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Newton Miles per Hour Yards Fudongs Furlongs Miles Pounds per Square Inch inch Atmospheres British Thermal Units Ton-Force Horse iiorse Power (Electric) (Eieciric) Feet per Minute Cubic Foot Gallons per Minute Gallons per Hour Cubic Inches Fluid Ounces Pinls Pints Gallons Gahons i Kilowatt Kilowatl Hours 1l lnch Pounds per Square inch
lnch Tons per Square Inch Feet Fool Furlong Fudong Yards Inches of Mercury Fluid Ounces Inches Miles Pounds-Force Kilogram-Force FoolPound Foot Pound Square Inches Square Feet ‘ Square Feet Square Yards Square Inches Square Miles Long Tons Tone (2,240 (2240 pounds) pa-.unesi ShortTons(2,0lJlipounds) Short Tons (2,000 pounds) ` 1 __
MULTIPLY BY 14.5038 0.3037 9.3937 0.0610 27.4962 35.3147 11.3079 .3079 X9 + 5 + 32 x9+5+32 0.0353 15.4324 0.0353 0.0022 2.4710 1.0000 0.0197 2.2046 9.8066 0.6214 1093.6132 4.9750 0.6214 0.1450 0.0099 0.9478 0.1004 1.3410 2.1190 13.1980 791.8900 791 .8900 60.9362 35.2113 1.7598 0.2200 0.2778 145.0389 145.0366 0.0649 3.2808
0.0050 1 .0936 1.0936 0.0296 0.0352 0.0394 1.1508 fl I'll) I0 U|LL"l'U 0.1020 0.7376 0.1550 0.0011 10.7639 1.1959 0.0015 0.3861 0.9842 1.1020 . r’ 7 1 I. '. 1-'-'_ L _ S7 ii” _ -,- 000009 `.0039 .10 .10 — 7 1 1 .-'1 _____.__.___JIIl___ 1 .150 9? 0063 01.1000 ‘_ .100 _ 90 0100 ___0067 0000700 ..170 0 1L- . 01 100 .0071 0071 ..180 CD 0075 1 ..100 _ -0075;
n_ /128 _ -007_0_1 Q8 .0070 .2 00701 -20. ‘0000___ .0000 .210 d . /Mg JI'\f\ nnwn 1 50 0'51041 $1.-.0. 1mg ewaw wfiEflW nm-:0 1 .u-ru .640 _0250 @250 cocozococo J>uI-ikm-si COLDQ3- CD $.-0 _010 520 ..6 30 fl')'IR .1,-m UU[Q_1 1 .0200 1 .0240 1 770240 .0244 _ 024_` _ 8_1 1 .0240 .\iL__._:i_1 .0252 _|{1Q 7170400 0400 -71.1700. 1 1.100 U1 I‘! R
DLO 70_ 1-1' 1.0450 I 1.150 _ 1í7453Ĺ1.1í Q 1 .405_1.101_1_5e 040501 1.101 1 50 01 64 1 0ą@g'11101_ _ 5-'97.cw Ja- 1 0007co 111911 3% ‘ “--I CO | 1% ‘Q30 005 .635 72 72 2/In .1 7_ 1:1 1.c:-—-4 `1 0472 1.‘ 1 I1 1 _ 200 1 LII HAO? ’)Rfl 17 717_779271.257(J7 7 04 _' 1 -_. __ _ 1. 051 2 150_0_ ._1 _I >1 -l4415-..11i4;@*j .0256 _ 77-0250.17-601 ___ .._
1.02001 _500 052 010011.021 1 .021` _1 __ _ 05 55 _ 000 71 _Éa0a-m -0 40 I CO _.1. nao*-4 CDCDLD §§-'$57 E1 %%Ww%*$ VflVË!* 0 2&0 1 r\ .UUU _-000.0011..4_ .254 -250 _“__87 1 . ÄQO 1 cc: -c:> __ L__ on ~41 r\'>i\C:J‘lU‘I 4:-ca 1 -_ _ . . u1 [T. @CI> o'1r.n;c.n-—~1r. \1:1 ._L| II:-l=~ uwc C3 44 11.0210_ .0279
-710 _ 901 0 70 _ 1.0200 1_w_1-7__1_1_1 70 _ _ 7W7¢7.. 7. 720 _0283 7.720 1.0200771 1 1 .0625 1.588 1 .0287 1 ..730 A -1710 . __ *__ 1 700 .71 1m11 _.005o' __ 11-` 0114 1 .200 000001001 200 . 04 1 -0291 __740 ~ 34_ 742 69 1 .0635 1 1.613 0635~1.01s__52 1_ 1.0292 .0202 .742 0118 1 -311_-0110.-00 7 7.0050 1.050 1.02057_P750 1 .0120 .305
_8L 83 0.0122 15111 -410. 110.2951 0000 1.700 7 7.00fss1717700 .0200 700__ _ 01221 _ .310 1 .0299 1*§E%'¥!1"-$1‘: _, 01021 .201 .0102 .260 ‘ 0 “#5 43 20. 701070 .0106 1 j270_700 .270 86_ 85 W1%"l ;[0110__ .200 05 011077 7200 (J1 £0 '“-I Z‘1G I .. U1 DJ il- ._; in CTI Z "7§=)§k1'€¥.\ 1L bu-Q -Q cn en smv _s,,.wm nwæmw„ _______ “--I"'~.I ____
0 1 0125 0125 0.0170 517 02 .0 1 0120 .020 _____ -020. _ - ____ 0120.1 1 0130 ._ .330 _0100 030 _ 8101 fiwæmwmwæmwflæwmæ ___ 0 _ 010471 0 7 11 .. 49101051 1.0105 .0040 ._s_437`1 00 77 1/32 101001 _050 .050 1.0100 _ 7 1.0142 E7500 _ 000 __7 L: 00140107000 770_00mmm. _ __1301/16 »0140_`1 _0_fi0__ .370 1 _ 014071 .070 0- 170150
__.000 77-080 7 =cn1u-1I12 7_7_03_0l“1 _.770 1 100.0000 —-4-41 011:» ‘1:0007 » @711? 700 .007l_1.702_51 .0570 1 1.702 ! r‘__.0669___ . ___ _ @Q5 _ 1-750 _ 0150 15000245050 1'“--I .0700_1.7Q_ 1.0700 f 1.770 50 _ ..0310_ .707 _00_ ‘£700 0700 I 15001 1.s_00_1_._0g11 _ 0011 11 ._700 1 __0720__ 1,050. .1 =1:-4.0 0 0 _
14.:-1'0.41m051m> _0._.omg 000100_1 .704 1_§.1_.0728 11 1.850 _.0700__ I __ 1054 40 ‘.0015 .00 _ 2 1.072.011.0540 _-0_3_1í_-30 0 0.77.0107 171077740 1_1.007_0 _.0a10_ .01_0_ 0 77107010 __-Qwl-900 _ 070 0 1000 _ __ 40 0320 @_ _ 07 07_ xaemjuæąmsnwmæsycan ..002_0__01_._010 1.0700_101.0gL 0700 _ 1050 . ___ .0020__ .020 1 00201 1 __
1.070011.031 4 1.0701 _ 1.0g_ .0s27_ .056 000 1 1.002771 5/04 1W1 11.9041 0705 1.004 __ .(1330 .äížžłi 0154 1 .000 1 .07337077. .0370 7 00 1 7 1-11705171-994.7 _47 .0154 000 7___ 2.00_ _ _ 1 .0707 1 2.00 .840 007 _‘ 7 1/0 4 17_7_017s0 1 .0977 71'..0331 07001170040 10007 .0335 1 .050 _B50 1 1 .0807_. 2.000 2.050 1 7701757 1.0005 _0157 17
.40 1 _40e__7 110100 0100001_ .4007 ‘ 708 _77}02~3Ž7-860__10.000091 .000 71 _0 ___1_-Ōfl19_ 2057 1__4_f_5_ .0819 12110.7 . _0820 2.003_45 _.0040___ .070 1 F 0101 _1.00401 . _ A . _410 , ._-0112013-033.‘. .0_101_ .41_0__ _ _ 1.0027 1 2.100 _ .0105__ .4g__oa axwm _ 717071705771 .0139. . :.002712.1000_ 0 ;-0240. 080 65 *5_400 1 7 01. 1i
.0846 .0040 1 2.150 2.150 1 _889_ 1.0100. 1 00 0.4000. 00 1.0350 . 005011 .009 0 7717111709707! `.001šo72.104 7777170000 2.104 74444 ‘ 77.,1__ 11.0050 1 ,01731 .440 7 1 0170 1.440 . 0 050 1 000 090 1 .0000 , _00_00 _1 2.20017 2.200_ 0054 ___0177 = -450 .450 1 0.117 1 13 110100 n12n .457_ 4 571 1 2.250 7 . 1.007507: A
77 1_.0000 1-1188612-27501 -1 -4 77 ~ _ .o05_0_ I910 .01o 17 na~>._1_0000 790 1` 22.201 201 _ Q 1 .0350 .914 _ 014 7_ 64 17347 1 013.1 0101 I 400 51\ 1 051 [*3. 39 1 1.0002 _ 920. 000002 1 .9211 mmm _0105 ~ .0000_ 2041 _ .0185 11 0.470 .470 fią w 1 .oseş 0025_ 2.050 000 _400 -0.25 2-451111 472 . _ 7.0100 0109.71 .400 »-9.3.900 -930
@mmm `o.` 935 2% smo .0370 .040 .940 63 __1,00701 -0020 12.2.001 41.11 117 77 44 [L_7-0100; .©7153 .400 490 _1 7 - 1_/32 7770771 om 1 J9 0007711 2221 _M-. .050 ...W _50 1.0074~ F70007 _ 50 _ 07045 1 2.400 _ 0370 .seo _.(210 _500 1 70 _ 0200 . .500 17.00701 .900 ~ 1._004512.4001 Š 1_f0_000 1 .0960 1 2.400' 2.438 41 000 .0c5` 02 70
.0201 17.510 .510 1 000 _020101 1 ____+7.0000___?1 .005 __0005 2.450 7000051 2.510570 0 .070 .520 _ .02o5 0205 .5200 _ 1 000277 00g1_9701 .0900 2.4001 40 0 H10 .500 -4, 0200 0.500 000 1 -980 00 j 000Ĺ6" 111..-....11..1 . 7 1 .0700012400 ńniz/1 1 'J 1-:nn 1 flfiflfl .wu-v 1 r...zvv k_u.Juu_ uqu _ 1.0000 000 ~1U-1 .0210 _ 02111^ _ ."""" 50707 /E)
of f0_.009512._527 ' .0995 1 2.527 39 007 __' .0210, 1100901 10001 0161 00 _0210 .540 1.0090. -001 _ W . 1004__1_2.5§[]___ 00 1.0004 _1.0o__ 0 J 02177? .5501 _1.0304011_.01L 1 0 `7.1004_2.550___ .0217 .550 sxWowm ałwsm w _\w.\1v.\-.< .101_____ 2.570 38 .1015 00 1 fi_(1.'7:_>0'.0220 02'01Af1'"7' 500 040011.010 70400 11.010 1 00 507 .560 ‘
ww . 4 ‘ 2. 71 .10274_ 2.000 0410 11.041 1.041 '1_ 50 .570 7 1.02110 __1.0224 _.0224 _ .570 z„4fl on ~41-.1 P c .r1\ ~ .|_\.14u+ 2.04; ms 7 _1.7027251 .0225_ ..572 _5_72 0 74 0 0 1_041š_1.05o__7 ‘- I"- .I‘-J U‘-I CD -I":-1:)"- I fifif 1 ___ - _ .-, CD1U1 . ‘In Z L2-:5,‘20$;,), mg I __ 'f_""""' ‘__"" _ ¢ _. U1 -I5 Z1? K§S$'21~ ‘I~'i§ ‘£\ ._._._.__. WE .4. -I-5CA}
(D109 ___.._ I _.. I ____ T1 JO " _I '__‘.‘_‘T_'"" 1 """ 'I_.'. . _ -);'\'§\~'A 1383*“?-\?.>&E 1 '..Hf .7 "'éE'4=3‘2§~':?'E\&3$.?I1?§"{45:§ 1 .0220 .500 1 .0228 1 .5B0 ;.. @N51 HOQA 1 0 Rflfl I1 6- 1 .0420 1.007 1.067 1.0420 58 01 wm 5 ' . IEHU 1 1043 1 P* 2 cnurca 650 _1043 1111111 11 1 1. CD liI 1111 Inu- " 3se _ ' 05 05 _ _ /___-Ib- _2031 ‘L __ 34 ‘I Ii
I_'f_' “"""""' 1 .0|c.uu _ I-U I'\DOJ —*--I50 CD CA3 DJ1 '-I T51: _l. O 1 '"1- 1' (I31 :. $10’$5 .-3i ...3. .. -5-"F0 ""01 »$W.§.‘ 1141' '‘.*-.._. '\.- U-LUUU1 C10 CD 17 u CDCOJ KY??? *1‘ 7 Q /I'-IQ }.|."ruu 400-1 _ -IL -L""-. [,1_L '\§¥:3-Z\}.'-W5 .>. Q“§7fi\ 7 H1? A an» _- '.00 _LL71 5. U3 -I=I- "-‘§.~'\$"0 ‘Q3514 ‘$302544 5&3‘ (fit ugg 1 '-w- CD 717 ‘A ‘@011: ‘:4J7
'15 lyi "'3"-2'§4>‘F§-: X A 1 12 1 11 111 I 4.070 09 _ 0 000.00011_17.000 .196_Q______ 1 1 .1959 49701 -2071 _ 7_000_ 1.100001 5.00 1 . j_-_ .3110 01_1_0 7.900 7.900 -1%0_50 1_ .1990 15.0551 5/510.010205_0107.000 _____ 5.055 0 5/15 0125 _ 7.0;10_ ..-199.9 .2.0037] _ 2008 _ 5100 0150 0.00 _ ' _ _ 13151.11 3-"9 „201015105 .2010 1 5.105
0100 0020 0.020 Z 0 7~4 10100‘ 0 ‘R? l'\J 1 11 11 7 Z O‘) OJ Š*š\\`- 1; :; 1; _- .3.) _ 0/5 .2003 5159 _0100 81100 0.100 21-0100; 2040 ~ 210.0 _ 151072170 5-132 _5 __ "i1 1š_2_20_8-200; """"11—= ' 3996 ' “‘ ' 5 8.200 ---2047 5 200 I .s2ąg_ 0.204 ba070170.204 P __2047 5 wæwæwwm w .3268 1‘ 3-3.0.9 8.300 _ ._ 111 7 33 .2002 5 . 220 1.7 1 ;1.1142 .~.
UAÄSIO .1121_1_1-07. 2.000 2087 5.300 5.300 I_ _ __0 21/54 _._s_20i77f1 0.004 11 42 12.000 ' _Ĺ ?0 s-10 251 0 . 0 10.110001 . 1160 2.940 2 .946 7 32 _ 2090 í399_ _ 2000 5.309 11 44 _" -Q.05 §a577 06.400 0.400 i 0 1__ 1101 1'|fi1 QQRH ___ 91 on 1-: Ann _' 7m mwmwæ 2 .050 _ ^ ' _ 21201 5._-490 5020 1 0.400 0 "' ‘N .1181 .1101 5_ 3.00 0.00
2100 1 5.410 5.410 _ 33 ' _suš 8.5001 0.500 "W010“ 0505050 57515 7 __7711200 7172070] 070400 s.04T_71 2105 2165 15.500 0000 0.000 0 0.0001 _1220 3_100 -4 2107 21871 5.550 _ 01 21871 5.550 ..3390 8.611 R E _1Å20_3-_19U iä ‘5. 01! 1.» . 1 5-5591i .1 1250 _ 017 _.12s0 0.175 _222050 0 5.6701J17 'Ž 7 700 .0425 _ 0700 2_ã__í man I -1 onn _ .1250__0.200
.2210 i 5.01017 —27 5.010 1 2 3 11/az .3437 1 6.731 coha ' 1 1 ;Ë_2l° _ '.1285 0.204 _ 00 4 ` .224 .22444 i 5.7001 5.700 1 777 71 on no0:0:cu coon --lIv-=1:ocoow -1-:0r\:1r.0 -4|.r |1:w_zmwwmmnwxeai .0022 9.200 _ 7.0šs72271_ga._200 _ 0.20000. 420.01 0.0451 mmwoeamwmxw _1440 0.00 3.658 1 01.1440 _50 0027 4; 00.251002010.1001 0‘-mw1
1.00130 9.000 _ _ .2402 6.100 .3501 1_0_000_1__ 10.10457 ‘ .2420_10.1470_ 0 @_ _*0.000_00§ 0.04T _1_457 1 0.7000_1_ 3.70Cl__ .242o_ 5.147 “_ 5000 0.047 u0 1 14701 . ‘ 26 'æewm4 . ,37__1_J1__0__400 .1470 3.734 11. .2441 0.200 124411002000 0 _111“em .0701 _ 0.400 $515405 757 00.7547 25 _ .149513707 _ 2400 1 0240 1240010240 .0740
0.500 _ D0_Ž 1 .0740 .1405 _ 3.000 T2480 106.0700 1 1-.-3750 9.5251 _ 0.000 _ ' 07501 9_5_251_ _ .2 L-1495 -3.-800 M .1520 1 0.001 7724 _ 1.1500200 0040 1/4 250010.050] 2500 6 _ 350 75E ' _ 177I00770007019.570 .07701 0.570 _ v 7 __ 1_535 _ 3.900 _ 6 400 1 0000 1.150510.9001 0. _1.2520 0.4001 . .0700 37.3 0 _ | 9.600 1-
25.20 1540000j 0.012 __20_20 .._0010 I 1540 1 2 5501 6 _ 599 500 17 00100 70700 0 _.700 77 _ 1.255910, 5/az _._150s 0 _-ËQL* 11.25701 _0520 0.5000 F 0_7_ 1 _0050 0.000 000501 9.000 011 3.000 4 000 1 15.--; æflmwm wm. _.17570 3.000 22 gmemm vm ___ _;j7010.0001 .2000 0.000. _.2500 0.000 0050 00004 0_0_0_11_ wW 1.000000! 2510 .2010
_1 0.020 0.529 1 m 0000 0.0001 _ .1575 1 4.00 _ _ 3891..1 .9-900 1* wmmm .1 500 1 4030 _ _ 2j___ 1771500 .009 0 12500 0 . 700 9.922 00000} 0.700‘ 30/05001 00001 0.922 25/04 .3906 m _1010 00 10,1010 14.000 14.0001 20 __ ~ 17/04 1 205.6... 5-7471 \ _2555 1°-"0 . 7 7 _G-Ĺ47 _-3_9E 111-_Q0 0_;.20001 1.2000 0.750 0.756 I H1-1 *" .3970
10.084_X „1014 . 1.. .1. 011 4.100 4-1001 _ ..-3.9701008.-';1k_ 1 .105_4 _ 4.200 1 .2677 0.000 _3976 _10.10_0 _ .0970 110.1001 '-.1.55%1..1 4-200 1.677 10000. .11-300 1 4.210_ 19 10_ 1 6014.216" 1 .2717 6.900 0.900000 Šf 4010102001 _4 4010 _10-200 w » w w e _1 4.000 .2720 6 909 .4040 10.262 1 1 mwa‘wflcxwasw 40 10
2021I Y 4-3.. . _ 1.1 .2750 .-2756 72.9-9-21197 §77-. 11.1695 4.3051 18 . ,1005 1_4_305_ 10 1 A 700 4055 10000 7.00 .4055110000 | _1_1 1 11/0410.17119 14.000 _ 11 19 14.000 _ 11 _2 770 7.000 _ J 10/02 .40001_10.0010 -1D9__'ł-_365 .17g0__4004 1 1011700 4.094 17 795 7.1000.f__ 110.400 -27110-. ._ 7.4004 =.1110.=1
..111141111...__.1702 _1 4.400 /.1702 4.400_ .201_0_1 1 .410000_10100.4900 m owaowo0a 2810 7.107 7137 A K É __ 4130 11-_fi!_71_Ë_fJĹ Z .17_70 `4.4_001 _ _ 020.1770 '4.4901_10 1ě 0/az f7201_70_ 7.0340 7.144 _000_ 10 .4104 4134 j1_0.5001 10.500 1.1 .2005__ 7.7.2000. -.4170210.000 -177.? _4-5Q0_ _ _ -1712 4-500 _ amo _å1_73 .10-600 „1000
4.52 15_g ;_. 2074 7.300 _421_ _ 7 15 3 10700 11801.4-572 10.000207417770001 711117210711O.707il .1011 }4000 14.000 129007.000? _1011 .200o 7.000 L 27/04 .427F110.71707 42101107170 7 __1g20 Am: 14 77 9g10 5170207 .7407 425210000 :j 77 i... 1 _1. (J1 O3 OJ ‘K3? E11} 15.5055 _ @ (D -L_I. U1 _|. ‘3?*}§5§(§¥-i .10s0_2.70o 10 __
00.10003 12.7001 _ ._101š5 2 705 3-705 .was 772.73 ._ _.7J.7933 22.1759 7 7/04 .1004 7/164 _.1 _ 770 _ 004 7 22.770 _.1100_2.704_ 0 ___;1_1000001 2.7940 _0 _.1`102__ .1102 12.000 2 _ 800 _ 1 0_.11101. _~111_Q ;2-319. '1 @gasu _1.112212. 1_ ~Z—0 11 4 1 _1._0_f1m 1450_ a=.0591 1 1_Iin.500 _0505 Ĺ 1-fi1_1 5737 QQ10 _ 1.550 _ 1._02761__7Q
02701 _/" Fract. Gauge ri'$15.5 Fract.1(inch)101n1m1 met. (inch)1 1110111111 101001 11111111 7' cauge Fraut. 11110111 111111111c1|.Let.rrz1:1. 11110111- 11111111 Lene: 7 1 1Gg.L'et.Fra0t:111nch]1-147111117-L'etter 1 1 .0400 _1_o02_ 1.092 1 57 0 ..500 I ' .0202 .102021 77 I1'- =1. DRILL SIZE 81 & DEGIMAI. DEGIMAL EQUIVALENT
EQUIVAĹENT CHART GHÅRT Fractfi (inch). (mm) Iliauge Fract.1(Inch) Jiaugei1 Z 1 .uuuí nncn ‘ 1:n 1 UUJU 1_ .iou _ _ I 2 . __W0 GHABI im 12 .\!.4.LENT'I' CHART I: 111 12 ËË :D ¡_ EQUIVALENT DRILL SIZE & IJECIMAI. Fract :(inch)1(mm) (inch)1 {mm} Gauge 101101 '0 Gauge tiauge FIact_.1(inch)1 Fract.1(inch)_1111m1 | 0 7; _1.-.g_:!1.- 1-. ;:
,-.11 :§.' _E'. — 1-70141 4 - 14/4' Žg WW1,1 Ca! 1000 -l\Jl_\J' 1;_. ._ __ __*._7 _'""--. >.L 1 . _2. /I Clflfi :-5 -:4 'T|\J\-IL! 7(D _»eeLDLD -\CDU't wz m åfim w m5” 7_571 I -UULU Qnfin 11 71.u10 27-1| 1 10001 7.700 cocoC: 11111cu 7' 0 1 _«aun WW‘? Aann '11-mn ihzuu ' ‘ 7' .4440111.000 .4449 1 1 .300 __ __ | V « 71:: BILL SIZE 8181.
DEGIIVIAL EQUIVALENT CHART F‘-10 DEGIMAL E(_!l_l!\!_ALEll'[GHÅRT DRILL SIZE & IJECIMAI. DECIMAL EQUIVALENT EOUIVALENT CHART GHART ractio'n1 (inch) (mm) 015511011? Fractinnfi 1100111 (inch) 1 (mm) >~\w:_43. 1 -4.011. 28.500 100750 1 .7770 10.750 .11.1220 .3127411 7444.11.11 [_3_1_/04 4044 31/64 _
410114 _ 12.303 28.575 7 1.1250 23.575 10.044__0 104 11/0 .-0 _p \Q 25/32 25/32 _ .7813 _.7a13 _ 10.044 .4882 4002 12.400 20,750 4 1.1310 20750 20.00 _ ' 40217 112.500 12.500 @Q _ _-l§l._' -7024. _1_720.0o___ -'.5;0 ».v_ęx0*0m×xa~z1\~:mŠ1. 1x v17 _' 20.072 28.972 . 10/0 J> i _1_.1_400 20.241 20.24 1 5 10 0503 _10/04 51/64 1` 117969
.7969 4961 1Č12000 _1 4001 12.600 ___51/64 ____71.1417 29.00 431. 50 250 20.250 1 .7972 " _20 12700 _ 7 '7f7972_ 1/2 .5000 Zj_ 12.700 29.250 ' _ 31: _1 ¢"1 cn v0\ . \' 1 1.1510 .8071 20.500 0071 mm . _5030 12.000 4100...-. 12.300 1 5/32 . 1.1503_0120.300 1.15037'} 720.300 27077030 vam 15/32 _ 173/16 .8125__1` 20.638 12.900 13/10
|_.012s_ 1 50.79 .12-90.0* _1_-5919. 29.500 171.10' 1'4 11 39-599 20.750 1 .5118 _= 13.00 __. 5110 7.-..1.1..1§.14 _ 1 .8169 41.69 . __20.750 '1'11.1713 .17'1'3 1 20.750 1 0200 1 21.00 33/64 1 .5156 113.007 33/04 ______.5150 -. fi_-0.3.53 100.07 111/0" 17717010 20.700 20.705 21.034 53/64 1 0201 .8281 _; 21.054 ` .5157 _1 13.100
\~.0>:rs05,^>\01.\:e103\%i×F 53/04 1l1/54 1.1110 3-245157 2. 01 1 30.00 0 1_1.1311W_i 3.2 00 .5197 1_ 13.200 3" 99 _ _ -.8i_ 3355 _ 21.250 .-.5107)" 1 300102 13/106_ 1 1.1875____1 075 _ 30.102 21.431 27/32 .1 .3437 1‘ _ .5236 1 13.300 .Å/0.2 .SÅS7 M._ 21.431 1 1.1000 1 .1_0_0_0 30.250 ~_1 .3405 .8465 1_ 21.500 v5=,_1×5*4\m10. \'3:*.;\ _ ‘
.-11.2100_ 112003 _.5 30.750 22.00 22.007 _ 1 .0001 co? cs: 13.600 5354 ; 13.000 1 ..-505.4 _2_1_0_7 =_ 30.050 7 7/32 1 1__..2187 22.225 T. 117/32 13 7/8 .8750 22.225" 5394 1 13.700 1/11 ". ‘ L-.0m__ 1 _.-~5304 . 700 11.220577 22.250 _ 13.30_0 _ 7 .5433 13.00 0_ 1%.. 31311007 - 00 1Q0700 _____1.722.250; _i4l3_7.. 11.2303 _ 250 1.2303__ 31
31.050 22.5000 __3053 225 35/64 35704 _154_6_9 .541-ii 71 13.891 10"Ž;1:A7 &11 .8858 7 15/04771 1.23_44 1.2344 _ 31.353 . 22.622 115/04 57/04 i 0000 .00000j.22.022 |__ -5.4.7.2 .5472 13.000 31.500 1 1f 1.2492 1.2402 . 31.500 .ã957__1 22.750 2x1\1\:\ .5_512__ 14.00 14 00 1 1 2.005710 -5512 2 11/4 1.2500 @0 1 1/4 1.2500 _1 731.750 23.00
.0055__1 7 7 '- -551.9. .5010___. 14.250 Q -905521.. 23.00 1 32.00 . 29/32 32 .00003 00 ‘1 23.019 _7'.5 . __11.2503 0/106 ..5625 .5025_ 1 174230 14200 š 29 '1-2593...-1.32-00 '3‘ 1 Ë147 2 051-11_1,2,. 147 17/04 -1,17.2050 .0154_Ä250 0154 E 23.250 \¡ \»~_m\×0 1117/04 .5700 _ _ 114.500 -57.00_1 44-00 50/04 _"_1.2705_1 32.500 _ .9219___4 5410
23.410 1 5 37/04 1 7_1 -5.5731 .701--_1 14.004 14-404 59/64 70.0210 .-1-27021 32.500 10/3_2 _ A1._21_813_~ 3_2.544 1.2013__32544 19/32 23.500 .0252___ 23.-000 4.750 -.»92.521 _».5.ä0Z_1114.-750 _ 32.041 1110/04 10/04 _ 1.2000 _32.041 23.750 .0350 23.750 _ _ ' .5000 0 15.00 ; -99.59. 1.2002 33.00 11.2002
23.012_.... ul 15.811 1..-.-9375 10/32 _ _ .5037 .5937 _1 15.001 __ 19/32 _._.-1 23.812 .0440 1 24.00 \> ifi 9225 1 3/8 77 1.0750.. 17.07750 34 _.5 10.272 03/04 1_ 0044 41/04 j____04_00 .0400 _ 15.272 2i0__03 _ 10/11 03./04 -0044 ; 25.003 25.250 774 10.500 Fvem0'7'.>fr0;^1\ 2015345 .0400 ‘ 16.500 ' ..1.-37.8.l.121i4°° .137a0_20fl0
-0.041.1 ._1._ _5.2_50 _99 35.322 400 125/04 ; 1.3000 1 35.322 21/32___0503 10.000 57. 05.63 . 1.6.1.659 1 ,_v|_.UUuü 11 1-0. 1100. 5.400 21/ :nn 50" 77713075 1 35.500 1.0030 r~.>|\:N57191.uvu _ 7*? 050*4 10.750_ 1 .0504 14.0037 1 35.710 35.7710 r\:1|~.:1\: F“F" _0 1-. 113/32 7140037 17.00 Ë _P0130 .6693 17.00 ‘L01 35. 7 @W ._ 31.5.1293
~11 _;_ 25.707 7 14173 1.4173 1 30.00 25.797 1. 0150___ 17.000 11/04 1.0156 43/64 .67.19 _17000 43/04 ___.0710 30.110 20.00 '1127/04 27/04 7 1.427101 1.4210 30.110( ) 1_0_2_30 26.00 _ 1 .0236‘ 1 .0701 __7 ,1 17.250 2.1 166791.. 1 .4370 - 36-502-17.7370 30.500 207.104 26.194 00:\10012 7 3 1/32 11.001 _1.0_3_13 | 11/10 11[__.0075__
.0075_:_; 17.402 M 111/32 2 „.„... 1 1.4375 1 2o.2:1u 1LUJOO .0335 . 20.250 6890 _ _ .0000___17.500 É 1 .._' _lË.. _ 30.512 1 17-5011 cu it 1.4531 1 30.000 ou _, 1.4531 ha J -*_. N` _, u o_ 26.500 11.0433 .0433 É l=-3-‘ 7 110000 .0030 17.750; 17.750 (mm) Fraction Fracüon $060 'TI .030 1 1 Yfifix ‘Q f 1 1/2 -1 1 1 .4 .1‘ 4¥ 1 1 11 1 £1-‘§i\'.\1 W -In 1 .
_- 1- - nnn _UU '7f."7-I '1 _ IU.-JUU ‘ ___ ____.i.{ _. 1..._; _. _ 1 . '* 33 4461 _1_: -\4\I\4 . 101 _ 1 010 - 5-L: 1 .7 Ff"r 3. .‘& / 11 ;,_. .-. 1 '3..1 -‘>15 .1‘ -)'> Q ? .v'- 114 ____. . ..._.-.. 1 1 1L 1231 2832 IX. A ___ .. x .-I, .-1 . 4i_~ 1 .--1 3\$E1 ‘5{lPfi\.i=E‘*3{'!6 §1:~.k'6‘8§ 5R07fi\ 1 13‘ .--.1-31 / 0 -.4 É .*' ___. 3” _.= /11 Z2 -.1-s '__ ‘I J__ 1 g .4 0‘ 1.» .< _‘.‘* .5-'.' '5'.
'>3 1 . .\| "4 |_-:1 61*0 651 . -.-._.__..__ ...._. -» í_1...111 33?“. .5}; 1 .314 .15.‘ ._f_ 'I '107R |.uulu__1 .€' "-J r 1,. up 1).»*5 M.'- .4. .-. .-- .3 . D '2) ‘I D 4 11- E? .1 Ž 4:11:: 77 QR Qnfi uui-uuv 15:1-,». /I 7 :.;.\ 1 -I». [121 F41 I 4?? 0;-_=_. .41 ' __' 1 ‘IL-1 1 1 2442 . . 75;72012.i34.544 1 _ 1.... 1 1 1 1 1 _ ____ 1 . .1 fi w 'I-' 'J 121'- -:3 -1:-1 .F_,: ‘.* 3 i 4 11'. Šš 7. 1
1! 217/32 1 2.5313 04.204 39/16 3.5625 . 1 1.7520 1-75211-_ 21.42-50.0, .1022j.7/32 2-53.1.3..-1_1L1-2% .3-02.5-1 00444 004.00 1 49/64 140/ . 2 442847 _ '6 4 10.7550 1 1.7050 . 2.5501 05.00 3.5027 T0100 3.5827 91.00 .2-.5591. 65100. ___1 ; 1 f Ĺ_ 0/10 1 __2_5_525 2.5025 05.000 3 19/32 _ 3_._5037 65 088 310/32 91.281 73.5937 ...1-_7.71Ž _
45.00 Ž 220/10 2.321.-ZZ1_7.--1 125/32 }__1.7013 _.1 45.244 Š 2.1002 125/32 219/32 _ 2 _.2 -40 5013__7_ 05.001 . 3.6220 65 681 92.00 077_ - _.1.._?>-5_22L.-.92-.00_1__1.7013“ 2.5984 ' 00.00 66.00 35/0 13.0250 92.075 05/_3_1 3.0250 ____0_2_.075 ; 45.500 11 __2.-åäåí... 151/04 __1._7000 1045.0411 15 1/04
01.07000 25/8 1 _20 2.0250 00.075 321/32 ...3-..542Z'__93-53925/0 3.6492 1 92.689 1.0110 46-IE1..1 3.6614 ` 93.00 2.6370 1 57100. 67.00 . --_ . .. L?11_0 3-551..4._J_9.3-"9 1._2..0078 1 5 1.0125 1.01251;_ 40.030 221_/32 205101 2.0503 1_ 07.400 221/32 67 469 5Hr—~——————¢— 3.0375 1 93.662 03.002 3
L/1e_ 3.0075 '153./04 1 53/04, 1.0201 40.434 68 00 3.700 0 94.00 04.00 ._ _.....Z~_5772 _00.00 .3.-70.03 _0091070 1.0307 _ 40.500 211/Q0 211/10 __ 2.0075 2.68 75 1 001202 3 23/32 1 .3-.?.1.1.3Ll4F& 323/32 3.7107__ 04.4 55. . -9 _0 65-262 127/32 1.3437 1 40.031 4 1 27/32 _ 1 1.0437 _ 1_2.7165 0_ .0 2.7105 00.00 3.7402 3.7402 i1 05.00 1.0504 1
47.00 _10504 223/32 1 2.7137 69.056 69 056 5.250 33/4 .1..70I7.500 3750077 095-.250 777 155/64 __ 1.8594 11$/04 1.0504 Š1 4_7_. gg0_ __223/4 00 350 7 2.' 69.850 3/4 | 2.7500 00.00 _ __ 3.7705 _ 95-.0.Q. .___1.57u1 47.000 0 00 1.0701 1 47.500 _ .....i?.-7.529 2.7550 70 70.00 32032 32'5/3'"2 11_ 3.7013 0000.044 _ _95-E 17/0 7
1.0750 47. __ 0- 2225/32 25/32 ¡ 2.-Z853». 2.7133 70.644 70 644 li-_31_3/10 1 3.0125 _ 95.-.8_3_8. 00.333 17 . 1-_8Z§0_L.4Z-625 1 2.7053 1 . ____1,0000 43.110 Z1 1.0000 40.00 71.00 3.161 39 1 07.00 1 2.72fi3-_71-110 30.100 1 57/04 1.0000__ 40.022_ 2 . 0125 . 7.1.!§35 27/32 1_3i43.7. ;__ .3..043.7 1 07.031 327/32 07.331 1.1.52/6.4 . 1.-8900.-48-
022. 1.1-- 13/10.. . 2-.3.1..25 71.1435. 1120.132 43.410 _ ăV_2. 0_340_ 1 20/32 5 1.0003 40.410 2,0346 72.00 1 3.8583 72.00 __ _ _ 1 98.00 03.00 ~3_Ji5_8í * A 1.0004 1 40.500 43.500 2227/32 3.5750 : 00.5125 2//52 $431.-.. 2449/ 72.231 1/ _3_7/13 _3_7/`1?__3-_1`17él_=-_9l2.42?2 50/04 1.0210 1 40.010 _22.8740 0740 ' 73-DU 73.00 3.8976 99.00 1
59»'%....1.-9.2.1.51. 48-816 .3-.39Z5_?9.9-09 _ i 1.9291 1.0201_`1 49.00 40.00 ;z 227/37 0 1- 2.37507 2.0750 73.025 3.9063 _ 99.219 3 20/32 3.0003 Z3.-0_2_5. 5 11 101716 49._2l2_ §1_2Q9/32 1 5/10 1.110075 9_3_75 49.212 2.9063 _ 229/32 2.0003___ _ 73.819 3.9370__ 3.9310“). 100.00 - 1.9488 11.9488") 49.500 2.9134 74.00 315/10 1
3.0375__10_0.012 315/16 3.9375 0 100.0121 -2|]-——-___ 1113151717 __ W75 'I 3 _L_m 7'“-4. . . 1 1 1 Zl- U3 1 — §A‘4,‘"¥ 1§¥31*\ ‘L 11'?-J -1 fir' 'JA 74211 .u¢.-:10 1.5945 1 L'-Iv‘ '/. 13.1 1'4. 1 4 131 -'5 .-'/. .-:1; Z 1;; I15 ; _„»;| 31' _ 1 1 1.5025 392036 1.5740 40.00 -...1..-§..7f16.. 1.5701 40.084 W1,070_10 1.5037 A 40.481 2.0037 _ 75.400 231/32 1
2.0007 ' .. 2.-9.921 70.007 2 9921 1 76.00 3.0000 3.0000 'I 70.200 2 31/32 _ 3.0313 1.1411/32 .jf...3..0313 1 70.004 f 2 3.0315 77.00 3.0315 77.00 21/32 72.031737' 2.0313 757151.594 .504 31/10 _ 75007221.... 30025 77.700 1 2.0472 52.00 2.0472 52.00 1}Š 1___ 3-9.709 3.0700 A 70.00 _ 21/16 1 2.0625 2.0025 .52.-.385. 52.388 _ 3 3/32 70.501
3.0037 70.531 3/32_.---§..993.? 41 2.0000 2.0300 _ 53.00 70.00 -__ 79.00 _ 3.11021. 3.1102 23/32 2 3/32 2.0037 29937 ;_ 53.181 9 31/3 3.1250 _3J.2ä0.._ 1 70.375 221/0 1I 21250 ` 53.075 2.1250 1/Ö . 53.975 '1 1 3.1400 1 80.00 00.00 21200 54.00 ,_ 35/ 3 2__ _31_63___ . 5 __ 54.00 35/32 3.150317700.100 00.100 ._Z-125.9 25/32 2,1 21503 5163 .1
54.769 'f 33/16 3.1875 00.002 25/32 44-7119 1 69-9.52 21054 55.00 3.1000 ' 001.00 ._2-105.4.-1 44. 1 111 01040 1-Q9_ 23/10 213_75_1_ 21075 1 55-552 .502 37/32 on 3.2137 3210771 01. .-._5._5. .750 - _._ _§§ 22047 2.2047 7 55.-90. 56.00 82.00 322837 02.00 SLSS. 2.2137 56.356 27/32 22107 82.550 31/4 13250707777' 3.2500__ 02.550 2.2441 57.00
320-Ti 00 83.00 __ . ã-.2.ã7L__. 1 224 Š 25 01.-. 2 1/4 _ .Z2 .-.00..-. 21/4 00_ 57.150 25 _ 29/SL ._3.-2.1&.ë»344 2 9/32 1 22013_ 20/32 2 2313 57.944 if 3.3071 84.00 3.3071 04.00 335 . 58.00 50.00 Ë130 35/_1_0__3.3125 1.2 _33.5 1'1 1- 2..-3 Ĺ 2 1-04125 04.130. _Ĺ__31 2255//11 00112 _ _2 . 0125 _ 25 _11 58.738 ¡ 311/32 1 3.3437 1 04.031 .32 2
_L2_2.5...1 _28-.-1 59.00 _3ěiã_1. 05.00 1_3§ 3510" -._ 211/32 2.3437 2 .3 4 37 I 59.531 ri 33 4/0" 3.0750 05.725 3/8 ...7§'1-37.§Q;-§§.-7.25. 60.00 0 2.3022 ; (00.00 3.3858 00.00 _ .2-.3.62_2_. . >3.-3556.; B5-"L 23/0 _ 2.3750 _ 60.325 60 325 313/32 3.4063 00.510 313/32 3-f1Q§§_?.-._8_5_-519_ 2.4010 61 .00_ 00 3.4252 7 87.00
3.4252_,._07.00_ Ž ___.E 2 13/3 N .12.-4.06.22.4003ll .» 3 7/10 3.4375 707731727 07.312 213/32 014.10 2 7/10 2.4375 2 4375 61 1 01.012 _ .3-4545... 3.4040 _ 00.00 33.-"U 2.4400 2 2409 A 02.00 3315/32 15/32 1 3-4537 3.4687 000 00100 30-.1.05_ 2 15/32 1 2.4007 $215/32 2.4037 _: 02.700 35000] 230.200 .0-50.00_ 8.8.-9.00. 031 1 03.00 @4003 03
00 _ 3.5030 * 00.00 30.001 2-4ŠÖLŠ_7__ 2-1/2 ' 2.5000) 21/2 2.5000 1 03.500 3317/32 3.5313 _89.694 1;/32 ` 737.5313 89.694 1 3.5433 _ 1 2.5107 2.51070 1 04.00 04.00. 00007 3.543_3_.-:L00-02. 1.11 1__Ĺ. 1.0332 50.500 1 -0302 .Ĺ 50.500 111 1 0.0000 177511-11011. 50.800 2-00.00; 1 2.0070 1- 51.00 51 .- .4 3, _-:- ;_ j 1 31/32 _1.000.7.-š A 1-
95_.1 07 550.006 101/02 ..0-Q9...0 103704 f 1.9844 1.0344 1 50.403 163/64 50.403 .~. 1‘-"J. ._;_ ‘-9"' .'I" _"\ 1 . 0 _. _._}_ _ _ _. J? . -1110_ ‘/11-"16 1.00.75-._ 42.862 -.J-.0.2L£400. 1.0020-.. 45 64 1 1.70_31____5__43.250 11^ 15.04 1.7031 1.7120 _ 1 _ (1.7120003.500 1.7107 _‘ 43-650. '123!1’ 2332 _ >_2 . 1-7.18.? 1.7323___‘ 44-00 _ --1.-7323 1147/04
1.73440} sz 7 3:. 1.7344 _ 44.053 13/4\Ñàcí 11.7500 . 75001 _ 44 . 450 _.¢ f< Q3 1 1.5045 40.500 "3_95_4__ 1.5094 » _40-_87.8. 00404. 104-14 1.0142 1.01412 41.00.1 5/0 1.0250 _1 41--275. E.1-.0.2.40 1.0330 L 1.6339 _ 41.500 1 -11.104 '14 A 6-11 1.0400 _ 41.072 1.0535 _ 42200-. . . __. 115535 21 32_._ 1..0503. . 42.069 . 1‘ 31'33_-.-.1.-.5.5.5§.....
