup> 1 lb/gal = 0.099 776 3 kg/dm <sup>3</sup> = 0.099 78 kg/l 1 slug/ft <sup>3</sup> = 515.379 kg/m <sup>3</sup>
<b>Acceleration</b> 1 m-s <sup>2</sup> = 3.280 84 ft/s <sup>2</sup>	<b>Moment of section</b> (second moment of area) 1 ft <sup>4</sup> = 86.309 7 dm <sup>4</sup> 1 in <sup>4</sup> = 41.623 1 cm <sup>4</sup>	<b>Moments of Inertia</b> 1 lb ft <sup>2</sup> = 0.042 140 1 kg m <sup>2</sup> 1 lb in <sup>2</sup> = 2.926 40 kg cm <sup>2</sup> 1 oz in <sup>2</sup> = 0.182 900 kg cm <sup>2</sup> 1 slug ft <sup>2</sup> = 1.355 82 kg m <sup>2</sup>
<b>Mass</b> 1 kg = 2.204 62lb 1 g = 0.305 274 0 oz = 15.4324 gr (grain)	<b>Velocity</b> 1 mile/h (m.p.h.) = 1.609 34 km/h 1 ft/s = 0.304 8 m/s 1 ft/min = 0.304 8 m/min	<b>Force</b> 1 tonf = 9964.02 N 1 lbf = 4.448 22 N 1 ozf = 0.278 014 N
<b>Density</b> 1 kg-m <sup>3</sup> = 0.062 428 0 lb/ft <sup>3</sup> 1 g-cm <sup>3</sup> = 0.036 127 3 lb/ft <sup>3</sup> Force 1N = 0.224 809 lbf ft = 7.233 01 pdl	<b>Torque</b> 1 N m = 0.737 562 lbf ft = 8.8507 lbf ins	