~'001 43.»"-04_ 1.0710 107.10. 42.466 1.0732 42.500 . - . 1-67$-.. _ V -P-_ . -F»@|. “"4165 -0-L -nah .-_ -3704 1 ~37 04 #'-0 10 32 ti. (- 33-99 115000 30.100 1.5000__ 1.5156 .71.-.4150 17 _---0.407 I8 _ 1-.151577 51.5i_1 00 500 .4.) J‘? ‘-&$§&'-:0 “& i . li."1'I"i'I 37.00 37000 37-500 37.703 1.530.. 53 L__3§ 894 .5354 1.5354 _1 30. 00 _ - 3504 :1: ,0.-1
1.5400 . 40.201 1.5469 1.5551 ; 30.500 . ~ 010__-- . 14551 1.5025 "T32 >J‘173 7 2 1 ‘\ -$035’ 1 _ |._| U-IUU _-5 1 1 (mm) 1 1.4507 1 11532 1.4007 no "š32 1 1._4_037 1.4704 1. . ...1.47.6.4 1 ‘1"\ .1‘7‘Jfl') uuz. (inch) 9 _ : _ 1.51 _ Fraction;(inch) rmiiun (inch) 1 (mm) 15-Fraction; Fraction (inch) _5 (mm) (mm) 1 '/7'. Fraction Fractiun _ (inch) '% |— 1I 1H1
1l M11 l1M11M1l1I 11 I 1.1-,- PP /1 .2, E ; -I'.{1 E-1 1:_-1 __ 4,45,} E .‘1_1 . 1_.._ 1 1;-'~:- 1 1 €é :30 -5»: ,4 ._l cu E0 1 .9531 4_._1W_ .49-_609 “Z 650.J2; ...1-9531... -> .t~ 1 19°.=O)Q1 => CJ (I) 1.9685 1750.00 unPQo 1 MC _L 0 - _-04 2.9375 5 .62 2.2.-.9375 IO/I ' ._2cz Ë_ 1 2.9528 2.0520 74.612 75.00 75.00 3.9667 1 100.806 331/32 11 3._9Ë/__
3:11/32. 4.0000 101.004 .0000 1` 101.604 \H \'\ 12]”. . 1 011 .-. _ 4 _ METRIC METRIG 0001000 um=/um: 7__ panner Sganner Opening Thread Tm d Spar7nerSEa|1n0r_0peninq Thread SSi ze A/F ii/F mln min '"'_g'a' Size max Size Size S448 (mm) (mm) (mm) 01 Hlinch) (inch) 1 ínin “"0 (mm) 1 mãi fifii (mm) 1 It lh .., -1:2 ‘Z01 ,_._._1 - 1 11.18 1 11.33
11.33Žý 1 1110 12.80 1 12. 12.95 A 12.00 7 1 14.55 16 _ 1 14.00 14.38 14.55 9/L ..9/15 15.98 . 16.15 5/5/8_11 1 15-96_16-15 _ 3/4419.18 ý19.38 L 3/4 10.10 ? _10.00 Jil»mw-1 1 V I ___ U1 . 7/Ii 1/15 7 :.;-. U|U From foot-pound to Newton-metre 1.‘ 3.2 3.22 3.28 1M16 022 020 1/4 . M1.0 _ 02 I/A.. T 1 _J/11 7477975/714771 T. 7 1-1577 4.02 4.12 M 2.0
2.0 4.0 M 4.0 . 221/2 3/0 5.1_2 _502 02 1 *M25 5.0 1 _5. 7M2.5 .7/i_. 5.52) 5.02 . ..4/1fi_.-.. 5.5 1 552 M00 M 0.0 55 '_1 7035715 7.15 W 1/4 7.00 M4.0 7.0 . 7.0 M 4.0' 98 11*/10 20.70 20.70 20.98 0.15 (jo/10 M011 0.00 0:10 1 8.0 M 5.0 00 24.21 15/10 A 20.90 1_ 3'21 10.0_4__ 10.19 1 5/1.... *MM5-"_ ._1°-1§ 0.0 10.0 . 1°-94_.-1°-19 1/56%20.7071'20.01 ? A
20.75 1 29.01 1/1,. *if*/10 1 1/4 33.53 33.81 M 7.0 _ 11.0 11.04 11.19 ._W7/0 10.24 ._1___ 10.0 10.04 M 8.0 13.0 ‘ 13. M00 ‘~41 13-24 1 A 11 1/4 00.00 00.01 38.61 1/2 17.01 1 _1]-30 17.05 17.00 W 1 1/ÅWŽ1111/15 ‘ M 10.0 10.0 17.1 43.38 { 40.00 .08 1_40.00 11/10 _Jê 7/0 19.00 121.1/I M12011011 19.00 M 12.0 19.0 10. 48.21
47.88 1316 19-36 1 4700 40.21 .__1 .1/4 . _1__ Ž/0 53.04 L 1 02.001_00.04 21/10 52.68 22.00 0 11/0 22.0 22.00 22.00 M14.01 M 14.0 22.1: 1 3/0 07.04 21/4 1 57.45 57.04 1216 24.36 1 57.45 71 24. 1 1/2 24.0 24.00 724.00 M 10.0 F115-". 5/11 1 07.00 _ 07.40 1318 1%;/48 0/422 5/4 1_3/4 27.00 ` 27.40 M 10.0 27.0 27, M10.0 0 70.01 1 77.00 77.09 2
00.00»__0111.40 rxarxa .C‘.‘*1."* 4 00.001 76-51 M 20.0 w00.0 M200 00.10 86-72 00.72 FËŽJ .4/8 1/B 1 86-48.1 02.0c_1c:4;1;»_ 02.007—02.40 02.00 02.40 7,21 M 22. 22.00 02.1 95.70 90.04 4-4-/‘#1 95>74%96"34—1 00.0 00.10 00.10 00.00 Z 24.0 00.07 M 24.0‘ 105.97 50 41/0 1 105.33 i359? 1 10 41. 41.10 41.00 M27.0 41.0 1 41. 17127.0 115.57 4
1/2 114.91 03 41/2 1, 114.01 115.57 40.0_ 46.10 40.101 46.60 40.00 . M 00.0 46.0 M30.0 1 50.0 50. 50.10 _ 50% 4.1-1 Th dl SBS (Whitworth) M 33.0 00.071 50.0 M s_ 5"" _ ‘Fan: 1 67 rea |l3|I|'|Bl' Size IZB B3785 Fifiing I Il'l§ I Spanner 1 Nearesl 55.12 ' 55.72 55.72 Thread' M 00.0_ 1 55.0" _ _1 A/ff A/FN______1$panner {1§|0ar1n0_r _ “size ' A/F M
36 0‘ 5510 Size size A/F1 00.0 00.12—i-725 00.72 09.0 _ 00.0_ _M 00.0 _ 60.12 60 (inch) (mm) 1 (inch) (""111 (mm) BS Whit 1(inch)1(mm)1(in011)1 E 0 as 05.0 ` 65.12 05.12.1 65 05.72 M 42.0 65.0 M42.0 3/10W .44511.30 7/10 12mm W1 .445 11.30_ 7/1152 mmi 74/4 ili. 3/10 rm /1:: n -7n 70.0n ‘I 70.12 70.12 70.72 77-5/707771/4M M 45.0 .525 .
10.00 13.33 L/32 _14mm 5/10 .. 1/4 W .525 i211-111151 75.0 1 75.15 75.05 40.0 770.1D 75.15 75-85 M 400 W1 .000 15.24 H [44/02 |16mm_ 5/mw .0_00_1__5.24 19/0260101 319 15/14 00.15 1 00.05 222715013Q_.711;1 52.0 00.0 00. M 52.0 23/32 18mm 10.05 23/02 7/10 73/zi .71018.03 85.0 85.15 05.05 85.85 M 50.0 00.0 00.10 M50.0j 13/10 21 mnl
mnl 20_. 83 1 13/IE1 w_ .820 .020 20.83 ...Ĺ/A 7/10 W__ 90.15 90.85 £1 1/10 M 00.0 ' 90.0 M000 00.0 90-15 .920 23.37 15/10 24mm1 24mm 1/2 W .021:/20.071 9/10„Q2 05.15 00.05 M04.0 5/4' 1 2220111111 20 mm 95.0 1 95_.1iý95.05 M 04.0 00.0 5/0 70/71571/v11.01T1fi0 9/10W_ 1.010 25.05 _1_Ž_ 1131 1.200 00.40 30.48 H 11/4 ___ 31 mm 1
100.01100.15 1M‘00.0"“ 11 00. 100.05 00.05 *W 11,/mv W11.2Q1..1 Mí0.0 100.0 33mm 05 20 1171 7/0 A 3/4 W11.301E1.33.U2 mm W41 1.300 33.02 15/10 ,33 10-5.0 105.20 106.00 72.0- 1.000 M720 .- .1--._._-6.0-0 4007 07 38mm 3759111/4 . 50“1 11/4 13I}mm 7/0 W . 1.1.480 110.0 2110.20 110.20 111.00 M76111 111.00 flf” H]/0 M 70.0; 110.0
43mm: 42.421 111/10 111/140 mm W 1.070 142.42 M 00. 011 115.0 110.20 115.20 ‘11000 1110.00 1 1/0 1 111/71.07131 M00.01_115.0 1 7/0 11 @ 48111 mrn 11/0 W 1.00011 47.2411?/0 1200 120.20 120.í'121.00 M 05.0 120.0 M000 121.00 11 1/4 41% w l-863147-24 11/W 2.050 5207] 21/10 '`52 mm .1 3/11 M 7 1000 10100 @7171716 100.20 101.00
' /4 41/4 " -959 52 M 000 90I-9.0 fi ' 11130 ' 201P =Ífl11/2 11/01111 21/4 152 57mm 50.0912*/4 13/0W 2.220 50.00 1 .20 1100.00 100.00 ~~~ “M0501 WK2_58O165l53A 29/7-10 '66 1100 ml -1 105.0. 1100.20 2.500 05.50 29/10 mm Masu 1355 14520 14000 15/BW M1 00.01 450 1 145 _.20fi . 01* 0001145. 1 1_. Li*114600 13/4 70.101 23/4 170 mm
211/T70 mí 2 13/4 1/v12.700 W 2.7í1'70.10 151.25_ 0015 z ~.^m11~.~.5115,1 M105.0 150.0 150.25 ‘10120 a1.da1.1 ‘ 1 = 010 01554514 .25 150.20 155.0 7155 155.0 7155 155.25 156.25 MM110.0 110.0 150.0 1; onBS fj U3 C: = New Standard . 11 ft 1110lb == 1355817948 L055017940 Nm nm 1 A Spanner 1 SSparnnervirigiening annerfl F__C
WPF ning ._. Size 5/‘F1 ñ/'F 5 arze (inch) bJI'\J—l- 1.36 2.71 4.07 5.42 6.78 _, `4'- 1 I-DID - L5-|L_L- L -PI-O-7I'\7—l »,._ 1 /4-- . si/4 11, 1 4 1/4 21. "I *l'\|-U lU.U _ I|\`>¡N:l.\:4-.L»-.~-I-.\ _n|.cf§|n‘-mDųOmD F . LOUD 1 70.50 1 71.00 __ U‘! -Pb 1 Pa! 1` 0101ma:- GIT U1 H H UIUI "-1.61 74.57 1 75.93 75.90 1 77.28 77.20 1 f1 ' \J'\I U'|J'l EDD
a:nuru4r=`1u.a1:n`|:n U1 Z 01ul U1 U1 88.13 89.48 90.84 92.20 92.20 93.55 94.91 96.26 ‘` 1.` A »iman 1 0 09 3259 4.43 5.16 5.10" 1 1 , QL Z _Lcabon ___ _ 4 0.11 _ ._3-11 7 U1 -Fh __L¢L U‘-\U'l U'l1J'l CO1” 1 mU‘)U\O1uUl 1U 1U 1 Z Ou:N-I av fiJ§_l¢L—L j pl 11.06 . 11.80 11.00 12.54 12,54 i U10‘! UQU1 10.20 14.01 14.01 14.75 14.75 15.49
15.40_'- I'-JG'lO'lD'I —lZ¢“~1l 16.23 "|~¡mOfi:1cnm mflä N-n1:ucz|`O1wI\-1 '“ -Lcuzaoa‘- I N'"' N_¡ z_¡ N-lcm ųa: ‘ .02 11 1 10.00 10.33 If 7 @3151 -P-O-3 39.09 39.83 40.57 41.30 4:4 :- E“.-* Qua4:-o 52204, 42..79.1 ,42-79, 43.52 1 40.52 44.25 mi 44.99 -5'1- 00. 1 > 4 ‘"-JLD 451731 U1 N) ' _1 Š 1% C UU 299.59 -59 1 _ fi lb fill! 37.62
07.02 38.35 00.00 O"lU'l '--I5‘! _ -5 -lb _ T 11 1 U1 U1 9° U1 53° onouuw —L l._L OOl\3—l- _0 |._0 |._0 u1.>wN-4 97.02 7 777 07.02 90.97 9?-97 100.00 101.09 . 191.-59 _ U'lU'l O3|'\3 0.00 5.90 6.64 7.38 7.00 COED‘-|O'IU'l l'J"l —L 2.05 2.95 1 14;] 11 09.40 01ar U3 G’) "~|~|:n:n1:z |\'1_|.1=1n: ~| 01.057 11 04.00 84.06 1-1 05.42 _ 1 00.77 86.77 O1
mmmm -I‘-klu-b‘:I- I 78.64 79.99 81.35 ai. 1-x-liba:- N-1 zęwxnã 1.~_~_¡-01530 1 02.70 02.70 O15‘-\O1 (Al i-3-‘ '1-l' 4070'-IU'J —-5-= '1.DZ"-I 73.21 _1__l 1i_ Nm 5:' \r .a> 0.74 1.48 2.21 CAJCD 1 46.47 45,147 47.20 47.20, 47.944. L1 48.68 =17-0. 40.00 1K 40.42 49 42 50.15 50.09 50.00 51 .00 A 51.00 52.07 1 52.37 53.10 01 .10 16.96 53.84 1` 10.00
NIr~:1-.:-»;1|=~\ ~. 02.54 ~|7~|J:-cz:“i400 NNhm 02.04 . 17.70 sw 17_70 00.90 10.44 V 7 55.32 00.00 NNNN, 00.20 103.04 ifi __% 19.18 56.05 05.25 100.04 00.01 N`| 104.40 104.40 50.70 19.91 56.79 .1 10.01 37.96 57.53 105.75 2000A _é W 1 57.00 @fi 105. . 7 5 09,02 107.11 39.32 107.11 50.27 21.00 50.27_ 40.07 1 22.10 100.47 7 j _,* 40.67
100.47 59.00 1 59.00 42.00 1 22.00 59.74 109.02 1 -r¢..uo 100.02 00 40.09 1 43.39 111.10 1_ 20.00 60.48 ; 44.74 5_"EL 112.00 1 24.04 51.22 A 61.22} 40.10 a.mc=u:m~|l ~| ~| z>:aN-l=L:|m` u1-Irnw 110.09 1 46.10 1 113.89 25.08 no can0:1: -l=nC.dl\'|- I 61.96 47.45 W na::I 1 1.10-24 115.24 _ 47.45 25.81 62.69 02-99. 40.01 48.81 110.00 1 11
116.60 1 20.55 63.43 53.43 50.17 64.17 wwwgwwwuflmcflwww N-*naneo 50.17 r\NN:|\:>r\Jm ._*5:mmmo' @Louca-1-leocom `41a: 1 117.96 117.90 51.52 7 .Ë3 , 11 119.31 l28.03 \Jl\J 9°.“ areozco co:an0w1:0Ofie=~4`| ~ na`lc1u.r>:-Na:cno`|a1quNcno4Dum`¡r1 28.76 65.64 _3_9 J9 1 120.07 1 1.22.02 29.50 754.20 66.38 54.20 122.02 lãžlńý' :„ 90
55.59 1 123.38 _07.12_ 55.59 _ 120.00 30.24 50.94 ; 00.04 1 124.74 0. 92 67.86 cowF113 iz-|=J>a=-:xa-4:> 1:awmų mawmfl :nmwu:959"Ym.GO0on o“o-u:-zo Š-'JaoJ>ucu ua 58 00F7' tn 31.18 INJION J>‘O1Jl'\-I -l'fl-‘C-\Jl\' hi CI'! |'\3l'\3 DIfl$G'U|'là1G¡I \ '1- I'- IOUCJ1 "-l'1-I-"-I1- *-.'- .Ifl'l\-I'-I!-E CAI'\. I\Il\DI\I CD00"- I (Q11 Ca3hJl'\J!'\JNl $¢
'-JO! $Z OJ GOZ-A f :1"! fir) 71 Z1‘-DOG"-1-I W 1 LL. 0 5'- 1|'- l'~1 77VV__ I 1 1 C-\lCAJ CURB 00000:: g;|\3-. 4. O1-"I -bu O0 -Eh CAQCAJOI1-'l .1u'I -I‘- hO§|'\-1-1 ,,_ GOODO10"! %'OOB1101 C4000 @\-I OOOO @'-I %X ODI-O %$%@$ l.D$- lfl'IU'l 1 ;_. UUh|+u1rnr -3“ vvllluvul 5+ 20.00 20.05 24.40 _L 24.40 25.70 25.76 27.12 27.12 __1
_ 28.47 ZËĄĹ 1 20.00 29.03 1 1:4-4 |\ll'\TI: IIU I l- :Z U':IlCU'Il1UOIc'l b.u'I 'N-\J—Ll- H T7 I O0 Q O3 U1 1 -L 21.69 21.09 4- 7f'\'7') ru./4. : iriiili -L_. L "-l'O'I 5-. 1 1 1;z10,“e\:1\ 69.14 69. 14 70.50 -0U1 1.1:‘- 1110 Nm 0_1 fill! Nm ; 1 7 1 10.50 14.91 10.27 _ . _. 0 un-4:=° ° 17.00 _Åc1 10.00 10.90 20.34 20.04 15* --LQ From Newlpn-metre Newton-metre j
to foot-gound 7 H j F; 5 3 ž 2 F _________ Š-17.33 _;>_.(PU) 9.49~ 10.85 12.20 13.56 14.91 16.27 17.63 _ 11 nm Nm = = OJ37562149 0.707502149 ft1110lb Š filb 111011 1 _ 0.10 U-U I C] [J in TOROUE TORQUE CONVERSION CHART GHAHT _.NEK SELECTION SELEQTILIN CHART QHART SPANNER III :U .bZ -‘PbD .1 V 90 RH ._.1...11..1 L DD 191
04.90 GOI\J—'\= _i_.....1 _ _ CD -D -PI-F-PI- 5-O‘FI!-bC|OI\J'—l _ MH1 HMl1Ml|1Ml1HMHl1|Il __ __ __~,.._ _ . _ OJ LO '_0 CD v_2._ -13-fin-fi-rlU'5U'l lflflflflfl -Fh -4161 -DI-DIl.D$ ¢.D1lfl I-D$ -PI-PGbOOD QDCDLDWO 1*-l¢'I11U'l LO f-O i Cfl -1'11 dU.|"+ ti ‘-21 112-I 0 Matti? 6 555111 SOKGET srzmc SIZING cnoss GROSS 115512351105 REFERENCE
01111117 CHÅRT A ETRIC INCH TO IVIETRIQ liłielric ;l\lternati1re Altemaiive Metric Equivalent 1, Socket Size 1 (mm (mm)1 *11 NF (mm) Socket Sizes (inch) me awznmwmr* Nearest 1 Nearesł Hex1 Decimal llecimal Jlternalive llifi. Socket Hexi 1Alternative Difi. ‘ Equivalent SocketSi1e Socket Size in Size (AF) "iquivalent In (inch)mm 1 1111711)
(mm) (inch) 5 NF (illcli) "B3856 ||fiil'GSf 1 - llifl. Ditt. in mm I 71.457 1 2-13/15"" 71.437 W š_z-1:-1/15" nog _2-7/5" ' 7/32" 7/azšíf' 5.555__5.5r11111 -0.055_' _‘2-7/3" _j 5.555 5.50115 -0055 7 3.025 75mm -1-0.388 +0.388 74.612 „„z 311.5/15" 2-_15/li 7% 6 1/4" 5.350 75.200 _ _ _ '. 3/32" —41 11 _) 75.200 9*/52"' 5))_)1' 7.14 7.144 __)3" 16.. 77.757 .
'¡"°1E€' _uz_ ‘ 77.787 8mm +0063 +0.063 Wm wmvfm 3-1/15" 5/16" 7 Ë7 7.937 1 8mm 80mm +0.525 +0625 1 _s_75 A 50111111 3-1/3" ‘ 79_. 73.375 3-1/8 9mm +0 Qmm +0.269 . 269 11/a2_" _` 8.731 ___ 5 1 50152 ML/§£". _ ála/15"* , @Q5-2 80.962 it 10mm 7 +0475 +0.475 sm 3-3/16" 9.525 _ 9.525 10111111 1-. 3/3" 3./9" 1_'§F11:"' 1-1110 ___
11mm _n119 105.15 3 1 1'4 '1 52.550 82.550 11mm -0.112 7/15" ; 11.112 . 4-1./4" . em Š" Q _n ai .z1 12mm +0.034 +0.094 ‘ 15/32" 11.305 ; 12111111 3-5/15" 34.137 1 15/az" _é 11.906 54-197 13mm +0.300 ;\mmm 3-3/5" 12.700 ‘ 1/2" 7I 12.700 E1 55.725 85.725 57.512 3-7/15" 37.312 __ +0506 13.494 (17/32" 14mm +0.506 3'Ž/.1fi'.`.. 11/.fl2_-.._
13.434 3-1/2'“ 35.300 5-1/2" 1. 85.909 14.287 3/15" 9/15" ._14.257 1 1. 90.457 8 1 5 - 0-951 53/15" 30437 '1 90mm -0.457 -0.437 1 15mm 19/32“. 1 _15051 1-19/3.?.'.' 15508115mm. 0081 .0-is" 375 ‘1 15111111' 16mm +0.125 3-5/8 fí__92.075 E 92.075 1 5/5" - ?5-_ 15.575 2.5!“. ' 11 '"'*' -0.250) ` 95250 95111111 -0.250 . 4 95.250 1 95mm _11/15"
.1/15" 17.452 1 ÉÅ74' mwm m x 5-15_/15"" 95.557 96837 3/4" . 050 _ _‘ mm - 0 . 050_,. __m3-13/16" q 1‘ 19mm -0.050_ 19 19.050 3/4."__ _ 19 " 95.425 20mm +0.156 5":'a.7/a" 25/32" I .._1_ 19.644 100111111 (-0.012 -0.012”) 100.012 1100111111 1-0.363 1 3 353051.3-: 3-15/15" 20.537 15/15" 13/15" _1 20537)) 21mm +0.353 34.5/ _492 . 100.012
7/8.. 4"‘ 7 ...2 it l171T1.500 -0.225 .J." 1 101.500 22mm -0225 22.22 25 1 7/3" 22.225 4-1715" 1 103.157 24mm +0.15a_ 25.512 1 124mm (W15/15" 0 23.312 +0.155 714-1/1755 __ 1047 104.775 +0.225 / ' 6 75 ; 105mm +0_225 4-1/0" _ 1 V 25.400 1 26_mm 25_mm 4-0.600 +0500 0' "4-1/3" 25400 4-5/15" . 133354 105.552_ 1-1/15" . 1 25.957 25.337 R 43
27111111 27mm +0.013 4-3/ 1 6. 1 11-1/_"iČ 107.950 _ -1-0.425 wm únw xmw w m M4-J/4"‘ 25.575 61 29mm +0.425 4:1"^?Ĺ. _ 1 107.350 .,.1."1./W' 41 _-1-1/8" 21 23.575 +0.453 4-5/15" 1 109.537 110mm +0.463 -0-0.162 50.152_`1 30mm 1-3/15") 1. 30152 ,)1 .1)52 \mvmx _4:§11§'.' 109-537 110mm ..J:3_L1.'5" 4-3/3" R 111.125 4-Š/aj" 1-1/4" __
@JSO 31.750 1 32mm 32mm +0.250 +0250 „ „fw zum 1 '1“-1'1 i "1?.i=‘.{'\¥1"t'|.\‘@i':-‘.1 Y1?$'1‘~&\‘.K". 1 ___1_/ Iv 11.111_ I 11111111 v-- -1- I~.fl§'@ V-id} __ _ $553» 2 1 J 1. "§EA%3 (O '€'}¡)\íS'¡ä\)Nfi\“åwR9. u 4 ‘ _ 52 : t F“:-nnrrnnse LI) OL _ ' '.'l__"HR“ q H! nu mi _,. 1 11 ..- 111 J 33.337 ‘1 ''__)1_-51' 1)'11"H 33.337 1:5/1fiĹQ .41- 54.925 -3/3" 11 _
34.325 mi 1-=/51.. 1-7/15" 1 36.512 1-__1. L 1-7/15" 1-1/2"_M M:f ..1;1/2" 13/1) q _)__-_9/15" 1-5/5" 1-5/3" 1 1 _ 6!! - " i1-_1_1/16" f-11.1151". ; 1 -3/4" _ ` __1_-_3/4" 1-13/16" 1-13/15" 35.512 55.100 . 100 87_) " 39.687 33.5 41.275 1 42.862 1 42.8621 44.450 46.037 45.037 - ' ._47. 525 1_-7/5"' __1_1 _47 .525 1?/.3.’ 49.212 1-15/15" 21)1 43.212
50500 '50500 52.557 2 -I1/15" » 52.337 111/1_5L I1 12" 59.975 53 .375 2-1/9" .‘1____i__1__ _ 2!! re I 1 __4. 0.311111 1 33111111 35mm 37mm 38mm 33111111 40mm 41mm 41mm 43mm 41mm 43mm i1 Hm 1 §1;?‘_44n -2-in li-1/lfi" “__!/lu =1-_ f‘|fl_! 150.488 +0.433 -0.100_ -0100 +0.313_ E +0313 -0.275 +0.13B +0138 ||L.¡1L 112.512 4-5/4" 120'1í{'_m 4-
3/4_1"_ 1 120.550 411’ 120mm 724-7/5"í125.525 '4-7 3" 123.325 /1 127.000 127.000 1uz . _1 5-1/3" 7* __* __130.176 130.175 505- `@>\WI`'J>\9`Ë1%IĹ.`7^å'č5Ž1\5l$* / '55 ;15 5- 2-1 . r1 -1411-1:" 71 2-3/4" 2-5/4" -0.175 ___ . 2 >3 152400 1) 155mm 155mm +2500; +2.600 152.400 155mm q -0575 0.575 155 155575 - 575 1 155mm +1.250 155.750
160mm +1250 153.750 151 151.925 1 . 325 . _ _ . 155.100 _ 155mm 0.1004 165.100_:_165m111i-0.1U1J_ 155.275 153.275 E A 171.450 i _ “Z 3:5.-510119-51513 3 2” 1 177.800 7"11" 77 177.500- 70mm +0.150 mwmä" 5:1 . ----+1» 1 1 1 -- ---- f _ 1 ii0 709" 709" 1 9-723"“ '~~ ; I 1 l i 0.787" 0.527" 1 5271" 001 1 . _ _4. _ ,_ 11 1 111 11 ,. „„ 1` u.ouô"
0.666" I! 1 1 1 "5-5 7 '-:4 52110 ">\1.1~v 1| 52mm _71 _ 54513) 54 m|_n __ I _ 2-1/16" 2»1/15" 2-1/5" 2-1/3" 2-3/15" 2_5/15" 2-3/15" 2-3/16" 2-1/4" 2-1/4" 2.126" !"-2. ._.1.5|\c;'J-F'- O3-"1'- fízzš; 55mm 2.155" zæä.. 55"1i“..-_ . 5 .229?" -5'¡"l". 1 +0387 +0.3B7 -0.025 flvfiš +0562 _-0.43_7_ -0.43;/_ " +0150 +0.150 55111111 _1 2.255" 58mm 2.233" _
40.925 2-5/5" 60mm 2.362 _O_1.N\I _ 50111111 6 (662.3527)? 2-3/3" +0.325 5/8 7 Š/41"" --0127_ Åx«1.sa>\«e5v;:1=æ>.wm"»x\09: 5?""" 52111111 ___2.4g" -0037 ..2:4fl'1._ 2-7/15" -0.057 3mm 2430" 1 2-1./2" 2-1 /2" +0.-500 +0.500 Sfåmm 2.480" 3/4" -1-0.051 G5mm 7 2.559" +0051 2-3/15" +0.08? +0.057 65mm 2.553" 2-9/1.9" ~ 77 TT 5 2-5/5"
-0.325 -0.157 25/32 67mm _ _..,2-6,3?" 2638” 2-5/3" -0.525 Ž 70mm 2-3/4" -0.150 2-5/4" -0.150 2.755"1 ..-:-.3.rY56’ - Ã ñ',„,: //0" -1-u.22u 7/'6‘" +0226 75mm -11.387 2-15/16" -u.507' 2.955" 2.30a" 12-13/10" B0mm . 2_3"'"1.7 . 5.150" 3-1.220’ 15/15"’ -0.155 B5mm H -0.188 85mm 5-5/5" +0.725 5.545" 3.345" 3 3-3/8L+0.725 1"1" +0.400 3-9/15"' 40.457"
9.545" Qllmm +0400 _ 90mm 3-9/16" +0487 3.543" 57mm 1 2.244 2.244" Z-"E '-E-H1}.-I'§' 6:1 1 0.748" 1 1 OOH" l1UUU 1 0.669" 1 "lUlIllll p. , 1 U 5'9 i.\“¥§$:1>§1‘-“~' 030513 . nu-nu n 4|-14!-nu n an E1; "3.."'*"\"1,-:_.;1";-L1 .4 5+J _ff _ .2". .. .12 ___. 74172115 ___1__-1 BiE¡\` Ðć51X'i2ca^I€d$*1ä .„A28×\Ž"5.$:3ł2\W» 151595 15 -10.056 +0.056 v 1
+0.438 +0.4s5 45mm ;.-..J.-.?72I’_ 1.772' _45"1"' +0.03? _Ž¡; 45111111 1%/15" 11.050 1.; 45111111 W__1.511" 1311 . " .1-13/15" 47111111 7 1.550"" 1.550" "45111111 1.590" 5/16 " 1.590" 5/16" -0.063 -0.053 1 1 125 J9L“."!_ 49mm .J_1;929 -PËL Ž 50111111 1.955" 1.355" 7/32 7/32“" 7! 0.630 " -0.137 1-11/15" _ -0.157 1.732" 1.732" 2? ‘. ..- no 115:0 UU-
LUL 63.252 69.850 53.350 -0.550 ' 0.550 “1 55.562 _ Žj299°i' "` 0559" 1 _ 130mm -_ - . ` 0.905" A 25111111 23111111) ;(0305" 24111111 _ 0.94_5" 0345" 1 1 z4111111_ 25111111 0.954" *1 .2504 25111111 0-11234?’ 1.024" 35/4" +0.250 95mm f;.9;149.íi_. 3.740" 1 3-3/4" £1???‘ 27111111 1«1/15" 90.012 27mm 1 1.053" 1.063" 1-1/15" 3.937"
+0.012 -0.012 100mm 3.937” 13-15/16" 3-15/16" +0012 25111111 1.102" . 4-1/5" 28mm -0.225 4.134" :1 105mm 4-1/8" -0.225 . _ . j . _ _ ' . _1 _155.-.4.991" 11 Umm 29111111 20mm 5 1.142" 1.142” --112!“.'?1...4-3§1f...-.,1 30mm 111111 R ~`*1Ë51"fi 1.181" 1 T-9/175" 1-3/16'' +0.152 4-1/2" -0.700 4.527" _ 11 ãmm +0.162 1715111111 i)4.527")j) 4-
1/2" -0.700 =mw-g~u*x1mw-æ:m;1\xe;mw‘.sæ'-wmF5 3° 31 mm ,J_;??.°" 1.220" . 7 71. 1 571 *""7 4-3/4" +0.650 4-9/4" +0.650 120mm __ ÅTT. 3 4.921" 1 32mm 1.260" 1 1-1/4" --0.250 125111111 j 4.321" O ru +0.700 +0700 I! 0150 -0.150 -. .5-1/8 G"-Š./_fl.". 2 +0.255 süm wxw _ 5-1/4" . _1_ +0253 5 3/3" A 5 60mm _-0.525 -W3/B" 1 50525 50325 1
5011111 -0325 g__5-5/5" 22-3./9; +0.055 5-1/2" 62mm +0033 51.912 1 52111111 2-7/15" . 51.312 5-1/2" _:_-7/15" 0.500 55.500 i(_2;)1/2"" 53.500 _ W63mm 5-5/3" 5 HL .. Hm ' -0.500 3:1/2" 5 1 0\4" -0.057' 555152' 5-3/4" 65.087 -3/13" 55.037 65mm -0057 2-9/15"__ 174.525 5" " 1 ' 1741525 +0.325 za5 5-7 3"" it þ7mm 67mm +0325 z-5/15"12,75 66.675
_. r. 2151. . @515 L'I I] IU 115mm " uiiilfl 22171711 _| 114.300 4-1/2” .1`‘H4300 __\.am _.4-1/2" 4-5/5" 4-5/Q?' 1117.475 1 111475 š 117» '.'-' 1 __155550 A___ 1/4 45111111* +0550 +0.550 \ >___1i103.350i* 77 1 4511151 °." ._.,?.eJe .1 1155.525 5-3/5" 35.52 5 -0.057 \~. 'P 46mm -0.037 45111114 -1 5-Tfifi" ' 138.112 ___q 48mm 451-mn +0375
+0.575 "TS-7/1"6"'Ž1s5.112_ A 153.700 T 140111111 1 75-1/2" 5-1/2" it_139700 14__0_nm +0300 +0.500 49mm -0.212 q 43mm_ 142.875 ËË5'/5" +0.200 3115.-5/4?i._ 50mm +0200 142-875.1 1 . 5-3/4"_5 145.050 *_is-5/4""'"T145.050_' 87 -0.387 -0.3 52mm I11 , 52m 2 + 0 025 -3 5-7/3" 5-1/5" _1 .149.-225 149.225 _1.. 2 Ž 2 71 4mm +0025 1 554mm
. -2 56mm sęmm '4 ___57.150 Q 57.15 0 1 57mm 2-1/__"f__q__(2-1/4" 59mm 58.737 W,i911111"_1_ 2-5/1,3" z-5/15" 50737 -31' " 1 2:3./1.9" r\ 'U.0OI -0.01" o +0.075 +0075 1 16mm 15mm 17mm *iiimm ‘Iflmm 19mm 20mm 21 mm 21mm in mm | 1.653" 44mm 44mm + -:35 OF! /105 -Iv-"wv 1 R _431111_11 .+290 - . ____1.533" - .1.
]=.9=."»i'. __ 49111111 __1.59_5_"_ 42mm . . Diif. Biff. zflåë-.Q->5 \ 7/15 +0112 7/15" +0.112 -5415 41)_ 12111111 15/32" ~0.094 -0034 1 1z111_1T _0472" 0.472" 15/32" "1:1mm É?")_w_m1_11))~_0512" 2 Ž +,\«.-x0«:~\»2×:1\v "_*Z 14mm _1-09.-.5.51' . ? .;_ +0.28? 0051“ 9/16" .‘f'"“" 9/16" +0.287 . 15mm `§ 0590" 0.590" 19/32"
+0.081 19/32" +0051 Q‘ -fin.-1.-1.-1.-1 1 n -ICC ¢u11||1| V TU. luu 511111 it Nearesi Nearest Socket Hex Nex Decimal Deeimai Allernative Alternative Size (AF) Equivalent Eųulvaleni Socket Size 1111111 A/F (inch) (inch) li/F _ 3-1. mm) '\1f-3§'5-.§\'1§'‘§'3I§\1.\3':141§':-.§;1-_ 5 % '5:-.' ‘ Efi1' :1 - ii -an nan I110‘-t"-1 9.199" .9117'i-r 3.5mm 3-5"!" .1
“-1321 4mm 0.157" dmm 0.157" 4.5mm 4.5mm 2177' 2 ãmm 0.197" 5.5111111 1 0.21Ë 0215" 21.255.5mm ômm 5111111 Q16 0.235" 0.255"Ñ; 7111111 __ 7* 0.275" 0275" . 7mm 8mm 8mm 3m111_ 1 0.315" 0.315" ` 0.354" 0.354" 9mm 1Umm 0.394" 1111-1. -.. . 30.455" 13.11"' 711111111 11111111 0.433 -1 it |Ë| METRIC TO INCH IVIETRIC 1 Ngafgfl
iiearesi Socket Metric Alternative Diff. Nlełric Equivaient Socket Size Sizes (AF) Equivalent in (inch) (mm) A/F mm. NF (mm) 38 5/15" 4.752 ___ 5111111m +02 40.295 *1 3/15" 4.752 75m SOCKET SIZING CROSS REFERENCE GHÅRT CHART SOGKET -11...... 7"; 557765117 + Š:. QQ 33:11:11 1.299" ; ‘1_|71f'lR" 1 5"`se 213Š _1_fl cgcuuv lI\I I I I I II
I 1u11u I -I-\l\J 34mm 5411111 mi- "(11.338" .šcší 1 35mm ý1.Š75" 1.378" 35111111* 36mm 1.417" 1.417" , 11m.."'" 17111 1.45*1f W" .1 1.496" 11111111 1H H1 H1 1 M1H1 1H ?'38mm :B"'"‘ .1.-496” 1 1 39mm V 1.535" "40111111 40mm 1 1.575” 41mm 41 mm 5 1.614" 1.614” . 1.575" l__ ._ __.. 1 1 1 1 1 1 1 11 1 1-1/3" 1-3/B" 1-7/1 5" 1-7/16" I U-\J\J
-0.075 5\>1=~'*lz~5\ ~ W 9x\ ~91 .1\;> +0512 +0.512 I 1-1/2" 1-1/2" +0.100 1-9/16" 1-3/15" -0312 -0.312 1-5/8" +0.275 +0275 1-5/5" 1. I.., _" .~\1_r-j j.‘ 1, . _;. `1\«»-.154«izfi~.\1í,s5=1 » 1QI'Irnrn l\'\IIIII'II 130mm 135mm 140mm 145mm 150mm 155mm 160mm 165mm 155T11m 170mm \J-Il\J 1:E 1-in” 119" 91.1114 i 5.315" 5.315’? 1 1 |,ru cnuII
1/Q" --1(TiĹF1 CD '...=: +-1-SD 5-1/2" _-0.500 -0.300 5.51g_ 5.512" 1 _5-1/2" 5,709" 5.709" 5.905" 1 | 6,102" 6.102" 5-1/5" +0575 +0.575 5-1/5"? 6.299" 1 5.233 ll 6.496" 6.693" 1 5.533" .2 ~ ;i -1- 5-1/2" 6-1/2" +0.100 J - . r. Ml ,fli Symbol ACME-G AMO Aiviü ANPT BA BSB BSCy BS CON BSF BS GAS BSPP BSPT BSW M ME |ii||= MF NN BUTI' N

BUTT ________ __ __ _ _____________i___a_______, ABBREVIATIONS (SYMBOLS) Aesnevuirions (sYMBoLs) USEDFOR THREADS USED FCR STANDARD STANDARD THREADS 7 I Reference Acme Thread - General Pu Purpose FD ose American Standard Microscope ivlicroscope Obiectlve Goiective Thread Aeronautical National Pipe Taper Thread
British Association Standard Thread British Standard Brass (26 tpi) Thread British Standard Cycle Thread British Standard Conduit Thread British Standard Fine Thread British Standard Gas Thread British Standard Pipe Parallel Thread British Standard Pipe Plpe Taper Thread British Standard Whitworth (Coarse) Thread ISO Metric Metrio (Coarse
Pitch) Thread Model Engineers Thread -' - r ..1 1/_: 1 9 ; ;.' -j- :-.,_-. _-- _, ;;. .- L-_ -,3 lä P Z III ‘ arm r"_i ,i*i L‘ `¡/2d2|pay " 1/-(1 /1 B A 1/20p|ay` orieri-=‘ nde2Špzy I [,~‘}|eA 71 B /¡1¡2dp¡ay^ Po ca. "ca 0.7157P 1/ 1711 _Ĺ (1/2e2piay‘|,i“~\(e 1/2°i"ay (1/2 play at’ 0051579 8167P P 40 P ./iii _15 „g 1.9334P O . 5P 1 . 933411? .S l.9334P O.5P l.9334P
NIl> iii. A BOLT I 0 . 71 67P "ay L J 1/2 "Iat I1 A:0_3707P BOLT BOLT B:0_3]07p_0_25g Xx [Id play p|ay a=o.aro7P~0.25s (C=0.37U7P-0.259 (dt (01 þiãy-d2 play) C=D.3707P-0.259 play-d2 play) ACME Use : Acme-General is used in the mechanical industry for motion ‘ transmission screws t 1 P c _4. ‘-\ =1‘. "‘ID „___, C) D‘) 1 03" @%§é§»PL(
0.5905P1_ "_1~)_"J I i /7=i.. 45° Kb m10.\0525P |0.0826P \~l I-/»l H2 d1 may 1/' u 0.5%)59P 10.55 0.5059P EšIf _0.:cs\ I'\JaI\3Nz TI"7G.Q N_„_ ‘E E D351 < *< "ay F'1— B=U.42Ž4P-0.259 XX Ad Diíty PW C=0.4Ž24P-0.259 (ill (di rilflii-d2i1lavl piay-CI2 play 1 0=0-4224P~0-259 PP _ 1 ^` -— 0lD59P 010591" E \ \ 1 + ‘5É1 -_ - T _ ' à (I
‘l r" 151 4b“ måg5P| o.1aesP| /I "r-I P// 2p 1 2P 002-P 5059P o5o5sP O -Q- co _C3_.L A-___--_ ___ 1 STUB ACME Use : Stub Acme is used for motion transmission screws where deep. normal Acme is too deep ‘ ose _I _L. 1/2 dt play 0.5167P I A=()_4224P J„'"1"Ĺ'_'*y \ ' A=g,4g24|=> ‘ O - 2453P O.6_27P lm _ _‘_ 05275 - L ‘ U-2453? *fI/éilfldy '-'r:i onre-ci
O-1532" C V A=0.3707P „MZ 2 i *3—i0 13 '5 1 i A I I1 NC -1: I'|'IË W l ISO Metric (Fine Pitch) Thread National S, 8. 12 and 16 Thread Series (8N, (BN, 12l\l, 12N, 16N) National Buttress Thread I National Coarse Thread Series NEF National EXtra~Fine Extra-Fine Thread Series NF National Fine Thread Series NGO National Gas Outlet Thread
(specify right or left hand) National Gas Straight Thread NGS National Gas Taper Thread (See also "SGT“) “SGT”) NGT National Hose (Garden 8!& Fire Hose Coupling) Thread llatioiial NH Plpe Taper Thread National Pipe NPT National Pipe Taper Fuel (Fuel &81 Oil) Thread NPTF National Pipe Taper Railing (Railing Joints) Thread TaperRai1ing
NPTR National Pipe Straight Thread NPS Plpe Straight Coupling (Pipe Couplings) Thread NPSC National Pipe Plpe Straight Fuel (Fuel & Oil) Thread NPSF National Pipe NPSH National Pipe Plpe Straight Hose (Hose Couplings) Thread Plpe Straight Intermediate lntermediate Thread National Pipe NPSI National Pipe Straight Lock (Lock Nut) Thread
NPSL NPSM National Pipe Straight Mechanical Thread National Special Thread NS Panzerrohr-Gewinde (Steel Conduit Conduít Thread) PG Panzerrohr-Gewlnde SB Stove Bolt Standard Thread Special Gas Taper Thread SGT STI Special Thread lnsert insert (tor Helical Hellcal Coil Wire Screw Thread inserts) lnserts) STUB ACME i1 Stub Acme
Thread j Trapezoidal Trapezoldal Thread TR Unitied National (Constant-Pitch) (Gonstant-Pitch) Thread Series UN Unified Unified National Coarse Thread Unified UNC Unified National Extra-Fine Thread Series UNEF Unified Unitied National Fine Thread UNF Unified Unified p to O.T3U4p UNJ Unitied Nat. Thread Series Senes with a 0.1501
0.15üipt0 1118040 Controlled Coniroiied Root Radius (external threads) Unified National Miniature Thread Series UNM 0.1082p to O.l443p 0.1443p Controlled Root Radius Unified National Round (round root) Thread with a O.1l]82p UNR UNS Unified National Special Thread 60°° “V” Thread with Truncated Trunoated Crest @rest and Root. Root U\.
¡ 1I .A. SC WHIT Whitworth Form (Special) Thread WHIT § wnirweiiii COMMON THREAD FORMS ..-__ F.9Ĺ'!I'l° u ::2 :1` :UEE Š 1:: c: va' EI ÉI = :ri-IEE =Š rrl E! USEIJ IN THE THI: ENGINEERING USED INDUSTRY ‘ 1/2015151 i/2 d1 play BOLT I: ID I :2 on E: on :|: ENGLIS.. .. l-nu rn in 0 1:: -|-I:u-IIIQQ AMERICAN BUTT1 .1 :=-ii l“l'l E! 4:1:=-:: cu

a- 1/2020151 1/2 'E 'äizEu I"l'lan I3 In inin Use : Mechanical industry for motion Use : Mechanical industry for motion transmission screws when the load transmission screws when the load is acting from one direction, is acting from one direction, milis, etc. eto. e.g., in presses, rolling mills, e.g., in presses, rolling milis, mills etc 0.075P U.O75P I 2: c:
-4.~| P , P i.O1.€~ ""- ix 0.5515P _L II _ I P P \ I to 60° \1/ L" lkjd . 0.1723P O.1723P __i 1 Äln eotr gofi 60° 600 055921-I O5tI92P SD 'U I' axis ms of Screw iHlflil il flil ilflilfl I -i-I131>>'U'U I'rriZu I"I :io -L o.4579P 873° Å XT I 90 Q 0.1520P U152UP _4 - eotr _ - 1.65 4$.15 .Q 'U T eotrL P90.. 90° ` TAPER 11:56 ífip 0 ' 06p axis of screw (V-0.040"
FLAT) API : TAPER 1:4 Q!)-0.040" : TAPER_1:6 (V-0.038"R) API :TAPER 1:5 (V O O38"R] Use : Oil Industry Use: Oil uii industry T - El Å common FORMS GDMMDN THREAD THREAD FDRMS usen IN IN THE THE ENGINEERING ENGINEERING INDUSTRY USED INDUSTRY i. EAD FORMS FDRMS COMMON THREAD :I C: U! ii-: : :I:Š ru
ENGINEERING Ëİ = E! 5:':3 USED IN INDUSTRY ii THE c:varu:I 2 e» šsl S side,., J B(Np,) B(NR) I I 0.626PP 0.e2e0i= 90 0% .`1 axis of screw II fl f Ñ! Ht{—l_—4 B(ER) B(EFl) imvi 90° _ ._ lflill *1"/47' Ilii E `1 O 3„ \ I O.'|i98P 0 .1 19BP 1116 TAPER 1:16 TH I Use : Oil industry o e605P aw 0,15%: O.1fil'l1P P 01373P 0.i373P Tj A _I _ i` 0 1
 vi i .i,. I s QM" l rAPER1;e 0i1501P TAPER 1:8 0-l60iP BOLT 90-1 0.1373P of screw ~axis 51 BUTTRESS API BUITRESS Use : Oil industry for casing Pipe size : 4 1/2" 1/2" to 13-3/8" 13-3/8" 01601P 0_16[)'iP l a "' -"1"" \vri in tn} il T \¥ V o1a73P O.i373P l I'-Ĺ L BOT O 16I01P 01601;, BSP (G scares) seniias) B-SP M axis of screw API :
TAPER 1:16 (ROIINDED) IRDUNDEDI A l nut ~ - \ rpi -\ l—-35.' 0.1a7aP 0-1373P 0.1 19€P 0.1198P BS GAS [BRITISH STANDARD STAND (BRITISH (BRITISH {BRITISH STANDARD GAS) Use : Valves for gas cylinders and similar pressure vessels PIPE PARALLEL) PARA I Use : Fittings and pipe couplings tor for gas, water and sewer lines l i i NUT It -
\ B(NR) B(ER) Blue) B(ERl 1 2C >2a' 'rĖ¡i'Q._ 2'2°23' |3Q|_'|' ž :OLT i 10 90 l P -i-J (yagggp O.i808P S l 5 _ i V \ 1) 1.1`363P l.i|363P i i 4 ¡1 Q_6p g_(5|:> 47 59 47.5,, , i siiwet Parallel to taper Paralleltotaper O axis of screw 0.1808P U.) BUBP BOLT -_\ £l.9602P 1%; 1 0.2682P 0.2ea2P L I T* I 3 -W W' .5' 51,'-ci OJ 1:1 0.1373P fl1fifl'1P 0.16 /'-1. t___ ljm
VĹK i O 1 0.se05P l .iu 0.9605P cncri I gp O0.600 I. 640 3P 0.I373P ..0 3 E' OJ -U1 H c La. "UCD cn Cn-i:i I OKSBOP o.0seoP I Im? ——I- -— 016 P 0.1601 B_$B jBRITISH |BRITlSH STANDARD TPII BRASS - 26 TPI) ngs Use : Brass fittings tidings and pipe coupli couplings é I .I . , 0.6403P ~ l 1 1 14 "W l 7___ - I 0.i6OCP l 90° I 013773') SP 0.1000
TAPER1I16_* TAPER 1116 A ' 0137 BSPT (Re (Rc szniis) SERIES) Ĺ (BRITISH sro. TAPER) STD. PIPE TAPER) Use : Pipe thread for steam, gas and water lines F Fit . iI P c cn -1:: o.1eesP H '..» 0.8$57P Aki O.53?'/P io; I 1: 053070 A AT BOLT OU p iih in n2 iiz męęsp Ili ül flilflilflil flilfli 0.941 0.ee2 0.002 does 0.000 0.042 0.040 S;Š l f[1.411 1.046 1.040
e.10e 0.100 0.0ee 0.000 » O//7'T one/V axis of screw MP 0.i6eeP BSO! }BRITISH STANDARD CYGLEI (BRITISH CYCLE) Use : Bicycle industry y A -. H \/lLLi_' i(oiesev O1601P OJGOTP Z CA3 —_|"UCO "U 01373P 09605P 0.9605P \/ ti f' axis of screw screw EBr—-— L 1- . X '\. U3 Q BOLT P 0.1seei= CI -—-I il arm ' BOLT 0263? Use : Fine - mechanical
industry utllity, electronics. especially electrical utility, P 1 ~_:_>| 0-1591'" 01500' U.2682P Y -UT Z (I '-I I1 \Å / >' Nut ýy _A T p I 55,, I P o.e40sP 0.l373P B.I-I. I17 I 0.1e0oP o.1e00P t 1 (BRITISH ASSOCIATION) ASSOGIATIUNI (BRITISH BU1TRESS API BUTTRESS Use : Oil industry for casing Pipe size : 16" 16" and larger P 1 i TAPER 1;ie rAi>Ei=
BSINZ BSF BSW [BRITISH STD BSW IBRITISH $TlJ- WHITWD WHITWBBTHI| BSF (BRITISH STD STD. FINE)I Use : As a general machine thread tlse na 00.052P 052P O0.052P 052P P T 27 Z (I —I . 'IV I ~I ,L EL--I--I -uI~—:r 1.814 2.200 a.17s 3.175 1.014 2.209 1.396 1.692 2.442 1.300 1.092 0.109 0:32 0.175 ears 0.100 0.132 0.060 0.089 0,132
0.132 0.000 0.009 DRYSEAL Use : Widely used for fluid-tight pipe couplings in the motor industry coupiings 1 L 0 864 /š -»I 9°" I 0.351» T 01050 0.105r> , so") TAPER 110 U axis oi screw I HUGHES HH-90 90 llse : Oiiiiiüusiiy Oil industry use I 7 ~. 1&1 ëfl HREAD FORMS FDRMS GOMMDN T common THREAD EERING INDUSTRY USED IN
T"E.E["i"E.EB'""l"."'"$T"Y THE ENGIN "SEN" PP . 'T ._ "—'d.125i=i n19i:i= '"' \ ._ U.TEUZI" 0,108 ZF 'W' P k O.iOB1P 0.10e1P i O. i_._. m 600 . 0.0722P)I 0O of6134 34PP I O.8657P I (§) - l of"! -^-' IT) °""'43P [)_25P 0_25p ih' 0.6495P 5P _ I / eotr BOLT 0.144-3P 0.1443P I M [ISO METRIC) METRIGI nso ~ V $ di 0% P O"WP O38P _ 0.8`G60P
O.8|66OP é < i J_ 0.0330 CD CD Ci.) CO TU -U i 0.0_057P I 0-8I657P) BOLT oeeeeoe 0.66660P 1TEIBEOP .s000P i< 56° t 58... U . ̄1 90° so" '[1 ' /\ K. 30°O .--" J>`U :i=="U C0 CD -._->»- OF3_O(J1U1 'U 'U I '--4. 3> j> -->--4-]> -4-_->-> axis of ot screw $0.65-33OP l0.683OP ~- CIT CD - _L |\J >i2mm 12mm -v.Omm 1.0mm BonBOLT pmNo.OLI gml\Ji
mcn (II .C'Um: 01 (TRAPEZ) ITRAPEZI DIN 103 Use: Mechanical industry Tndustry for motion transmisson transmission screws STRAIGHT THREAD] THREAD) Use : Mechanical couplings of tight tubings normally not fluidfluid-tight tunings 'I I '° + 0.s0;seP U.5959P "'I. OI" III H 80., 80. t _ 5 I T' iI 0.e000P oeeeoe I S ÉA I '- 0.4;erP 0_4Ž07P BOLT uz
D i1 01-måe _ o.1oe2P D.1082P U.i443P I i l"_ -Š 0.25P o.2sr> —""| I) 0.0722P O.6*134P 0,0ü1a4P) `'\/ 'I Wt I 0J082P o.1os2P .--i-— Ñ """" 0.25P 0.l443P Flat or Rounded C.25P O.i443P I-IE E IUNIFIED NATIONAL FINE) (UNIFIED Use : Mechanical industry i o.10e2P O.i082P y _I _l %i=—-—P——'-l a ,k (MSP i _-FIBI ' 0.0722P o.0722P Ii I(0.6i34P
o.01a4P 0-86501' 0-BÖGUP 1 i ,I '"1_§i,_ _ Flat or Rounded Q13 r\: can "U [La OËŽP II qr 'Níllĭi :_ I IINII LINC IUNIFIED NATIONAL GOARSEI [UNIFIED COARSE) E B %i=fi —-—P—-m25P 0.120P W, use Ii o.ae|e0P 0.00\00i> l '- iI TAPER 1:10 0-0328' 0-0328 P \ |TAPERi:l6 7 ',4' I Å ii/'_'\Vl I 1 I I I BOLT 1 IOa O E :=- :| 30° :: 513 Cl'l -J cu DIN -i:|:
*\l -1——a- ll'l {VD 0.osiei= 0.0328 P O.683OP PI 'U"U T [NATIONAL (NATIONAL PIPE Plpe couplings where there is Use : Pipe no demand for fluid-tightness ,1 _ 1 O.i243P 0.124sP fi P "Pl I .essoe I gqn 0.1P II I: 'U 'U Ell 4. #_ U3' . 1: 'I. '__»2Q-i 'U ___.. RD DIN 405 an _I Bon U"! I BOLT eotr U.'IU8iP 0.I081P TAPER 1:16 IAPIZRTIIB _ P0caco-Ucio
'U % T c:o.2aasP I I 0525,, o.s2.%1.P \[_° ¡l\,o.2eseP \ ifilåflp l igrilrtt 1 0.117sP"(+4I 3 J 0,750 , /\Iy ((0.45(0i= l orsr»ir I km: 27 »~4- 1 i "i I V»~ cn l METRIG TAPER M Use : Grease fittings and pipe couplings Use : All branches of mechanical industry C: —I .. il I 1 4 AH; 90, 90° 0_-1082p 0.10B2P : ' axis of screw _ i ^0.2211P 0.osi> 06830,, 1
QYÅÑF *iii* \/ (Q Š OP ¡_i__, i—-—P—~t . l lÉ_I-: EI i oi, t._R_.- E 1 CU i É 1 i———P€~i ll ! IR H COMMON THREAD ..___ P.9Ĺ'lI'II: !I'1° _*I.IË' .F_E! = ::::IFORMS 2Ë EE :iw::vi_ : USED ENGINEERING INDUSTRY U$I:I.I IN THE I:NIilNhh EI , iIi I 0.1443P o.144aP *Root Radius ROUNDI (UNIFIED NATIONAL ROUND) ` UNR „ IUNIFIED _ Unihed ..
National . Round (round root) * UNR - Unified t I ' W 0.1oe2P 0.i082P y I 1' o.09o2P 0.09ozP l0.5774P i0.srr4P _ \/I l\/ I i_ku_(M_ eotr ' '_'.— I(„ 1 l °iI8°4P (11591 Pp 01501 *R°°III*"""S *R°°m*"""S "ml „.eN.:.Be¡ ¡ :Ð EE : ąnnl' u: : -|I „AB uIE 5 II I I C C 1all >1-_1:: :: G- _ T5 Ac: :: -|-uIlillnl-I-IJ applies to External Threads. ltIt is a UN thread in all """
'II\I\|I "V _ ""' External Threads. Root Radius ma :1 =r::._.- PiD æe:O"EQ "0 plies to respects except that the root radius must be he rounded. rounded 3>APPIËS TO Ëb>ílfiina||Threładlí\\ãcI>ott Radiułs rnãn A '1 BOLT|-/ B(]|_'|"|_/ I _' E (NATIONAL PIPE TAPER) Use : Fittings and pipe couplings BE E imizennoun--sewiunil (PANZERROHR GEIAIINDE)
Use : Steel conduit condult (electric) IPMIMlHiIMlIiMI ilMIMilI mspected SpeCified_ | t d only | when h 'f d_ Most manIIiIzI]cIi1IiårsugfyexefrçaãeęęñIeäd manufacturers of externally threaded fasteners produce threads ratherthan plain oii. un. preduze UNR urin rolled ioiieatnreaas miieitiian porn Use : Mechanical industry Assembles only with UNJ
internal SSEITI ES Oilywl nema threads. (82 S. Ma"I_IaI°IV lis"$*fll°lr IHSPŠCIIU" mspewon Iequifedrequired" _ Use : High Tensile Fasteners in Aircraft & Space industry 'f< } 12 cotoun conen HIGH-PERFORMANCE mes lfl, lfl coLounconiso_iiic_ii1i{isiri=oitiiiiANcEms I Č -I .HREAD TAPS MAIN EË EE I: TYPES :U in lv: OF ID -11 GROUND {Ð :I ID
I: := I: THREAD _ & APPLICATIONS & APi=i.icArioNs F S, ""'"'°"; Straight Flute Tap (Short Short Machine) Machine iŽ High-Performance Machine Taps are produced from specially selected premium —:sS-E ęteel Steel and are developed with unique geometries designed to provide ¡ -'ss-E l accurateiy accurately sizeotnreads, sized threads,
superiortapping ability and iongertool iongertooi life. éifl _.. short production runs. Itit A general purpose tap for hand and machine operation suitable for forshort performs best in materials where the cutting action results in chips which break up readily. l J-",' s irai Fiute Ta „ li-..IIIIIII\lii~.. IU- S"iral FIUI6 -I-G" w~www\M'vvvv——*-__i The coded
rings and a variety of surface coatings, facilitating se taps come with colour colourcodedrings aase of selection and ensuring optimum performance in specific material groups. ease fir >x< 7 . E... Examples of High-Performance with Colour Coded Rings E5 -an 1 cl:~ crrrnance Taps w'th I-.-__...._|__ CXCIIIIPIU5 I.I ii i/\.i/ Pi I =1 _II1 i This tap is
designed primarily for machine tapping of blind holes. Most suitable for M HARM Aluminium and Soft Steel which produce long stringy chips. The cutting action of the spiral the hole, allowing greater depth ofthreadlng. of threading. flute curls the chips and draws them out of oithe "S ii Q Thread Ta 4 The interruptedthread interrupted thread ensures
lessfriction less friction and hence, less resistance, which is particularly important when threading materials which are resilient & dilficult difficult to machine, e.g. Stainless Steel, Bronze. This design also facilitates ease of delivery of coolant to the cutting edge. Spiral / Gun Point lil >x< I éfl Straight Flute Ta Tap sirai iiieiuie mainly tortapping
through holes. The point the chips The spiral point tap is used malnlyfortapping poirit helps to cut cutthe of the tap, leaving the flutes clear forthe the free with a shearing action directing them ahead oi' to the point. flow of coolant coolantto iiiiiiiiiieui Flulnlnee Flnfnlnee . ...„... Tan ...E '1 without Oil Grooves without oii empires WQZE. .41 $1 I I I I I 3
.Il >X oil grooves helping to deliver lubricant easierto thetap point. Taper Plpe Pipe Straight Flute Tap . - r Q E Cut — Threa i1re ' :íųí _r"-1' ".;:I.f. tn, -._ . '.', v i . '-A Chamier Chamfer Lead A ' 115€* . Heat Resistant Alloys r~ li liIiilIiIlli lill se se M &×s.s\sw I1 A f "ff` Orange Ullite Š. I . = En rm I n r| 'Ferming """"5 Lead I Free-cutting Steels, Steels S
. . ' Structural Steels, teels, Aluminium, Copper, Therm0p|aSt¡cs' hermo plastics. i i 3 1200 N/mm'? 2 -._ i CE __ | - 4|('\.f\f\ |i|r_ DLUUIS 3 ldUU l\IflIIiIl Stainless Steels -lr_Cš 5S 1000 iv/rrrrrr N/rnmz r 5 - 15 m/min. .i . 15 in/'iiiiri. m/min. 22 -- 15 15 - 30 m/min. Grey Cast iron, lron, Malleable Cast . iron, S. G. iron, Brass 8.& Bronze. T5 _ 15 _' 30
m/mm' m/min' Alloys ' Nickel-based Alloys, II I . Cobalt-based Alloys, Super Alloys , with Hardness < 350 HB. . 3 - S m/min. Structural Steels, Steels. „._._ g. „M oieeis izuo iv/inin z Alloy Anoy Steels, SmehSteels. Carbon Steels,' n1- 15 -» SO 30 m/min. I\li'rrirIInrr Q. Pac-13 I-I rI nnrI C'-I-nnln IIILIILITEIH IA UUOU ll QB '-1C Q) DU ULUUID. ,1 Cast
Irons » Oi Gii| wik Grooves lr . /< _ L _ Fglprmeg ormed . rea Tiireaii_jz I f' | 1H I n n \ T __=I" (Setting) . i; Zi. Auuumw 1-jf; :;;Ž'¡~`¡._¡. Il"";Tl}_5 . \ \I If ? Tapping Speeds gggglgdh in/miri. (Coated) Steels ' Heat Free-Cutting Steels, Treatable Steels, S. G. Iron, Nitriding & Case Hardened Steels. @ ieesoiv/mrrr S 850 N/mmz lttliite .Vl'1'.i° . TAP
GEOMETRY Fintaies ËutelessT_`_~ _____ WW Material (Examples) Examples rice iiiduhiiiiiig, iriiauiiiiiiiiig, Austenitic, /~\u_5lé11lllC, . Universal U . IAApplications l. . SQIÅËIË1 l(_ Steels 51000 N/mmi " Green UTUBII Pipe Plpe taps are designed primarily for threading pipe fittings and are suitable for hand and machine use. Pressure Points
Martensitic Stainless |, Ferritic & Martensitlc ýý 4 Steels. I'\..'__ Thread Cuttino Catrina -_--... _ Ta 3 i1 "PF /7; "L A< ,.;:; ?'-T"*'»"%'~:~. _ Steels, Steels ' High-Speed I-it atA H d, Sh Ch . . I Hard, Short,t, Chipping , Tool ,,M,_Steels ,,_,,,_'___, ,,,___,_ Steels, Q Case Hardened OLUUIIS, Steels, I"IUi.1l Heat ' ' N uclbG'llc1lUUllUU mjledn Q
MME:1ąer¡a¡s0Ĺ120'(?Iü?r%m2 at eria- 1 s _< /mm 2 1 Treatabl ` Treatablee Steels. Ste els . e The application oi the fluteless tap with oil grooves is the same as the tluteless ofthe flutelesstap fluteless tap, with the Flutes , T Staimess steels St I w t it gfl iiiiiiiiiiiiiiiiiiiiiii:.-_Š 'l'l'l'lll'lllllllllllllll 'l'\'l'l'\'lllllllillll 1 p 1 i in. © gsofuon Soft Long Cm Chipping
- S Bgghfimma Yellow ; Materiamgg Materials 800 N/mm z A 4) , L f"\-....-._._J-~l-.-.-'nip-4.-r. A.-III 1'lT"'IfI'\ I'\Y'f\ r\rl||r\|Il r in-I-v+n»-1+ Fluteless FIUIBIBSS Tap Tai! with Oil Grooves I I 20) 0.2682P 0.238213 l I To find Iind Tapping Drill Size for MB M6 x 1.0 1 .0 tap with 70% thread Example : T0 70 Xx 1.0 Drill Size = oriiisizz = 6.0 0.0-— 76.98 \
Nne ii Z Š :1 31 i_ i m' ię METRIC INcI'I INCH 11?. lw TAPPING 5''HPIN DRILL SIZE FOR 'l'l Cl :I THREAD -i:I :I Elfl:I UCUTTING I- Z:ili mi= TAPS l'l'l-I=| 'II UI 61)2 c: -|P,:I CALCULATION GALCULATIUN OF TAPPING DRILL FORMULAE I FURMULAE FOR THREÅD OUTTING TÅPS F0" TAPS I 0.2682P å-ł_(anirisri ASSOCIATION) iissociiiriori)
(BRITISH IQ _- I D-Hr. = .2010 .2010inches inches = 5.1 mm I(Basic (I Basic Basic ' Basic Tapping ICIearance Clearance ITapping 1 Drill ' Drill I(of of Thread? Size Size L Thread Diameter i Diameter 5 Diameter ;(inch)] (inch) _ (inch) (mm) . i""'I (mm) (inch) (inch)-I (inch) I (inch) (trim) P¡tch`I Depth Ilepth .i Majur Iiflective Mayor Minor I Q en '
Pneii ' leneeriirei FOR eagles-.e§.§ FLUTELESS TÅPS FUR > METRIC _ _ MaiorDia. Th re ad Drill Size = Basic Major Dia. of Thread- ` % 'E/0 of Full Thread x Pitch (mm) 147.06 147.06 IIo. I 0.2126 0.2120,_ 0.2087 0.1874 0.2007 0.1074 .0319 ` 0.1850 0.1659 .0010 0.1000 1 3 I.0287 .0287 I 0.0172 0.1614 0.1441 0.1014 4 I .0260
0.0156 0.1417 0.1417 0.1262 . D s5 .02a2 0.0139 0.013; 0.1200 70.1120 .0232 0.1120 0 0.0125 0.1102 0.1102 0.0970 ..o2o9 0.0125 0.0070 0159 0.0113 7 I .01e0I 0.0110 .I 0.0904 0.0004 0.0070 0.00703 .0169 0.0102 0.0866 0.0764 0 I .0 010 0.0102 0.0000 0.0704 0.0092 0.0748 0.0656 0 I .O154 .0154' 0.0002 0.0740 0.0050 I 10 I .0138 0.0669
0.0587 . 0100 0.0083 I 0.0000 0.0007 5 7 11 4.0122, 0122 0.0070 0.0073 0.0591 0.0591 0.0513 0.0010 I 121 5 0.0066 0.0000 0.0512 0.0445 0.0445 I 10l . 0.0000 0.0472 0.0059 0.0413 0.0410 _a.e_a _a J:-e.-:|\ -Ac"° -' 0.0054 0.0394 `.oi:`o'oo-mu::- -»mo 0.0339 0.0000 15 l .0083 0.0305 0.0050 0.0354 0.0005 7 1eI 15 .0o75 oooš 0.0311 0.0311 0.0200 I
.0075 0.0045 I 0 :Å_ . .0394 .0354 I` .0054 1 0. 0236 0.0236 1 0.2362 0.0213 0.0210 0.0191 0.0101 0.1890 0.1000 ëiilü-I 147.06 {I l = 5.5 mm INCH Dm' Size of Full Threadd . Thread - (0068 0.% °IF""I"'e" Basic Major Dia. of Thread— xmrea-äsfper inch) DrlllSlz0 = 00010 .0000>% I Threads per inch) ___-1 Iind Tapping Drill Size for 1/4-20 lap with
75% thread Example : To find _i_I Drill Size = .2000-I.0000> IIDTE : itlt is advisable to use a good cutting oil or lubricant rather than coolant for Ftuteiess Fluteless NDTE (Thread Forming) taps. Correcttapping drill sizes are equally important. I Il.Il lMII ltMli lM 14I E 2 I I ZZ Z—l Q9--L O02 ' 2 _ ZZ $3 COCO DO-I» 4. 5.10 0.10 . 0.1268 0.1106 I
0.0661 0.0001 1.80 1.00 1.55 51500 1.40 1.40 1.205 1.05 1.00 . 0.90 0.00 I 0.80 0.00 0.70 0.70 0.00 0.0504 0.0004 0.0445 0.0378 0.0070 0.0354 0.0004 0.0283 0.0200 0.0256 0.0200 0.0220 6.10 5.40 i 0.40 4.80 4.00 I 4.00 3.40 TIT 4.20 3.00 3.70 F'-"9" ca-=11: 0.70 2.05 3.00 2.55 0.00 0.0900* 0.0980 0.0550 0.0000 0.0750 0.0563 0.0000 I 4.50 4.00
0.1468 _ Example : To find Tapping Drill Size for M6 x 1.0 tap with 70% thread 70 ×1.0 6I0_70x1.0 ri Size ize = 6.0- 14706 D'llS' Drill I 0.1661 0.1001 2.30 2.30 2.00 II I I' 2.90 I 2.00 2:60 2.25 1.95 1.75 as 1.00 1.60 I I l 1.40 140 - 1.30 1.10 0.98 , 0.00 I r \ Å' 7 7110011113 SIZE _ TAPPING nmu. DRILI. SIZE TAPS NG 7113540 0077103 ms THREÅD
GUTTI FOR 0%' L"iP*"'' 0.13739 K 0.1373P 0 W 1 0.9005P 0.93053 1 550 1.- '. 1-.A 1 X/ \/ | 0 1373P 0.1373P ' |-'BSU1! 15_W 301.7 1__ E 0.111010 0.1001P . 1 1.85 _; 2.50 0.0672 _H1.35 .0133 'R1' 0.0930 _'_ 0.0005 M3/32 4_3_ T0133 0.0933 0.0305 10.0372 2.50 I .3/_33__ _ 48 A 2 /U-14 n mvm n :_: 7 o 7' of on 7 L.\m a.uu 0.1.11.1 .0160 U. ILUU 1
0.1090 u.12auA u.1u:1u 10.0930 _ _ 1/3 .0130 2.55 1/0 _ 1 40 ,02Ĺ__0.1532 0.1562 _1 0.1362 _5/327*' 32_ 10200 0.1332 1 0.1162 _ 3.20 _ 4.10 _5/32 4.90 .0267 1 0.1875 .0237 0.137 5 1 0.1608 0.1303 0.1341 1 3.70 3/16 3/10 fi_ 24 0.1054 2 133 0 0.1921 .0267 zaN 1 N24-l> 7/32 .0237 0.0.2100 0.1354 1 4.50 1 5.70 Q' l'1'-190 Fi/7.
1/4 on ' ,vuzv nfion n oqnn '1 0.2100 n - 2139 5111 5 513 _J 5.10 6.50 _, .1 20 1 "0.2500 ' 1 Q0.1000 "13513 1 8.10 0.50 _0 0.10 0.2769 0.2413 .0356 5/15 _ 0 18 13 .0353 1 0.3125 0.3125 0.2739 0.2413_ 3.50 5/10 9.70 0.2950' 1 7.90 .0400 70.3750 7 0.3750 ` 0.3350 0.2950 177773/3 7* _15 13 1_ 7-90 _ 9-70_ 3/ĹJ.. 9.30 ' 11.30 0.3910 _ 0.3431 0.3401
0.4375 1_ 0.3913 7/_1_6__11 14 *5 .045z___ 1 77/13 .0457 91.301 11.30 1 13.00 J. 0.4466 0 3932 1 10.50 _1i100 .0534 1 0.5000 __' 0.4433 0.3932 1/2 1 12 0.4557 1 12.10 14.50* 0.5091 9/10 9/137777777"_ 12 ' .0534 '_ 0.5025 0.5325 0.5091 0.4557 14.50% 10.25 13.50 3 0.5000 1 0.5086 0.6250 1 0.5333 5/00 11 __ .0582 1 0.3250 775/37777 TW32
0.5033 1.50 13.25 17.75 A 15.00 0.5711_ 0.6293 .0582 0.6875 711/917377 11 .0532 0.3375 0.3293 0.5711 1 15.00 1 17.75 .11.lĒĺ. Š 11 0.6220 1 10.25 _ 1 .0640 0.7500 3/4 1 10 .0340 0.7500 0.6860 0.3330 0.3220 13.25 = 19.25 10.00 21.00 0.6845 _0740 0751_1 0.3345 0.8125 _ 1_3/18* 10 Ž .0640 Y03125 1"'1":I/11'3f_'1_ 10*".1i340 0.7435 22.50
0.7328 1 19.25 0.0039 0.7323 0711 0.3750 0.8750 7"?/3 .0711 0.3039 ËË 99 24.00 _ . 64 _l 0.7953 20.75 _1 24.00 0.0004 0.7953 _ 20.75 0711 1 0.9375 A 086 15/15 11715/13"11_9 ".0711 25.75* 0.0400" 22.00 1 ._0_0 00 1 00.9200 0800 1 1.0000 1 .0300 . 9200 0.34001 25.75__ 24.7? 29.00 1 .1 250 "1117 1 .0915 091571` 1.1250 1.0335 1 0.9420 1
24.75 AL 129.00 _1.1/É... 7 ,___.3_ 20.00 32.00 .0915 11.2500 1 53 5 1 11.0070 111/4 1/4 .0 9 15 . 2500 1.1.1505 1. 0670 23.00 1.1010 30.25 ` 35.50 35.50 fi _1_.3750 1.2000 '5.1313' 1 1 3/8 1 A .1037 1.3750 1~ 1.2333 30.25111? 1067 30.50 0j 1.3 933 ` 1.2000 1067 1 11/2 1 A .1037 1.5000 1.3933 1.2333 1 33.50 33.50 33.50 41.50 1 35.50
2'u'r01"Ch\ic> ' ""1 1""**" .0 T4939 . .000 * OELUU _7' *1. 1.6250 1.4909 1 1 .OU00 1201 1 :1/___3 A . Ji'/U 1.4938 A 39.00 . 45.00 1517500 1.4933 1.6219 mm oocx 1201 1.7500 ' 1.3219 5.010 1 3/4M _13E.. 41.50 _40.00 1.0750 00' .1 423 1.-0 7/3 41/2 .423 1.750 .0 1.7327 1.5904 77:10.50 ' 43.00 \ na. 51.00 7 1.71 57 444.50 4.50 17.00 1.8577 1.7154
4 1/ 2 7 .1423 1 2.0000 1.8577 54 2_ 7 41/2 . /1 7"" . 1|2fi'| 0 ocnn 0bvvvv 11 . 0052' nv/T ii. «EH 'J rmoo 05100 09 Rflfl 151.00 51.00 1 ' 50.00 92 .N .W . 7; 2.250? ..,„ 64,00 57.00 34.00 1 2.3399 2.1798 1 57.00 2.5000 ; 2.3399 21/2 1 .1301 2.1793 I 21/2 4 .1001 lf'l"'" ' 1 LU_ .U\JL..u _ I U - L U UV 0 1/0.2. r 1 /I '1' . luul r_.c.uuu 1-. u u u u I - u L -Iv
4.- 1 + 0.1601P CD '__|. CDCD _1. "U -Basid Basic 1 "_':Basi0-"Basic 1'1 Biasi-0 Basic _1Tappin \Tapping 015101 1511001 Mai.n'1* Efiect - Minor _1 D'lI fl Drill mnhii 1 1 Ðiamcłe Diamnfnr nlnrnnlnr Ðiarncier E2:0rcełer nulnunn 11 Size (inch) (inch) ¡ (inch) inch) _ 1115311) 1111011111 3 (mm) (mm) I lIIU§U'l 0.1475 0.1475 1 4.00 0.1730 0.2008 _
.0534 _. cz0532 U:oo 2 0.7500 0.8750 1.0000 1.0000 __0.6966 0.6966 081681 0.8168 CD O2 'R1 1 1 1 1 101 1 } 2 2. . ' 21/4_MW 21/2 1 _, _ 1/2 _ ž 11 1/2" j : mnom 01.19/43f' 3/4 *_ O':)O'>$"\'il 1 .0229 0229 _ ._; i_-_ _; _ 1 3/8 | JU . .0200 0200 11 10: .0040 0340 W 0.9360 _ 0.9300 |_._ _E 11=2aGO .0711 1.1250 1.0539 9 0711 1.1250 1.0539 01 0 _
1111/4 10174 9 .0711 0711 1.2500 1.1789 11._ I.'!- . 0800 1.3750 .0001L1.s750 0800 1 1.5000 0000 1.5000 0915 .0915 091 5 .0915 1 067 _ .1067 1 067 .1067 01111 Drill ' Qiwn Size ' Ull.-U Il'I\lllll\U' 1 117A Clearance 3 1 -L A-I 1:n _ 5v-uv 14 H 773/47 3/4 Ë1212 h '77-'57 1 fl L l]"'l I iii. . JË. CJ'JCD'*-J ._.|.'_L'_ 1. 0-54031" 9/1%; 0.1015_ 1 0.1375
0.1959 _1 0.2254 1 0.2254 0.2034* 0.2834 0.3430 0.3430 0.4019 _1 0.4019 4 10 ' .0400___0.5000___0.4000_ 0400 0.5000 0.4300 1 15 . I/2 00/10 10 A .0400 0.5025 0400 0.5625 0.5225 1 .. 14 .0457 5/8 14 0.6250 0.5793 5/0 0457 0.5793 _ _ 11/10 1 1 11/13 , .0457 0.6875 0.6418 0.3413 1 "J00 \I 1. 0.1075 0.1875 0.2100 0.2188 1/4 5 Aöý 23 7 .0246
0246 1 0.2500 1/4 5/13 1 22 22 1 0291 5/10 0291 ` 0.3125 0.3125 0.3750 0320 _ 0.3750 7 3/0 57/3 1 20 17 .0320 7/1fi 1I 5107" 13 __7/16 0050 0356 _ 0.4375 0.4375 _I'_';.'.___1 _"_ _ 3/16 3/13 32 32 7/32 120 28 _ In: En 1 5 0.1373P 1 2 -1fänhn' nnnn I 0 55° 1 1 V I17 " 1 3 11 1 Num. Nom. 1Thrcads 1Thread3-1 Basic Dia. 1 Éper 1 D|a ' _Depth II -1
005111 1I BSF 1 icci: "RF 15551 7111-.533 Threađ 0.5.1.1) (inch) (inch) ' (l.)¡.i. I _}Ž 9 1 1 0_1601p 0.1301P E §§E \LUUJU Z 1 (nnmsu sninunnu (_BRi_Ti§i'i 3T|1i\i0|'tR0 HN:) Fii\iE) 1_l I \" 1-"-"1 BOLT IBOLT F 103171311 (BRITISH s7/mu/\|=1 STANDARD WHITWORTH) _ D WHITWURTH) - f\-lfl|"\fl ` 1 . 0.1001P 0.1601P 0.1373P 9-13731" ¡ .i 1 1 ___
1- .\1 0.9605P Threadsf1 B:-isie Basic Basic Basic Basic Tapping Efllearfancei Clearance llom. 7 .Basit: Nam. 5 Thieads llepth Maicr Eflecłivc I Minor 1 Drill Drill nia. Dia I per Depth ui 0|' ' Maior E-ffective Dr||l 1 lnch ' Thread íbiameier Diameier Size 1 BSW 1 Inch 1 Diameter _ Diameier Diameter 1 Diameter Size M (inch) "inch (inch) (inch) finch)
_11 (Ip (mm) ..1; 11113 hi 2 (inch) 1(inch)1 ` (inch). (mm) (mm! 1.20 11 1.35 1.65 1 0.0510 0.0625 ,0107 10.0325 0.0513 0 0.0411 00411 '$11.20 1/16 _1_ 30 1 1.0107 R-lf\|'f\ P 1421 :2:z c: -1 O.64U3P 0«6403P H '_5 1 1 \ '12.2% TAPPING DRILL nmu SIZE s|z|z TÅPPING FÖR THRËÃO ËUTTINË FOR THREABWTTINE TÂPŠ TAPS 1.2950 1.2950
1.4200 _ 1.4200 5.30 4.90 4.90 1 1 5.70 5.70 6.50 0.50 0.10 6.80 I 8.10 ; 3.30 0.30 9.70 9.70 0.3003 I 9.70 0.70 11.30 0.3663 11.30 11.10 0.4200 13.00 11.10 13.00 0.4825 1 12.70 7* 14.50 0.4325 W 0.5336 14.00 7 710.25 0.5333 13.25 0.5961 15.50 15.50 1 17.75 0.5931 0.6432 W 13.75 16.75 0* 19.25 0.75Ĺ_i 19.75 7 22.50 0.7586 0.8720 1' 2213
22.75 25.75 0.9020 0.9828 1 25.50 29.00 1 1.1078 1.1070 '.1 2??-2" 20.50 1 32.00 32.00 1.2150 35.50 1 .215 0 _1_31.50 3150 . 35 . 50 I 0.2543 0.3110 0.3110 _ _Ž 1.3400 1.7500 1.3535 1.6585 _ 2.0000 2.0000 2.2500 2.2500 2.1433 1 2.0300 2.0333 2.1433* ` 2.5000 2.5000 2.3933 1 2.3933 1.9085 . 4.50 415" (mm) 1.5370 1.5670 1.8170 2.2866
2.2333 "_.ĹĹf0I W 34.50 38.50 41 .00 *45.00 41.00 45.00 47.700 52.00 47.00 53.00 53.00 753.00" 50.00 50.00 1 64.00 58.00 1 r 'K 0... .1 . @I TAPPING TÅPPING 0011.1. DRILL s|z0 SIZE FOR 7110040 currme FOR THREÅD GUTTING mes TÅPŠ |"_-_'_' 1 11 1 1 _ . >34 110 'Q' \/ kyíų 013 0.1373P z`Z c:3|-r L____I F-Ili-l1)-ii--1 T1 \\f- I 2-. . g_95g5p
0.9605P I 1 1 1 1 1. 0.1373P 111137311 BOLT I 1 1 1 { 0.1601P 0-160"' I ~ _ _ "T 1 DDrill '|| (511_rz1_ B 51 lajrping Size ' ""5 5 1-.-. 1/12.-- 7)1 >J 13 (JO 3/3 I 19 " 0.656 0.555 1 . 1/2 . . _57a___ .0337 115223 75.00 .0337__(n;0.5555 0.5223 0.5335__ _15.00 .0457 0.7793 0.7793 0.733511 0.7335 1110.50 13.50 . 0.3105 20.50_"_1 20.50 .0457
0.05% _.0457 0.0105 . 24.100 .0457_ 0.0053 0.9953 0.0405 0.9495__24.00 1 .0457 27.75 _1 I .0457 11I1 1.1433 1.0075 1.0975 27.75_ 1.1926 __ 30.25 05521111 0532 1.2500 1.2503 _11925 30.25 __ 1.5015 30.00 .0582 5.0532 1.5913 1.53351 1.5333 39.00 1 0.825 0.325 14 0.902 0.902 1117157/I 1.041 9./.4 Ĺ1 14 1.150 1.139 7/0 7/3
1I 14 11.309 309 1 I 11 _T"11711 1 l 1.550 11/4 __ 11 1 1.650 .0582 .0532 31111111/12111 11 71 71.332 fi1.882 11/2 2.115 j I .0582 .0532 1 `"1_3/54" 134 ' 11 11 '_21.1115 2L' 1 111 i ' 2.347 I .0582 \ .0552 1(2.537 (_0532 (11 . 2.587 .„21/4 2.011 -21/4 [53:11 " "'-*1.-5"7""'-».$11 .JÅIL]\3 |\;_.. .n|.-L1 CD CGQ _¢-5 -E _ .:__ -.-- ./22% 1ii_i_-*4 01 1 _.
1L 'L. ?.I/2 I .?l/.2. 223/4 3/4 1 T111 j 3 11 31/2 11 _. T_ ... 2.960 2.930 3.210 3.210 -L 'L 1I 11 55 1 1111 5 11 10111 . .ÑWJ ._ _ 1 I 3.450 L _ 3.050 3050 i ' 4.450 4.450 . 5.4150 5.450 6.450 1 73.450 5' 11111 15.25 19.00 10.00 21.00 *7 4 24.50 0 ~ 24.50 23.25 20.25 30.75 . 39.50 1 30.50 1.7355 145.00 i5.00 (45.50 _ 1.5235 1.3233 1 1.7555 51 - 00 00
. 51 ž.0571T 71.9335 2.0575 1.0005 1I 50.50 __(A 57.50 57 00 2.2353 2.2305 55._5_5_ 2.2888 ' ~ 52.70 62.70 2.5255 2.5233 ' 2.4706 2.4703 *1' 52.70% 52.70 72.10 72.10 j 2.3433 ' 72.10 .0582 .0532 2.0015 2.9013 ' 2.04351 72.10 73.50 73.50 0 309357 70.50 ___j-._ 70 .0582 3.1518 I 30035;? .0532"I_3Ž1513 I5 34.30 . ííí 04.00 .0582 34.30 B-3° 0532
3.4018 3.4013 3.3435 3 97.30 3.3335 97.30 _J. 9 0 .0502 .0532 ' 13.0015 3.3913 3.5335 97-É" 110.00 4.3336 .1. 110.00 10 00 110 .001 .0532 4.3915 4.3335 .0582 _ 1_ 4.3918 135.40 1 5135.40 135.40 .0552 .0532 1 5.3015 5.3913 5.3335 1 7135.40 100.00 1 .0502 0532 5.30110 3.3913 5.3335 5.3335* 100.00 150.30 T¡)¡¡¡_3U 1 CACQUD 00.00 Ill MI
IMIM MI .3; —' . BOLT OLT I 1 '% |21_11 Z: UI "l| Cl, P _ 1 P ' U15UUP U.I600P ' - 55% "L 1" 1 —|. . 1 > 0 1 90° 00°/"1 7/ 1 0.6403P 06403P +-P1 \7 ii 0.1373P 0.1373P I 0.1600P TAPER 1:16 TAPER1:16 axis of screw ' Basic 1 Bash: Basic %'%':ie;' %ri;sm. G smes llom. Bash: Iiurn. 1Threads1 1Threads~ Basie Basic 1 Basie Basic Ilp Series Ilia Major
,_ Dia. ` per Malur 1 Depth Depih 1Eflective§ Effective Minor Mlncr 5 ,________\ ,pâíafiñl' 1 Fastening} (lastanłni) 1 E lnch 11mame-'"1 Diameter Thread Thread 1mamete|1mamBte'11 lbiameter Diameter 1(r;g|:|:;1 I ' _B_§E Inch (BSPF) (BSPP) 1 (BSPF) 001711 mm 1 inch 1 1I (inch ineh) 1 (inch) (inch) 1 (t.p.i.] (i.p.i.) 1 1(inch) (inch)1 I 1(inch) 1 inh 91
I 1(mm) 1(mm) 6.00 0.2583 6.6[l_______ 6.8L 00.304 304 I .02200 1/16 _ 28 .02290 1I 0.2012 0.2812 6.60 0.00 8.80 2 9 I 0.500' ^^ 70533 0223 ^^^^' 0383 _ .02" 1/li 20 u.50u| I 0.3372 u.55/z -I 8.00 3.00 11.80 1 11.50117 11.00 2 Q0 1:.: \I 0.4343 _ 0.4505 04505 __ 11.50 .0337 1 0.404 1/4 Ä 13 0.518 . -—+1 1 BSF E (BRITISH smnnnnn srANOAnn
PIPE) (enmsu 1 0.0502P 0.9 | 2-- _ 11 1' I >341-; @W. .1 1 1 2:c:5 -1 1 3 0.61103P 0.6403P - " . .1 .. _, _. Ë :I "II * 013015 0. 1501P "~J Ca.) -U 15;:-i= ;. ._... PIN BRILL SIZE TAPPING 5!1ziŠ! =:-32 ŠI 5' I- Gi= TAPS c:: -¡'_:! '""EI FBB THBEA.B...§.!!EI!.|!.§ _I _ _. ' 1FE Outside Diameter §.";i 1,°§"''B' of Pipe 0% Ma'0r.PIë-IEF 010 51000
n 1n J- - . -.P_% __1_____»__'_V_'____]'___wh-1" Q 8 Q (BRITISH STANDARD PIPE TAPER) TAPEE) Nam Nom. Size BSPT (inch) 1 l¥amelera_t_G_auge . D|amfle_1'a|_Gą0_ge Plane Length 1 Iength = "' 1 ' ""1 ,ThreadsI1 Basic * Major Maior 1Efiectivee ¡Eiiec|iveIñfin0r Gauge 1t0iUseiuI 1T0l'B3dS1 Miner 1 Gauge 01 Useful; 1I per
5 fieeih 16101501071 '|ii5rneier1-fiiameier Length 1 Thread Depth 01 of~DiameierIDiameter`DiameierI lnch 1Threa1:l 1` Inch (B) :1 11 1 Thffiflfl 1 (B) 1 (F) (E) ¡ (1.p.(i.) (t.p.i.) 1I (inich) (Inch) (inch) 1' (inch) (inch) 1I (inch) (inch) 1I (inch) (inch) 1 (inph) 1.0- I 28 1 _____1/8 M1/81 + ;1_ 1/4 1/4 ` ((3/0 3/3_ 15 1 15 20 1\00229 0.0220 1 0.304 (0.2012
0.2312 1 0.2553 0.2533 1 0.1553 0.1553 W 0.2545 0.2545 28 0.0229 00220 0353 035011 1 0.333 0.3í5_[II7I 0.3370 I 01563 02545 721 28 1 . 1 . . 0.33 . 1 . 2 _ L 10 0.4543 1 0.4505 19 10.0337 X 0.0337 ' 0.515 0.518 1 0.4843 0.4506 0.235711 0.2367 0.3014 0.3814 1 10 .337 0656 . 52231 00.5335 555511I 0.2500 30 47 1 1_9_ 11I 00 0.0% 0,555
0.2500(1 0.0.3347 00.5223 1/2 1 14 1 1/2 14 0.0457 0.325 1 0.775? 0,73; 0.3214 0.3214?1 0.5170 0.5173 1 0.0457 1I 0825 07793 0.7336 3/4 -1 14 R 0.0457 1.041 0.0053 0.04051 0.3750 T05714 0.04í1.041iJ.995ñ19403v0.3750 1 0.5714 _.:."l'1 0.0532 1 1.309 1.309 1.2508 1.2503 1 1.1926 1.1323 0.4001 0.4091 1 0.5501 0.5591 1 1 I 1111 I 0.0582 1
1/4 11 10.0502 1 1 IMŠ2 1.5913 1.550 1 1.5010 1 11 1.5336 . 0.5000 05000 1 0.7500 . . . . ._ 1/2% 1111 1 0.0502 11 1/2 0.0532 1I 1.002 1,352 1 1.0235 1.3233 1 1.7555 1.7656 0.5000 0.7500' 07500I 205.111 W 7711 7 0.0552 0.0532 2.347 \ 2.2555 2.Ñ3_2,2305 0.3250 1 0.0204 0.9204 2.2305 1 0.5250 21/2 11 0.0582 2.960rI2.9018 2.8436 1 0.5575
0.6875 ' 1.0511 2.050 1 2.0015 1 2.0435 21/2 11 0-95821 1L"*-_ 2. uni Q5 Tapping Tapping Drillsize Drill Size (wiihoui (without reamer) 13311131) (mm) 6.40 2 8.40 0.40 11.20 11.20 14.75 18.25 1 10.25 23.75 30.00 38.50 44.50 56.00 71.00 ___JuI|I___. 5" .. .11 i7_____..._.. 1! 1 '——————__________ P 0.0339 __1 1% N01 0.0323P _;7. .i l..._._. .
60° .. . __ _ 7 0 1 005 90° 7 Diameter DI3mełeI _of Pipe 12% L2 I '4 7% / __EZ_____ .__._._._._. . Ë1___________ _._._._._._. of screw I/71 TAPEFUI15 TAPER 1315 0-032817 0^0328P axis oi I1 0.8660P 0.5515010 0 _7 it Q0. 3 1 0.072251 0.0722P 0.6134P 0 10.511345 54150.:5=—5 — 1 //// 0.1|082P 010325 Im: _ = fjA _. zog BOLT Gume n..4..:.4,.
UULDIUU I1 uiĺlií Ĺ 0.8657P 1_1. P 1 1 FOR ĆIITTINË TAPS TAP5 F9" TIIRËAO TOB...§4§...§..$E§?0§ '7 '""7"'¡ '§u__ i. 5 \ l I1%-2% TAPPING 11111115125 TAPPING DRILL SIZE TAPPLL SIZE TAPPING DRILL SIZE 'II III) 7" TI-IRËAO ËUTTINË TA FOR THREAD CUTTING TAPS FUR >fi51=1"= I . £2? 1 15. _ „ĹQ 0.1443P 1 (J_25P 0_z5P BOLT ' _'_ __ I 0.1443P
0.1443P NPT (AMERIGAN AMERICAN NATIONAL PIPE TAPER) (* Dia. Gauge j Lengih Threads '_-Basie Basic 1I 0111511111 Outside 1\ .E_fi..D_ia. Eli. Dia. Eii. Efl.Dia. Length Useiui Length Useiui 1 Length 1 oi 0111111111111. at:Sn_1_a|I at Large ' Length. 0lUse1ul Depih ui 1Iiliameier aiSrnaii ai Size 1 per 1 Depthiet I' Thread 1 '1Enii 1 eiExi' iFT 'I inch
Thread 71110511 .; oiPipe 11151115 IEndoiExi.IEnd 1511113111511.' ciixt. RT I r:'Tltd. (E211 T-hd. (E11) L1 1 L2 I Lz L1 Thd. (Ez)I Thd. (E1) (inch) (inch) (t'.p.i.)' ._;, (inch) 1 (inch) 1 (inch) 1 (i_r1et1) (iri0h)w_*_1 (inch) I_ (i.|¡.i.) Ncm. Nom. 0 1/15 1115 1/8 1/3 717747 1/4 3/5 3/3 7 1/2 7 73/74 3/4 1 .. _. _ 27 0.0296 0.0293 1 . 27 27 I 0.0296 ,
002.00 1_ Q 15 I5 0.0444 0.0444 1 __13 15 0.0571 77 14 ' 14 77 0.0571 1 711 17/ 11 -1710 „2 0.0595 . 1111:. l H HROG U|UU\JU __ = _ Basie 7 Basic Basie Basie Tapping Basic Basic Basic Tapnin g Clearanc Clearance iiominal Nominal . . Dia. . . Dia. . . . Ma|0r Effective Mm0rD1a. Nlrnorflia. Drill Maior Minor Minor Dia. Drill Drili iiiameier x Pitch
""'""°'°""'"" Diameier 011111115151 Diameier Diameter 111 Ext. Thd of 011110111111 Size 0iExt.Thd ini. Thd Size Size (mm) (mm) _ (mm) . (mm) (0101) (0011) (mm) (mm) M (mm) M (mm) (mm) 1 3.30 01598 _ 0.251_1 _ _ 0.2312 0.2512 ' 0.1% 0.251_1__4 5.30 3.70_ 01613 0.2639 0.3735 1 0.1513 0.2530 570 11.10 0.4018 0.2275 _ 0.4015 0.4015
0.2275 1 0.5400 0.5400'_ 0.4774 7 0.4915 0.312_5 _0 0.3125 0.4050 1 . 0.-1000 0.2712 0.3635 0.52_70 0.3120 _ 0.5270 0.5120 0.7734 0.7754 0 . 7584 0.7554 0.9339 00.9577 9677 0 0.0550 _ W 777777 77717" 1...135 'J 0104: (1.2333 1 2355 1. 5.821 1.5571 1.5834 _ 5 571 1 1/4 111/2 111 _/2 _ 0.0696 ` 1.6600 I 1: 1.7961 1 .5223 1.9000 1.8223 1 1/2 11
1/2 0.0696 11/2 111/2 2.2963 0.05051 2.3750 W) 2.2690 _2.2053 __72.2_ . 11711/2 I 11 1/2 0.0696 2.7622 2.7522 2.7195 2.5750 ÉÑFT 21/2 1 58 I' 0.1000 2.5750' 1I (ISO) METRIC GOARSE COARSE (@) METRIO Tapping lirill Size Drill (withcut (wiiheut reamer) (mm) (""111 _ 0.5750 (_ O . 8400 _ 711.0500 1 . 1.3150 1 1I-LLIUU Qtfifl 0.2398 0.3199
0 - 3391 0.3391 93997 0.4078 0.5337 5457 I 0.5457 1 name 0.31_9_9 1 0.5337 0. 03997 0.5323 _ (133 107055 04197 0.4197 0.4107 _ 0.7235 U-vvl-v 0.4354 0-054. 0.7565 1.1375 0.6825 1 1.13757 0.5525 __-1 14.50 13_00 23.25 29.00 33.00 44.00 53.00 67.00 ' 1 ii' 0.5959P 0.5015010 1 17 OD CD I 3) 0.47575 0.4767P O 'T v 'T _1i1 -1
I 'lgGI 7-Ei PG (PANZERROHR-GEWINDE) F'12:- N I'l'I ::r::r:1 :|-:: gr1:1': rr E 2 : E 1 Threads 1 Designaiio 1 per Designation Pg 29 1 inch 1 (t.p.i.) 1 7 111.113.); 20 Pg7_1 P97_ Pg 9 1. _Hi Pg9 15 13 Pg 11 A Pg11 15 18 Pg 13.5 0' _15 P071735 E 0 _ 18 Pg 15 16 Pg 210 16 PJ 21 16 Pg Pg 20 29 j _10 Pg 35 36 1 16 011 15 1-._ az. „T 1 15 16 1 rg P015.
15 16 Pg 48 1 Basie Basic Major iiiameier Diameter 1111111) IITIITII 12.5 12.5 1 ' 15.2 152 18.6 20.4 22.5 28.3 37.0 47.0 ` 2 54.0 32 1 A 1 37.0 47.0 54.0 50.3 59.3 ' 1 = Basic Piich Pitch lliameier Diameter (mm) 11.89 14.53 17.93 19.73 21.83 27.54 36.24 46.24 C') '7)/1 \]\J1L"l' 53.24 58.54 35.24 _ A 1 Basic Minor Miner Diameter (mm) 1.."""1 44
Tapping iirii I Drill Size INITII immi 11.30 11.28 3 13.90 13.86 Å, if 17.26 17.30 17.30 19.10 19.06 1 19.10 21.15 271.20 21.20 21.16 25.75 25.50 26.78 25.30 35.457 [___35.50 35.48 35.50 35.50 45.50 45.50 45.48 :57 7 no r:n na mi \JL."fU UL-UU 02.40 52.50 Clearance Ciearanc 1 Drril Drill Size (mm) 2.1 57.78 ___13.00 57.80 57.30 '__- _ 1 20350 22.75
23.75 37.25 47.25 54.25 59.55 M 1 0.10 11x 0.z5_' 0.333 1 0.393 0.25 1 100 1.00 0.838 0.503 1770.720 0.75 1 0739 J1 0-15 M111 1.1 x150.25 0.938 0.25 .1 1.10 1.10 0.933 1 0.793 0.703 1 0.329_ 0.5207 7 _7 7_.9 _1 _ 37,50 37.50 45.00 42.077 30.470 40.120 140.50 01450 Xx 4.50 ' 45.00 42.077 39.479 _ 40.129 40.50 0 48. 0115.001
11191430 48.00 Q2, 44.752 44.752 x 5.00 43.00* 41.3_5_3 41-850 42-58Z_ .43.-"'1. -. 42007, .. 40-90. ._ _-._ ... 1 ___ 111151520 52. 0 x 5.00 _1_ 52.00 57-2.00 I 46.752 45.752 40.6139 40 .557 10 470; .0" 45.866 1 45.537 47.55__ M56.0 31530 x 5.50 '1 55.00 56.00 1 52.428 52.423 49.252 50.50 1 50.046 L% I U U L @ |\i\-I 1 I\J-\J\\J I\J-L-\J_'7 1 H i
731:3? 12.60 15.30 18.70 ._.i1_i___. . A -. 1 - 1 . ll OB fl III UU-U MI1MIl1 M1lI1IM I1 MIl 5. R I flfl 'I-UU QC' fifl T AH?! i "1-I773: H4 f\7f'\ an nn OC.UU 1 1.05 1.05 1.15 1.15 1.25 1.45 1.55 1.55 1.35 1.55 2.05 2.25 _ 2.25 2.50 2.60 3.10 3.10 3.60 4.10 4.60 5.10 5.10 5.5.10 7170 7.20 7.20 3.20 8.20 9.20 .9-20 10.20 10.20 11.20 1.1-7401 12.20 7 12.20
14.25 16.25 1_5.275f 18.25 20.25 'TU UR l_l_.l-U 22.25 24.25 24.25 7 27.25_ 27.25 30.50 30.50 33.50% 33.50 OD.DU 36.50 30.50 39.50 _ 42050 42.50 45.50 45.50 48.50 53.00 57.00 103; F!f'l'I'I V 'R i I . 5 :5 ' :15 55 " Ti F TAPPING DRILL SIZE run FOR 70550050111515 THREÅD CUTTINË ms TÅFŠ _W 6% 1NUT F. 'U "U UcaC: '_. r\:r\> 01U-1 'U E
1.1. 1 5 \É I >22 0 8660P 0.86|60P 'ar r I omma Dlameter x Pitch M mm) (mm) $ 1 1 . _CJ c> ma |\> "U 0.0722P 1:' 2--1 C10 4:- "U 0.6134P --..—-—i —-- 4> 1 0.1443P _> 0.1443P fiiametcr Thai. cfii1t.Tf1ii liliamefer cf of E111. Ext.'lhd. nflnf.Thd. (mm) (mm) 1 (mm) W 7Qf2fl '7 Qflifi ¡.u.m u.uu I -UUU . 6.080 1 1 1 C77'1 C2 '77'?! u.: ru 1.25 1.50 1.50
2.55_Ž___ E-E 3.50 3.50 4.50 4.50 5.20 6.188 5.20 6.20 C017 C'. O17 '1l'\fl T fin I,,vu .u'u v..;1¡ U-I IU U-U I I 10.00 0.100 1Ž 5.455 0.4661 10.00 9.155 12.00 _)jh 11.100 12.00 11.188 (10.466 10.466 14.00 _) 15.025 13.026 1 12.150 12.160 1Å 14.00 16.00 15.026 1714.160 15.00 15.025 14.150 1? D_ M160 x 6.513 nn Q fifl U|UU 1.25 __ 7.00 Tapping
Clearance Drill Drill Drlll 0:..Size Gilli Size (mm) 2.570 2.621 2.570_1 2.521 5.557 3.3077 5.459 3.459 4.307 4.450 4.557 45.459 5.000 W__5.100 5.050 5.355 __ 14.25 7 14.50 14.507 16.25 17.026 16.160 . 16.50 16.37L'ý16V.50 16.376 18.376 1 8.3 75 iv122ux 1.50 5 22.00 L LULD 21.026 18.160 15.1501 20.160* 20.160 2.00 24.00 22.701
21.546* 21.546- 25.701 25 .701 24.506 ' T2.00 M300x 2.00 A 7.0 0 227.00 30.00 5 _ nnn 1 20.701 27.546 1 28.701 1 27.546 20.376 1357] 18.50 LU.OlO GONDUIT 5 (150) METRIG 5000017 (M) METRIC M16011 1.50 16.00 H1200 x 1.50 zu.uu 20.00 1.50 25.00 1.50 52.00 32.00 1.50 40.00 M500 X 51.50 50.00 50.00 an J\'! 1 15.026 19.020 19.026 An
nan 1 14.160 14376 14.376 18.160 15.576 18.376 1 n (\-'7 15.00 18.50 1-? 5 nn mi 14.50 JR I-I\ 20.25 2 25.25 23.375 . 23.50 23 24.026 123.160_ 23.160 24.026 23.370 f5" ' 2% 5 54 0 32.50 31.026 30.160) 50.575 30.370 H 50.50 30.50 52.50 51.0525 550.150 55.50 40.50 30.026 30.160 1 38.376 30.376 :10.50 39.026 7 38.160 48.50 50.50 40.026
40.1601 40.376 40.50 49.026 48.160 48376 \fiL]1\/ ~ 0.1443P \U.1443F' 0_z5p O_25P 5 L _ 1 I 1 0.1443P 0.1443P L Basic 1 Basic 1 Basic 1 Tapping . Clearance Major Effective Maior Efiective '|1IIincrDia.' Minor Dia. Mmcr Minor D|a. Dia. Drill Drill ml Int. In-I Tlnl e:_.-. liliamefer Diameter Ilameter cfExt.1'hd' of Ext. Thd. of Thd. Biameter Size
Size mac (mm) (mm) (mm) (mm) (mm) (mm) !"!'°!" 1.70 1.70 2.00 nnn __]__2.30 I u.-vu 1 l"l Jfl ' U-"I'U 0 "Jfl I L-UU 45 6 X 0.45 2.60 5.00 3.00 1 1.473 1.475 1.700 1 1.705 n n/m nri/in _1_.\.r~|u L.U"l'U 1 . 2.505 2.308 2.610 3.513 3.513 /1717111: /11: 4.4.3 1 1.270 1.440 1 . 600 2.048 2.045 -1 onn I.UUU 1.321 1.513 1-1 no-1 na-1 |.OU¡ 1.OUf 2.113
2.113 11 1 M 1 ää E:--. IIILU Illu- /I fi')fl -r.uLu _|'|_ff\J 1450 1 16.25 1625 1i5;4; 0.6134P 0.515419) M 3.0 ×70.50 0.60 M_|L=,.0 2.264 2.550 2.350 M 4.0 W;x 0.75 4.00 7 3.300 0.100 5.155_ /| no? R nn ~ Q nu:: 510 5.00 5.0 4550.590 X 0.90 5 .,.,.,.„ „.-...N 4.1120 12. 01 5.5; 5.5 1 0.90 5.50 . 4.915 5.50 4.915 4.396 4.526 M015.05 0.0 × _0.75 0.75 1 8.00
500 ' 7.513 7.080 1 7.188 7.050 M 9.0 X 1.00 |v|_9.0H 1.00 1 9.00 9.00 % 8.350 7.773 7.917 M10.0 0.75 0110.02X 0.75 10.00 10.00 9.513 9.080 9.155 0.100 L"M10.0 50170.0 {1.00 {15.00 10.00 10.00 8.773 9.350 5.775 5 0.017 5.917 M12.0 M12.0 ×X 1.00 1.00 '51 . 12.00 Å 11.050 1.550 _ 10.773 1.0773 . 1 10.917 10917 M1z.0 x 1.50 1 12.00 1
11.026 M12.0X1.50 10.150 10.375 i 10.160_ Ž1fT?s76 M14.0 x 725 1 14.00 _ 13.188 12.466 15.155 12.455 V 12.647 12..647 555150 100 M1š.0 x 1.00 16.00 15.350 15.00i_ 15.550 L 14.773 14.775 14.917 * 14.917 2o1oT1'w5~ 01200 2100 A 20.00 15.77? 18.917 15.917 1 20.007 . 19.550 19.350 10.773 m55520. . . %117.555 M20.005555xx 2.00 1
20.00 10.701 2000 15701 5 17.546 17545 17.835 _ 11124.0 22.775 1 22.917 22.917 M 24.0 IX 1.00 24.00 1 25.550 23.350 22.773 M24.0 Xx 1.50 5 1.50; 24.00 22.150J? 22.575? 24.00 55 25.0% 23.026 32 22.160_)__Ž 22.376' " M25.0 0125.02x 1.50 25.00 24.025 25.150 25.575 25.00 24.026 23.160 23.376 M32.0 X 1.50 HM32.0x1.50 52.00 ; 51.025
50.150 f 50.575 32.00 31.026 30.160 30.376 1l M"1HBBÐBM1MH1l 1 22.25 20.50 1 59"" 5 "Ti 9 24.25 22.00 24.25% 21 .835ý _ *22.00 21.835 27.25 24.835 . 25.00 25 -9" 27-25 30.50 ' 25.00 A 50.50 27.0357""20.00 27.835 nn -1-:r~ šš) _. .7 x 0.35 0.35 _ × 0.45 E3 !'°!-" cu:: Av 18.25 55721125 20.25 55 " _P Ill Illln _ (mm) ŠEËŠ Eii 7.20 12.2707 10.80
" 12.20_ 10.0LA__ 19.026 19 .026 __- 0.20 10.20 12.50 12.50 18.00 10.0722P 0 0722P I (150) 5PE0l1i. PITCHES WTCHE5 (ISO) METRE METRIC SPECIAL Nominal ; al Nomin Pitch Diameter xX Pitch 5.10 12.376 12.575 14.376 14.575 20.00 20.00 /\ BOLT 4.10 10.647 10.647 1.50 Z4 3.10 11801! BB 6.10 8.80 0.6477 5.547 L 720.00 1.50 M 00 ÑË 1 I_
fiiameter Diamefer [mm] (mm) 3.00 5.00 I-UU 0 E _c:_CD—-L--L 0:ozna -1: 1 r\a 1:7 l' 0.5550P 0.0660P ' J Basic '` Basic Basic Effective Minor Dia. Minorllia. Minor Dia. '|I'\I'I TÅPPING DRILL SIZE TAPPING 1 Basic Major Maior 0.75 7 Füfi 1§ THRËÃË üü`l`Ti¡\il`i TÄPŠ FOR EAEg§;§0ITiNG ms 0.1082P .1 \0.1443P 0.1443P 0.25P 0.25P °~§L.
rrrrrrrrrrrrrrrrr if P 1\/ 2.773 1 2.775 0575055774.00 7 40 4 0 Iisoýnfl 3.675 7 1 5.575 4.675 5.00 5.00 4.575 5.513 6.00 1 55.515 5.00 0.75 M 30 xii0.35 7 3 _ (LSQ) METRIG FINE (ISO) METRIC N ii _ 0,125P _0 .125P in 60° 'V i 1.35 L_ 1.80 1.35 1.50 2.10 J1.55 -äš 1 2.10 1.00 1 2.40 2.40 4 nn |. U.U 2.70 3.10 4.10 4.10 2.15 2.15 2.40 3.20 5.10! 5.1?
¡|1n A1" -v.|u 45.5550 4.60 7.20 7.20 8.00 9.20 9.00 11.00 10.50 . 12.80 77 5.60 1 5.60 Ž 0.20 8.20 9|. 0.20 10.20 10.20 % 10.20 10.20 12.20 12.520 12.20 12.20 14.25 15.500 15.00 if 16.25 19.00 20.25 18.00 20.25 1500 25.00 24.25 Å*-99 22.50 22.50 23.50 23.50 24.25 25.25 32.50 32.50 *2 .Šíí 30.50 El I'I"l'lI1 -1 -"IE! ED In :I SI 7: 7! 'T1 35:75EE!2 šl
CD '-1?:I 'II ¡-. C: GD É! . 'M10. . 1 10.00 M10.005100 X 1.00 1 9.550 *1 8.773 5.775 1 0.917_ 10.00 9.350 8.917 9.00 Mq2_ux~~1~~% 5 11188 MT20 {1.25 .25 . . . 1200 10466 10647 12.00 11.100 10.466 10.647 10.80 M14.0f1.25 14.00 5 15.155 12.455 12.547 1 Tziłí 12.50 M14.0l 1.25 13.100 " 12 466 12.647 M18 M18.0 . 0 xX 1.50 18.00 1 17.026 1
16.160 ' PI 16.376 16.50 5 10.20 12.20 14.25 14.25 5515.25 18.25 , w—_ _.; _.: __ .. 11 I #21 pi 1 Ii 2 pi _ . ... H "— TAPPING DRILL SIZE TAPPINGDRILLSIZE THREAD 0077.105 OUTTWG TÅPŠ FOR ms FOR 711715/10 ___," 1 '~~;::::::* .C 3»,,_U3 C) "U 0.8660P f\f'\ 54.7 1 7 ~'-A =2. -. 0.1443P 5P1 0.25P - E01... 8_ UNC ILQ CD CD "U _CD 1 1
0.1443P 88. _ 1 1 1 0.06299 0.07_30 1 006 1 0.0750 0744 0.0860 1 00.0744 55 1 0.0550 1 54Gi 1 Po 0.0530 0.0538 50.0541 0.0641 0.0561 0.0667 0.0667 1 1 1 ~ U.u/04 U.U70'-lu.u/.54 0.0655 0.0734 0.0990 ' 0.0855 140. 71 45 40 _ U.UUE:1U 0.0549_ 0.0049 120 M 0.0958 _ 0.0813 0.1120 ""ÑãŽ4 ` 40 A 0.1 11115. 0.1000 _ 0.0945 0.0943 1 0.0979 _
No.5 nu. 5 7 40 40 _j 0.1250 11 0.1055 I 15.I55555_5.—i'157 N0. J .-..-mm; f\I'\-II'\4l. 0.1177 _ 0.0997 0.0997 0.1177_ 0.1380 117144176 32 0.1550 No. 6 . 11 3? 0.1437 0.1257 0.1257 No.8 0.1640 ' 0.1457 N11. 0 1 52 02 1 0.1540 110.'1'1í 34 ff..~~ 0.1629 0.1389 0.1900 0.1900w _ 0.1889 ' 0.1549 0.1649 0.2160 0.2150 0.1559 n n-rn/I Ann A n 1 1/')
Ill- 1'2 lu O'J"-.l"-J O'O'¡O-7\1l \ 0.1443P __? 259 0.25P I + —-_ - }- 1+ -qi 92—-— 0.14459 0.1443P I llcm. 1Threads1 1l'hreads1 Basic 1 llom. ma per M Dna. \ per 11 Major a)or 111 fllfi 1_ Dlamnlorł Ė 1 inch .0iarneter (No./inch) (f.p.i.) 1 (11155) (N0./inch)? (t.p.i,j (inch) ` No._80 0.0600 1 11°12... N0. No. 1 72 11 0.0730 No. Ž 54 _ 0.0860 1 No.25 64
1.55 1.551 1.85 1.55 1.95 2.30 2.50 *nili -In L.|u L. 2.65 1 |u 1 2.55 2..-35 i 2.65 1 2.05 2.85 2.55 7 4 _&T_i1 4.50 1 P'.r.:1 c r-!\ (J|'\J CCJ1 1 U-UU B1 5.60 |1\ '—;L 0.0519 0.0640 1 F-"1. cno nfi 1 1 1 0.0447 0.0447 0.0465 0.0455 1 1.25 1.50 1.60 ` 0.0560 0.0560 0.0580 0.05517 751.55 __1.55 1 1.9571 1.95 0.0660 0.0759 1 0.0668 0.0691 1 1.90 _ 2.30
No. 33 56 | 0.0990 No. 56 0.0771 0.0797 102.155' 2.15 1 2.555 2.65 No. Nu. 44 1 48 40 1 0.1120 0.1120 10.0905 0.0064 1__0_.0094 0.0955 0.0864 0.0894 . 2.40 1 2.40 2.95 N0551T No. 01250 111.02 -111 0.0971 0.0971 ` 0.1004 44 an 1 0.1250 1.1102 0.1004 1 2.70 2.70"T1 1 '23.30 No. 6 40 1 0.1550 0T300 0.1218 0.1210 11 0.1073 0.1073 0.1109
2.95 1 2.95 3.60 N6. 80 1 36 No. 0.1640 0.1460 0.1299 36 1 0.1540 0.1339 1 5.50 4.50 3.50 E 4.30 116.10 5 77732 05.10 32 1 0.1900 _1 0.1697 0.1697 0.151771;1.15'62 0.1517 00552 1 74.10 4.10 1 4.90 4.90 5 116.12 .1 28 20 No.12 0.2160 0.1928 0.1722 0.2160 0.1773 j 4.70 0.1773 5.50 5.60 1/4 1 20 28 1 0.2500 0.2500 0.2260 1 0.2052 0.2062
0.2268 0.2113 5.50 5.50? 5.50 6.50 5/176" 11T 5/16 24 0.3125 0.2054 0.2614 0.2614 0.2854 0.2674 1 5.90 5.904 5.10 0.1071 5/3 1 24 3701 24 1 10.5750 0.3750 0.3479 0 .3239 0.3299 1 8.50 9.70 7/16 20 1 0.4575 7/1? . í1 0.4375 0.4050 0.3762 50.4050 0.5752 0.3834 1 0.5554 9.90 _11.30 9.90 A 11.50 1/2 1/T"1 20 Ñ' 0.5000 0.4575 0.4675 1 0.4387
0.4307 0.4459 1Vl.50 11.50 £00 13.00 jm 9/16 9/16 11 18 10 1 0.5525 0.5625 0.5264 0.4943 0.5254 0.5024 12.90 12.90 14.50 14.50 0.6250 0.5889 0.5568 0.5649 11"14.50 16.25 1 14.50 551 15.25 5/l-1-1 F 1" . 0.5250 .5/8 — — 6.50 1 5.50 0.10 0 5.10__ 1 9.70 11.307 11.50 13.00 15.00 1 14.50 16.25711 _j5 15.25 19.25 22.50 1*FD 225.75 9'1 -\101
29.00 0 32.00 1 5_2.00 35.50 W 1 55.50 01 55.50 30.0) *1. 45.0L; 45.00 51.00 1 j_ 51.00 58.00 1 55.00 Basic 1 Basic 1 Basic 1 Tappin Tapping9 10learance1 1 Clearance . . 1 . . n .Il Elfecflve D|a.1 Mrnor Dra. r| Effective-f Minor Dia. Minor Dia. 1 Drill Brill Drill l1iameter1 of Ext. Ihri. Thd. ol Int. 155. Thd. 1 Size 1 Size 0159191911 51 51 14:. 5129
(11106) 1 1114511) 1111611) 1 (111511 jfinch) 11111111 (inch 9 11111111 (mm) 1 (mm) 0.0i9 1 0.0640 0.0759 11 50.0574 0.0074 2.95 3.ã1 5.50 0 3.60 0.1042 ; 5.50 F" onQ 4.30 P11'cn 3.50Q 0.1302 0.1302 4.90 1 3.901 L490 0.1449 f_590 0.1449 0.1709 X2. CAD . |I':>"T3 . _C) .ME ME 0.1959 1 5.10 0.2175 _j 0.1557 0.1887 0.2175 6.60 5.50
0.2524 0.2524 0.2764 0.2443 0.2754 0.2445 0.00 0.3073 1 5.00 0.3073 0 . 3344 ___ _ 0.2955 0 . 2983 0.5544 9.40 0.3602 0.5502 0.5911 0.3911 1 0.5499 0.34995 10.50 10.00 0.4167 0.4500 __0.4056 0.4055 1 0.4167 5 12.20 0047% 4723 05054 0.5004 0.4603 if 1 04 .50 5 13.50 1. . 26 550 056 0.5266 0.5550 0.5660 1 0.5155 0.5135 15.50 16.50 1 10
70.6273 0.6417 0.6050 0.5550 0. 5275 1 7 0.6417 559.50 19.56 0.7547 0.7387 U.8UZö é 0.7557) _ 5/aj U.8/5U 5 0.5025 7/5 1 9 0.5750 22.25 05547 1 22.25 0.041sfs410.0547 0.9188 0 0.5455 1.0000 1 0.9155 1 8 _ 1 1.0000 Li 1.0322 1 0.9497 E_ 0.9704 0.9704 5 25.00 \I 5 1.1250 1.0522 1 1/0 1-711/5 954 1 25.00 1.1572" _ 1074i 107471 1.0 1.0954
1.2500 1 1.1572 1.2500 ?1i-.°° _11/.4 _ĹË4 30.75 1946 7_ 50.75 5_ 1 5/5 11.5750 1.2557 1.1705 1.71.1 .1945 1.2667 1 71.1705 1.3750 3/0 5.400 34.00 1.3195 1.3917 1_ 1129% 1 1.5000_ 1.5917 .2955 1 15195 . _ 1.5000 11 1/2 1/2 f_ 39.50 1.5335 1 59.50 1.6201 1 1.5045 1.5046 1.5201 1.5555 1.7500 13/_4__ 5 2 . 1-"L2 1.7594 1 45.00 1.8557 50
1.72740 1.7274 5 1.7594 ___ 2.0000 10 1.5557 22 __41/2 41/2 j 2.0000 .L2___.- 2 . 52.00 52.00 21/4 41/2 1 2.2500 1 2.1057 1 1.9774 1 2.0094 0_ 200 _' 0.2500 1/4 '_20 0.3125 = 5/16"1_ 15 10 0.5125 ' 5/16 0.3750 1 0.57505 577O 7/16 73/3/058 1514167j 0.4575 0.43755 1 . --1/.1i_1 ""17ifÑ 0.5000 1 0.5625 12 10.5525 9/16 * j__
IQ219 0.6250 1 37775/6 .5/8 _ 1111 0.5250 7; 0.7500__0 7005/40 10 W 0.7500 7" 13/4 0 072 l\7 "U Z (UNIFIED :1'. F" :1CI 2 n l"' FINE) I2E 'E5 E5I! I11 CI NÅTIUNÅL — 7 7 Y 1 I Threads-1 Basic 1 Basic" _B'as5ic Tapping _C1earancg1 Basic Basic Basic Tapping Clearance j1Threads1 Ilia. i per Major Effective j Minor Dia. 1 Minor Ilia. Dia. Maior
Efieclive;Minor Dia. 1 Drill 1 Drill 5 014195144 94 1119. 51111:. I115. . 5129 1l)ian|eler_DianlelerfofEXf.1'hd.1oflnt.Thd. Size 1 Size 000 1 inch 150ia::2eter (inch) (No./inch) (r.p.i.j1 (t.p.i.) _ (1550) (inch) 1 (men) (05./155511 iinchjm. 04011 1 inch1 (inch) (inch) 1 mm) 1 141011 (mm) 1 _0j.N91 11_|j0._j1 N0. 2 No.2 1 E: BOLT llom. I ~ i)1I'iR?P
0.1082P i -_- O") CD GI I:I ll CID 5!! .2:1:1'1.1>- C 2 I F1 CIGOARSE) E"(UNIFIED e= 211 I! I'l'l CI 3NATIONAL ! 4:- D I E 181 0.f51°í60P @Avg010mo116134P 1 j 1 1 _Q {Q 1% 6- 0 072 1\3 "U +1 _CD CU _\.OJ .[;:1."U 0.6134P > @'UU -5 rxa l'\D 01 U1 "U "Q 'U \ 1 \/ II __________ — NUT 1 0 CT} 1> .1 I I|l..._._.. __________ vi' TAPPING DRILL SIZE FOR
1|1|.B.EAO..§.UTTING THËËÃË Ë¡¡TTl¡'lË TAPS TÃPŠ 010029 0.1082P '_; i\J U1 "U 'U >4-I 1 ——— 2 C —l C: ——1 \É — — 4.4T -6 0%-1 _1°1-1251" 1 — 1 1 --1 3/4 3/4 H Qfiflfl U.ULUU 1 0.7500 0.7500 0.7094 0.6733 0.6823 0.8286 0.7874 0.7977 7 n A fifl-Ifl nnwn 0.9098 ,_. 111 Il. 1117011121 1/8 12 1-77 1 I M1lM1OMl1U0
1HIM1H1Ml H QQQO u.ul_u~J 14 1 0.5750 0.8750 7/B5 1 14 5555557/ 1 16 16 fi Q/170 u.u-1| u 111/4 1/4 1"] IL 1 12 12 3/8 7 11 5/5 111/2 1/2 1 1 i 1 -1 nnnn fi r\AL'I\ n nA|:n U.U'+UU u.:4uu 1.0709 I .UUUU 1.0000 1.1250 1.2500 1.1959 1_ 1.5209 1.3209 1.3750 12 1.5000 u.o9/0 U.OUlO 1.0228 1.0348 1.1470 1.1478 1 .1 598 1.1598 11.2720 .2728
1.4459 1 1.3978 1.4459 1.3970 1 .2848 1.2545 1.1959 44 12 1 1 11.4098 .4098 0 g:n 1 D-UU | 7 n -rn U-{U 1 17.50 41_19.25_ 1 19.25 20.40 22 1 22.50 ! .5 0 1an 9-; 1613 23.25 Z3./'O 1 25.757" 1 | :—- -— 1 1126.50 26.50 729.007 29.00 29.50 1j 32.00 1 129.50 32.00 1 ___ 5. 2 75 1 55.50 32.75 35.50 36.00 55.00 38.50 ' _ ël TU '|'A|>|>|N[; DRILL |]|q|
[|_5|z|5$ TAPPING SIZES Fon i=i.urEi.Ess (glinene METRIC COARSE M 2.0 2.0 x i M 3.0 x M 3.5 x 'M"4.0 M 4.0 Xx MM 4.5 x M 5.0 x M6.0X M 6.0 x 1.80 2.00 3.25 3.70 5.70 415 4.15 465 . _ 4.65 5.55 555 . 0.40 mm mm _ 0.50 mm___ 0.60 mm 0.50 0.10 0.70 mm mm 2 lJ.75 mm mm__ *W* 0.15 0.80 mm U-fiqfll" 1.00W? mm =I l.'U 1.-119 mm u I 4 flfl
In..l.U'U llllll 1.50 mm 1_50mm_ _ 1.75mm _ 5.00 mm l 2.00 mm 2.00r1|m 2.00 mm 2.50 mmf mm 2.50 mm if .5l'1m,4 411-»? M12.0 1 1.75__mn_1 V g . . Tag Tap Size x P|tch Pitch 1 ×_ x . 75 mm ×x 0.0.75 ×x 1.00 mm ; x_1.00mm___, × 1.00 mm_ k_ 1.00 mm >Ž1.00mm ; M10.0 x 1.25 125 . mm _ '. _ .e1:1: ll 1111-11n U-\JJ ! |V|||.u U1 n'1|-n 00 mm x
1.00 M 11.0 Al M 12.0 x 1.00 mm 1.00mm M 12.0 x 1.2ímm M 1211 11.20 11.20 13.10 13.10 15.10 15.90 15.00 I 1 |||||| 4_.75 4.15 5.65 5.65 6.65 e.e5 /.55 7.55 _e.55 _ 555 9.55 955 0110 940 ' _ _ _ _, _N ' 10.55 11.55 1155 . 11.40 11.30 1 1.2_5_mm V 13.55 13 . 55 13.40 _ _ 113,30 3.530 15.55 15.30 15,30 17.00 17.30 _ -~';a11'>>"1=":" _ _ _ 5 lodged
Broken Tap Iodged _.- in the Workpiece workpiece 1l GOD I-I-|rY1 L.\JU Illlll a _ 6 5.00 mm ._ mm 7.30 mm 8.00 8.80 mm % §_-.15.. 12,2, |____.... 560mm 5.00 mm i 4.90 mm Ë 4.40 mm 4.40 mm 3.80 mm rzšnmm aaomm f5—"""""'66T600606 1l 1 i . I=~;r.o "Ni i i _ :=`|:1 l1.|:-b2N OD'- lO'IU'! L--\J\J'I||||l iemfifl unl- ¢ " 0 ' 1.55 mm mm 1.55 ai Y :1 ;j
II" . I' It 11' 1" I .1.1",, -:1»-,'.'--, 1 I,., H'. I munv if l\\\\\;?* \ \\\~i '/ 1 9 5.10 510 . mm __ 5.90 mm mm .5911 7.50 mm 9,00 mm 9.00 I '__./ B.SS.W Ĺ _| Ĺ_ 1/4" "7 1/4"..,,...,... 5/10" ___»V . . 5./3.15" W Ve „ " 3/an 3/8" Using a Ball Nose Carbide Rotary Burr, grind a semi-circular indent into the core of the broken semi-circular tap. This
provides a centre-point (seat) for locating the Solid Carbide Screw (Tap) Drill bit and prevents it from wandering. This operation is very critical to the success oi of subsequent drilling. 1 3/16,, . . i7!§.";?I_,...2_l. 1/4:1 1/4" . ._._.- .._A . | 1 :;/11:" za/ru uy Iu 3/8:: 3/3" . . 1 . 1 A a ~' .- 2.90 mm 4.30 mm 5.80 mm 7.30 mm 8.80 mm -. rrf-'-" .,... _4 .- -_ ee.32:-
I-;\ t 1!'> '. @Ä\`å`\¡N l ." 5 . {E.- !DQ!) -n 5/1§'i. ' . ' - Using a suitable diameter Solid Carbide Screw (Tap) Drill at a speed of 1500 to 3000 rpm and a steady and continuous manual teed, feed, drill out the core of the broken tap. Clean out the swarf swart and any broken chips of oi the tap with compressed air at regular intervals during the drilling
operation. This process should only be carried out using a rigid setup with Workpiece solidly clamped in a vice 8& preferably be done the workpiece on a iviiiling/Driiiing lviilling/Drilling machine. No cutting iiuid fluid is required. z - 2.9501111 2.95 mm 2.60 mm 2.60mm_ 2.30 mm '7'U nn mm fifl mm Lutz „nm I | 5;aI—@'l* "" 1 2 ' 1/8" ii -~=-—\-Z R, _
T i L ., -111i%._.__ 5/15,, 1/1" a lp~ 5/16" _ . _ _M . N0. 12 0.12? Ž'ËËr"Ž" . _; Å 0 0 0 PROCEDURE necessary. _ n Tl» speed : 1500 - 3000 rpm. No coolant Fl fdš -* -:1-"1 Solid Carbide Screw (Tap) Drill tor drilling This drill is specially designed for out broken taps and other materials with hardness 5s 72 Re. Flc. Recommended drill _ .= -7 ll.N.G. 1 _
T""¡"9 Tapping __= _ _ Size (mm) ;~ uriii Urtllislzelmml 'gi Bi Drilling Out a Broken Tap using a Solid Carbide Screw (Tap) Drill _11.40 M160 x 1.50 mm 1' M10.0 Q1 TT 0"TM"1a.0 1.50mm mm ll 'M10.0 x 1.50 10.90 18.90 0 l ||J-ll'-J sa _ _|io. 12 No.12 1/4" 5/16" 3/8'.' 3/8" REMOVAL OF BBQKEM BROKEN TAPS BEMQVAL GF Removing a Broken Tap
Tapping 1 rzu . Tan size Sizeüriii Size SIZE (mm) (mm) | || F HI'-Ill 1.40 mm ma? _. . 1.65mm N0-U1 5... Wn.i._.. , No.1 W. _ 1.65 mm __ ___ 115.0 N,°;Ĺ_,o_ _ 1.70 mm 1.95 mm mm __ N" .1 o 2 No.2 Q 1.95 2.00 mm W 2-Ofií 2.25 mm 7 No. 22 nu. 3a 3 ii.-Q g 7 2.2,-191.-1 110. 44 2.55 mm ___ ___|!0. ___- . _. _. ___ _ _ 2.60 mm_ 2.50 mm T No._4 _ —
".1!-.4 -°!\3!\° commQ0101 335335 No. _ _ _ _ F'2.90__rnm No. 55 2.90 mm _ No. 5 1 - 1____________.NPT No. n9__ę___ im. s _ 3.20 mm mm 3.20 mrn 6 l mm_ 3.80 mm seo __ ____ No.8 NM __ 3 no. a 1 . no.a_________l 3.00 mmýf mm 4.50 mm No.1l]__ . 4.30 mm ' 110.10 F. _"JL1L__.. Tan Size. Size Tap ' K Broken Taps that get lodged workpiece can be
removed without damaging Iodged into a Workpiece the component. Many methods are employed, the most common being: being 1 eg., WALTON®. 0O Using a Tap Extractor, e.g., QO Electrodischarge Machining (EDM) (EDI\./I},// (Spark Eroding). O Using a Tap Disintegrator. 0O Welding a Nut onto the protruding part of oi the Broken Tap. 0
Drilling Drill ing outthe Broken Tap using a Solid Carbide Drill Bit. _ 1111:: T 1T mm 1.50mm M 12_o_ ×x 1.50 1 . 00_mm M4 i/1140 1--.0 >5X _1.ífmm M 14.0 Xx 11.25 .25 mm mm_ 7 M14.0 M14.0 111 1.50 mm? mm*4 M14.0 XAA __.50 mm M 15.0 ×x *n1n1 M10.0 10.25 10.25 _ 1 T ' _ ...z:.|?pm.g ..Ë|fp'n.g . I-Iflll
bile lmml ürlllaize imm; | |ĹM 5.0 M eo M10 M 1.0 T TM f *rí 0.0 M 90 9.0 l _ M100 M10.0 6.55 7.40 8.40 9.25 9.25 mm __ MM9.0x 9.0_x_ _ 1.1.25 25mmi M10. 0_ x M100 M11. lJ_ x M12. 0 x M14.0 M14. 0 1x M100 M15. U x M18.0 M18. U x M20. 0 x M2o.0 1 0 50 mm g' WM 5.0 x 0.50 7 _ M 6.0 1010.75 0 75 mm?" mm 1.80 2.80 3.25 7 in-I 'l.I'\ 7.0
×1.0omm __ _ l M8.lJx M 0.0 FM? 5 1.25 mm _ J— K METRIC FINE 8& SPECIAL PlTCHES PITCHES ' _ ..EEp|n.g ..Ta_Ppln.9 . I]l'll| MZB (mm) ílrillãlze imm) Tap Size x Pitch 0 Eera TAPS TAPS Foflmtflfit ?" ->:-1 -:- K1': .--.- ~", 4.40 mm 5.20 mm mm 5.90 mm 7 /H1 rnrn 7.40 mm 9.00 mot 1'--TU Illlll _ _ _ li fli li liflli flil il . 1 1 /% j .,. . .- /„Ð W9 //5
i.1'i'i'l/2 . LLLM '. '*; Using a Scriber or sharp instrument remove the instrument, remaining of the FéE1'ai}{1mipieces 'è1"éćëš5}i1è tap. Clean out the tapped hole with compressed air and retap the hole again. 3-_t ëfl1I - DRILL DRILL SIZES SIZES FOR FOR scnew SGBEW EXTRACTORS, EXTRAGTORS, wooo WOOD É' SCREWS, SLREWS, SELF
SELF TAPPERS, TAPPERS, BLIND BLIND RIVETS RIVETS & & LAC LI-\G scnews SCHEWS É :_ I11 CHASERS IDI: IB {II I'I'I :H IV! COVENTRY/OSG (1 I: I:I'l1 :Z -1:II 15lb {II Ih STYLE fi 134 UP HHGHT 134 GAUGE NUMBER S LIP HEIGHT GAUGE NUMBER R/*KE SYMBOL 5 THREAD THREAD SIZE size Recommended Drill Sizes for Standard
Screw Extractors ' *" I 2 Extractor Screw Liztractor 01.05105 Recommended 0015100 or:-.1. niz. 51ur Screw smo 7 nm-mmmmęa onu miri Size sam IS RAKE SYMBOL I No. N0.) THROAT ANGLE) THROAT ANGLE unnw 11111.1; 20° FOR S, S. M & 81 M5 RAKE ii RAKE 'if 33° FOR B RÅKE (inch) (inc!h_)_w Me-M7' Me-M10 I I' TM0-M10 M12-M14
1 11.10120 __ílV'_1fifl"20 _ I I . iI30i='1'1/"1'i3i§il1"1'I1"FI'E.5 40s) 0si;.er.i..5 XX Em'll""l'I il min l\lllT M'.Tlfli\l {A M Rake 0° - ZERO 0" If-'__, Rakc M5 Rake \ I' THROAT THROAT / I /'T I I T\ . I I ' \\ I I \\i ,1 ~ _ ¢ 1 \ \ I \\ I! \\' Ill -4. -- 4 — I àzi AI / S Rake 13° - POSITIVE 5° 5" - POSITIVE 1% T r RÅKE ANGLE RAKE _J Ĺ_ 1 Y I '\ ,'- 3/4" _.- 12° 12° 12° 12°
12° 12° 12° (metres per mrnuie) minute) -1 CIN 'rig Speff ldentification _ I I Threading Speed (meires I Chaser identification DieHead SizelI x'; X ł Y S U SurfaceSpgæ_1_i__|or_t_.p_.. i. Die Head Size 1/4" 1/4" 5/16" 1|- =2 91 _ 4 mu |___|/2 I] L ((3/4 II 1!! 2" 2!! 5/9213 5/32" 7/16" " _ 5/32" 5/32"* 7 7/15" 3 4 /mi -i //iv ~I UL I/"1' ` 3/4" I/2" P" . 1 I I" i/4
H "T", hi Material _; I __l 2;-„„¡ 4.5 45 7.5 7.5 " 4.5 7 J1-R.G10n:>c«-\N-4 252" SpeedÅ naka (speed 56 90 I g_ C' "T T L] i Material 3.)-Material; 45 45 Q [Inn llnlnl U I '\:I_l I1LIL§I¢II 4 ; V MI I IVI _ _.[1:|:._i______ .. ____ ._ _L____ DB0" 111 - ncry W6 à H at-I 1l»I I t 01'ËlCH$I\-5i_6ncul\3- l-:1 Uh '3' 1.52 ; I 073" 1.05 1.85 = 005" .I. _-___. 210 2.10 1I 2.51"
I'D; 5 åä 4_g1)1*2""_ggi 2.04 2.84 .125"Uzflgsflz "T U S _| 3.50 ._'#1541 1,/10" __ 0* "I (138" . 138" L 3.501 _ 0/54" _ I 5/32" 3.83 __S/fl_2"_ 5/54" 1 71 1» 151" 3.03I 11/54" 4.16 1 4% 164" 1 4.15 / 3.13?" . 1 3 * 1 I154" _-__ ... 2/22." _.1.454.83 3/15" 3/32" 10*I .100" 3/32" _ r_1o*„ @Ĺ I 4.03I 5.49 7/32" _ _12 . 21 0" I_ 5.4eI 7/54" I .215" 1/4 15.15 _ }_ _
1/4"; 1/se ' ij 14 14"" 2.42? ; Ëtâ 1/0" _žeçggii -.i.- Preferred Sizes u '** Preferred"ST2es I 4:4" 7/32" 7/32" 7.5 7.5 11.0 11.0 7/16" 13.5 13.5 17/32" 20.0 _ W KW1Ël1' 20.0 13/16" 5."' 27.50 2770 T7"M'17"1*/710" 1 1/16" 15/15" 33.0 1 5/16" n /in 0.40 1 U-"TU . 00.55 1 55 I-454. 5 I_` N° 44 N0. (204 mm) mm) (2.84 Ĺ ; I _4 _ 075 U-75 ' . No. 66 No.
(3.50 mm) mm) l 0.75 U-75 0.90 0.90 ; I 'I ufllgli 2.2 2.4 .' . . _ 24_ 0.90 1.00 10? 0.40 0.55 _ .U-55 0.90 I 2.2 '1 '1 "L--L 2,4 2.4 2.5 2.5 2.5 2.5 2.6 2.6 |'Ul Bblflw 2 T 20 2.0 h 2.4 28 7 iii_3_ FUI Qlrluw 12 1.2 2 21'*1..5_51.01.0 3,2 I if M 3.2 ________ A 36 men 1.6 2.0 2.0 žfoý 219 _ 2.4__W_ 2.4 2.4 2.47" W 4.0 4.4 TI' T 44 1.00 | ' 0 2.7' | '"W2.7T '
t'.D%"-lU'lCJ'Ih l 4.8 4.8 2.8 _ ; _ë. I ___ 0.55 2.8 5.0 - - ___ 3.6 se 5* - _JE.____. I PT 0.75 IT 2.9 _ @7.5 No. 8 14 54 4.0 6,4 4.0 0.90 0.30 3.0 (4.10 (4.16 mm) 7.2 1' I 4.4' 4.4 TART_'__7._2___ 3*" I 11?» 1.00 _ ___.__I ___ 3.1 3,1 _. 4.5:n:n4>N*° ° 18 8.0 4.8 4.8 1.20 3.3 "es W 8.8 5.6 se l 0.55 3.3 I\'I*I\2 Ne 22 98 9.8 5.0 6.0 '(iii 0.75 3.3 No. 10 1 0-75 1 No.10
24 W 24 "i7'TR1I5T I '6.4""'"_ 10.5 6.4 0.90 RR mm) 34 (453 mm)"1 U-90 1 §-4 \1'4 ------1.00 _ 1.00 3.5 l Recommended commended Drill 1.20 1 3.8 1.20 5.8 I I es for tor Lag Screws Sizes đ¡:hí> Recommended Drill ___ _Eol_Sr_:_rew 51 For Gihip QM §__f_or_Screw sqegi For_ScrewJ -- for - Blind --- --- |i W ""' Size -.- nkirnrn.-_l Thread Tnrefi imin:) _
111117.} | 1/ ror unnu ruvets sna Sizes Rivets I $i1ani I _ e ~ -1 __-iita-___» _._J 1 _ Wood 81&._ American. Gauge Number_S_creviis Number_ NScrews Self Tapping, Seli Drilling, WooII . . T . Iileare-stapprox I N . Naresiapprox" _,H _ I INe"arestappr_o-11 ~ earestapprox Gauge NoI N01 (inch) I{1r1e1I (mm) N-abfionssize h,ac¡¡°" s¡z_e___tía_i
_1_ge___o.1 IlllCIII__ (inch) (10511. _ 1.1.1; . "actio_nW§)ize haman sm Cauge IGauge.No.I n — L_; 5/32" 5/32" 5.5 - 5.5 1 S . # 35 #35 I -1 R é I ._._.___?i___,i'i;__ AH ____.` IF" I'I3"I'I"°°'I5I (FW "Se II" 0" "="""°°fl=l Wood Screw * Recommende+d_D1'ilI§ize_g*_ Re commended Drill Size r\......... I l-..... |:\.!....... r-.. o._.-... Gauge For Screw For Screw
I 3' ize ';11;";'.1_1 Th read j';;2r1< =i"*.-a"".1_1 Size l Sh Shaank nk 1flwvsfil Thread r»*~-——~~e~ R ake 1 Speed naiie speeuri f ~»-WAII 0 P'==1i9=_iS2f!l .___L.__ C 50 S YIl\I\IIUIl l l i il il il 7'5 l 5 M Aluminium S 6 Ž Gun Metal M5.1 I M5 .0 S 5U'! UJ ; High .Hi_fl'Tensile 1Ĺfl11i¡'5Steel ë!ssl am" ___ __BI.§5§.. C.iJ—*-C _ĖL9 _'EË1MË"9Ë."eSË _
_'!lli!!!St°9' __E[I_I_'lZE:...III'-I.II§I_?II_e§.E_ . _-\ua mu-1 _ l!ronze(pho_spho_r) Ĺ Monel M75151 Metal __ M 5 -.Br101e.IP.II . !!§Pll 9 II._ Fuel' Irnn Ina-nut 1:-0-T 101 n§.'Ii;'i"_é?.;}T7—"_"1T 111ivi_55_ _ Egg . ___tiic:kei'Sieel - -31,-;;.i.1..:'_:!1rf I _c_aå¡_¡L'fl(_!I'°_V)___.. _, .um "3; P|astics(sott) _Castlron Castlron (malleable) _' ___ 5 U'i(»J > _
0351555510515?" _ PlasticsË1r_d) __ U100 Is T I Ë9PP9!____. I s5 (nitrided) 1 :v Q. nz-cz.l ; —LU'1-l->\J—lgcn 01 Steels O") SteelsU3 mífnššš | Diecast = 6 ` Stainless _M5 Qnrn -: ca CD I: I n3-Flinmniniire finr T uunu Screwfiauge Drametersfor 1:. fllnwuninimnn Hlullllllllulll I g 50 Ĺ 9 12 15 _g 7.5 12 _ 15 24__g 12 45 1 24 30 I-2 24 :O'n3o:C.\- I I--I'-I" 1-
I3" ._ _ I . 30 11/2" I 5/0" 5rs ; 15 5/e Material Rake And Speed Symbols I 1'/8" . _....__.. _I 3'7tP| 0+151i11115-241111I :38' (".3-11511 If , I & flner iner 25 !* U —I II 7/87! _ _ _ _ ' _ 5 __1_%3;l_3Ĺ4 11 7/e 7/8-21/8 » 2 1/s ' 2 1/4-2 1/2 §"2"W2'1'/2"" »\ r~ .- \ I El- 3l!"II"°I 7 5/15" = 3/4 _ 5/.16 7/0" 3/e" 3/0" 7/15 1" 7/15" 3/4" 1" 1 1/4" 11/4" 1 1 /9" ___
___'L_'_-_ 5/15" 5/16" I_40__40 7/8-1 1 1/8-1 1/2 _1_ Screw Size I SheetThicknesI ' size ' I _________ sWDrill)Size __ oriii sneer rnieimess ND. I f] 'N11., 1... NIL I.-1 l,_-.-,..(.-':":';':';-1 1 1 12° =I" -R (inch) (inch) -WI-\ 1 3 \\~ 2.8 218 J # 47* _I I ___t'i*Žf17_.____ _,Recommended Drill Recommended Drill Siz Sizes 3-3 .“Reeemmended Brill Sizcs Sizes for =5
:15ca 5: :3mended Britt I-'ID U5 SIJ 12% II I I Self 5:55:55 for Wood Screws Self Tapping Screws Type 'A' P.Si mtllĭkw ng \ Mze - /vise M28-IV36 M 40 - M45 M48-N52 Šš -Ä-Ä@S Šš ETI-I» I\JU'l M56 - M60 M 56-IV60 2.0 ' \ I I 1 ,_ _ _ 13° - NEGATIVE I _M22 - M24 . _ _Ll_11.2a-~24 5 _ . _ .
(nur: 1. (111111 _ 7/32 -1/4 1/4 s/is-3/e____ 5/15-I_3/0 1/2 » 9/16 I/2-9./l6._LI 5/0 - 3/4 3/4 5/8 I 1 22 IA1/z° NUT ivur ACTION Aonon I I 5/32 5/32-Q/@_ M4 - M5 Wi_ M8-II/7 _ - IIIIIIII l a/az" ___a/32" i i i i íi. wi-.y __ I 1 -I H\ nu ——I"_" I/U4 r/'64'f_'1/3" 4.0:: 3.3 3.3 4.1 i 1' z____I i ##40 40 " "Ll M." 517: -Ji/f_.:q__P~?_...... # 30 #30 3/8" iiflmml (10mm)
.313" 1,1 iu I llllll 1/1 e" mmm) _-.....~-J~a»a_'.'.. ml/2" _!Z2."._ (12mm) (12"""l. _ 10.5 4f1n 71-1 1:" r-11.-..T_—' "A5 n _ lL.U iL.u I ; 13.5 of (mmm) 17_5 55/s" /o"(10mmL%)_17_.5_ #20 —_ (zomm) ;_ 44,90 IT "##10 10 I 3/4" izommiw 2121.00 _ 5.5 .. II. #2 #7 25.5 ..-._§.-.6. pl/_3§'_.I?Z!!!!!1l _7_/E*Ĺ'_.l.??.l'1ml I 23-5 5/32"? 5/az* i 5.5.5."" = _-Jl32 . I I(
1/4" % 3/15" 7/32" 2.45 2.45 "_——.-§"F\.L53 1/an 5.5 6.5 1I I FF 5 1" 1" (25mm) (25mm) 27.0 27.0 7.0 I A I "Š z Oz; E-"MI U.\J 0.5 9.5 12.5 12.5) 15.0 17 5 I T7-5-" W 20.0 £1 ormcusrons PF. or Ë9!!!'IË!* B.° .'"_"_'¡_/-_-...COUNTERBCRINGI Fi'counrransrmnno _ _ ____P!!* 'Ë!!å'P*!å GUUNTERSINKING |=on FUH socrnzr SUUKET 0240 HEÃIJ cm» GAP
scnaws $l.||tI:Wb *_ Counter Bore "W U I" L wow 4,66. _>lCl+_ /// Counter Sink 11.4/ I ///C ' 02° 7 žczI E. 0:1: 9_ 61 = 62° Countersink Counlersink DUCKBI Socket l1EHtl Head Cap Cap bCrBw Screw au|..|u:t Socket nuau Head uap Cap auuw Screw -1 ||___| l___ l______ -_ C! 1 i D 1 ! 1 i Clearance For Thread .c, _ . . L . 4. Z O0 29.-9
_._.| I._ . 26.0 M24 M27 _jeo WU -60.0 1 M60 66.0 M30 330_ 1l l 1. 40.00 40 43.0 46.0 48.0 . 043301 = 0.46601 = 086803 -6666 _ ; 1 'IF . livą 'Č 5 -I"I0l8 5-i-ioie 6: ;T___. . ._ _-_1 -C ni 61"-6'Ä-4:i T._.4_. = = = Dfiwlrz = CJQUJL n - II 0.18164 018164 0.55902 0.40451 0.29389 029389 4 A\ \v ,-l\ Z 'Hi 'dl 1 ._._fu._. _ (_-Ć) 4—¢> .5 E' 3 16/62" „lie 1:51
4: EĹ 43: 4 = 0.46601 043301 = 0.25000 025000 C'0.:1UU:l: 3I1=- = 0.50000 o.50000 -4!. ..._!' 1!'-\r" 'P lältlDé B 11 21*" H. II 'HA " »Q se %'-"--%F 1 B ©1317 » ,4A . —I»-> Q 4- / AQ A' 0.»,0 vq \W I 1. \ ar =Šš" O .35355 =0.65655 = Il gig 1 6 B 11+/1 11 (+4 +1 CD '¢W3> GD B3>- =0.14645 = 014645 - C3 Gil- __.l 'II + 6W` ~—-1-—"—"
li1MilMi11lHi1 lBi1lH 'V l ._i_._. IL '1' , ~>| D 0.701" K 1' _ 7 0.761" 11-Hole A = 047075 0.47075 1 2 . -_'-_1_-_-_ In VI .V1i"'" = in'! gr'); C: "~" ==10 Il 1'C1tz He4.~S" W' Ouf .p__ \Y I-_ wA 7'F4 gel 1411 'III 551 @fi' B 'I' " WRIYAH 6% = 0.25000 025000 = 015451 0.15451 '‚_ I w 7-Hole -Hole = 0.27052 033922 tn):-| = 0.66022 =
0.45040 045049 021694 = 0.21604 = 031175 0.61175 "`I'1|T`I'l|1©C(5JüC7"L = 0.60002 0.39092 10-Hole A = 029309 0.20660 0.09549 == 0.00540 018164 == 0.16164 FWCJHHÖÖRJQUJ C 4- ._-;-_T-_-m l :3lZIG®3`7IT'r'l"'©€C'3>lZWD3)=>-(Q F "iĹ"55 \I 'I . iv In' Il 0.056" _0.656" if mi = 0.46065 046905 017101 = 0.17101 =
0.26201 = 0.21065 0.21985 = 030302 0.66602 = 032139 0.62160 017101 = 0.17101 029620 = 0.20620 _ ,4$\... T 7/02" __"W_ 0.125" 7/62" D lb "I -Hole 66-Hole _ _i_i>Ti___-.. 1 ->"l jg/1 B C *1 1 1 .. H liv Ih' ..`___¡zÅ D Ć II L AV! Dimensions infhrches in inches Dim'e'ns'i0ns = 0.46104 046194 = 0.10164 019134 I Hole 9-Hole 6 W61 \
H 1- I -1 -_-___ i 55" *Š* 7 _'F _ 7 0.844" ___ 15/32" _M 15/62" 0.644" 0.900" _ 17/32" 17/62" 0.066" 1.100" 0.6mTi21/62"" 1.166" 0.675" 21/32" — 0.810" 1 7 25/62"' 25/32" _i 71.466""7 0.610" 1 D173 ÖÖWB l 01551 Dimensions in mm A 6.7 1 _ 9.0 *_ 1 ____ 11.2 13.4 17.9 _ L22.4 _Ë 26.9 na _Gcu 30.3 33.6 . i | 37.0 40.3 4°- 3" _ 1 1 WI B ni _ 5 _a l>*""-
'ul 'i_-"1I I3 A-> .-.4-+. I 11/32" 11/62" ' _' in G §1i'%G1:; |\25.5 :>|\:>r\:>—~ F17?-'97"?-C' U"|u"rcJ"1 1"' 1"7 25/62" 1 6/16" 25/32" 3/16" 29/32" _ 10/aw 1 3/0" 0.930" 7/8" 7./1i;w 1._050" 1/32"" - 1 Z-i 5/8" 1.050"" 1".¡„ 1 1/62" 5/6" 1.310" 1771/4 15/16" 1.310" 15/16" 1" 2"2" 21/32" 21/32" 'I I 29.0 1 20.0 , 62.0", 32.0 01..1;~_._ --1/.1" 1 11/32" 0/12""
1_ 17/62" 0.350" 0.650" 17/32" -2/11"" Žj13/8" =./_1.9í_14/2" 0.415" 13/32" 1 5/6" 5/8" 7'70.415" 13/32" 0.475" 15/32" 1 26/62" 20/32" 0.475"; ._1/7/16"'??? 11/2" _fi_" . 15/62" 0.540" 16/16"" Ï 0.540" 17/32"' 11713/16" 17/62" . IA 1 1|-4n ._ _1/ËĹ' 5/0"__.§L3l. 6/4" -Hole 8-Hole 027059 ~- ~—— —1—f" -— 46 == 0.27050 0.27059 0.27050 I` IÄ Al ll 04>.
1«rw 1 #29 #20 0.255" * _ 0.201"" 0.281 74123 7 1 __ _ 1 1/4" 0.140" '5 __No._.5 1/4" No.5 ; 4#1316 7 0.607"_7* 0.007" 0.160" No. 6 1 #18 #107 9/32" 7 5.1567" No.6 0.359" #10 0.650" 5/16" 0.185" 7 7 Nt_l_._8 #10 ___ii_o._t3_____ 5/16' _0.i85" 0.411"7 77 #2 7 0.411" # 2_ _ + No.10 1_#%2 7 3/8" 77} #2 0/8" _ 0.215" A &_°E5f 0.531"" 1 0.561
0/62" 0.200" 1 7/16" 9/32" 7/16" _ 0.280" 1/4" #29 #20 #23 #26 @ 1fi 5 'I' ...IIII.. = 'D, INCH _No. 4 _n6.4 if 1. (ÖQJ BUD):- ot Diameter of Countersink .D, C: :: =3 :Ë 0: aa ~.„ I 1 ' 1 M ł 5` 'cl 3.4 3,4 3.4 M6 6.4 6.0 6.4 3.4 6.0 irva 4.5 60.00 44.66 1_ M4 4.5 M4 5.5 5.5 5.5 _ 10.0 10.0 '1 5.7 M5 6.6 F" 6.8 Ms ' M6 6.6 _ 11.0 9.0 9.0 _
15.0 9.0 A 15% _Na 1 0.0 . _'Y!5 11.0 11.0 __1_1.0 18.0 1 16.0 M1U /___1_1.0 M10 14.0 13.0 20.0 M12 1 14.0 - - W? 16.0 15.27 ___ 15.0 23.0 15.2 M14 1 M14" 16.0 18.0 17.5 1 7 10.0 _260 18.0 M1fi 16 16.0 26.0 7 19,5 _ .2909 20.0 29.0 M10 _ 20.0 _Zi-l~° 22.0 _215 l _ 22.0 32.09 _020 22.0 3 MQ vmifi - 32 M22 24.0 1 r.35.0 /o 4:: 2?~5_ _ 1
I___l.'lll'_...l l'___ fl-_-...-. Nominal Clearance Clearance Clearance Threarlg For Head 1 Depth Thread 1I For ForThread ,H, 1; =Ë Size *_ Size ' fãE3 l'l'1 --rE! ca METHC D1 I c: -1 ETFfi :r FS' E „- E cl:1 : F. 1\ Hm 4 // Counlerbore Counterbore : RUB Ð o0In` : 5h f i -I-lole -_._.1_._- _._.i_._._ A33-Hole = 0.25000 025000 %% ' NUTE : n. .| /. \F°"l/
/rm:41.112 _»lg H Multiply values shown by diameter oi ot pitch circle 3/ "`u\„ '___ .-\ IQ LOCATING HOLE CUORDINATES L9P_^I'!'.9_Ë'9!ËPP_° 'i"!H*IĹE_S FOR SPACED HULES HOLES FUR EOUALl.Y EUUÅLLY SPÅUEI] '2"f";"" Q74 '7-1-""~' 4 +10 |+A>| 1+ »io 6/1>| e6 W = 0.14087 = 023700 0.23700 015231 = 0.15231 0.11704 = 0.1.1.704 =
0.25627 = 042063 0.42063 = 027032 0.27032 018449 = 0.18449 __X>IG 12-Hole = 0.22415 022415 = 0.12041 012041 = 048296 0.46206 = 0.12041 012941 "|'l'©@(¢3'DWZlUJ]>:. = 0.25662 025002 1 M _li 'U52:: -i SHARPENING III ::::>::i'U Ifl EE :z i:: DRILL ::iEE ,_, POINT \/ /T 30°\ GeneralPurpose1'I8°Poi0TAngle General Purpose 118° Point
Anglj /~\/6 ,1; \,_~/'\Ĺ/"1, "Č "Iz 6-12 i Te, V °$""\ /6 «;>"\ Öfgx/ \Ž Q 59V __\ E X A [L l I '-// l 1 \ //1i lt is vitaily vitally important that both lips should be identical in length ength and angle to the drill axis. (W)' The web thickness gradually increases after the drill has been reground several times. itistherefore ltistherefore recommended thatthe original
webthickness web thickness be malntairied maintained 1_ 30 3 5 ..+.__._ . ___. > 25 ., i"""W""i 1'-'..':""' *'*""-i'*1 137-" .1 f`"i drillpointifmuchrnetal uriii point ii muzu rnetzi .1 ,._..__ 1 . = 1i 7 " D (\ \/ ./ /' . V// / 6 Š/ 1/4 6 Å?/4 2 \ \i 2eqí11 U /7 'Y\W 1 //F-\ 5.115 5* I \,.\ /\sile _~ .. .1 0 - 'B: 5/43 Q @W C' 01' \65'\'\\ N 9132 %;'x*\°„-Žęý O
7132 mi I m c\ ©7162 "\'~>".d \. 9" 7"afl \°° ° Q3/'G O6/16 ËË 160" @M C) 1/4 O os/az W 6=„ J 1 1/11 / Š \ C: CD CID CD 5+ 171/1 " 1/11 1 ' Ĺ)/1.3 nishing __ 'L' V 4/ 7 » -j ' 2003 by Pat Fiapp Enterprises the bit to run out of true, producing !lncorrect -'1 correct _ grinding ccauses 6 he drill hit oversized and often. often, out-of-round holes. This puts
severe strain on overs1zed wear and premature drill failure. the drill bit causing rapid wearand I V i i Recommendations U1*" \, L") _ \,u?/()\ "xii Qýeä \P \/ 6 þ Effects Eltects of Incorrect lncorrect Grinding of the Drill Point ._ _. l_ / _ (\é,\ \"~'1-3 KY' Nole EiI Points to Note —rfi--1T - Keep the drill point constantly sharp. sharp, *' The side of the wheel -
Avoid excessive grinding pressures should be used for Y - Avoid overheating the drill point. finishing. finishing. 1 _- . 4.. - of drill point. - Avoid- sudden cooling _m1m£|l|h§§J - Use copious supply of coolant. Gri ' ._______ 71 H - . 11 1 CUPYYIQDY \\ . \ .-4__. _. t. \ 1R1 O. I: 6/6 i; ` \1 1 ti % 11 The DRILL PUINT POINT SHARPENING GAUGE (on adiacent
page) is the tool most frequently used to check the drill point during the sharpening operation. sef? l u\@ 1 Y-1..1 mustbegroundaway. mustbe groundaway. /3 /6 0 iviiu: steer. 113== " HIGH TENSILE STEEL ' 130°-1 as" STAINLESS STEEL 1 so"-1 as" TOUGH STEEL 135 14o 1 SHVEET STEEL 130 135 ALUMINIUM 113=BRASS, BRONZE 116 CAST
IRON I T113=»' 1 PLASTICS ' 116"" KHAHD RUBBER FIBRE so K\ 714% 14 % 12 "/6 _1Q > 1" 1 O io DRILL POINT 20 °/U ni- \-._~_..-I Bl 17 e/„ _ ii?iTf' _ 11% 716 1/2" 13 I 1/2" 25 if 71" 1 ___ / 3 š\« _ Nleiies ::ci 171111-1.113 minute Cutting Speed : I-'1i3i1'3s 12 18 ______24 27______30 1?-19-2 1311122241 ?1T_22W3"
CuttirlS_peed:F_e_e_tpeLrr1_inute ____ \'Iuttir§lS::eed : Feet per minute 1.5 1/111212445 1/16 _ 2445 1 _3fäfi7_ 1.5' 3337 1 4869 4339 _5500 5500 1 3112 % 1222313335 6112 13553 85ą5__12_223l16335 2.5 11?/3;_1_ 3259 1 3667 3337 1, 4074 5704 1 3149v1_2223 1620 2445 f1 3259 4074 1 _5_704 8149ýI2223 3/32 1320_12445 1_11/111322
2750 1 3053 4273 3112 9137 1633 112445 2445 2750 3056 4278 6112 0167 __'/6 _1g22 1 1333 1956 'S_ 7 Q00 2445 5/92 ili 973 1 1467 1437 _ 1953 2200 _I 244? 3422 =2 I 4889 4339 _ 11I 7334 HF _ 5/32 T. 3422 _ 815 1 1222 1630 1330 1 1333 2037 1 2352 1833 2037 2852 1 4074 4074 1 3112 61_12 3/16 Ir111 315 654 '1' is _ 1637 1 __2292__
3274 _4911 1/4 354 9322 1 1309 1 147_3_1473 _i1—fi7 2292 *5 3274* 4911 615 1066 1 122T11353 1% 11356 1 fi1 1901 2713 2716 T54074 4074 11?/3211543 09/32 _543 1 3151_11033 1 Q W 1222+7 *3_1 3667 469 733 1 973 1 55/16 /miss 171111 976 _ 1100 1711 0 2445 3667 9 pl?/991 ' 393 1003 446__{1 372 672 __ _ 1120 1 §33 696 1_ 1006
1566 1 2241 3331 3361 "/32 443 10 3/3 407 _0 311 1423 2037 3053 611 1 315 815 1 917 917 11019 1 1019 1426 2037 305Q 3/6 11 25?/157349 393 1222 1743_Q319 524 696 _ 733 766 ` _ 373 873 1 1222 1746 2619 7/15 349 13 306 1—453 \ 456 1_311 611 1_1 333 666 764 223 764 11 1070 1070 1 1528 1528 2292 _1/2 14 9/13 407
1i 543 1 311 1i 543l'611 _ 679 11951%'_1353 9/16 272 ~ 951 j 1356 _2037 _ 2037 5/3"7244 Ézåjëmwflmmaw 13 5/L 244_3_37 550 311 353 1222 _1 1633 1333 _ 367 439 489 611 1 656 13 23 23/3 i 1222 333 500 1 553 1 1111 1 _i 1337 222 333 556A 1 773 77642 __1111 ,ËË/32 i 2 444 1 T _,E 1911 J/4 407 11 453 509 1'i 713_1!_ 306 __407_l 456 `
1019 _1 1 523 3/4 L20 l 2044 1l 303 526 210125/92 332 ` 943 169 _1_224 224 1 373 376 1l 425 _1 473 __ 662 of 1419 1419_ 25/az _ 139 22 6 llv Y/11 175 232 ' 349 397* H1 1311? 393 437 ME1 611 876 1310 "^` 1' 2511111111111111 1 344 3 332 734 153 1 229 1 303 306]Ë344 HL51—1143 _1146 382 1~ 535 23 .U/L _1j_/11* 133 1 272 1i 303 136 1
204 _272 306 '1340 340 1 475 1 379 679 1019 321_1111[11111 133 1 24_4 244 ' 275 _1 306 303 423 311 1 917 122 1 Ä 611 426 _11/4,,_ 13/ni 111 167 276 1 369 339 1 556__ 553 1 633 333 I511?/91 137 _ 222 1 250 _1 273 88 11]/z1_ 200 11 :Q7 957 1 509 sue /04 11/zi 102 102 1 153 f 284 204 _1 223 229 255 764 41 _l5/31__ 94 1 141 141 _ 235 _
329 1 470 _705 705 1 5/8 166_212 _235 44 W111 314 3141_„ 87 131 175 . 196 218 437 1 655 216 _ 306 471 _1]/31 163 1 _ 183 285 1 407 ' 407 if 1611 163 _1 204 _1 265 611 1 7011 181 _ 122 50 11 im 2 I 73_1 _115 1 153 1 172__ 172 .. _ 101 2137 929 \J\JI- _ 573 _L U1 191 _' 267 362 573. 21/4 33 _136 153 1 170 170 238 340 }_ _509 57 it/141 102
133 1 E 233 1 340 a1UlcnJ>« æ-:nwcuN Nw-A`lC2`|&-lm m uwmtnm G> 73ov ' 102 115 127 173 1 255 1 332 11571 7178 i 362 Š1161 Il\ 2_2 I *" 11*(inch) i"-1 (inch) l pper & Some Copper Alloys Copper £973 1127 mil" Diameter Biameeg /1E "l?„`" ZZ ___; I' 111 I Drill I-IFEII T . 4 151 'I%1>IV/K1/(81 I i 0 DeeppH0le Hole Drilling ' 22"'1s"" 1"" 1
T2_1334;23311 4.* \ Tough Steels ___ 'BI U9no- Q É/ __ 14-31 71 "7?1111;§11,,,7. 1777* H" Medium Free Stainless1 Tool ' 7C3Cast 1Malleable1 ,._. _rh__ iz,___,,__ wood Stainless Malleable Alum. 1 Wood 11-..1_- 1\..„=— \JCI IIUII hlllllllu __S_teel _Steel_` Iron sme' 1 Brass 1 Plastic 1 Wmw""1 W"'g >'\ 53 Hi SPEEDS 8| FEEDS ___
åffË9åf=_f!iIäJå____ ____ FDR SPEED STEEL fun HIGH 111011 si-Eizo sim TWIST iwisr DRlI.LS onius Note := The iflfflrmfltion information on this M l`lian1ete_r_oil_) _r_i_ll 77_Fe_ęd per_Revolutio_n____ per,lfe70lution ____1 page is intended as a general 1_Djamete_Lotj Dgill 1 _,___1___l=ggd 11 (inch) (mb) mm; f 11 (inch) "nem
guideonly.Fígureswillvarywith guide only. Figures will vary with lifirifi i:t1i1".i -51111113-i _-,. 1 Ql'8dBS[)II'flBI_BI'IEill_lSBCI= oradesofmaterialused, 3 1 __ .117" 1 .02,_. :1,. l „Å --_. --j;i 1/n__` /B ' UUd __.uu1-.uua I 7 ___9t_1_321....-'¢'-_'1"m1 -'"31? . . 1 5 P 1/4 7173 _li 77*;/"27 6_ 25 1~—~—1~ »— 4444444 >V NN-25 1 V< >1 A umwma: 1__,
_L|\'I 9 . 1115 __15 1102 _ me 11116 _OO2 _10_125 1004_ O-1-6 1 speed and , 004 _ 0170 feed, increasing either 20 40 -------607 11-11- 1- 5 ' lt ISis best to start SI&l"[1WlTh inoderate with a moderate one, or both, after observing the ' ' , :_..1 '007 `7% '015 cutting action and condition of .40.025 1I 11-16111111 bit 'J>^`-b ogcm..1 '.6511 Q-, J:-
i\3' n.' _u1C>o'i 1 ill #l TYPES APPLICATIONS TYPES & APPLICATIDNS DF OF HIGH HŠËH SPEED ŠPËËD STEEL ŠTËËĹ END ËÑD MILLS lII¡¡i.¡.Š stamiani 30° Spiral 5|¡¡1-ai Standard SPEEDS AND FEEDS FDR STANDARD SDLID CARBIDE DRILLS CARBIDË DÉÍLĹŠ Types of Solid Carbide Drills Drills E -:» ; -.4112 2 -. ».-..:--2' ::;,;. .;'.
>11»;1:/.;i:'. .11-. -'. .4:/_.Efi;_y" -7-. -' . .-I %%@ 1.'-':;':2-1 %%& fifii ¥&E @wfi F-.22;/3 .;_;'-.1.'/,;-_ 1 -:4E:-,§;'-:; %%% ifii fi%% mfim wgfi 1.;-'.'>:ilI??e '1 =-—:'-'».:';,'>-:5-.-' la-I->-1.-14:1 . ,. .2 -'-2:1»:-" sad if-'-'1-"-1'5' 2 '.75 152.3-'1',"=-J >5-K E-'1:-=2" aas. 'aee :~'1- -> ;» ew'sf E%d ';a-'.; ,1--;.'-."-:.' ';4 9 aawa iaaw baafi life?-"5/1
13'-'4 .~»- . .-.. 5-:» -4.9 l Roughing Round Knuckle (Sinusoidal) Teeth itoughing ųų * M 1 l li'ifI'fi§I"S"\ sh \ I I | 7;.-\._ are \ ~.-j'.¢ -we; m>-as 41:-_-._ '/:1 5%' 0%! ac 1*: -1' $2. ',.- ,1. 1.--:-64;» -J» ,\;.--.. ' '.4; :LI'-\. A \ N fa'?-"\Q' \\'1-1.1.1,"-' -\.-\':\'-\ _ Qfi :IIM .I mes: L Drill - 25°-30° Slowfspiral siow snimi Drill oriii -- 15°-20° 15°-20° Twist Dr'll Strong
construction with Designed to drill hardened 2 & 3 Flute general purpose 140° drill point angle and gummy materials and drill ideal for low-tensile & suitable for hardened & High-temperature Alloys. non-ferrous materials such Straight Flute Drill A Speed {m/min) rpm 1.5 (m/min) mm/r mm 'mm/r Material Mfliflrifll 3.0 mm designed for rapid metal

removal, additional finishing operations are necessary. Flat Knuckle Teeth Roughing 01 'Il' 9-mi I' Ž $311K °'tii:1.T_> 'Š„l l_1¡¡¡1__ "I" 1 iliII 1 .- 10.0 12.0 mm 5 mm 8.0 5.0 - 6.0 = 8.0 mm mm mm ,mm;mm 4.0 mm innn 2390 iaou FJ c: u: usc: 1 ...;_. 75-80 "J a n _ _ 021 025 0390 ce00 A 0.21 1 F' c o _ ~ F: u :-* 15_9'ž01 7960 15070 A 5970 A 47701 4770 3000 rpm,_ 1159201 rpm 3980 2980 239 2390 _ 1 990 Brass 75 009 . _c: F3c:010 F' —* '._t'-Qt-Q_ 006 007 1 0.075 F3006 0.015 i F30.05 feed fe ed 0.015: ca 01 gs c:ow 1 0.07 1-mn' 1,141? I mm .„„ 1aon7 .wo 11nn 1.30 2930 2660 170n. .1„.. 9550 lĔ77o * 35301l noon Bronze/Copper 45 "" :1 Q2? 01 10.076 0.075 0.08 . 1 s=0.09 $30.10 if i if ffeed eed 0.015 1 0.05 1 0.06 '1 00.07 4030 3020 040 ,114030 30201 2420 2420 A 2020 2020 mm 151501 161301 C06060 cac:- K"c: ca 1 6060 1 4640 (Salt) Cast iron (Soft) 76-81 lpm 0.20`0.25 oncs- C3 CBc: 9'0.12 5'.12 0.15 0.20 !1 0.25 . 0.30 0.075 1 0.10_1 15611 0.02511 0.015 fe ed 0.025 |... 2.. . -. _ ..-_] iT n7cni']oon 'llIl"]l"'ii'l/lfifl won 2440 rp 9760 ,1` 4880 l c3660 ha2930 OD - . 1830 ""'"l1 1460 "U" 1220 Cast Iron (Hard) 45-51 46-51 .;P'" . 0.18 ' 0.06 1 0.10 0.13 1 0.15 0.10 C3cC3 fe feed 0.013 0.05 j10.05 50 0.0101 . cC"c: 0.00 2440 100011/150% 1830 11460' 1220 3660 1 2930 2440 rpm Plastics/ Plaslics/ rpm 4 9760 44880 000 555012000 46-51 0.10 70.11 0.11 1 0.12 0.13 0.13 0.07 0.09 0 feed 0.025 1 0.05 ' H 0 70.025 Composites r rnnwi 950 800 600 rpm l R57fiT_Q1Qfi 637071;3180 2390 1910 15901190 . 2__J Mild Mild Steel Steel 30-35 1 10.10 I 0.131015 0.18 oía 0.15 0.16 1' 0.06 777.1 10.00 0.06 0.05 0.05 feed ee 10.025 0.025 = 0.05 3660 1 27501 2750 `122007' 1630 5490 Y1 4300 4390 assoc 7320 5490 2200 ;1ss0 rpm i14640` 7020 1 rpm 114640' Carbon Steel 69-74 0.09 1001210015 0.012 0.015 0.06 « 0.07 0.075 1 000 0.05 0.001 feed fe ed 10.025 0.025 0.05 onvn on . non mon l 1mn"_7o'zn7 ::on I fmvn t 1nan 1ccn .„W1.,„.„„ ...W ' nen dw ._t„o .wo 1 1onn rpm rpm 1l 5520 5520 oven zivu Alloy 1 Ailoy Steel,' Steei/ 0.025 0.0255 ' 0.025 0.025 0.025 0.025 feed 10.013 1 26-31 feed B.01_3_ 0.018 0.02 0.02 .1 0.025 High Tensile 600 i 500 1 400 430 950 13 000 1 400 rpm rp m*33180 180 15902 1 1190 950 Hardenedfl'ool Hardened/Tool' ii 15-20 F? cn oowc: _0.01_2i 0075"' 1_ 0.15 0.06 007 0.07 feed 0.025 ed 1l 0025 . 0.05 0.00 . i1007 . u-1_ 10.0sY1—0.012 Steel 211% om nnn 050 1 .ooo oo.. 111 coo ..w_ 1 rpm 1 5370 Stainless wi ti 3180 Luųv 1e10115e0I1100= iuiu l1i:on Stairrless S EFEL=:7 30-35 O _ ._. oo 1 0.20 1 0.131 F? :Ž-*tomo A 0.17071 0.09 0.10 0.10 pi 013 0.15 Free M/C 3°35 = feed feed 10.025 0.025 70.075 0.075 Z0. _ . 1830 1114501 1460 .1_220_i 12201 020 4880 2440; 2440 1 10301 rpm 920 130 730 1 010 61_0_ rpm 1* 4000 Stainless Slainless Steel/ H 23-28 feed 0.013, 0.013 0.05 1 0.07 0.00 0.09 1i 0.10 1 0.12 0.13 1l 0.15 Work Hardened 23°28 reed n|.. ::.. I Hlllllllllllllll Aluminium/ Al Alloys A1 i I Irpm .pHl1;¢° vnnn vnon iuuu IUUU manna-\ cnvn Cfl'H\ 1 JIHU uvru avvn I1 fiiru I1 A'7'7fl "II IU I nnun @aun OPIOH UUUU "')flOfi LUUU co fififil U\]\]U 1 1 1 . A77 '111 i @ OD -I ' "JQC2fl 1 LJUU 1 LUUU 1 _ . .1L _l|\JU' CD E CD . I] Fine Pitch Knuckle Teeth Roughing 1 \ H Ë)ih K"0 I'1'lJU G CD - Teeth cutter, yet requires additional finishing operations. Z (.D3U"l - . Suitable for Medium Roughing operations where rapid metal removal is the prime requisite. This cutter produces pmdutzes a finish that is generally better than the Round Knuckle -_L LO Z ll l Suitable for maximum Roughing where rapid metal removal is the prime requisite. The cutting action produces short chips with excellent chip removal. As this cutter is mainly difficult to machine Also recommended for as high Si Aluminium. materials. Hole depth Stainless Steel, Tool Steel Bronze, Masonite & Resini' Resiw should not exceed 2 xdia. Fibreglass Laminates. &Titanlum-Nickel Alloys. &Titanium-Nickel Solid Carbide Drill Diameter Solid_Carb1deD !L"P.R'"°1.°' 11 Suitable for both Finishing and Roughing operations on Mild Steel, Heat Treatable and Structural Steels with tensile strengths 5 1000 N/mm2. This cutter can also be used for short chipping Non-Ferrous metals. Usually comes with aavariety variety ofsurface coatings. 1 j J 1 as ii'!/_&-' "'1 wmwe nah, E :Šš §X"'\'§ 7T*-§/ 777 19%? :> 5-: I -1' anm r-. 1/¢ -1 L?"-'13.7.51 mvm :'.j:7-F-i'¢-I A ifi |Ë1 4 ' Q-;CD Suitable for Medium Roughing applications on high tensile material where rapid metal removal plus surface finish are the prime requisites. itlt produces aafinish finish that is betterthan both ofthe above roughing cutters and generally no additional finishing is required. Ln -* @O')(3CO ¢3Cc vnn-1 ||J||l UIUU 1 UUIU 1 "fUUU , ODD UQDH LUUU L'|U\J '77Rfl GRAD Lwwu O1fi ulu 1RGfi IUUU EUUU |\J\JU 1 1100 i Il\JU1 1_ Duick Spiral 40° Quick iFTT\(\ Dfifl uuu V" &X\ 1 ~l - Ll' UU Qfl UU Finfshing Soft, Tough and Long-Chipping materials. This cutter Suitable for Roughing and Finishing produces an excellent surface finish with no additional finishing required. Gomes Comes in a variety ofsurface coatings. l LUIU \J 1 \J\-IL' ' \J \J'\J 1:-' -.1. CD Q3C|\;| CH CD CD ')'1DI\ QQOH |_uuu 1 O1fl h 1 5551551 3."d Too' Life, Ue the 'be use of copiousquaotior copious quaflfity of coolant coolaflt is recommended recommerided,| NOTE T0 enhan NQTE ::To erihan C')c point to preventchipping ortlaking of the Carbide cutting edge. SlE;CDmCDm ED ED:.c particularly directeCDmQ_g; NEL:II:§ sa cmcz CIZ, e==s2a E ~11'ntt0 l h U i _ ',' Š Hlti l i l il tl il til Quick Spiral 45°- 55° Extremely Ouick NXXXÑ9.2111 l§I\$*§\ SXXXXB JU Suitable for Finishing High Tensile materials up to 1200 N/mm2 as well as Titanium, Gomes in a variety of surface Nodular Cast Iron and difficult to machine materials. Comes coatings. 'A91 #2 CCNVERSION mete _ ___ ________c0[1_17E1_0_|011_7110_LE__ c0Nv|s11s10N 711015 CDNVERSIDN TABLE SURFACE SURFÅCE / CUTTING GUTTING SPEED TD TU R.P.M. 7 ' EĹŽJEĹĹJŠL10cutting Speed : Surface/ Cutting __20 25 77?1.i _30 __35 F -A U1 _@_ 10Q 7;;_-. 15_28 7 278 .7.7;.-..=.1-8 -. 303. I: E5 EE.=3:IlllGI °°nona 'II'II 'I5HDCID1: II-II. 69917.81 9|E: Feat pe: m inu1L_____ ea E: .Liina Ii'!GI CI}na C1 G? .. . Diameter 1_7 7,7710 10 - 1-18 16___,yS_, B2 1 98 115 . 28 33149 GB _-._1-.1.8 ,Spi,ndle gpíziiflè Speed speed (RPM) Wwýwrfl 0'7'."1»:~_. 7 (inch) U06") 1 1 2305 _ 301 I 7 477 _705 795 1272 1590 72305 3101 397514 0771 5555 ' 0002 2, L... -... Ih ,. ._„_ one _ 1nnn 11:0n 2121 QOJ 2551 CT)CD Q')-4. 1050 _ 1590 FT 530 .'043 :'.'I'~.'.. "-"i':'_~.._'L-!:'fEr'. 15003501 i 25 Z€.J'I"-~I _ 500 000 1000 ?1266 1 1200 1 1500 ___________1/0" 699o;-t996 _____2___ml2-3[§7__1p.§99 1590_0300, W1__fl__0w,Ww__W__0__"W,i:7739071 4 239 239 398 _ 535 535" 795 A0 1193 ___1900 1019ë0000 _1_500_ 1 4; 7" 2 33 77-77 Q10 318 U IU &i\-LI 7| LILI _L_L_L _ -.: 1u1_d77_7l"";-57,. _L 1 J __. 1 _— _ . -_. _.i. Z @U1 (D _....".'I'.' .. """. . .. . .. .1 6 ' ;. | 117-" Afi -I-IA ..____... _ ..._.. ______......2__i 1 __. l'.'f\-I UUI 7I _~¢______ __ . l rlnlfi 1 flflfl flll- 1 .._. J _. .... 00 ' fil*fl 1-___i - -----7-m 00 7 0 51 1 0331 ; __l U1, 7CD ___. , ____ ,..._. "'_' 1' ;-I51l\J AD /10 'TU I20 ' 202200000 025000000 00,42í11_220001fi l1 28 23 ___-_-.--._8..------_"p__;J22c--.1 300 1 7 8 1 10 16 8131212_1 39 2;24?2-;_i¥i_2 _ 470 0 05,5, 1 39 1 ËD 'IE! OE O") Q l1 , UU '7l"'| HE I'D dd -I1-l I 300 ' _ _ 1 12" 1 OOU1 c.>u1U1 weoma, 3 1 5 _ 0 3 0 192016000' " 0 U1U"lOD " CO 1 __ 26 31 31 _ 37 37 I 21 1 25 1 31 37 10 1 15 1 "21 07 '?"7?"'i'W' _n.Z -L O') NOTE : R.F!M. R.RM. for Surface Surlace / Cutting Culling Speeds not nul given, can be he obtained uhlained by simple addition or subtraction. sublraction. Example : -1211: DM ._ ma our : 147410 rt50.91.40 Di-.71 (fnr mm.-015 = 1gg 100 ++ og 20 == 3134 3199 n0=1..=e1.4.+ 535 I251.9114. è 3019 1101 '1I7Imm 100911 71141 01901 -;_-J I 1'! .._: I In I K) Il-l-III- I \I\I\J IInI'In \J\J I\J Il|I|III| \I\Jl l\)IIlil LlI\4\-, 118011/min 180 H/min = 262 - -82 62 = 2004 R.F?M. RPM. - 626 Fi.F!M. R.F3M. = 1378 R.P.M. R.PM. (fort/2"dia.) (f0r1/2"día.) 1 , 0 -._ _ _ ____ __.___ .__ 90,1 90 100 1 200, zoo 77 7 10.2148- 184 ij...1877TT'18877717.§25a§...288 i 8761888 79597 6362 f 777__fi__000g 1 111 4241 4241 4127" i _ _i.._ U1 L. 1 1 ______.___1___..2._ . U"Y'1 I _____________,,_ _ 4 .._ 1 l1 1lIt1l 1l 1il1 i1l 1Il _ . I 1 . A _. ___. 373 . i 1*'~—~—-——' I. _. ._____...i_____. I 1 ,,__ . 1* 1 1 T0 calcug T888l 811t81_8 0 „_ ~_;0 10_0. „__ , 10z0,. = ----_ 1000xVc 10111.1.'iI17ti7Ir!i= 40 -__ -4 777' 7 77 7" 1:7:×D xD ' Ve = surface speed (m,/min}, (m/min), Where V0 D =diameter = d1amet9r —' 1 _. 313.3 1 1,_ ., _ , 99!-1 \-I l_Uv Ill 1_l. IQ -L __ Lem -nl- I\J Z , 1 I . $15 . 7157 7952 7952 9542 954241133 7157 11133 12723 12723 414314 31000 14314 15904 15904 31808 . 4771 8 5301 0352 742277 0402 1 9543 1100037721205 1050321205 00f11?1_52>L!33062 7422 00092220 0 777777717777 001 174501 90037110003 120005 4501 1 5001 170002 5002 _i 7002 E70002 1 0002 l` 9003 110003120005 1 1/11" 4001 1 _.-118"-t_8 3578 . 3676.g 3975 4771 L 5666 5555 ;0 6362 5352 , 716?,L,Y952 7157 7952 _15904 .4.4 _ -.2g_ 1;__31_01 31§J-{_3576 .16964 3/111" 1 2573 2673 1: 3007 18 3341 _1 5014___ '1 3/15" 1 4009 l 457015345 4570 11 5345 5014 1 0502 5502 A113354 474444-4111---184 .._- . 3442545 _ 112865_ 55 ____,* *, _ 2546 318,3 _ 3820 445,6w'_5093 V5730 6366 712732 2865 ____3103 3020 4455i09_3__ 5730 _ 0355 _ §g",,, , 000. Q202 2122 0 02357 2307 1 _2553 1 3103 _ 0Z10;_ 4710M1_5305 10010 3714 424471 4244 4775 _ 5305 _10510 5 _254 1 2505 2505__1 3005 A 3505 _ 4007 1 45Q_8__ i 1/4" 1 2004 1 2254 4500 ___5Q09___1_0018 7 5009 10010 2004_2 1803 1 2999.2009 _ 0404___ 2004 11 9295 3205 0003fi9äflQ95 1 3X16" 5/15 12_]99? 1 1602 1 _1993 I 2.. 2494 ..?994 1 3999 1_4999-1-9912 8012 1592 11790 1790 81909 08 5 7771 1592 1900_ 2307 2705 j3103 2705 j3103 z 3153 X35017 0501 3979 77950 7950 7 57$?-%1°**444; 1 4EnH7 ;fiHn 1 ,.a,..~"1fiY4.;".:,.,.,. 1 7.33,: 1 12/5" 1305 1502 " 2221., .°1?~'.....1.. _'~"~" 499° 9°49 11 55075 991° __ lit0 1 1273 2003 l €.°'.°.9..q'i9L2_1_iJ.9.'* 2399101001204 Ĺ' 3335 ___ j 1432 1592 10____1_27_3____1_432 1592 _; 1910 0_ 2220 . __ 2545 . 2055 3103 5355 9965 ..91§§.; §9§§ 1 2004 004 711 2290 2 290 25_77 Ë3__5720 1200 1714.32.177 1432 171 1710§,1_; 25770; 2000M1_5725 7.7.2. . 7/7/15? 1.8.?' __ 1145 i17?7667i 1_z ____ , 1991gg4194 1_051__ na _1§29., 2553 5305 __2122_ 2307 _, §_ i?"__--_-m.. 1593 p]9§ZLgpZ1Z2"-.2397 5395 01926 f1' š 02' " 1fi0570 T1» 1/2 l 1500_____1753 15 ' 17,03_1 22004 010 112711252 02 _;1 112 ,0? 1 12 5 2 ,""003 004 __l 2255 ,, 11 2259505010 50.5 51,: 1/2"" , __1 10 1002 2255 14 i1 1 909 1022 1A* 1135*"77%"~*" 1 2045 ; 2272 1 4544 1353 1590 1_ 1010 *1'~8~"—'~'!*** ""'_"'" 890 1002 1 1113 ;` 9/15" 8901002 1113 1335 1336 0 1558 1 1781 1 2004 2004 1 2226 15580;7Ë1__0 2229014452 4405020 5/1" 1, 001 i;90777710027171202 901 1002 120_2___1__1_402 :1502 1503 17200371740EEY7 ,,_fi_ 1 5/0" 1 1402717T5027771003 _ 4006 15 795 _ 686 095 . 986 995 .7.71194 1790" 1989 3979 16. B6 .'17_17.7.1':177.1393 7 1591 15181 ..17§Q977:§76989Y8 10 p--..pggg,p.797. _ _ ______707 795 --.884 004____1_000 1237 __yyZ90_ 15___ ' 1767g,,§§§5_ 1757 3534 .-.191966 , 1237,,,1414 , 1§90mg 75_1___1__03_5 1159 71335 3/4" _ 1 550 500 ; 751 1305 1 1503 _;157o 1 4/4" 17035 = 1002 8 1159 3340 1070'_ 337411" 20 _... 637 715 i 799 795 9§§_2 955 1114 1273 1270 . 1432_ 71592777003 __1592 3103 . 997_2..7l9 72_3____907_ 057. 3 1012 .1. 1157__1_s01 1157 ;1445___- __,__ 2092 22 7 __ 578 1 651- . 7200 22-___ 1_14 7/0" - - 11 _0 1445 7/5" :70 1 R/l/I N14 l noon 'men 1 I270 71:: -r-tar: 1 4000 1 -i,_m-i 719 1 0:0 059 11 4r-'1 1002 1" 711% 1200 1 1Hol LOUL Iu .H 4. ~ 544 24 __g` , ' 1000 530 ` 595 920 ; 1999 1000 00119200 1102 1325 _ 2650 590 ' 553 0,795,,, E 925 25721 537 _1 754 . _A 091.--___a__-. ,,u0g§_, ,0, _ 509 509 , 573 .ac3__32-.. 1019 1145 13Z§_22§4§ 1019 1273 2546 564 1" 525 626 _1 751 % 077 877 A 1002 7 1" . 501 8 554 1002 z 1127 10 1252 1252___t 2504 _00 _,1 530 1 537,,M_j00___ 537 7437049 477_i;_000 049 955 955 §71057772122 _ 1061 _ 2122 _, 424 1 477 . -39 11/4".' 1 . 400 1 450a_;-. 8.50181 ,.881 0 701 881 B01 1.8.817 l777691§i 1001 T_ 77888 2003 _ ...._1_-1.1./4' : 1 8112-c1_41. 0 501 000_0_0_ ___i 1' 417 10;00[:1_504 11/"2 1,m00g__1_375 _011 1 504 1 000 _i ' 11/2" __ 334717375 0 668 _* 751 _1 035 835 1 15707 1670 _ 3100,, 315 350 390 557 059100000 0715 0 7960 07 1592 1-0440,00, I 1 3 90 _1 477 1 557,00000j;;::f157T77795 É920 353 _429 . 13/4" 1 429 I 501 1 _572___ 572 3 _544 544 ; 715 1431 ___! 3/4" 205 200 , 322 l 350 71_5 _1 431 ___255 _ 205 _1 310 50 7777 573 _ 5330001210, 315 302 , 440A__00001 7 44577509 27 537010000? 2" 250 0102027777313 ;i1___;jW,71 250 553, 100000007252 435 _1.501 501 1 553 ; 525 1252 1 205200 313 375 . __ 430 75 1 77 170 1__1_191 Y 19777 721277 212 _ 255 255 297 1 340 302 _' 424 049 340 A 352 549 1500 03 1790 3" 77771577717100 167 1 100 0,009 777771 3" 209 171005717292 0 250 1 292 1 334 7773707777417 075 4170 1 0357 100 _______` 127 7 143 7 7100,077777__g,7127 159__, 191 7 2237777255 159 `191 223 255 77205 7 310 7 037 141 1 156 187 107 I' 219 219 250 Z 4" 125 _ 141 3 313 3 525 626 250 11 281 20_1__3_13 7, H399 00 95 111 _1g_7__l0__ 127 143 i 159 319 310 2000 ,1, 0 ,,,______,04, 000_ý006*! , _72 __00____9_5 8" 0" ~ 63170178194117IO17I2517I47Ii7I56i37I3 53 170 70 94 110 125 1 141 _ 155 _ 313 3001* 7 300 77777777777'42 42 40 43 77753777754 53 54 7 74 7777fi?7777957°7 55 95 105 1721277 212 1 53 1 73 5 03 A 94 8 12" 0 101 | 41 10 47 , 52 1_00 94* ,r7 7 104 1 209 Q711 7 1 773101 7 3711 oo3501 01 Q 1 3001 c:c: -4 2703 cnc:>-1- 4| 86 2783 1 2305 7 r\:'r\3o c»o-r>-005 _i 2339 2339 509 111002 1335 * 1571 113005 1002 0 3 3 3001/1.93" 00ä700,00334 535 : 500 1590_11900 _2227' 1900 _2227 __ ,55 _ _191 191 -p2§1§22_lfl¥l_2_939 010 509_____535 954*'1272 954 1272 15901 159 255 434p_p§§9 795 1060 1050 1325 192571590 1055 1 424 590 799 6 , 159 7 1599 ;_1955 751% 1002 150 _ 250 _ 401 1002 1252 1252 1 1503-L1Z§32 1503 1759 401 8 501 501 1 751 _7 '/4". _1 .150 501 881 001 _1002 1202 l__1_00_2_ _ 5/15" __ 120 200 320 ; 401 5; 001 1882 _ 1888 .1.411_7.. 994 1,`111000903000 193_"11392 . 119 9 1 595 7957 795 139 2 I . 80 . 01109201 0900 379 2 " 39 .._.._..7'W7 77;, . 1001 l 1166 1 3/'0"W 100 _ 157__ 257 _: 334 501' bbfi 157 __267_3 34 3_ 501 555 0E 564 034 0_1010Q0Q100_0 1150 'W' 7 Wýaiif 636 _ 795 254 _ 319_2 4Z7 318 __ __477 795 1I 954 ; 1113 77 710 777777 1 95 159 _ 2§4__ 229 205 429 573 `1 716 286 1 429 02 1 045" 1 _00____ 05 143 229 92_ 00002201/iiíý 420 w_„Nooo 7712 E 1,100 30 7 553 12 21_2___ 255 265 , _ 390 398 77775 _ 530 663 170,7: 1 00 7? 133 7_ 212 525 _1290 4 \751771 :\|oauwcouw _ 077 7 375___ 501 _ 020 1/2" _ 75 75 __125 200 Z 250 1_ 370 _____ _ 1/2" _ 568 682 102 227 6 62., _ 795 5 68 114 182 227 }_ 341 341 454 14 7 7 77750 454 , 566.i. 76.. 170 1 223 2231334 445 0005,555 1 334_0m445 1 50 1 779 505901099 111---17§a _ 03 9/10" °/157 _0 5767 ____111 701 1 300 401 ; 501 11501 100 1 150 1' 200 200___1___000__` 5/B77 69 5/@Ĺ 000430 88.1. 1181 16 60 9 0 2.88 290 390 1 497 7 595 ` 595 _,,,,,,_107777 777 7777 50 188 1.88-. 00990000010ä200000l9 10 , , 53 141 :_ 171 18 53 88 1 71_ . 255 353 sg 442 44; .15300000 _ 530 1 618 010 504 134 -.l157 334 1 417 4171501 3/4 1 59 50 03 134......l 177757111 584 67 1750 288 334 1. 99" 20 48 80 390 477 3 557 77 20 , 40 127 150 ; __239______310 239 310 , 390 217 209,1 209 051, 351 ,;_0 434 f 145 7721777 434,,1 505 78.22 i 1 7-"..- 4843.„ 729,. 115 U. .M 1 „UIH 1 143 11o_1__L|s_205 ; coo 3551 .426 429 _l . 501 i|4 1 210 _ 200 ' '/5 1 40 'I li 4.9 12 40 66 130 777199777 ___1099, 255 24 7 7 ,40 105 . 133 77331 . 390 1 454 0206050000000ãã1 310277 30277 191 254 __ 318 25 38 64 -- 102 127 1; 191 127 888 445 25 .p"-m"2.99»-_m94 1,, 430 250 _1. 313 313 .1-.876-..l 1 075 _ 488.. 30' " _00010205001 11"0 0 _38 100 1 125 1 013030000 100 200 159 212 _ 255 371 . 0 30 1 32 0 SQ 85 21277 53 05 _ 1_05 105 ;_159 818 1.87.1 2650. 301800. _150 ___2_00____250 1 300 359 350 __00 _ 1111.1 100 1 .188 30 .0 1 11/4 20202201_i_§992i 0 0, -.1 11/4' 202,00 . l "_28 0200010 ________ . _111/2" /2 __25_1__41 _67_83 157 _ 299. 200 . _L2269. 1 250 E_ 200 57 1, 03 1,125 125 19702 292 40 . 24 46.-__230__ 270 40 __ 63 50 1 79 1l1119 1% __199_ 119 159.. 49 . 24 199 1,200__ 1 107 143 i 179 5 214 250 250 13/4" 7 21 1 35 , 57 1 ,7171 1_107_____14g___1_701214 100" 127 1 159;m` 22200l' 50 0 70 1 9 .-- 32 32 1 51 1 93. 95000--.___._.- _7_.L722178}. _127_0E1 0 507 ___ 007 19 _;l8§_ § 2719 1 2" 2031 1 19 7 50 1 52 1 94 1911 31 0000ë0_000 94 . 125 125 I 156 10056000 110720 ili 4 . 85 _ 13 _ 21 , 34 1 02 05 T_ 106 105 _127 127 _ 148 140 75 42 1 554___ 33 _0 42 53 ' 83 1 104 := 125 8 146 00 00 3" 3"0 00 13 1 21 j_33 30ž000 1L530 39 104 125 140__ na 7n L . _ 1 .. -.-.; =:\ uu la 95 1111 15IU 1 LU ____. . .,_ ._... _. ._ ___ 1 47 52 1 70 001010 \D01 110 03l00001QL0 4"-R: 1 _. E l25 ion _; 94 1_119 32 _ 40 ._.49W__§9a_ 1:caQ 1 ca ! 176 1 24 32140 0 48 00059 0 _._1.... 250? "Wf 01140on 38» _.T 1313_17_24_ 777 _ ..__a._.._._ _. 1 Surface,/Cutting Surtaee / Gufling Soeed7:77Feeipe7r7minute Speed : Fee! pe: misu.-te 777 V 1fl0 000000143 1 154 1001097 WŽŠC 100ł5_2_000Z0095 0 00551 Spindle speed (inch) ,_ åpindle Speed (arm (RPMI 618106192 D¡am09¡ËL '.1 7777_ (3 DIN) 1I _åųrflrge/Cufling Surface / C7utting Speed : ¡f1*"'»;~; _191 :8-"1131.-1:3 3_|1e1ad:11' ~ _'-01-= _; 1»f __ _ 7 1 1 __40_40 ____45 1 40,W 50 , so 50 1 70 __j1 00 90 dII ""-- Fl |fl| SURFACE N.II{l"¡-\lili /I CUTTING UUITING SPEED SPEEIJ TD TU R.P.M. K.l'.IVl. - ___, I I 'HR U = - R17 U .. _ - ;-------T4----~ Tu calculale 70551501010 s1=|v1>;3_02 f1~ RPM i_n_f_t/min .in it/min . = SFMx3.82 . _ "'"'"" D0 \.^./here SFM SF1./1 = Where "I së. E5"Eł (DSD. EE ''(2C3 co25 CD:3. 1DD = £4go 53 E:2Q 45 "-i-/ __ 4°48 * 1 Hots snws HOLE ŠA ____2 =: ' '\' P "' 1 - /r " % ., I (' . 10 1 . 1 .2 _ " . . NOTE: NUTEI Goolant when cutting E5 Metals. Eso Use Coolant sufficient pressure to ensure that the 6O Apply suicient Hole Saw cuts and does not rub. QO When cutting wood, finish ofi the operation from the reverse side to avoid splinters. égsgiggjgegqmgmenggd Speedtlrpml,_,,_ ,Ë°.FP'"'°_'?ĚP_'L_ t (inch) 4 3/4-1" 19-25 1-2 " 1-2" 25-50 2-3" 50-75 - 75-125 I 3-5" .,75-125 125-150 125-150 5-5" (mm) llllllll _______ -+'DI ` W00l|& WWI!. 31 Plastics i 1 2 ' $1? b .1 11 _ 125-75 125-75 2 . E,„„„,„ ,.,.,,.,,D $9 53° . '1-1 5*' \€lE'1" 1*@M '-11 1 _. \' 1 2 -¢==P 50-25 1000-500 50-25 1100-50 100-501000-500 Asbestos] Ashestosl Ceramicsl Geramicsl 1Reinio-Plasties,, 1|teinlu-Plastics, Suhstitutes 1 l Substitutes 1 700-350 700-350 ,1 350-175 350-175 175-100 1 I 100-50 1 50-25 1 Stone Slims Fibreglass ' 1 Fillrstllsss 500-250 500 250 1000-500 1000-50 -I 0 0_ 1 0 12 /'-\\ 5 250-100 250100 100-75 100-75 . 2 _. 2. 500250 500-250 1 -40 75-40 ` 40-20 °` l °'"_1 F 150-75 75-50 1 40-20 "D EDGE „pu enes 250-150 V tfl-'\` \1 is 5 .£:,._.;3.1' 1 for Carbide Grit Hole Saws 1 RPM tor it ""--. OOH UUU "HOD eto. 1 Uses :2 Asbestos/Substitutes, Ceramic Tiles, Reinforced Plastics, etc. Wltole sawýlliametýeryń ltshestos/ Hole Saw 01555151; Asbestos/W11 Suhstitutes (mm) j (inch) 1 Substitutes 71812.1 5 @_FĹ1/5". O0 U1 1 U1 U"l 11150-100 150-100 ...22...2__Ti 3-5 n l 1 .- - _ is-za 19-25 5 700-350 I 50-75 50-75 772-5" '2'*2 Ĺ '' 75-1 zo 75-125 } 1 350-175 175-100 IUU-DU 100-50 25-50 25-50 25' 242T. _.1 . 4-3" 4-8" Hole1Saw_"Di3meter Hole Saw Diameter 1 I-(I-1114 LLU 1 C Uses : Asbestos/Substitutes, Ceramics, Marble, Stone, etc. eto. „-259 1 T: RPM tor Diamond Edged Hole Saws it ""2-~ "|'U 3 1 ,V.Ë —L it 1 _l . 100-200 1 2 (3 1 , 2.22 1 it l_ 1% 4° - - - - -- m vvs ole cnSaws. -l- 375-300 1550-40013000-2500 550-400 3000-2500 14-25 9/16-1" 9/15-1" 1 850-600 550-500 750-5501 750-550 375-300 1 ~ -1 -1 -1 300-125 400-20012500-2000 1550-2501300-125i400-20012500-2000 25-50 1` 1-2" 1-2" 1 500-300 500-30071550-250 25-50 200-125 2000-15007 2-3" 1 t W _300-200 1250-175= 125-75 200-12512000-1500 50-75 50-75 T`1 Mm___ 1250-175 ` 75-50 ,1ý-000 200-150 175-125 175-125 75-50 3-4" 2510015001 3'-4" ' 1 200-150 125-100 1500-1000 75-100 '` U1 —L 11' ' 14-25 CAI 1 4-"----W I 2 cu 1:. SJ! saw P-lama" --1 Alummtumi Alurniniuml Brass 12 Cast 12 Mill! 1 Hm Hole Saw (mn ~ Steel ' flinch) Iron (mm) Diameter 1111010 1 .1;. lmml __i "'"-1 -;up 'S 3I ""°"s'°" Mild 1 Cast 1ToolSteeI1 1Tuul Steel1 1 1 V Wood 1 = Brass lltluminiuml' itiuminiumi itiinoti Iron 1Stainless1 1$tai_n_le5s_j___m _ I 1 1 1___filfi__ Steel _ iron (mm) 1 fins"). (inch) I WSEQI 12UHfl02l 14 119/15"", 0/15 1 W5a0ý_ 300 900 3000 1 790 790 550 1 400 1 300 1 730 47777325 33000 000 1 825 365 5/11": W 15 >555-I _(_ 550 @5 275 P730 590 500 3000 460 19 " 3/4" 450 1 300 1 230 1 500 3% 660 550 000 200 1 220 550 20 440 ~1 290 530 33000 20. -1440 635 3000 21 j 13/15"? 1 21 3715";1 425 1 @Mim 230 210 1 550 535 _3000 97 1 1,/É* Flfifi 585 122 I 3000 22 2 2 , 535 .-4 'E 39071 250 l 2 105 195 .1 520 52077 2700 235 175 470 ' 525 1 25 7? 7350 . .1 350 2700 2700" 400 j li 450 _ 1 .-3o2. 29 4 1 1/8"v 3007 li 0 500 200 l 150 150 24% 190 ,1 145 380 425 2400 30 * 190 3004 425 285 410 240L 173;" 275 130 1 140 330 1 11 1/4--TW140 350 77W' 77107775735557 32 777 2400 375 3/la" 250 165 330 i4__u_ 2400 357 155 I 125 330 35 T222Ž 11 3K§f2 2400 230 7150 300 1 345 545 1 2400 230 150 7 7115 115 ž 300 sa za frf/iz-f 1 an I 2100 ' . 1 110 110 250 W - *živ 145 145 290 330 200 ` 315 2 10 0 41 1 5/B"l 5/8" 140 11 105 315 y *2100 210 140 230 41 2100 72100 130 1 95 295 3/4" I 1 95 7130 9? 7 250 295 44 1 1 3/4" 195 270 1* 772100 2100 40 1 7/9" 180 4871 120 '771111Ž"240 1 00 1 240 1 270 255 255 1 2000 2000 35 7%" 115 l 85 230 7 51 51 l1 2" s 170 7115 75 ff 225 2000 225 2000 200 57 121M" 2 1/4" 7H0 150 100 57 100 1 75 2000 220 ""'2000 190 ' 50 7 2 3/s", 140 95 1 70 190 72773757" 7140 7 F", L. 205 1 800 05 "Ž 150 180 A 205 90 1 55 1 1300 64`1' . Z2"1*/72" 135 90 54 . 1/2"". 125 185 1 800 1 150 7* 135 1300 30 1 50 3/4" 125 70" 60 i 70 r i 1 2 3/4'? 80 1500 15 775 55 75 1 55 150 1" 170 00 76 I223022 3" 75 115 155 "1500 1 155 1500 , 40 50 33 105 83 1 3 '!/4" 1./4" 105 1 70 ,' 50 2 2 2| 1 7 45 130 145 1200 ' 145 55 45 as" 3 1/2" 95 05 65 2 W. 130 1 1000 130 55 40 3 '*5 4" 05 55,740 1 110 _ 102 #5 90 , Ñ 800 45 1 30 90 1 45 30 5j__ E 127 .W 122552-. 55 25 75 75 1 800 25 75 75 1 800 25 75 35 55 35 1(É 152 1 =36" #2- l—Il_------Ii Gas! CC r—l- G' _ N\ ET AL -Iuuuuuuui LU tn 0 0 ('3 /3 .-cu __1r*= etc. intr:E m n-.c cEE-2 :5 :Élood, B1355' Aluminium' Wood' 910- . -. rs E /"-' -l\l E:m' E5 ` 3 CI CZ U) K/1 CD U3 ili Brass, Aluminium, Wood, etc. _ 5' , pp Z for K Carbide C'! Q3 rbid Tipp RPM Ilzwu-1 - Illlîlfl C nl Pa I Tnnl Q I Cł 1| l\Il'lri 01.001, 0+ 5?. CIDne 0")on O')ne COCD F4'.--ri:C'DEl SE E_ CO (12 1, CO utr-+E2 EB. Eł uaca . lvlliu UĔGUI, ua3t|fG1'1, TO iuui u I-+»-+C13Cl) El U533 |v|i|u CE'!-'511i't.'ri'i, .. 1 Ël U 'I I'I'I l'l'l :I CID RPM tor High Speed Steel Hole Saws \V -. —n noi: not: saws sttws REBOMMENBED n5e0n11v1511550 cuTT||l|t; 01111111 s|>E|5ns- fłl 'I I'l' I'I GUI REGDMMENDED RËl`5ü¡ll¡ílñË¡liüËll CUTTING U E:E2: Gi SPEEDS m 2 1 374-1" 3/4-1" 71-2" 1-2" "Š-5" 125-150 5-6" 125-150; 5-5" 1-.- 3-5!.- 1 Geramic Ceramic Tiles Tiles 500-250 500-250 2507-100 250-100 100-75 100-75 łlteinln- Plasties, 1Neit1i0:P|asties, Fibreglass 1 Fihrsslsss 1 1000-500 1000-500 500-250 7 i 500-250 250-150 250-150 _ _ - i -qr' A11 11- im -lffl -H' 50-25 40-20 40-20 75-50 la-Hu IO-'+U cÑ`$\„¡ mm GRIT e\°E _, vr- '" Ĺ'41-.-1 I::Ju-1:) DU-I O Jf\!\ I-f\ 1 " 2.--. 1 0 ' .11 . \v '1 11' J -"" 1". . 1- 1' ,, __/I-' if ~ J 'Å 1 NOTE NOTE:: The above information is intended as a general guide only. Speeds will vary ;._- _ lll l ül lül l _„__ ____ ___ „_„„_.._e with wli'n grades oi of materials used. itli is bestto 'desi iu startvvith siartwiiii a slow siuw speed and increase 111011-:as the speed after observing the cutting action and condition of ot the Hole Saw. Coolant should be used, especially when cutting metals and ceramics. Always use enough pressure to ensure that the Hole Saw cuts and does not rubthe material being cut. out. it 1%' i nrtcxsnw HACKSÅW AND AND POWERSAWBLADES POWERSÅW BLÅDES 'allastaaasis _ SELECTION AND APPLICATIONS ÅPPLICÅTIONS Bandsaw Blades Hacksaw Blades Bi-Metal Blade ::This This blade is made of athin strip of HSS welded on to a I __ I _. __ . __ . III-Iillfllal spring steel backing. The result is a durable blade that can withstand ""M"-ml heatgenerated ___________ __ _ heat generated when cutting steels. @ : Mild / Carbon / Alloy/ Tool and Stainless steels. Uses:Mild/Carbon/Alloy/Tooland " " " " 18 teeth per inch /VVV¥' /VV All Hard 300mm 1-|¡gh Spegd Speed Steel 31391 l' High 12" X WN Q O Carbide-Tipped Carbide-Tippcd Blade : This blade is made of Solid Carbide Tips welded l 32 teeth per inch on to a high-strength spring steel alloy backing. The very hard cutting durability, edges ofthe Carbide tips ensure extended durability. E @ :1 Alloy steels, Stainless steels, Nickel and Titanium-based alloys. 32 teeth per inch Hacksaw blade b|adg types: typgs; Hacksaw Åflfllål Teeth TUUHT Sire S/-ZE defile! hard/Flexible) ¢4 Standard (All hard/ Flexible) - High Speed Steel, 0 Bi-metal (Flexible) —- High Speed Steel, +O Cobalt (Flexible) —- Cobalt High Speed Steel ¢O Low-Alloy (Flexible) —- Carbon Steel All hard blades are breakable buttend to cut straighterthan flexible blades. buftendto Flexible designedforcutting HCXIDIC blades are shatter-proof and are designed for cutting odd shapes. General Recommendations fortooth tortooth sizes: 18 teeth per inch : For cutting solid sections of Forcutting oi Steel and Non-Ferrous Metals over 1 3mm (1/2"). (1./2"), 24 teeth ger per inch : For cutting solid sections of oi Steel between 3 mm (1/8") and 13mm i3mm (1/2"), (1/2"), as metals. @ gi: Fibre glass and Composite materials. Carbon Hard-Back Blade : This blade is made of one-piece Carbon steel stifier backing material ensures that is hardened and tempered. The stiffer straightercutting straighter cutting and resists swaging. g : Wood, Plastics and Non-ferrous materials. @ 6 teeth per inch _ . A A „ „ J°1=~=1h vsfiflfli lflleethperinch V V VVVVVVVVV 'i/"i/"1/"1/"r/"L/"1/'t/'l/'t/'t/' 350mm x 25mm 140 X 111 Standard /lctrrai Size _ trial Tooth lentil" Srze Powerhlades types:: Power blades types 0O Standard --All-Hard All-Hard High Speed Steel ¢O Bi-metal —-High High Speed Steel Hacksaw ll./lachine Machine and worki work in the direotfon These blades are designed for use in a Power Haclrsaw E2: CD :1".CD CDof-4-. the down stroke. Recommendationsfortooth General Recommendations fortooth sizes: liteelh per inch : Forcutting large solid sections of ot soft materials and steels Steels over 50mm (2"). (2"). : 10 teeth oer ner inch : For cutting medium solid sections of soft materials and all ali types of other over25mm materials over 25mm (1 "). 14teeth oi all types of materials such as pipe, tubing, light lightangle 14 teeth per inch : For cutting thin section of angle iron and solid metal sections under l 3mm (1/2"). under13mm (1/2"). "1 C'J I3 r'—F IT .1.-" H' -___-..:—" 1,. -1 J ' ' ' _-. ;~- -__» _-.; _::.? Diamond-Edge Carbon Hard-Back -r\r\r\z\¡\r\r\r\r\ K/\¡\¡l' \(\(\f \(\(\(F; € r-FZ3' CD ' . \. _-'t-4:' Standard Tooth Forms 14 teeth per inch VVVW I3 '--:-.-H...-¢v Carbon Flex-Back Blade : This blade is made of one-piece Carbon steel Carbon Flex-Back that is hardened and tempered and is especially designed for cutting ×r"\r\r\r\r\ curves. g Non-ferrous materials. Q : Wood, Plastics and Non-ierrous `i/W/W/V`T/W/W/ V)/W/)/W/W/V ` ' I :.' _:;'-;;;-_-. bonded to a spring steel alloy backing. The blade performs well on abrasive non-metals.. @ g : Marble, Granite and Ceramics. Powersaw Blades Powersaw_B|ades D|'|||Uld|l'i|g[|ÖpUUU ~r\r\r\f\r Ll'.-f`_:;':_;-'v' Diamond-Edge Blade : This blade is made of industrial diamond grit Steel and LightAngle-iron. Steeland n_ 2-.-. L HP Ñ I A Di-|"i'l6'tEii . Ln J rrigll olifiifiu l Carbide-Tipped carbide-TIPPBA Carbide-Grit Blade : This blade is made ofTungsten _ _ ' 0fTungsten carbide particle grit ' bonded on to a spring steel backing. This blade performs well on non- 1. ~ -_ ..M .._,- Carbide-Grit _ _g _ »-. ,.. _.»,»-- _,._»_,_.»-A r... .~ , MediumTubing well as Medium Tubing and Medium Angle-iron. 32 teeth per inch : For cutting sections less than 3 mm (l/8") (1/8") such as Thin Wall Tubing, Sheet @gteii1_iir1ch m \J U 'H BÅNDSÅW BLÅDES TYPES TYPËŠ AND ÅNO APPLICATIONS ÅPPi.it`;ÅTi0ÑS I\f_\\f~\f_\s!gkf*'\('\I*\I L(\(\(\II;'Uk\(\(\,(\I Standard Tooth Set CD Alternate Z1 Ir Z11 :r it ihj c lim Raker Baker if-1:) . l I „...„.„„ ,,.. ..„..„ g.... „., „„...„„„ .. .... , ..., a 5.....„a.„. ..„„„s„„ ...Me and is speciimaiiy forcutting Plastios & Composites. designed for cutting odd shapes in Ceramic Tiles, Reinforced Plastics whirh rurhirln nnrfirln navlinlz r1rI'l' ni-ii Io in I'nrInrI hnmlml If fi+c~ me in+n imn ct5 c~+'1nrIm-H z~i-„vłfml I'lnnI1cH1\u l.»„-|„-mi, -fr-n-nn am.-W. "ll"\('I -.Ni In 1.- r\r\r\r\I'FIr\flII\I f-.Mi-14:,--ii., tnrhinh r*:trhirIn Hlllult uululuu pl.-u uulu Hill. lu uulluuu. IL IILO IIILU U. \Jtf.l.llULAlu ll(.l\;I'\OCtW IIGIIIU CIIIU IO O|JUblllI.1ClI|y I jl :1 g lg 1] Vari-Baker Vari-Raker C HI' IIIIII I 6- G I'II I FIOCI Carbide-Grit Rod SEW Saw BIHOB Blade This saw blade is manufactured using a 3 mm (1/8") (1/8") diameter, high tensile, flexible cable onto L.-r ./[I!-1._'.'. /i ____,--l { IQQIQ _ IHl il il li li lil . I ' J-"'1 /l 4-Z4 __ . J-"'1 __ . I -"l \ji/1\ Q A L1 I 4-.'-,1 Alternate sequence - Every tooth set in an alternating sequence. Groups of teeth are set to each side in a controlled coriirolled pattern Three tooth sequence - Left, Right, Straight Uniform set angle Multi-tooth sequence depending on tooth niinh \Ianrinn sinnlnc nifnh out nnnlnc pm,... 'tl'aruinr1 ....¡„.„ cat cc. ---3-»C .JII.\JiI| ILAIJIIIS \J\J\ HLIISIUU Maximum Blade WidthSelection Width Selection Chart for Radius Cutting Bladewidthimml Maximum BladeWidthl_mr'rli | 3 i Minimum Cutting Radius littinl (mini I MinimumCutting 3 i 5_5 _l 6" 10 A 13 6____;_ it] 15140 8 15 i 40 65 16 l6 100 20 _ 25 140 'I75 175 ,, -- w _ T I i?—77———l —7——————————————————— "is SHARPENING EE in inSPEED 111 1-ri1: STEEL --IID ID _, EE -Iin BITS on lb :H 111 EE :: 1:: OF'11 HIGH iv: -I111 111 ,_ TOOL COOLANTS/ COOLANTSI LUBRICANTS LUBBICÅNTS / CUTTING FLUIDS USED UŠĚO IN ili NIACHINING ¡lllÅCH¡iiitifi GH :I "U I: ID "U itlt is advisable to always use a Coolant Ccolant when cutting / machining metals. for Sharpening HSS Tool Bits Hints tor Coolants : 9e Dissipate heat from both the tool a8. workpiece, heatfrcrn werkpiece, permitting permiiting faster cutting s5 , =EŠQ.C-D C2.Š).EC pa 0¢ Act as a lubricant between the tool and the workpiece, preventing heatb heat bu'is; 511 -o":3 . Proper sharpening of HSS Tool Bits results in increased production, better surface finish and accuracy of work. The tool bit should be roughed out using an aluminium oxide wheel of 46-60 gritfollowed by a wheel of finer gritto secure a keen edge. finergritto The main steels used for HSS Tool Bits are: ii'i2 M2 - Tungsten llioiybdenunt Molybdenum grade HSS, which has very good toughness and wear resistance properties and recommended for machining low alloy &&free free machining steels and most non-ferrous materials. 1 . l M42 - Tungsten-Molybdenum-Cobalt grade HSS, possessing excellent toughness and rirnatrar nhrncinn \iirH'h "rnri hardness". hsirdnmec" Tool Tnnl Bits Rife made mstrln from frgrln this mafnriql greater rneictstnnn resistance 1'n to abrasion with 2a hinh high "red this material can withstand higher cutting speeds and are suited to machining tough steels. HIUMLUI lU\JlIJlb\llUU GU' KAIJIIAUIUII IIILII Piece Ul IIIBII lU\J IILLILIIIUUU I IUUI LJILU IIILIUIU II I I I.lll Q"(1) A v0 Significantly extend the life of the cutting tool by reducing its wear. O0 Remove swarf away from the cutting edge. 0o Act as a short-term rust preventative. The selection of the most appropriate coolant is important to ensure efficiency of the cutting tool. The following is a general guide for day-to-day workshop machining requirements. For long-run production jobs, iobs, it is advisable to seek the assistance of Coolant Manufacturers. I IIILILUIILL I Mama' M t . l 'uenerai curring for Drilling, General Cuttin_ i-iuio Fluid uecommenoauons Recommendations Drillin , . . . _ i Aluminium 1AA mixture of Kerosene and Lard Oil is very effective as a coolant and Milling, Reaming, Beaming, Tapping and Turning. a em il lubricant in most machining operations. Soluble Oil is used as an alternative. '` inIn Rough Machining applications, where excessive heat is produced, a Soluble Oil mixture containing at least 90 per cent water may be used to , dissipate the heat. Sulphurised Oils should be avoided for machining ', dissipate g__ '~ 1 Aluminium as this magi may reEultin result in discoloration ofthe metal. I __e "`» l i< \\`\ C l l \ l— 'ill gglyief ® © Top Relief ei* 'FlTE] Approach ^l"l°'BRelief šł.°_'1 *_ /T i Front /mx5 ® (SW Clearance T F V Angie íž l fl I 1 i , i t "._ .„rieiiel " rroiil ÅfiËTå@-4 M J F®ÅiËiË""°' ® 1:15 ®taa 1-VJ Angle® I' *'" *® Angle NUTE :A coolant must be used to minimise temperature build-up. An overheated overheatedtool bit should never , NOTE tool bitshould cracks, resulting in chipping ofthe be plunged into wateras this will produce hair-line cmcks, of the cutting edge. I A Material to be Machined llurnerical Numerical Order for Grinding HSS Toolbits Toolbils . to 6) ,1 @ ® ® co @D ® (D @CD ® @ @ 1ApproachIApproach 'Approach illpproach Front Front Top i Top Nose 2 lFtelief.4 Reliefz ; Cl.A RelielA1Rake.4 Reliefz Radius A CLA Rellelzl Rakezil-'telielz iI_lAluminium _I_I1_1Il'lIl__I_l_TT 12° Brass-Bronze 7 Brass-Bronze _1 g 10° 10" 8" 8° 35° l _S_5° 8° _ 0° 0" Normally Noziliíilly , 15¢, Normally Nozrłrãiživlly 150 , ° 8 12° Eihre Fibre, 15° : 5° 5" O1 , r 12" 1S°_- 20° 00 __ 00 , To suit Wmk in |¡ vvfifn I \ 15° 12° A1, l f 15 ~ 12 O„ O „ _pmfi|e_ O O profile. 0 o 0 A mne' Monel_ L a ried e 15°O ~ Varied - - - -- - Mini sieei i1 Mild SIBEI ~ Med. Carbon Steel' M . . suit 12 U 1 re suit ÖUH G 15°„-—1-—— 14° - - ~ La'radii 9Ë" faull W0, 0° , Work ' 8° ' ° 14°° Work7'? - ~f extends ,, Will 5 3 0 ., 12 , ——% High Tensile Steel1 0°" 1 10° H _ O0 ° 3,_ 8°00%") J l_2°__ l'1I'J9'1§"°5""°'i iuioi life. q 6'7?,8„7 'C5 'G rofi no Stainless Steel ' ; _ r t°°'"Ee' siainiesssieei 1 'We' S 10°_me 10° ~ 15° U'lI\'J-I'=*~ o \J D Thermgnlasticg _ -LO0J _01 __ Q _L I30C) * 20° Thorroopiastics f @° L _i5° 90° ?0°__ 'l 0e o 0 0 Moulded Materials g 12 _L l\') 10° 10° ` 14° 1 Z _n.S J; # ta l I 1L -i 1!-1L1!.- -—L-_L I1 Brass is normally machined Dry. However, Soluble/Lard Oil is commonly lI ll 0 0. E-SIII-9'1 p9Copper l Brass Wév gq 1 usedforTapping. L used forTapping. effective in machining machining_Bron2Ve.ý Ž Bronze H Soluble Oil/Mineral Oil is effectivein Bronze. f ` Cast Iron is usually machined Dry or with an Air blast. biast. However, CastIron ' Sulphurized Oil/Mineral Lard Oil is used for Tapping. To avoid excessive metal W bepsed. V dust, Soluble Oil or low viscosity Mineral Oil may be used. 1 Cast SteelýýýúrSolubleOillsveryeffectiveasaCuttingf|uid. Soluble Oil is very effective as a Cutting fluid. CaslSteel I i —i Copper i Soluble Oil is very effective for machining copper. However Lard Oil is ___ ______ for Tapping. _fr wi; _ preferable preferablefor Tapping, V ~ Magnesium 1 Magnesium is machined Dry as coolants containing water could react with 1 Magnesium chips forming hydrogen gas that could pose afire danger. When fr Mr Ž* E a cutting fluid is needed, Lard Oil may be used. f Ž ž i *V Iron is generally machined Dry. However, Lard Oil is preferred fi Malleable Malleable iron ý_ý__WÅ> for Tapping. iv' .'Iron .'°", , r .,.,i.edd 9Nickel recommended.. V i N' ickel „Žl AA_Synthetic Synthetic Oil with high pressure additives is recommended Plastics IPlastics Plastics are usually machined Dry. However, a medium Sulphurised Oil may be used. ž i Mineral MineralOilmayb '_' Stainless A Semi-Synthetic cutting fluid with high pressure additives is 'Steel V __ _:1*recommended. ý, aLard is' effective. effect ive. i Steel W a Lard Oil / Mineralal Oil' mi> pproach Angle ('D Approach A l,\v_ _, V 4!® F Q) Top Rake 7 EË1 Il lil ilili 1 l _V "___- _ IISIIK %\'|\I\I|\I \-III I\I l\J\J\J'llllll\J'll\l\|.\- I IUIIUWII 'VI IMPFIIIB Ll. W *_ Tapping, a miflure of Lartjiil and Mineral Oil is effective. u J Tdnninn '1 rnI\rI-urn r\'FI an-I fill -1nrI Aflinnrnl nil In n-Finni-inn lCI.PPIIIg,D.lllIALl.IIUUI I_Cll\..I\JIl_CI.IIU IVIIIIIUICIIUIIIDUIIUULIVU. WTi_larriumg_vW V TitaýriiumýñW g A High-Soluble Synthetic Oil is recommended. Zinc Alloys A mixture of Kerosene and Lard Oil is effective. Taps. it is advisable to use a straight straioht Semi-Synthetic Semi-Svnthetic Oil with an NOTE: When using Fluteless Tabs, extreme high pressure additive as a lubricant ratherthan a coolant. 7 _. _5Ai #1 ' TRIGNOMETRY FORMULAE TRIANGLES FORMULÅE FOR SOLUTION OF TRIÅNGLES a 7 The Pythagoras Pflhagoras Theorem In a rioht-anole square of the hypotenuse ri0ht anale trianole trianule ABC, ABC the suuare hvnotenuse is 3 Q N=#+N ct = at + b2 0c ="\ia*+ue =\)a2+b2 = I Q A 3="\lC"—lJ' a=\]c2-b2 L"! I 7 0' L I Q 1'] M" T. 'I III YY=in = inches/ft ches/li 1; IIIII ',5- 1'2 /r ' neieimmi' A° A° 3 B (mm) +° Construct a Awhose sides measure 3 units units 5 units. units, 4 units, ~+ The angle opposite the 5 units is a right angle. u O 0 -.L 17 46 17.46 i 0 2°¡ 4, AA . The Sine rule /\ /\ i 3°-'-'~fi-'5'-°l"'- bi ii: °"' o -D i 0ooei "'`|G~i'l'J'li C I 9 ga 71°" 8 3 Parts _ . +_ Given A Parts beCD 'I'IFound 'UED OD to CD CT =2E5 l. DE a~m Darla I 'II lg -I IIIII P_ i _ = _ _ _ ___D£k>JbC'3Dl'Š>Q1-JI€O'JÖC"J' anB sinAA = sin Q: 1 12° __fi;_ 1 l tanAA = tan QJQJÖ CUQJ 1 ýlggíí' ' _4:__ c cosA=f c&b i cos A sin B našFDCFU' a=\ic-b 2 QOCT' G-inE- A&a A3.-7 B3=90°-A = 90°- A A&b A&b BB=90°-A =90°-A ?Ž__ A&c _A&c Î\-7 cc=w,/a2+b2 =\/a°+b° 7 __4_li 2 = Db= Ž a=bxtanA _ _ _ l l 3B=90°-A =90°—Al aa=cxsinA = cxsinA1 _ z:= _sinir a sin A TanA i bb=cxcosA = cxcosA ' 4 c ==l L cosgA_g _EUVSA ,__ ___ _. IHli1Hl iülMül1Hl liHil I\lI\ I\l\ . .1- i.1 ~+ #3 1 l I1 pi {Å l 649.41 649.41 -In-4-\ I-I- O 1.473 li* ___}.-£5. 910 31° * 7.21.0 7._.„ 1.636 l221 O 1.686 .".i>no oo 1.901 ~ 32° 7.493 0°9° i 1.901 7' \Izo co -5 2.116 wmuN 7.703 10° L 2.116 44° 34° U.UU'+ 3.094 11° ' 2.333 ' 0*! I I °1°2°°° 72.551 35° 1 8.403 . 12°0; ..-.Ë;55l....ifl 36° l 8.718 3.713 . 13° . , 2.770 }__ 33° . _l*.° "I i 90 ca .:>w 14°)- 2.992 2.592 37° 3.043 9.375 15° - 3.215 l 38° 9.375 15 »exzm«\.~wzx»„z~. §! :3 :l -=:cl:CD-1 -i-.¡.3 1::„un caËŠ i::5c: UVU C: Ë! O '8 läl Ibb A B U="\,lC'—€t'b=\io2fa2 I11 Ris co '5 E degree 1 3 IT;) ger /QXU/ 9 ual to the sum of the squares s u3res of the other two twołsides equal sides. c—H - ypo renuse, enuse,a '&b—lh - t eeootfht wo si'd. '3. es 7 a ertwa c-Ht '&b-/7 h er I55 RISE DEGREE — OUICK BEFEBENLÉE REFERENCE A_ Ql.|!l.3!(B!-SE PER PE!! LIEEBEE -A Q l 86° 1 - i Y' I l OO 5 '9. 2 Jr 3 ......T_.._._. _ - I'_""""_'"'_r?"' T"' _" U no§ ii i O O00 L.OOO 27.79:\ I\.r\r\ -hi O _'______ ll 000 mid"-. 13° ...9f9š.Ĺ^1° .19-39.1. 4.132 ' 42° 10.305 C0 :i 1-L —LQE -l l 3.899 of '&fi\l5°'.\$}'a§'€\'t~l§xT /. a. 4-': Mm.×«W 19° ; 4.132 _n.'I'-O~ 10.431 41° 42° i 10.805 i 11.100 111.190 11.533 00 44°'11Žš33m 45° 712.000 12.000 22° °"11i3>i5*ñ9f 4.848zzf 5.0974" 23° 5.0e4*°°° 20° 4.363 4.333 21° ' 4.303 4.606 21° l 43° 43° '"I w /' 1 5_6| W lä GEOMETRICAL CONSTRUCTION GEOMETRIGÅL in1:::rw: -|:I 1:in 1'4: z GEOMETRICAL saun5::ŠI'H -|E! en IB ,_ CONSTRUCTION n To construct a perpendicular to a line at point point X .< _ _ >< M X N i Y N Z fig M X X×____> à . _. . . - 3 . -- | X 1 Sguarelfclagon Sguarez0ctagon Ll- ,-zr-. /7 "\'*-. l'\` 3 Draw arcs on both sides sioes of or point x having naving the tne same radius. 3» Draw intersecting arcs from M and N. Y with pointX. 36 Connect point of intersection Ywith XYlsthe 3 XY isthe perpendicularof perpendicular of MN. _ .3 .71 '"/ 1/2'?i`\`* 1 /// l O 4------Z G \\\ '\\\ \ \\× //× : \\ I, // 74' 'iv Ž Š ,/, n~\. 1 To construct a perpendicular to a straight line at its end point X sufficiently large arc cutting the 3~ With X as centre, draw a sufficiently A nl"5l\lU hiun tiitm linnq ...., Ill ...v smrilne nnft stnrl 2t.. si r-irrla PIFPID whnea uiihnco 3- mc... nrnuu Iinnc I N Mfl W at rinhf :mnlne ...O ....„... ..„... »...3..„ ...N ....v.v ....u..... I1 ' I . .ai B B A li[iii teIi E \\~ \s ' - Cc D 6.. $5' 36 A straight line drawn through points X and Y is parallel to AB. Š To bisect an angle x G\ \\ \\ ///I c | 66 D A \ C) >< Il> B3 D V Å A LL \IIILII\J II'I|\J\J\-I »¢ Starting at point A, mark 6 arcs around the circle equal to the radius of the circle. 39 These points are the vertices of the required Hexagon. 3» Draw lines bisecting AB, BC & CD, through the centre of the circle. These points together with the vertices of the constructed hexagon, form the vertices of the dodecagon. Ellipse by means of two circles 3v With X and C as centres and with the same radius, draw arcs arc S \\ \¢\II\il «3 Draw two diameter lines AB & CD intersecting at right angles at the centre of the circle. O. With DO as centre and DA OA as radius, «3 Bisect radius PD at 0. mark an arc cutting the horizontal line GD CD at Y. »3 Length AY is the side length of the Pentagon which can be marked off along the circumference. v~ To construct a Decagon, mark 5 additional arcs starting from point B. O as centre, at any point on AB, draw a large arc through vb0v With point X, extending downwards to cut the line AB at C. /ëký- LIIIHILILI Pentagon/Decagon A B to intersect at A_?l—e atY. Y. 00 cC D IIBIII. 3» With any radius greaterthan one-half AB, draw two arcs from A on either side of the line AB. Similarly, using the same radius, draw two arcs from B intersecting the arcs drawn from point A. Draw a line joining points X and Y. of the line AB. 3z The line XY is the perpendicular bisector ofthe _ B LIL To bisect a line To construct a parallel line to AB throuqhpoint through point X ____ X ____ 1II,IIIY' l-lexagon/'Dodecagon Hexagon[Dodecagon F #9 ./11ii IIIILILI complete the regular octagon can be constructed. ,AA base line at one end at M extending upwards. 35 With M as centre, draw an arc to cut the former at N. 3» With N as centre and with the same radius, draw an arc in the same direction. 3z Draw a straight line through M and N to cut the last arc at Y. 3« The line XY is perpendicular to XM at point X. \.'I\I MN, N0 NO and DL, 0L, the other four corners required to NN I I-ll'-I-I' centre is the point of intersection of these two lines. ~ + Join the points LMNO where the circle cuts the lines, to š M get the square. 3~ By drawing the two diagonals which bisect the lines LM, Ltd, - -__ *#413 3z With X as centre, draw an arc intersecting XA and XB at C and D respectively. :nrl D TI as ne -lw...-~.-v, rantrne rlrmiu :irr-Q of nf nmlal rartit 3A- With CV and centres, we... draw wvv arcs equal radii ...... T! W... U ...H V. .„.¡.,...... .... intersecting at Y. 3v XY is the required bisector. 5'it QM' To locate the centre of a circle/arc circlezarc lIII 3 Draw any two chords AB and CD in the circle. circle 35 The intersecting point P of the perpendiculark bisectors of Of zi... 3...- „_1........|.. :.. el,... ..-.3... ...:...e ..„....:..„A l|lU tvvo lWU chords L-l|U|Ub is lb the [HU IJGHLIU IUHUIIUU. the centre PUII pointIL required. Ĺ Å Hli lMiHlÐlHl ÐlHl ;g/-/ cz l «3 Draw two concentric circles with diameters AB and CD maior and minor axis of the ellipse to be representing the major constructed. Draw additional diameters. »3 Now draw vertical lines starting from the points of intersection of these diameters with the circumference of bigger circle. +~ Then draw equal number of horizontal lines starting from the points of intersection of the diameters with the circumference of the smaller circle to meet the vertical lines. »3 Joining these intersecting points will complete the ellipse. Curvature Gurvature r ' rf ~3 Draw lines parallel to the curvature at a distance = r. 3» The point of intersection is the centre of the required radii. » _g. . .- :-__:-»._'_._; _l I--.-._;_ _l_ I--.- . ' L '_'_'. i_|-_. - .'-2 ii 3, ,_'_;_ . ._- : _-E 1; i USEFUL FORMULAE FINIJING USEFUL FORMULAE FOR i=on FINDING DIMENSIONS 3& AREAOFPLANE AREA OF PLANE FIGURES 'I'I USEFUL FORMULAE FINDING FORMULÅ FOR DIMENSIONS üiíÎñiiliåiüiiå & AREA ¡7\fiE¡7\ OF :U:zu=' 'H=IE ru FIGURES IMEGI2C:Ë :u I'I'I UI Cl1'II PLANE „CA Square Z Circumference C = Zrrf 2nr = 6.2832r = 3.14160 3.1416d S -1 E 6.2832 = A + 3.1416 ; = 0.56441. 0.56 r = C + 3.2832 AreaA = rrT°= 3.1416r' 1:r*=3.1416rZ LY Z ______________j 3.1416 = = AA + 0.7854 =1.128\/A =1.128\/Ã 0D == cC -:-+ 3.1413 4 0.7354 LSJ AreaA = s' sf = '/20' *A D" /°\ /Jí Circle circle / _ ____ , _~~c , 4_c l i 1 '1/ 2 v_g_ , ; , 3c = Dx0.14645 sx1.4142 =1.414«/Ã 0 = sx1.4142=1.414\/A s = Dx0.7071=\lA 01.0.7071 =JÃ |Ë¡ \=_/ 2 3 Recta g Rectanole a= =A+b - —A+b b= — =A+a Llh ——-l ídl L411 =3r7Fr=3rtrfe Triangle 6×o.5=0×0.25 0 = dx0.5=Dx0.25 0 == sx1.1547=2d SX1.1547=2d :zao CD S = ..._, ' i _ Q lnlnn rninr na/un E/1\ I-alon rn¥nr nnnn K/I\ rcuou IUIUI pugw 3.:-ry \umu :mc: yugo O-v¡ ii + a = b2 + C2 bb: = \la°—c° "LUZ._ @N @N C: lllll 'iii? , Right Angle Triarigle a=_, ___ evfllT.77'2R .....v.v..vv = DxO866 D X 0.866 . .7 Area A = o.735(o°.785(D" - 0°) dl) ° I1u I sz N _ g /`\ tia 2l . \/ T 8% ot Circle Sector oi ___ i Acute Angle Triangle ie Trian""" e"= AreaA = 1/zbxh AlsoArea «lS(- S-b)(S-c) Also Area = \/S(S—a)(S—b)(S-c) D \ l Area A = AreaA T ca"C v _T-< D \,\./ -l\3> f\J > ...|......„.f~ : 1/ T where S i_ '/2 (a + (DbCr ++ c) WIIGIUO '/2\t1'I Lå Obtuse Ohtuse Angle Triangle AreaA= AreaA = 1/zbxh '/zbxh Also Area A = x/S(S-a)(°S°—b)(S-c) AlsoArea ×/S(S- a) (S b)(S C) whereS = l/2(a +b+c) 1/z(a+b+ C) /i\\ zlšs L h 360 ` ///2//,.. 2 wheress == = Zrxsiné where 2rx Sin — ' r/\.lieIHilH0IlH lHlHl \ fir .ým _/Ĺ / 1. ~\ V) : ` Tiemifl/_Txfleeleifl Ñiflíą Trapezium /_Trap§zoid 1° i× :rII> \ l1 z_____4_i i l93% < b 4——Z" '77 iL--. I U" Cr >1 3':r i. where b = whereb =—= it /I /,× // nm.-E-5 5=Ë_. wiierea=%-5, b=%—a, ii„Å 2" n-'ii' a+b h 7 7"; l\)C|>I\'JCD '\-_i1-* /_2,.w -_ _ __.;, CD PO I\'ICD >1 ll 1- ųigíy l4i—S?e-l 1* s(r- h Area" _ rrxi'x0_s(r—h) AreaA =%30xe-f andhh = =r(1-cos and r11 — C3 C) C/J (f) — /°\' W r ot a Circle Segment of \ LLed 6 >1 /'\.. yfl/ D \W 4/°\~| / Arc length b = 5 . - " ?-. -fl -. J: Ci I: cll l('Ii J: =3 (Cl .\§§§ /~\ H AreaA= Area A = '/2 $U NbD- x>< cĈ) //4, Hollow Circle _ Tyjannln UIII:l\I : Ž ,/ 7 m+ QJMQK: Also Area A = %° %D = 0.78540' 0.7854D' _Å1. h =% U Li-hid 'l—Z'—l>l Pentagon W 7 .-\ . _ A ^z..-.- DU XX 0.0955 U.U9DD Ss Xx 1.7013 = d xX 1.2361 Ss x1.3764 X 1.3764 = D xX 0.809 D xX 0.5878 r/20.30-.1 %\ CI C! T ~.~, \~ 714701 / S i1 \./ » li __2-_4 AreaAIn == bs2x1.7205 XI '-.i I\J C) CJ'l 1:0' Q_ljC:- -I It hi s 8\s8i§®>" H: 0C L i 8S .t_ +_ AF „_l S 1111r.11 AF l"..".-Tl Si'iii".'.=ii1 Q 1 Area A = s°x7.6942 sz x 7.6942 _Q/9E'_.l 0-9281 44i_._._.-.-_ _ _._ _.....'i . 5 ..4~\ 1 93 1 _.L Elligse 4 1L. mu. 4ËË D x 0.0170 s x 3.8637 = ddxx 1.0353 s x 3.7320 = D x 0.9659 c/: 1.50 D x 0.2588 ..,2..-4-4 = blll s*x11.1961 EIAreaA CIJCLUC CI S I: = I_.L (.0Ch Area A =%x Dxd A.6aA=I×0×0 .._._ -422- .. -\ @SS__ r\..nn-awn UlU.UIIU 1`____ j____ =0.785xDxd =0.735×0×0 . 1:i R _»l - . :Dt-1d:D C=D,[d:D CC_:D mes_ -d_ D_C=D11. O;'_2_,0,'"';,"°°° "@153" f_2 _1010 O_5"_ " 2_552";'°° _ mes 25527 l mi tr r,L @-1 «Q 11528 ..i__4nn..........n_nnn........ u_lUUllllll,U——£UU|||||l| d_=100mm,D=200mm T8110 0 1 0D==100 4: 200 ratiod: 10 0200 = 0.5 = 0.5 x ratio 1 _ 2.3012 2. 6912 ._- cC = DDxratio ^ .. Q.-3. 0.4} __-_ 2.3013 23013 . 0.3 08 cC = DDx2.4221 x 2.4221 - 5Ĺ 2.0331 2-9351 j1g 0.5 CPPPË ^- U-I>l\)G _i` 2.4221 4-42721 |"" 1 U.!-.1 0.9 fA 2.0333 2.9866 | = 200 200×2.4221 434.42 mm mm x 2.4221 == 484.42 2.1930 2. 1930 0.7 07. l . 1_=1/19ii-1- 1-1490 Circumterence C can be calculated and depends D Circumference 00106 Example : To calculate C when 0" the T300 fflľ¡0 dÖ I DU (Refer (flflfel' table) l3b|fl) — '4f6f1í°°°«.1167 I-/3 5 1 iii 1 1 9-sw- _11/32j__ 0.4331 ...1/.1.9f1_i 0-9187 r 112 sides) Dodecagon (12 9245 0-2497 . .7 l Q '*0 „'' ^'__~ /_ |'1 A (1 Qflcln Qfiüñ H v n u u.uuuu 1.1 u.ųv.zv U-929- l "l ___„_/) D X 0.0245 S X 3.2360 = ddxX 1.0515 S X 3.0776 = D X 0.9511 ÅF iiriiiil 11111111 sl1illl'i7I1 S ií111`1'1I 1(2.5. d INCH 1 1111011 1 íF(i0c111. _° ° H Hii=.":t1l (inch)1k S (inch) 1\'l___ H (inch) S1106111 ~T11n1:1.1' 1.41421 1.1547 41 57.0323 47.3427 I 7_7_g/ 57_93231 47.3427 1.4142 1.1547 1 32' 1 0.0442 _1/3_2j 0.0442 >1 _°.-OE 2.3234 12.3004 5939701 43.4074 2.3094 .- 42 48.4974 f 1/13" , 0.0884 1 0.0722 0.0722 42 g L 50.3070, 4.2426 4.2426 3.4641 3.4641 g43_. 3112i 40 3521 _, ";l/32° 49.6521 43 30 60.31121 0.1033 3/32" ' 0.1323 0.1326 0.1083 5.6569 4.3133 4.6_13_3 44 _0A 32.2254 5.3530, 62.2254 50.8068 1/8"" 1) 0.1733 0.1768 0.1443 0.1443 7.0711 7.0711) 5.7735 W45 45 63.6396 51.9615 7 5/32" 33.3303 0.2210 my 0.1804 _ 65€.r|J>r.oN:-4 _ 3.4353) 46 =l 65.0538 8.4853 L 3.0232 6.9282 43 65.05381_53.1162 3/16" 770.2352 0.2652 > 53.1162 3/10" 0.2135 99.8995 8995 73.0320 63.4631 54.2709 8.0829 _47 47 _ gs.-4331, 0.3004 0.2526 7/32" 0.3094 54_27Q 7/32" T"--I 11 3137 9 11Ž31'377T9.2376 wu 40 _i37.3323l 43 67.3323 55.4256 M1/4" g3533 0.2337 1/4" _!* 0.3536 . _' 9 ' 12 10 3923 49 7 i. 30.2035) 69.2965_. 56.5803 M 0/32"?_ 0.3977 12.7279 10.3923 co 0.3077 0.3243 0.3248 49 14.1421 1 11.5470 11.5470 50 10 14.1421 50 70.7107 70.7107 57.7351 5/13" 0.4410 0.3303 5/16" 0.4419 0.3608 -111 11* L _ 15.5564 11 1_5.5564 _ 12.7017 12.7017 WP 72.1240 58.8898 i __ti/32"," _ 0.4331 l _ 0.3030 g 51 TT21249 16.9706 13.8564 13.3534 , 52 12cnr. r:-curs:-1 16.9706 60.0445 E 52 _ 73.5391 73.5301 ; 60.0445 3/B" 0.5303 0.4330 0.5303 04330 l 13.3343 150111 15.0111 53 _1 74.9533 13 _ 18.3848 7 13 61.1992 l 13/32" 74.0533 61.1992 13/32" K3 0.5745 0.5745 0.4301 0.4691 1979901 131353 16.1653 54 14 _ 107000 54 (@3370 _ 76.3676 62.3539 0.5052 62.3539 7 7/is" 7 0.3137 0.5052 L 15 i 212132 . __4.g. 55 l77.7818i 77.7818 63.5086 21.21321 17.3205 55 1732057 63.5036 7 15/32" 1 0.3320 0.6629 1 0.5413 0.5413 16 l 22.6274. 10 13.4752 3274 134 752 ° 64.6633 56 79.1960 64.6633 0.5774 1/2" 1 0.7071 0.5774 17 124.0416 19.6299' 17f24.0416' _ 32.3316 30 63 i 03.13331 96.1666 73.5107 78.5197 77sj_ P 1.2374 ' 11.0104_ 7/0" 0104 .23. 2290 ,1 41 .01 22 33.4863 3 3. 4863 41.0122 30 077.5303 69 97.5808 70.37441 79.6744 ,7_29/32" 2073727 1 1.2313 1.2316 _ 11.0464 .0434 N 42.4264 34.3410 34.6410 30 (42.-4234 30 70 70 98.9950 80.8291 15/16"___ 1.3253 1.3253_ 1.0825 l 30.3291 T175/713" 7 fll-1'7 flfi O-I HOOD 1 61 -11 0-rnn °Tl 4-ICID 01 /53!! lłlflfl O7f\I\ 'H 1iuu.-ma; nn tlfiflfi Annn g Jul -1 31 1 43.8405 35.7957 | -L| I UUUU 1 u|,i0L 1.0: 31.9333 l.lIOU 2:2IUU.'1UCIL . 1_'f__... - uu W 1.1186 4525484 36.9504 77 32 7 45.2543l 373.0504 72 72 _1o1.3234_ 001.3234 33.1335 $715777 1" , 1.4142 11.1547 1 547 3311466691 43.3301 38.1051 131051 L _1_03.2376 34.20% 73 (@2373 34.2932 1 173"T:T1.5910 1/0" i 1.5010 1-2%" 1.2990 Ä 7WT43.0333[30.2503 74 34v43.0333. 39.2511? 74 _104._6516 10 4.6518 85.4 17673 1.443»? 35.4479 470 , 71515//Ti 1/4" 1.73773 1.4434 -3/:171 1...mw o/14: ,7 17.5377 ÄËQ77 7: nrtr-:1' an £25027 1. £0 85 40.4075 49.4975 T,1 40.41.4577 40.4145 li_".'_. 35 75 i°1Tth 1050661 W.. ...|_ 1 10445 ...N11 '3'"-""'"." 35.6026 7777/57°" _L';J i36i 36 1 50.91171 107.4803 87.7573 76 11074303 5091171 41.5692 76 I'1_'l_ _) 2.1213 37.7573 "1 1/2* 1.7321 _52 .3259 42.72307 427239 77___ 710733045 7 _37 37 32.3250' 33.0120 111013945 3 33.9120 ("Ii-L 8." 1.8764 1 2.2981 33 53.740i143.37337 _ 3 7_70_g 53.7401 43376 73 ,ii0.3037(j110.3037_ 00.0337 _ 90 0607 __ 1—L_gg3/4:1 3/4" 2.4740 24749 2 .0 207 2.0207 H fm 111 |'Ii_mi'ni 51.9915 _9/3.32 l 0-2210 D Decaoon (10 11. D sides) sidesl Decagon -Ii\l -DPO .la -h \I = .|> _L >< I? l>1 > > "I1 'I1 'TI —L Tl : -Å J} _i I I G \/ . F "+- -Ju _Å Ja-1:3O] -L _L '-L -Å ';-| -.L .l7v'l ?if§i ,. D xX 0.038 2.6131 = d X 1.0824 sS xX 2.8131 0.9239 sS xX 2.4142 = CDC?-D >:X c:-_° c:- LDQOI'\3|-\3C.O_§ci:> cmawa nczgn D xX 0.3827 szx 4.8284 Area A = s'x 1 — 4; Octagon 3-3 Q _ 5 SX2 =dx1 =dx1.1547 5x2 sX1.7321= we Dx>1_;,_"*4ca0.866 sx1.7321= 866 CIwaga 'JQ.Cj(") Dx0.5 szx 2.5981 Area A = s°x2.5981 7\ÑS_ 4E8 Hexagon Dx0.067 '% DISTANCE DISTÅNGE ACROSS I-\OROSS CORNERS OORNERS HEXAGONS OF SQUARES SOUÅRËS & 8. HËXÅËONS USEFUL FORMULAE FORMULÅE FOR FINDING DIMENSIONS 8: & AREA ÅREÅ OF PLANE FIGURES FIGIIRES __ 2, -l . -ii._ IHli lM1lH1l Hl Hl ...1.Ž5ŽËŽ'Ž 2-2981 1L 39 771 557.i543 in 307, 551543]l 45.0333 450333 40 1565636 401 46.1330 56.5686 46.1880 T 70 111 7979 01. .2214 I 1111,/3" _ 11.11.7229; ....._-, 91.2214 70 7/0" 113.1371192.3761 80 71 113.1871 L 02.3731 ° 2"°° i-Bret- 2.6517 72.1. 72.1651 2.3517 351 2.8284 2.3094 2.3234 23004 *I| e"£=.\.-'11 :- .1 -,-.-, c .--.-._--*-. 41-V-I ,=.»-/; _. »; -3,7' .- : -: '_ till ,_1 useful FORMULAE Fonmuuus FOR Fon FINDING Hnoluc USEFUL AREA 8| VOLUME OF SOLID FIGURES '-5»"1">='f;F"'-':-'.' -" .'-*'-;;'1--.-; r-'r- .. -;. ;.";.-1,', _, 21:' -.,- ,~ :-: . ';;'j" 5 _-.j. 1. _n 5,. .- _ _-_-. p .-_-» l| In/L -;--.- ~_- 1.: -;-." 2 .| ei=-š„: USEFUL FORMULAE FOR FINDING AREA VOLUME SOLID FIGURES I1'I UI =l ãl58: ' Anan & volume of souu Frcunes 2E: i Cyfinder Cylinder Qlllfi —-tn Surface àlllfaüfl area Zlfflil = 6O xX s5 x X sb= os' A Volume = sxsxs= s" s 1 in 71 S f'\ 453/ ' % 0 J,.-- ....„ : _ m IE lllll DU GIUG GUI llllali fllflfl _ TL TL le >1 ca.ci. > U :r -I 'I l|\:\D Fl E'"IQ V0|u|1|ę=%Xd2Xh0l'=rrl1h llglume = % X d2X h 0!' = rrl'zI'| L .-- _ Prism Surface area = 2(a x b) + 2(a x h) + 2(b x h) Volume = a x b x h h 3"? Db ii ¢1"~A/ Ell ill i Area of cylindrical surface = 1: x rx (h + k) ifoiume Volume = git Šx rir' x (n (h + k) 1" If ./ T T' f' ,'_/ -—_ r—_ -,.—_ .-_ .___,/___' Pyramid +"I""fSguare/Rectangular base) co -I ::-cuan I ""\|n Surf.Area=2xareabaseA+ Surf Area = 2xareabaseA+ (axh)+(bxh)+(cxh) (axh) + (bxh) +(c×h) Volume = area base A x h , Frustum Fruslum of a Cylinder 'U --:-1 5|: I: I4 Surfac m ii.9area :' 3 jg= BC x CDUca + SurfaceEE. +5» M~23 2 Ei + l\D2 (area (areaAACD) AACD) "(areaAABC) " area AAB S iii + >~—=' f UOcu'2>-1:"- 2? =O BC CD h "f —4X_,L._l_____.:_ Volume=_% B _J Volume = gal-— U3 r|'1"'|""-____ El Ir \a/ b 1', \'_I _| " -. ""-— _ _ EH 01*Ocu / 'Q,' 1% Sphere It I' / ']>___--""'_/-F df = 3.1416d2 3 1416d" Surface area = rtfr x dz TC X Volume volume =="_" " Eyramid flriangular)Triangular base) Pyramid - Suri. area = areaABCD + areaL\ABC areaAABC + areaAACD + areaAABD Surf. area ABCD x h Vomme Volume == -igi 7% 0 szsed = 0.52se I__ t_._. _. ti '.=.Q—..-1-.M./ _ I _,_ _ C il| it Q ercal Segment Spherical 21rrh Surface area of segment = 21:rh Volme=rzxhr-=¢rxh'y/.r-HI 5S1 5: :3cu \ 3/ =n h- er=nxh(§+E\ 2 Surface area = % - x D (D + 2s) Volume V ume = 5 _ x Dzxfl D xfl 4 3 Frustum of a Gone surface area = .7e54o= 78540" + .7854d' 7854 volume = 1 g3 (uv|)*+ (Lrv|)*+ LM x AB + (AB)* (Aey Volume ffi l -_._____ _ L mf N / A *'"""'~~o Dc¥ Surface area = 1:' 1:* x D x Dc D„ Volume = axbxri;xD,, axbx1:xD„ "FIT: unT: I- 0„Q = = hanfrn mmm „enim nF f-.-na- \ II.\.lll- I 0 P ""---_ L a T as ¥ |«u_J Ltd UUIILIU Ul BIUIILJ U! UIUIJIJ OUULIUII D, = diameter of circle of centre of gravity W> Ill l l ll ll l l C3 A ' ' 'ye-E. Solids of Revolution 'ii-_--1;' Ring of Circular Cross¢Section Cross-Section Bingof T" Surface area = 1:' DC 1:2 x cid x D„ *W /""7 _/'\m L, e\D'_¡ __.0:i—:, _L'iL.' :-\)Ii- > i:»W _. —>] h I (guare base) Frustum of a Pyramid (Sguare area = area ABCD LMNO + 4(area ABML) Surface area? ABGD + area Ll\/ll\l0 \e 6/ Cone I r I l I' r £"i='I'€——H - f 0* —>l of D„ Volume = % x dzx TE1: x Dc I NOTE: s = centre of gravity of cross-section Dc D, = diameter of circle of centre of gravity ¢—\;~s1 \;»==-_= =:f~a-fit,-"2 _. ,:=~.-.::c-';-; ~15 .»:2,>:-1,» °' S ii , e_,% ;. i: ' -.».- ,.=.1 I1 -.».- ,5, .1. ;.= .- -. ~:~-=- .1; 1- ~,' 7, -' _2;-. 5' '-.-I: :'—_~_.1.'?; '.' f.-. .'- ':->»'--,- -: -.-.-.5- 1B_4I rfl' j USEFUL USEFUL TAPEBS TÅPERS & & ANGLES ÅNG|-55 USED IN THE TI-IË WUBK5|'|0P WURKŠHÖP 1 1 cune M Cone of 1in96 1 in9)6) 1in60 1in 60 1 ' Ta P er per Taper inch li erinch on diameter 0.010417 0.016666 .5 . 1 D D 3 nnnn 4 -_ r-n I III III] 1in50 fin 48 1in48 1in40 1 in 4505 1 LUUUU 0.020000 . 120833 0020833 i 1:1 . 1&1 41666 0.041666 0.050000 0.0150000 'l1 20 1in20 —L "1119 1in19 I 0.052632 0.052532 'lt 18 1in18 11in17 1n 17 1in16 ' 0055555 0.055555 QLQL I 0058824 0.058824 . 1062500 00.062500 1in15 1 ¡n5š55 I 11n11 `l¡n15`1 1in10 0.1 00000 0.100000 1in13 73 i 111113 1in12 555 51151112 5;; 11 innin91/2 91/2 1010 57 1in9 L__*_., 2 3 @m3m 3 ' 11 38 31 315 54 1 36 3/8" 0.031250 47 25 23 12 51 52 1/16" 7/16" ž 1/2" 1/2" 1in6 I 11115 1 in 51/2 1in 1 1 ¡n5s5 111114 in 8 I 1in8 I 1in3 *1 11113 1 1in2 _a 1 18 4-Å 46 ->OČI _LLO 19 15 18 ' 12 (HU CI" ! l 43 43 31 31 0_105263 0.10 5263 1 Ca) l\7 32 0.111111 34 mm53oo4> 0.166666 _ 0.500000 0.500000 _ -_. . _ .._ .. . . -.=_=e,-1 ' . , * :sr»-„"»z,'-„~._.-»-1 .-:z>fz< 1» - 4421-'1¢.:r..t~.I 1 \ l 9/1 6-" 9/16" 1 ..„.„ I/U 1i T/:3 as I I 26 1199 1 1 1/8" 1/8" 0.093750 0093750 1 1/4" 0.104166 1/4" 0.104166 0.104155 f 113/8" 3/8" 5.". ... _._._._.__ __1/2" 11 1/2" 5/a" 11 5/8" 5 0114583 0.114583 l 0.125000 0.125000 0.135417 0135417 J 0.145833 I 5 l qn U 0 5' .-. ., * -. -1'- ,-.'I».-,3.1,-;=.-.'»_- .-- 4-1'. ~. _ 16ID 0 L 23 28 20' 20 5 22 5 ` 6 1 7_\[C)(J1U'l 4% 7\I 01036665 0.166666 33 1/2" 1/2" GJ O0 0.208333 0203333 ` fl F1 E U.L C. CD CD CD CD 5,75 0.291666 1 CD (D ' l1 101 1l1l1 I ._?.._____ 4Hfi" 1/2" 55" ' 5 1/2" 1/2" 5" o"5 5 __ 2 0.375000 0375000 0416666 0.415553 0.458333 0.453333 0.500000 05000005 -5 .-,3 ;I..j 1...,_,'_.__ fq, ..' .42; _.+rA. _L 16 1 21 21 23 25 25 ý 23 _1;"; :51-. . ._7_-;"-,.-7-', ' :-' 2 l |\J U1 -'L A 5"_"i4`"___55" 5 5 0.333333 55 "5 55 Ts" 18 i ) 45 45 29 33 29 33 5 9955 5 10 10 l 49 -Åà 44 49 l 23 20C 28 l 37 31_L 37 53OJ 38 `3s 57 U) 4!! JD T51 5 1) 2!! sr" 37 Na CID I'\3 Od 28 2 1/2" 1/2" 20 42 l) -A -Dar. 46 16 l 48 52 „r -1.lu CD 4-|> 51 I 34 3CAJOJĹłJI\J 4J> 10 23 3 1 0.083330 47 fir 56 - JD 7 0078125 0.078125 8 i I 3 ze „azma-1 _CD CD "'-IPO CE) ._L -4 U.UIC3| I !! 8 Z3 115 525 14 l 157 15 Ĺ T 13 l 55 28 T 4 _,A5 23541 41 415 ž 59 se 13 16 PO I\7 NJ 1!! I 20 12 0.067708 0.057703 15/16" 15/15 1" 1 3/4" 2., 23 18 0.062500 01.062500 13/16" 13/16 37141 ~ 5 23 0.057292 0057292 Ž wiË; 3/4" —fi 2f\J PO |\J 0.052084 ž ý0.0520s4ý) ž ž 11/16 'I1,/16"" ili 0.036446 0.041667 0.046875 5/8" 5/a" it 1 _. _a G 10 JIJE *1 1/4!! Jë- _x OO \I 10 10 0.200000 0.200000 0.250000 0.250000 0250000 0 0.333333 _ . 31 ' 995317 0.181818 o.1s1s51s .1-.1 , I'\J -lä 24 9CD . I l. 6O1 OR on 1.v |_u J> J1 \I '\IO'JO70'J 1in7 W" CD ll I -ÄLO 49 1:uEU H 0.125000 re e 1/255 1/4.. 29 11in8 in 3 1 in 51/2 44 1_.L ' COI'\.') -l>|\) \I *4 47 53 1.a 1_.L 5 0.133333 0.133333 7 0.142857 0.142357 0.153345 0153846 35 0.026041 0.025041 cnoacn 1 'I 0.010416 0.015625 1 an 0.020833 0.117647 "0.1 17347 1' 55 38 Ca)-lä- * @CDM an 5/13" - 81/2 1 in 8'1/2 1in71/2 In 71/2 I 53 5/16" 3(JOU.) .12; Seconds I 17 ' 56 55556 5 CAD CA3 Degrees egrees Š Minutes 0.005208 3 6,, 3/'10" :..—I.5. JC 0oflæ 54 u-ru1u1- o -»rum 10 53 22 9 5543 34 48 I on diameter É 25 25 21 ĖB43 Mi 1/16" 1/15" ' 1 l on diameter . 11 3001". . 1 I 1' n'\l-~1 T) |'\D_L 5:: c: -.1 -L ..|':1..no O .1 1* Il 1/6,, 1/8" 9°01-1 _¡. * 0.066666 0071429" 1in-IA I 55'Il-I -L II} -I>\I C *Er USED IN THE WORKSHOP WURKSHOP 1'aperperlnc ' |¡ |N¡;LU|)ED ANGLE Taperperinchj 17|11c|.uo1so ANGLE '|'aperper fool Taper per 1551 0-1oz 'L11. _-L 1 1 J Ca) U'I 613CC n(43 1 uni» - 7 _._ 0.025000 J33333 0.033333 1in3l] 1in ________m-__WV"__wI______i__ n24 1in24 .___ 13 userut USEFUL ravens TAPERS & & ANGLES ANGLES INCLUDED ANGLE 5 INCLUDEDANGLE Ž _` N __ 4 Degrees Minutes 1l Seconds J 2 .'l""f3 ; ...,. _-.-, _-. .. 11?';-. -.2. .-5.1:} 5'.'-4"?»Z171' ,1?' 23 :-'; Z? M. .-,, ;.='-1'-I I-; 31,.-'-; ;. -.1-:-I .6"-'-;;.j -:--P. 2 5-. 5-. /' ' " ;-~-- 15 4 ;\ -~ 1. e 4 :9.4- .1 4-,»: .1"-2. -.;~.~.r' ':;/ 1' -.'~_-'.1 t»_~.~;~'~;_=-.1 -: -'4 E 'v." H -1 1 ` Za , :' .1 -.'» -IE 'JE Id IJ fl |"\ U 35 41 55 28 ísr 14 14 22 22 12 l 12 43l53 48 53 44l20 20 32 32 E ,., -' -;;. 1' A 1-\,.-.-*..~-.-3. . ,.._».;.;_-,_ - _.- -;-,-.§-_- :¢ .;- 1 »;,.-.-_._; :fx: 13:ml _ _.=...._ . .,. 1 »--:- 5-,. 1 ',;;. ,. -Er.' ;.,--4 ,.;' .2 -_- -. -~,.= 2 1-, -,.-.- . .-.-. ~- 11. . l . l...1\F . -~ +v When the angle 01.ot is known: The compound slide is rotated by to at W 04°"(,0 D 1 I' ' - Ot D _ d OI Tan E = ET , -'.-','.-'-.:{ ,5. .. ., , _,_. L-,. . 1- 0, »_,, . . -I - ;=.'-I ,.,,.,.. ;.-.;. L61 [til Sine Bar Z'\4¥.Qinn Rnr 1 I I I Q ' .._/ _4. '- 1 i MCI H Total Gauge Block _(ã)T0talGauge . ~i'~Å-4 ŠË1ËLŽ`°e -,_-_,_ : " -. :'r;-.-1 =;.i -' ' -1' 1-. Exantgles using a 200 mm Sine Bar Exampjesgusing To find H when given angle = 15°. Dfd Offset S = 9% O 1 11.. - II U III 'I-I' IIIIII Axis of the machine L._ 4 'I -0 " "1 L_J NOTE : Taper turning by offsetting the tail stock has its limitations and is applicable to tapers (or) less than 7°. ~ 0 3)1-4 1 N _; g T-lfla _'lfl° IV U, vv \h I Y'; .5000 3¡fl€1-_-IC/)) /4-Q. n I Sine15°×L HH== S' me 1 5°x L =.25882x5 = .2 5'882 x5 To Find ___ f 6 __.___ I To find A when given height (H) = 2.50 in. tindz n_.r ofiset Ss == 5-E9 % x× L,L, Offset Axls of the machine machlne 7 Axis /) ..~- IITJIHIIKI H = 1.2941 " (total gauge block height) _ - |_ - LI|\J\JI\ To find H when given angle = 15°. Ĺ) /'1 12 The Tail Stock will have to be offset forward at a distance = S, noting that the travel parallel to the axis of the machine. tool must trave l*1* \I.\.||.L\| Sine Bar Examples using a 5 inch Sine_Bar .34: ::fra.;:::::;izl _ *-»--å€--- wl1en1helenoll1oflaper< length ofor workpiece: workplecez ¢» When the length of taper H 100 Sine %=% .5000 $108 ol or = T =2-W = -5000 H : R1 mm /+n+aI ltnłul 51.11.1151. null nl: hlnr-I1 hlnnll 111.,15111.¡ hninhfl I-I = TI-id ncmnn) ._- u -1 1.1'IRÅ v-1 mm \WLL111 1z1v\11\ =11 53' 25. 1.0) 1+ _L, To find A when given height (H) = 100 mm H = Sine slne15° 25332 ×x 200 15° x× L = .25882 am-ti rn m11z~+ tv-111511 nqrnIInI n »1l|z1I '|'ln tha-1 ihn rnctnhinn munhinu I-nnl 0+ 'I'rn\rQI ca-wir _, U) canł ~F 'I'I' LUUI CLIIUI C :+cu" LUUI IIILIQI. llll-IOI. LIQUUI UGVUI Pal [J D IIUI lLU LIIU KAAIÐ Ut l.Il\¡ Illuvllllllu. ____3,_f I \.%"/-Anglfl ' 0)) -- fr-'1%-32.5211-._I;,.1-;-"I1;1,; IIIII The Tail Stock will have to be offset set forward at a distance = S, noting that the - . 22 .5: L I.. CD :ÉO5 na1. ::- GD:lu E2 ššf CfiCF) . -c:CB C1e: 7|?':r 1.. =3 til . .-=3' C: :2 II151: EË::: 24.2 «When of taper = length of Workpiece: +When the length oftaper workpiece: .~_ . .'-'=_-_,5-_.1, .- Gauge blocks are used for forestablishing establishing the setting height (H) ofthe Sine Bar. The setting height (H) can be determined by multiplying the Sine of the given angle by the length ofthe of the Sine Bar. (Fteferpages156 (Refer pages 156 and 157 - Table of Natural Sines) Sines). Height Heighf (H) = Sine on x L Where, H = Setting Height Heighf where Z1 L = Length ofSlne Bar . H L=LengthofSine Sine on oc = T The result can now be looked Iooked up in the Table of Natural Tangents on page 158. - .1 ;- 1 ;....'}.' 25E I?!" :3 - 1' Therefore % =13°20' IIIII ..- _G`_ an Example: When D = 80 mm, d = 56.3 mm, L = 50 mm, o1__80.0—56.3 g_Q7_ot__80.0-56.3 _ g_&7_ Tani - an ..._ Tan 2 --100 I00 - .237 Taní--_-*100 : '- -.-I ._.r The Sine Bar is used for accurately setting up work for machining orfor inspection purposes. lt consists of a hardened Steel Bar with two pins mounted at an accurate ; pre-determined distance. A Sine Bar can be of any length. However, 100 mm,125 mm 5" and 10" 10" are common inch Inch sizes sizes. & 200 mm are common Metric sizes and 5" -- - - - - - 9 . ,. --1. -1 -;,\ & SINE PLATE SETTING SINE BAR 81 H(X E Ž § Ë ('/2 ('/z the taper angle). 9» When the dimensions are given: The angle can be calculated using the formula: i'-'--2.'- ,_. .- , , .,1 ,. . _,_~f .-9 .. ,',„..z„.,«»,.4 .. 5; -I:I: rrl :: STANDARD CD:: A SitI: il ::II::I I5 LATHE TAPER -IC: ::I EE :: ED ON -|za"lunn:Il TURNING 1. 1 Swlvellng Swivelin the Gompound,Sl_ide Com ound Slide)l Líe . ,_I,'_I ;r-~' _,__,-_1__. .-. . II, ,-.;.;=,I;; .'-:-1.; 2: bf-._»_':-:»_;-_~..1 7-».-5,,-7 ,-' 3'.-,_,. .,-:_.,-,.- -.-_ »_-;~;._.--.q, .. .~_. ,.(1..1- .5.¢._.__.,. .; ;. -_; -,1; _/. -.--.= .1.-. -15- - —| . 1-..-. - -.-.:/3:» § -; y.2-3' 1_. -J 111. ;'. 15 |7 I 93'-1 ' dyv -4 . 1', 1;»,-_ 7. ;. 1,7' ~'|;,',' 5 1,1,4 . . 9. .1; --. .'~-, :5' 1.3) ,2;. Lvw L1 -bl'; '-347 I 15- -$4- -"—,,.... . ..-A -7-'--' 4% .-V 5. - -.1 P4 ,-.2 1.-,--'7 7 " ' -9% {I-I : -;-.- ('2.2 5 1 1.1-» 15'-: '4/5 1 '5':-'. '-'4! 4 4 DEXING CIIÅRT orvzomc olvlo 11549 - mncxmo ______cnnnr WORM GEAR EE - Š:I:El ::l:I "U 40:1 cs Š Ë St:-.:I_2RATIO '*"=' „;_ ; - llloexlllc ll 1111151111111 cllnllr 511457 WORM GEAR nllrlo RATIO 90:1 wonm clana 9oz1 No.01 N"-°' 1 Hole 'Me Divisions Division: Circle Comp|ete~ Hole Fraction No. of 1 Hole c°"'PM"` Fraction F"'"¡¡°" 7 No.ol N"-M "uh F'¡°fi°" N"-M "Me I1 Fraction F'5¡°'¡°" Turns o1aT1|rn Divisions Turn: olaTurn tilflivisions Division: Circle olaTurn malum Dmsiuns Circle cim" otaTurn °'aT"m 40 03 40/41 2 _Any_ ' Any ' 20 ---_ 41 __41 41 /41 124 1.,.1 313111/ 1/1 20_ ID 1 5/'16 21 '1 29/21 16 5/16 _ _ 13/39 ' ' "_"'1312 12 211/21 " 125 1211 3 47 _1 47 7 7 40/47 ' 14o 18/27 U'! f\J '*-.l C'! 1 8/27 ' 5/18 43 _13 15/18 144 18 13 15/13 35/49 49 77 40/49 8/29 mu-1 nom 1'49 'A 4?! 145 29 _9fi9_ |r\×J1J-Eh>v\1r., :l>-rw\-Au: u'wmmmmg 1'1.'.n ; 15/21 ~:-4~:n,:In-u1:-Iu : wmąefl 1037 _1_. _. ËGËËË a m -4- 1>wwzoezozo 20 16/20 148 37 10/37 y ulaz-:~>a= o1nm`|:'nul 20 \Ës\ 55 555 Any Ålly 55 U"l uu -__ 4/15 39 so/39 _ 150 150 39 30/39 15 £2 5/19 1525 55 5/19 29/27 19 20/21 3 152 co:: 27"*4 (D l\'| -In 112/27 2/27 54 ., 3?. No.01 Hole Complete Complete Fraction 1 No.of No. of 1Ho|e1Complete1 1Hole Com|1lelelFraclion Comp|ete1Fracti5n No.ol Hole Complete Fraction Fracfion No.ol lllole D71-isions_Circle Di\1isinns§Circle' olaTurn1_ Divisions'Clrcle Divisions Circle Turns ,oI,aTurn olaTurn Divisions Circle Turns olaTurn Division: Circle Turns 1olaTurn of aTvrn @SL 121 '_ Any 451 ||3z 32 45 1 32 33_5>:I Any1 30 33 199 -~< :25 22 _13/25 13/25 71 7347 wu:aca wu:»zo Jib Nmcom 22 ,14/23 M___23 14/23 1 35 rwco _ 5í if55541115 Any É-__ 18 -35 mwmv! ,__Any,_Ani/1 15 15 _1 ---35 1 25 24/23 1 231 12 124/23 35 ' 23 75 _~4~4a1:n.>;77* 12 se/17 77 12 '75; itwrat 5/77 7737 wwwamo: \:|\:m \lo chm 1 '23 11 Ë3_11'5 33 7/23 1 33 441_1 11/44 ' 39 44 111 11/44 Nda 25, 44 | 5 on ou '1') IL Hé Gfl UU 7 14 ' 1 1 5_ l'¥)CA3C.OCODJ-bl>-_.1.4 ul.:15 15 39 co:>co:wl\>c.>w.or.1:\lc:1w 27 i . umu: 177 Nrvom w s |'\J1l'\3 l\) NNo`l 207 l\J 17 NNN 27 13 0 13 A ` _lo 19 1 19 1 yi i 2o Any 4 .4. 7777 if i 13 . L/ }__ l2_ IU '\'l\7 41,2 22 335.5,-_ę _F N,NNN,-Ac r.»>1N> 23 , NNhu umlaw 24 39 _247 7 277' ' 25 20 F517 is _ 4/18 4/13 2/19 2/19 NM l'\JI\'J 29121 . 29 29 30 30 usa:NraæN_.eaNųmnN ha 31 32 33 uz-1:1 : aun 34 '--I __.._a_aL._;._n.|\-3 1:: ud 35 37 38 39 _L 1!-'Li I "11 Ll 9/21 11/29 13/39 _ 9/27 9/31 5/20 \ravnaEEE wo' 3/17 3/151 7/49 5 7/49 1| 19 'L _ Any šo:-:. l\sl\: -x> . 4:-osA _1_L._1. 1L —4| -_L~ 411 2/43 343 _1 1 43 1 37 _A 1L___1 1 3/37 3/87 _1 IQL J44 >mJ> 4>\lw 1L 139 ooto _Any _ é 1/Any 1 S '91 ' 1/44 Ša 1/89 _ Ćoneo ___. _L 90/91 -- T ao/91 45-r>on. 1 -- 1 45/43 45/46 99 -- "' eo/93 90/93 ' Š . 1 2! 45/47 -45/47 -- 5 36/38 33/33 1 30/32 30/32 97 90/97 90/97 4':znamc9o\|r\x> 1 -- 51545/49 45/'49 44 1 -' 40/44 l_4o/44 1 1* 1 90/99 27/30 11-1 14 , 1L 1 Aigh 21/53 21/63 52' 93 ez' cooc _ 42/93 42/93, saee 95 5/23 1 sa 53 A 49 3/23 49' 21/49 21/49 991 4:4: 53 ' 77 9/37 1 "ea 7'77'A I 33/17" 33/77 1 99 93 ---- """ 54 A 1 32 13/32*'7""" 13/32 Lloo 1 39 T mw-I; ora.:-` 34/93 34/931755 1 55 1 26 'Ž ' "_._1. 5 '10/25 10/23 1 -_¢L_L CAJCAJ 4/32 '5 32 caN no cnne ULJ1 A1 29/61 _x_. Ufifiå 92 eosaN_1 sana 93 5 31/59 A 94 47 17/34 33 157/54 1 7'95 491.: :Ila wuon\1 15/32 795 32 16/32 _J~1A..¢l. mm 82 :luN 'L wuww C40 BO zas 555 cour CH .a 5 23/32 25/32 1 A 31 ca _s sa/39 53/59 721/23 21/25 msnum cz.38' : ou 57 _L_11 T ` 33/44 01sa 00\A 58 113/30 18/30 A 5 5901in 59 OJCAJCO 1- l_L 4. a_L. - _|. an Ca"-JCAJCAJCAJ"-J 1'-C"-l%Z'\-ICJ 11 1 42/46 42/45 cu -In r\.r.lA O:eo\1 U7-15COO' 50 . 51 Ll, 52 :nulta N-me 1 14/23 7 osOJ-b 4.1 "-{"1 "II-4 4;A7 5-vf un- -IL '"Ca- OJ Q 793 Qfl/'2') 29/32 5110/34 0/34 3 3/23 1 1 22/77 3 1 22/77 .1> 4/44 _ J> W, 7/77 7/77 ou A y 1 30 '""*n 1 [\J l\3I'\J!\J J>-|>-l.rs=- __mm -~cn 1 wc:: o_1 1 27 5 1 wc:: o_1 1 27 53' NNmw 23 23 1 29 137 N0 owrvm \room Nth!cncn NNNm NJ '--I ll— I 7* NNNmula- -_-l._L1L l\Dl'\Z> J21- CI'! CD d (D _|. J>ea 1 -b-fir-l3=~\TJ1 NN r\:~ .nQ _11 177 21 \Ir\: r\:\Ion ml NN -x>-:> 22144 __ 722 1 \J\l 77 NNuN 1 45 3:.aa ""23 Nna 23 _1_§e2 caco 2451 24 l 24 144 1 25 "301l l\Jfl\JI'\J!\J l'\J 28/38 _1_28/38 A , .|>4> 1 13/26 _ 1.__ IQ 3 #44 |\JF\DT\-31 5 v.r|cnO':0": mu-u-11 l\J '-1-l'~J"-1 '-1*-I '- IO'lU'l-PICA? j 1 Ovo: 5 ul Cl) la Oflffi-l @mw CD 111/~< I\3 -9. I \'t*o-ICoU cu:> N..ein 4!, I| 5on LO O 32 vI- 7 31 31 1 _ 10 9zr: 8on .L on _Ln-I-—l| I OR I 15. 18, 20, 23, 27, 31, 37, 41, 47 16, 17, 39, 43, 1 13, 17, 19, 19, 21, 21, 29, 29, 33, 33, 39, 43, 49 49 14 , 28 77ton \IN\ V 1 ol Holes H0188 1 No of No. 1 NE-1____ _ 1 l\DI'\J CD00 14 fit-I No of Holes llloles 15, 16, 1_.?.1,1_3.1J§!1.-,'3.9_i 17, 18, 19, 20 15112.1. 21, 23, 27 27,' 29, 33 29"*_3131,1.; 33 37,39,41,43.47,49 _, 37, 39, 41,43, 47, 49 _ _ __ 71/19 1Ë 1/39 VË -A C43 '7 1 1|. 37 111 10 11 11 05 177 12 1 r\25:\4mw 5 ,1?12 1_'Å _ [W-la 1 13nu wwwn-1 :71-emaa _14_1 _-\-1L 39 ____ _ If 40 a-w u e uz næmųmenm I index Plate lnnzxelale __ *8__ A __,,1 Q7411 1 B_ OILI 0/ __ _ . _ ____ C c 1 3/27" Q Ž rutu `,_. ____ 1!- 5 an O12 I-I\l Any Any __A Any 44 4>4> mmm I-D1 1. 7 1 1,, 9131 7 ._L .1. 1 __ 27 I _21/49 21/49 _L %--I . ')1 r_| l\J CD 72/99 22/34 l'\J1 O')00 —L—l| 19/21 27/33 117/23 7/23 26/39 7 25/397 118/27 5/27 12/20 /27 5/27 12/20 21/39 21/39 13/21 13/27 .. N 39 27 ~ _mwr\>rua-`l-4~> , _ __ 9111135/91| 25/32 23/3 _ 1 _ 55,1911 _ 21155 1 135/91 66 44 1 _15/44 55 15/44. r\:1 55 G:da toua 1 y1 99 1 se/99 35/99_ 57 1 57 _ 7 523/s7_5 mi _ 16/28 ili/Za Nm 36/63 mm:»\l 1 35/53 71 meaw~| 55 34 11/34 I 11/34 _ 13/25 1 nann 1 4:-U: 1 N 69 .46 13/26 7 14 14/45 /45 1 5_171/237 14/23_ 59 y 59 31759 / 21/59 A — i NN 13/31 16/37 7o.: 23 umOf 3/23 /3371 1o 14/33 714 79 5 53 ` 555513/33 1 1299 3/2555 5 y 11 71 5 71 1I 1 19/71 5~ -zo1:-cn 1.: 23/91 y 12 72 321_13/321 5 5 3/325 -awe.: :talog 457 25 7 mrxarom 7/23 Non 7752? ' A 12 72 144 .mw cnma>oNv_L:.1>o Lo 5 _„ ._ _ 1 1` 11/44 5/44 4o 51, 44 3/44 40 11/44 5513 5 \Joo 25 511/44 17/73 5 1 17/735 14/77 _ 41 41 'Lil 41 14/77 8/4l__ 74 __í_8/37 3/37 _ ' 13/25 £42 13/23 42 1 23 2 4/23" y `|ulH 4/23 e/30 13/14/28 14/25 53 1_2 'W7 42 542 ea 1 9/33 `|aa__ wwwmaxi _ _ 1/se /38 _;213/77 24/26 _ 43 43 2 43 l 43 4/43 13/77 64/91 04/51 44 44 2 2/44 L/44 1' [U . 39 5/39 12/28 12/23 745 'PW 5Any5%2 -5 y5 14/91 35/55775 namu: 15 44/49" 46 5 545 , 44/46 _ 79 ~|`|~|`| : manu 1 79 \leo\Ico-\A 7 11/79 1 1/79 2 CA3 -I-H U70'! I'\DZ U1 7" mgr 27/33 —L- L- J-_|L.-L | bg 6/27 2 I'\J UCI 31 5/31 _1 55,_ 155 Ĉ Q ¡,_L u1_. 155 39 10/39 1_l_l /39 5/20 m20 c.:-4 : co-1×>; _1u=.:~4×1×1-= _3/31 135 133 , 47 11 10/47 1_o_/47 _ 190 19o 19 1, 4/19 33 5 A/3/39 195 1 39= 19 1_Q5 149 . _'Ji 1 93/15 HI 49 10/49 10/49 7-5 15 3/15 195 75 __sza too 4/_20 _ 76 19 15/19 20 ~4:-1 1o/19 1 zoo 4/29 7B 39 20/39 ii ___ 3/41 29/99 _ 1 _219 14 20 15/25 Nmom 10/20 1 210 4/21 4/3L , 1Bfi ___ 32 20/41 I215 '\3'I'\3 1: -1: 3/43 u::n~rNe:: _ _ 41 Š 1:1/01 011: 34' ' 7 7.5.27 5727 r51-r=~ 111121 * „111 ro~>-N.1>n~_`¡ow_x._4 ` 5/27 ' ` 17 85 8/1 33 wenma; _.ro `¡.. 3/177 1 220 zzo naca 7 6/33 5/33 5 anm a>ca 20/43 | 239 zao 4/23 35 143 20/43 23 , 4/23 15/33 '33 133 15/33 232 M29 5/29 naan naza ' mix:micT' o 1 5/29 _?Ë_ lu\l 12/27 235 A 571 3/47 'A R7 90 ' 27 12/27 7235 47.r>\l 8/47 lvm 1 10/23 1' 240 3/13 1:49Ne 10/'23 249 10 1 .1/in UL , _ Q1, ___ . __ 23 20/41 245 3/49 2_o/47 245 49 1 _B/"L , _47 -«asmw sa-1>- -f.ooo 55/31 3/19 243 _i5 31 5/31 95 _ if y 19 25/49 ' Ñ' 250 ' 39 *7'e/39 98 49" 1' 20'/49 5139 TNT _17 20 100 1 5/29 254 7* 33 ' 5/33 7 . ~_ 1n4mM. _ŽŽĹŽČ9/f2í1_Ž _TŽFĹCŽĹĹË 5/533 15/39 z1o 1 27 1 4/27 3,9, ,;l° _/§%L,' J7" ' 105 21 '1 5/21 _1.ama1 =,=w1u\uha 3/21 zoo A7 " ' 7/49_7/49 255' 23 r\: >wr\.13> na-4u:c>»u: 7 115 3/23 1 _ex 290 _ 29 4/29 __4/22 4/29 55 10/29 115 75! 29 37 5/37 296 m|\:1>|\>m `lc1: '1')/Ofl 21 B ' A 15 | mmm*' | '7" 24/33 55 33 35/49 _ 1 5.5 49 __ 35/49 Na:- now 520/2955 20/29 ulmul ul malene-N __: 55 29 21/33 __ 21/§_ 26/39 :59,, 1-1 Q ozza 13/39 _ 39 1 15/27 ru/ua | 13/27 1 1 511 27 _ 9/l @Q _I _, E5 _ 31 20/31 zo/31 1 _ 3/39 3/39 _ _ - -mmm _.×1 10/13 1 121211?/1f9 42/49 5_i__. 24/39 55 " 39 '1 24/39 18/21 13/21 '__ 20/33 5 5 20/35 68 33 ze/ssfi 1* 26/39 - \leo 1 72 ' 27 15/27 10/zo 10/20 ~4:1:1.: `l 20/37 _ 37 25/37 5/17_ l 74 6/17 8/18 Š al aa ._|. CD Ä 19 Any 1115555 H? 11 5 33 3` 117' 12 512 Q2, 37 _ 515 1 _1_4 13 5555 _39_5' . _ 7 14 49 [N -It Y J9 l§ E, C 27/30 2% 1 -2¢3 --J. 1L lude ln1lexPlatc oi Holes X Plate*11 No ofHoles A BB 0:: on 12., I 23 1 2., „V fmO OR 00 on -'J 7_u, uu, u uz I' .„ na O :- o-r O -J c. c :1 ur O D a.44 33 33 -I 5-' -11 OO C. _CC- -L 1 21.61_63v 67, 69_71 _73_77_79_81 ,7 63, 67,6 I.D 2 -2 .-_ _,, ;, »_. ,7 , LO >.. J -Fa. :£> -as-llP ga -¡> _zsJ;-Ks '..1' .- ~*1 1 -»-- _""'~J"*4 I-D $ ..4) -, -34' '-,1: : OD 0: ga $.40 42:. _~4-is .|';>.$13_coca C~"l _CI'.IA _cu -__'\l -4. U1UH P3_mU1Q1 _I __*-JQU11=.CIDt> on -\l CD _1 --L CD L01 _\I sr: pa_€.OCO LO _'\loCDn _co _f- Du: _'\lzCDaan ,.,,. 1 ...-_. ,- ¢ 1:.4-, 2., "-5---:-4' -=5 ,-. -.,.-.,-, _-. -1 1.' ./'.. 1-, P4 _1 J_'4'4 w 2 ;'. I--/4&1-,2'; -.¢: .-_¢.,?. 1'.-;_, „ c,-1'; 1 -.' 4 '.1.-M'. 4 -:" "~l _1. :-,7 _».¢.' 1 ' 1.' _. ; 1 ,-.._' 1 '. -_-_1 y \ .121 21 DESIGNATIONS ooereac & mcn :Non oesiomnnrs USEFULTOLERANCES I: in In -11 1: , _-4ID ,_ 111 IDIB I: {D |11on Nominal Nominal Diameter Diameter (mm hnm 1 co :ra "lll'\l:'I 1 IlUlll I IIUIII Tolerance I03 lo 3 BB e8 B9 e9 E?._-.=3U-E2ni ae no ""'cn nunr 'in nun! 1 nulu R rnunr :umu '1fl n UIGI 'U UIUI \Hm U uvo: IU iv Ulul I to10 I to18 I010 1"!020 .-.025 -.025 _ .o14 _- .020 .038 _- .047 -.047 _ .o2s _-.038 _.o14 -0477 _ .o2o 020 1-_.o2s 025 i _.ose _-.050 .osomi1-.001 _.oe1 .1 006 1 .010 -,013 _.ooo . -.o12 012'{- .018 I -.022 Q06 _- .01 -.013 _ .ooo oro10 _.ole . _.me 01 6 _ o22 _.o2e -_.ooo .005 _ .oo2 oo4 002 _- .004 n-1 n n4A - .U IL - . uiw -.ooo -.o14 uuo -'o12 ""1 _ 1" 1 _. "11'"1 1 .oool 000 1 .ooo 0.0 .ooo -.0 " 1-.000 _ ooo _-.008 ooo 1-.009 oos .000 .000 1 .000 .000 .000 .000 1-.010 -.012 -.015 - 01s -.010 -012 .ooo .ooo .000 .000

.ooo .000 1-_.o14 014 _oro 01o -022 - 022 *1Cd Ll) (idLO PO—¥ COO0 -I->- 16 I6 117 f . no5 SE3 9 he ha HII 1 I1 h7 "h A FF' hr; ha _ nnn l .vvv flflfl flflfl 1TT =5'=' u: .vvv .ųvv 000' .000 .000 S _.ooo 1-.030 _ .ose -_.o2s 025 2-.030 55 . h11 .000 .ooo .000 .ooo .000 .ooo I " -_ .075 - .060 ooo ovs A(_- _.090 ooo ";1gI7]000 I .0007 .000 .UUU .UUU .UUU h
12 1 -.1oo _i y - .150 . 150 _ 12oA_ .100 1-.120 = kg 14.000 1+»109 +1 Z110 +.006 Ž+.009 +.010 kfi 900 +.001 000 ++.001 001 +001 . Z flfl O :1 ITJ E.I030 . Usi"na Q-_ I -.027 :1 --.1033 .033 -ole* I-.020 _ .o2o I-.010 _.o41 -.034 _osg .-.041 -_.ooo .006 -_ .oo7 .007 n1 _ .o2o --.o17 Ull 000 _.000 000 .ooo - .013 -.011 _ o11 1-.013 .000 , .000 .000 I .000
.021 -.018 -.018 --.021 Čooo . .000 .000 -_ 027 _.osa - 033 7 . flĺlfl .000 _ .ÖÄŠ -.043 . .000 __.11o - .110 .000 .UÖU 180 --.. 180 I +.012 +012 +.001 +.019 +.023 ++.016 016 +019 ++.ooo_g+.o1o 008 +. 010 +.o12 +012 . +.o24 +.o2e ++.020 .020 +..124 +029 Tglęrancęg Tolerances in mm 0 -I:or nu 'EI- eu -1 :ri: ::== :3:: \mr C10 ::a - .040 -.032 .-.040
-.032 -- .059 050 1-- .O73 073 132 I-.040 - .040 _.os2' 1-_ .07 .75si -.092 .92 -1010 020 -.016 -- .020 flfifi .ULU |=on ANSI Füfi Ăiiši PREFERRED PRĚFĚËËËË LIMITS ¡.¡¡ll¡¡TŠ a & FITS FITS (ANSI B4.1-1967, R1979) & 81 (ANSI B4.2-1978, R1984) 'Il The following chart covers a selection of Preferred Fits (Hole Basis) for Holes & Shafts which will
meet the needs of a large proportion of the requirements for Components, Standard Engineering Components. Rfl nu;|r Rfl Ëfl mm' uu Rfll vu un" \I\I UIUI to 80 S!-a. _O=:5UICID21:: 1to80 U\I lo 120 to120l -'I an _ .ooo AA-.072 - .072 - .050 1-.000 1-.050 1-- .089 oeo _.1oe - 100 (1-_ .126 12s --.050 _ .ooo i - .072 --.112 .112 -.134 - .134 -.-.159 g - .030 -
-.030 .036 --.025 .025 L-.030 I ' --.1141 .041 1-- .049 _ .ošs -.025 oso I-.050 __- .ooo .009 no: _ _ .ozs .u::u _1"000 1 .000 - .016 %-.016 1 .000 .000 --.025 .025 ..000 -_ose 030 . Hole 81& Shall Shafl Designation Symbols .058 -.058 neg il_- .034 non -_ .029 . 1 . H _ con 1 1 _1j1[][) .000 .000 -.O19 -- ..022 022 -.010» ULJ r ULl"l' r\r\r\ 061+ 1 . .=1_1._ .!I_I .l'\f\
. . —--_' r - , --I-_r _ _- LOOSE RUNNING FIT - Wide commercial tolerances, FIT-Wide used where accuracy is not essential. (RC3) (B03) _ . _ H*'/ H9 / II" da (RC) (B01) 7 FREE RUNNING FIT - High running speeds, large temperature . variations, heavy pressures and where accuracy aocuracy -ISis not essential. BSSO ntial 1 I 1 1 Ha / I7 f7 I CLOSE
RUNNING FIT - Accurate location at moderate speeds H3 Ha / I7 f7 H3 (R04) (RG4) on accurate machines. (R02) SLIDING FIT - Accurate location where components are intended to move and turn freely but not run freely. „1 ,ga s*s„a¡„? H 5 / Q5 H7/g O'! . imal 7 5 ' 7 LOCATIUNAL GLEARANCE FIT-Snug FIT - Snug 111107 fit for locating Iocating
LUCATIONAL CLEARANCE stationary components which need to be freely assembled and disassembled. 6 HH1// hnfi 3 H1/ lhézl;hfi U-02) r-\r\ L.._.+* _ E -'__i si . -1 _J 1 u.\._ Description / Application 'Bescrintinn/Annlioa-tion CLEARANCE FITS GLEÅRANCE H10/39 H1"/09 .. . - § H9/ H9 / II" U9 1 1 \ _ _ . TRANSITION FITS H7 / kfi I-I7/I15 +028
++.O33 +.039 .039 ` +.045 +14 .033 +;+.028 .023 +.015 +.O17 ++.020 .020 1 + +023 þ+.oo4 +. +a 015 +. 1 + 059 +.035 +.O42 +,051 \ + .042 +.051 +059 '+035 +. pfi +.012 015 +018 +1118 1+ I22 ++.026 006 +13 .026 . +1032 +.032 + .037 I +022 112 +. +.006 +.012 +.015 1Z120 + +064 A +.I076 +.076 +090 + .090 +053 -+1104 .028 -
+1035 +.020 +028 +.035 -+1043 +.043 1+.05s F831+. 1 C106 + +.03O ' +.036 + .036 025 +1030 +.020 +.025 F ++.006 010 +.013 +.016 +.010 +016 ...ttJ¥¥ls;t: +.047 +- .040 +047 +.o2o ` ++.034 .034 +.040 012 `+.O16 '+016 +.020 +.024 +1024 '+028 H 570+G7 +.012 .0 g +.012 ". +.0G9U +010 uuo1+.uuo +.uur -I".UU +002 +.005 +006
+.oo7 +2 002 +004 +n +.035 .030 + .035 +.o2s ++.03O .018 +.o21 +.021 +.025 +.012 \+015 +018 II }i7 +.010 -+1010 +012 +015 '+1 .000 .000 .000 .oool .ooo .000 000 000 .000 000 .000 .000 000 .000 .000 .00C I.L 1 U3 +.054 .046 + .054 + 027 +.o3s + 033 l+.os9 +.oso ++.046 1s \+022 02 2 +.027 +.014 +n0 +.018 Ufl 1 []' n .000 .000 .000 .000 ' .000 000
.000 .000 .000 ooo .ooo .ooo Z100 .000 EEE _ +. 010 no +.010 n6 . ___ 1 F ' .. H11/611 H11 / 011 -0077 ooo . ooo .000 _ oso -1035 _ 035 4 -.030 .ooo 1100 .ooo .000 . 040 A _.os4 -046 - .054 Flflfl llflfl .000 .000 .000 .mn .000 Łožă -._ Łošš _ .osz V-.oe2_ _ .ošä _-.074 -.052 . .000 I .000 .000 .000 .000 .000 _.iso 130 '-(-.1oo 100 .-' 192, 100 - .220 220 -. .uuu
.üüü .uuu .000 I .000 . UUU .ooo .350 .aoo ` -_ .sso -_.21o . 210 \-250 -.250 _-.300 .021 (+.025 +025 +.015 +018 010 -++021 +015]"+. -+ .002 l+.003 +.0 0 3 +.oo2 +002 *+0O2 +002 r\r\r\ KV ' INC!-I INCH *;Čil,í`1 1 _-.030 .osońl1-.000 _ ose" _.ooo - .060 _ -.- .071 071__ _- .010 .oro - .012 _ I: 1% H7/ KB ILOCATIONALTRANSITION I-I7./I15
115,0 Fit)-Accurate LOGATIONAL TRANSITION FIT (Tap Fit) - Accurate location . H7 / n5 H7i/ns where assembly requires gentle persuasion. (Lła) (L13) |.|'I // n5 „B H7 ll I.-\ (LI5) 'Zia, I LUCATIONAL LOCATIONAL TRANSITION FIT - More accurate location where assembly permits greater interference. tnrhnrn 51QQClITlhI\I' nnrmitc nrnzttnr
intnrfnrnnrn IIII\JI\J \al\J\-I\JIIILIIJ rl\)lIIIll ul \J\¢\I~\JI ll l\.\JIl\Jl\-ll l\J\J| H INTERFERENCE FITS n F f\f'\I'\ ('\f\W . r\ l'\I'¥ + 0 *Hg i_SiS +.O62 +.oe2 ++ .0 3 +.03O +.036 +.043 +.o52 .000 Z-b ;:1c: EU"! 1I\D ooo ooo .00 7:35;? H 1 .000 .ooo .ooo .ooo .103 1-Hm-1 n +180 "- I"baa; + on 11T.:.lu 01n7 l +250 |")1|'\ 1, Olifl 4'+' '+ T.z.uu H12 I +100 +109
+.12G +150 ii H .00o .000 l .000 .000 .000 lg};' '3 -L 4ZCTI'4 EECCDC? U) 000l .000 .000 .000 1 .000 +. 025 I HQ91 +.025 1"l -I_.IC-U - T-IU U I _I_. L- IU .000 -an IU + .074 "+.o74 .000 ooo + Qfifi `; uuu Qflfl r.uuu .000 :Il: -1- .1 IIE n-4n 'I'UIL .087 + .1087 .000 1300 + .350 .000 Q5-In uuu \` 'C 'C :5 (55 '~5- u7r..R u'I /_R n.Ip.. ¡_¡.¡p.. (Lnz) (L112)
MliHII l1I11lMII1l Il H7/s5 H7/sfi H7 / s5 sfi -__ (FN2) H7/ ufi H7/u5 H7// U5 u5 H7 (F114) (FH4) ..„.. 2: In ,__ |..LUUH CI Cl :!ca =1' -:I '.. E1 1 I 1? ie accuracy :I -1"l'I I:.l1l:I'IbI: E? 2: r: -l"IIIlt.t accuraoy UI of lUU'ctllUIl location I-Pl"II-III'\P I'\._!.____ ...___.. _1l__1f__ ~.:: where 3 assembl rigi dlty. ` wher ca semblEE2- iti)and shrink fits on light
sections. FORCE FIT (Press Fit) - For assembly of components vvhere FURCE where high pressures and stresses are permitted. NOTE : See pages 74 &81 75 for 'z`liff~"1_ií1 and pages 72 & 73 for I.N§H_.tolerances. lN__(;__l-l tolerances. MEI / 12 _f /_-1 ».~t IE PREFERRED PREEEBBED LIMITS LIMIIS 81 & FITS PREFERRED PREFERBED LIMITS
81 & FITS The following chart covers a simple selection of Preferred Fits (Hole Basis) for Holes 81& Shafts which will meet the needs of a large proportion of the requirements for „. _ _ _. _. »- _ _ - . _ _ .- _ ,-_._ _ _ _ _ „-.-.___ ____ -za n__ |-z.n__=____ n=-_-\ Standard Components. \HCIEI (Refer PËQG page 71 Designations). ÐIEIHUHIU Engineering
Ellglllflülllg DUHIPUIIEIILS. I I for IUI Fit lll UESIQIIHIIUIISL The following chart covers a simple selection of Preferred Fits (Hole Basis) for Holes &81 Shafts which will meet the needs of a large proportion of the requirements for l_| | f To scale for diadia-_ meterrange 18 mm to 30 mm 1030mm , I Free Running nunning 1 CLEARANCE 5 "5 Close
Running close Sliding snning ; ; Standard Fii l1neinnaI'inneI Qfzndarrl Fnninnnrinrr flnmnnnnnfc Iflnfar nana ìnr nncinnalinnd .„„..„.„...... Fnninnorinn ._..=,..„„...=, finmnnnnntq „..,...„„ nann ,...,„. 71 . . fnr .„„ .Fił ....,.........-,. I-\¢lll\J I I-IIvII|\]\JIIIIu Locaiionai +075 Clearance Wlransitiorr Transition _!!Ql _E$_i LI!.l _lL.E.§_1 1 1 1 1 ,
1. o 1 ! 0 "IIIIfll.-IE.SIi Š Hlíiíí . 1 i .1 . II0 1 1 --.1oo-, .100 Nnminalnia lmml 1 ++.052 .052 30 50 1 120 120 180 180 100 '_ — 31 3155 400 250 250 ——— v—- ———— — — — 400 500 |-|8 H8 - 014 014 - 039 039 020 - .020 - .050 050 -025 025 - 061 061 - 032 032 075 - .075 +014 +.014 .000 000 +018 .000 +.022 + .022 000 .000 +.027 .000 +.033
.000 000 I +062 +.062 flflfi .000 .UUU - .050 050 - ,112 112 f+fl87 +087 .000 000 1+.100 +.100 .000 I+.115 +.115 000 l+.130 +.130 I '000 250 000 zao ` 515 :ns 1 .000 — Q9 e9 - .040 040 - .092 092 1 +.074 +074 80: 000 80 000 120 1 1—— 1 I+.140 +.140 A .000)+.155 +155 i(.000 000 IYI I II iYYIuIIZ\I¥II¥!l Interference lnlerference g 'L: I' Drive
1 - .000 +039 +.039 .000 + 046 060 +.046 060 134 .000 .134 000 072 +.054 .072 ,159 159 l .000 O84 1 + +.063 .063 084 .185 185 .000 ,100 +072 100 1 +.072 .215 215 l .000 ooo 110 - .110 240 -.240 125 - .125 - .265 135 -135 - .290 290 +.oe1 .ooo +.089 +.oeo +.081 .000 .000 _1—TI'If_! + 097 +HUU(.000 -we f1 f7 H7 |-|7 -006 006 +.010 -016_
.000 _-- I215 .010 +012 H7 H7 Q6 g6 +010 -.002)` +.010 .000 -008 .000 -.008 --.004 .004 i --.012 .012 I *+.o1*5"ñŽ.'ooŠ +.015 ~ .005 = .000 .014 .ooo -_ 014 +.o1e -_ .006 .ooo " +.018 .ooo -_ .o17 .000 .017 |'|6 he 2"' 2 65 10 IO 10 18 115 10 30 l +.021 + ozr l .000 .ooo 30 50 + .025 025 .000 006 - .006 .000 000 50 5O rs 65 +030 +.030 all1 .000 BO
55 80 + 012 +.012 - 008 .008 .000 ` _ .ozo 025 g -_ .oro .016 -_ .oa4 .034 ~- .020 +.021 041 .V .000 -- .041 .000 +015 +.015 .000 +018 +.018 -.009 .000 00 BO 1'IOU 00 120 120 .000 .000 - .011 .000 1 00 'IUD - .007 - .020 +021 +.021 .000 _ .000 120 -013 -.013 .000 140 _ .ozs 025 I +.o2swŠ.oo9 +025 -.000 + .025 +.O25 --.016 016 .000 _ .ofa ~.013
nr:n I -you - .050 000 .000 .000 flfil: -' 025 .ULu' .000 _.ooo l +.oso _.o1o - .010 + .030 +1050 --.029 .029 .000 ,000 - 019 .000 --.036 036 +.035 +035 071 -.0711 .000 - .012 — .034 -034 035 + .035 .000 - .022 .000 --,.043 - .083 - .014 . +.O40 + 040 - .039 .000 000 flflfl .UUU - .030 +.030 --0601 .060 .000 000 l - .050 096 _oool O56 _.ose 108 _.too 062
_.oo2l _.nel 119 _.ooo ` _.1s1» 131_ nnn 7 '.UUU +040 +.040 .000 +.046 .000 ooo +.os2 .ooo +.057 +.os7 ' .ooo .000 +.oos .ooo .000 +.052 .000 . nnn WHUUO - .015 015 - .044 044 _.o17 .049 .018 -_.oro .054 —-.os4 _.o2o _.ooo -.060 - .017 - .049 nnn ' .ULU +.052 + 052 .000 +.057 + .057 .000 + .063 +063 .000 +021 +.021 +.oo2 +.002 (150 160 I
+.o2s I ++035 +.025 .035 +003 + .003 ` .000 + .040 i +.o4o + 040 +028 + .028 . +.040 +003 +.003 I .000 'OQo .000 100 160 200 ZOO 225 225 250 Z50 250 ._+. +.O46 +046 .000 b0O .000 .000 HI IlBIlBlI íII Il IlMl 315 QA- son 355 355 400 400 450 459 Č 450 500 +.046 +046 000 000 H? |-|7 ++ .o4o .046 .ooo .uuu 1 +.052+ 052 .ooo .000)_ .036
+.052 +052 + 036 +004 +.004 , .000 + 066 +066 +034 4-.034 + .052 +052 .000 .057 _ ++.os7 .000 .ooo +040 +.004 +004 + .057 -1-.057 .000 +.073 +073 +037 + .057 .000 + .+ .063 3 O')OJ 000 tacaC: ++045 .045 ++005 .005 +063 II' CJZCDC') CD00 .000 .080 + .060 + .040 + + _ c:cao:c>caoa>caccoo:>r.-z 11 280 +004 + .004 pö p6 I 42 200
260 315 na + .033 +033 |-|7 ¡_|1 +.052 + .052 .000 1' / _-; '- .: 1/ -. , 36 sfi +.010 .000 .000 _ooo 100 180 290 200 '"" _'.'T"—I +.O2O +.020 +010 +.012 +.010 +.OO4 +006 _.000_ .000 +.014 +006 +.004 b +.016 'I +.012 +027 "+016 +017 +.020 +.012 +.027 + .008 .000 +.012 , .000 .000 +019 +.012 +008 +015 +024 +019 +.015 +.O24 +.019 +032
+ .023 +010 +.010 .000 +.015 .000 +023 + .039 +018 +029 +.o2a` +.018 +.o1'o +.O29 +.023 +.018 +.039 +018 +.012 +.O18 +028 .000 +028 + 035 + o4o 'I +.02B .035 +021 +.021. +.048 + 025 +.D2t + 021 +015 +.O15 .000 + .022 .000 _ +.035 +035 I +033 +.025 ++042 .042 +025 + .025 +059 +059 +043 +.017 .000 _++.026 .026 _
.000 + .043 I +030 +072 .000 +053 +039 + .030 +051 +.039 +.O51 +.O53 +078 + .020 +020 .000 +032 + 030 .030 +076 .000 +.059 +059 +093 + 035 .035 +.093 + 045 +035 + .059 +045 + .035 +071 ~ .000 +.071 +.101 I +023 +.023 .000 + .037 ++035 .035 +.1o1 .000 ,+019 +.079 1 ++040 .040 +.117 +092 000 .000 +.092 +125 ++052 .052
+ .040 ++068 .068 + ++040 .040 +.125 .000 ++027 .027 .000 ++043 .043 +.100 +133 ++040 .040 +.133 +.108 000 .000 +1.03) i +046* +.151 + .046 I1 51_ 1 .000 ooo +.122 +.060 ++.046 .046 +.079 ' +.o4o + .046 +.159 .ooo +050 +031 .000 +.031 +.050 .000 +.130 +.010 ++030 .030 .000 +035 I` +.035 .000 i .000 .000 052 - 032 1 160 140
141] - .022 .000 -- .025 .025 .000 .000 - 036 .000 Rf-1 R -- .u'+u .040 .000 |16 ne H7 +.010 .006 I +010 + 006 .000 .000 +.009 +.012 +009 +012 +.001 .000 +.D01 +.010 +.015 000 +0 +.015 .000 +001 __ .000 +.001 +.012 1 +.018 +018 +.001 !, .000 +0155 ` + +021 +.0t .021 +002 +.002 .000 +.018 .025 +018 (++.025 +.0O2 . .000 +.002 11 + 046 -- .159 .029 3
+045 .000 .000 +.015 .000 +018 +.018 .000 10 III +.012 .000 -.010 -.022 022 +.010 +010 .000 +.012 .000 3 _ 1-.. I. I. 1 |.-_-. ? * , 0 1I -. Toleranoes in mm Tolerances 65 Tolerances in mm Tolerar 103310111111 Nomioa! Dia. 1r=1-=*1Il 9 11155 ,Up1o Above Uplo &81 ir7cl.II incl. H Hg +.025 +025 O0133 .000 .000 +.030 +030 33456 .000 .000
+.036 +.036 66`10 10? .000 +043 1 +.043 10 18 _¢CD _¢Cb . .000 I Transition T' 1 O0 BO 80 I Ila-pin-ml ('I-nan 1""-11-.~\ 3 50 i Nominalýâize (mm) IIUIIIIIIGI DILII IIIIIIIII] H7 |(6 7 Ahove Above Uplo Uplo&incl.1 & incl H7kfi .050-- .050 30 1 SHAFTS 1 J 1 SHÅFTS liflfliii 18 'IIHIYI + .050 +050 v- +.025 +.o25 I UVINEFUIIUEILUI dia-__ _ Type "IF"
MF" To scale for dia-_ _ TYPE meter range 39 30 mm rn_A_us|r|oný _ g|NrEnFEnENcE meterrange TRANSITION INTERFERENCE to 50 mm "f t050mm I " Looatiooal 1 Looationa! LooatIi05a! _ I I\.I§0iom Localional Locational 7 Locational Medium Type 0' F" Tvpem Fit _ - _ ~+ + 050 +.o5o—l w--w , _ za EI._; / +.088 + 088 .055 + .056 052 + .052 .000
+057 + .057 +098 .000 +.062 +062 1 +.057 +057 .000 > 000 +.10B ++ Q-A sac:mam +060 .063 1 ++063 000 .000 nnnj 7 1 . ++063 .UUO 1 .000 +-fee +162 I +.14u +J40_ +.190 +.J40_ +.190 +.158 +.156 +.202 +.170 1 +.17O + .226 II +.226 +.190 + .244 + .208 +208 + .272 + .232 nnn 'I'.LUL +. .292 + .252 V»._ .; _ =_»».¢. .~ * r-'-1' .< 1.4- 5"-'-. -'1-, -.1. .-:
1..,'.- :- -'- . "-_~ - 1é '-;-=:-_»'\'?.,._-4: .1. ,_ L.~;\"Q.L. ;I_. :_-'-.', fi.v,_,_,-.A,5'-1_-.' _ , 1 , .-._..«„¡=eę'r: =.- -._-.1--: 1'. ._'~:-,~-;» _:1 .zz':< 4.,»- \I -B HI ,-1 o11v1ens1o111s mmfiuslous o1= of 1111ons1z Mon_sE TAPER l F __{ ' 1. a '1 __; hep is \az g C L» 'L?' Morse MNSE Taper Nn_ Nu, 11Å 3B cC 11 hi un: -P -li UT Hi '`I I I!-I1 11H (111111;
11111511 wam' g Morse Taper Nu. N0. 4 5 \\\\ 77 iii 1 IIIII L1. 111 1111 1 -{mini Y 1;1111111. '11.11 11," 1j11111111 1"1111.:i- 595 595 1 _ 37 - _ _ 4-03._ 9;1 l-4;0'5410: . 3; 1 1 L, 1:-B 10r\~\:1 42 Taper No. (mm) T"""°"°' {mm} 00 6.350 11 9.754 short" 1.3.940 13.940 2 short 91.- W22 33 33 943 iv 22 C:Cl .-0 sS _ ,_ ____ _,__ 7 _____,_____ ' _,_ `
1 _ .12 11 . _ _| =33»1L_L_J L "7 i-1% 2° 1 124 -an -5 Q1 GI :AI CA3 __ E |_0z10n1 01 _*Ñ 1 U1-5 flllh _Datum or Gauge Gfl"fl@P'plane @"@ DIN 4 310 B10 ,"", 1._Nu_ Nu, 1111111} 1mm1 1 N N 1 1111111} (mm) l 111111111 1011111;i 1_1"1"1111§1 tmml S {n'(mtv) 11'11_} Q n-1 f\ OJ I\1ll'\fI_1 U.U'-I'-530 | l'\J I\J I\J CJO (I1 lllflflălâhl . 1 l""I \J
--4-w !\J l\J \I Kl -.- 1.11. ,~—» :1 -1; — — -» ,_ ;i. _i _-. -» -.. -.,-. -:3, - -.,-.:. .,\.»Ì' -.1 " -:.; _-- -, ;' ' 5"'-'-3' _; _.-» _/1:; . 12.305 12.386 _ 42229 22.225 14.237 _ 14.237 25.400 _25&19 0.074929 004929 7 0.07709 007709 0.08155 0.03155 19.05 19.050#3 12.305 12.386 Taper per mm Included Angle (Apprpx (Approx.) lncludältlle on Dia. 1 Min. Deg. Mill.
18.951 '1 30.955 28.550 > 23550 . 35.890 35.390 25.345 26.346 32.422 32.422 1 42.049 47.625 0.05241 0.05168 005168 Marsa 1 Morse 15.052 15.852 D 11 . 1 25.400 25.400 d11 (HWI1 (mm) 1 5 l\D _. OJ 7 53154 g _ g 51 4 27 1--|_' 3| uwmuw _._m 44 '+1 52 7_ 31- \r:=- g CAJ.I:>|\3U'1 58 0 31 Ž 52 1.59 mm-_ .n .ooooru "1.2 -,_ »mm\>|\>-L Ž L 56
55 44 -I> -5 Illl BI li tl ilt l fltil fll I -_ Q3 C43 39 39 _ ËL it Ĺ 733 _ 50 58 02 'o2 II\7I\DI\D7 59 58 1 _L_ . _l '7T 49 4_9__ ! -1 J>.-D|\'¡ -h- Du OD |\`JĹAJ-Iä-à |\D L Taper per mm included Angle m Included 0nDia. See. cu ((mm) iiqmlil on Dia. -_._._E'QDeg. -.2 'P Min. Sec. I\J PO UT _a _L U1 |\J I\J |'\D\J|\3 OJ T3|JB.l' 0 _ 05205 1 3 L 49.2 _n 1_9.g5 _ 53.5_
._52.5 _5251 5.4 49.2 3 4.4 0.05205 39.045 _ 353.5 6.4 112.055 70.0 70.0_ 555 9.4_ 52L 5.5 _ g_ ..11 112.055 52.4 5.5 209% 0.04988 2 9.4 14.5 2 l1r.r5o 75.5" Ž14.5__ _D0.0 17.750 34.5 04.5_ 75.5 53.5 5.7 0049951 |\:r×:|\:a 9.8 17.3 7T123.325 335g_ 119.5_ 23.025 105.0" 105.1'J_03.5 77.0_ 8.3 0.3 0.05020 0.050201 4 1 31.257 31. 257 140.0 1400.
105.5 1055. 25.9 25.9 ' 9314 90.4 Z 12.3 0.05194 0.051941 37.4 AĹ125.4_10.0 005253 125.4 ' 16.6 0.05263 5 1`44.3í'155.0"132.0 44.399 165.0 132.0 " 37.4 1770 -109 1012 nn521z1`, _×z p r— — l 20.599 l'\J\D Taper 4 included |n|; uded Angle _l _ _ _íl _ 1-pe perrmm. mm. 1~~ . 5 ~'~ _ l 5 :I 1 See. Min. Sec. 1mn^11 in 1_1'r111t,1 1 un on dla dia.
19Ë :Deg. K LL (mm) (mm) 5.802 11.112 15.5 OD CD{D 8.469 11 16.66 10.094 1 9.4 004988 1 10.094 14.5 0.04988 >12_055111_1 10_5__ 0.04988 12.065 004900" 18.5 11.1 15.733 . 14.5 , 24.0 _.3 0.04995 004995 % 15.233 2410 B13 16.2 ;__å2-Q_.__°Ë995____ 32.0 0.04995 B;1_8__i W _ _ 1. 17.780 1_7»7Ë.°__"Ë 022 1 21.793 19.8 40.5 B22 __
__2L793_ 19-3_Ë 4°_-5 _ 0.05020 0-05929 _ 024 (T737 1 23,8 2 5 21.3 505_ _ 0.05020 0.05020 524 923325537 7 50.5 í×\\\\\\\\\\\\ L M L1|V| \ 0.0B155 Ollifli. 0.05350 0.05191 0.05191 005325 0.05325 g__ B12 012 „_ 11 015 9 315 _\\\\\\\\\\\` Datum or or l — 0a10m ———————1-- Gaugeplane A A 1'L; 1 1 (mm) D TaperNo. Taper
TaperNo. (mm) Taperlilo. No.1 (mi?) 1211 L Morse Taper L1 14.199 15.050 15.350 17.170 717.170 DIN Taper _+ _ 0 "_\\\\\\\\\\\\\v _,F .!.Sw;T A11 \ MM in Tager Socket Morse Taper 1 1 Jacobs Jacobs Taper Ta 9' Jacobs 1]010d J-9_ Morse Taper Shank U1,-h _ 51.0 Lg 51-0 :3 II ...:u. n Wllll IIiCID E CI :5.Ë1::CID 1..na::_ na CID CI. (CI el | Gauge plane
PQI mm. per mm. IE, 5| I (mm {:111' 1"1_l 'W 819 //_ Datum or Unm) on d¡¡_ DEQ. SEC. lmml (mm)s; (mm) 1f:1r1111ii{_1111"1' (11t11'1)gl111111"1_lgi*ondia. 1390- MII1. M1"- Sec. f54 7 l I\J 53 4 3.91 4 0.05205 r\J 50 54 _3.9 _ 56 5 565 595 - _ 59-5- . 27 57 1 0.04988 I\J 511 27 112.055 3.5 53.5 53.5 62.0 520 55.5 12.065 3.5 65.5 _,_5.2_ 1 117701"!
r:nl 55.0 RC H 71: n 17 'onn' no I rt n/mgr: :1 Y "r1 /11 004995 ru.u u.u'-rauu PO Ul 117.780 5.0 75.0 80.0 . U-U u.u| U\J.U ' IIIJUU L 35"" 521 31_4.0 mmm ¡-\;. _~ A DJ-à \\t.el'amCD 7 0.05020 mmmI\J 23.325 5.0 5.0 99.0 ___1_`1_J|"\: 123.025 01.0 94.0 9W'99.0 _ z 331.267 1. 2 57 5.5 1. 5%7f5_124_0 11 124.0 11.91 na 11.9 g_ 80 A 0.05194 0.05194
l'\3 31_e M A 53 Ut 00g 6.5 10 101.5 117.5 cu _0'52 O 01 |\7 156.0 15.9 10 0.05263 ;1 44.399 6.5 130.5 44399 _ 5.5 1305 __ 149.5 149.5 155.0 10 0.05253 _;|\J 7 N 53.343 183.0 19.0 13 0.U5214 0.05214 (J1 (D 1153340 _ 8.0 I 1030 _ 3210.0\ 210.0 218.0 2100 19.01 0101 CDKD 44_hd -Ä 33.053 10.0 251.0 1286.0 103.050 10.0 1251.0 2550 296.0 2950
28.6 20.5 19 0.05200 I|\J\J|\ |0Ov 755 1111111} 11111111 1 1_°*1 I 11;? 1J 1 Taper T3P9|' 1 lncludedfilngle Inltltlded Angle 1 0 1 9.045 3.0 _QJĹË @Q Bil 7/ E C EE * 1=F >31 -1- .{:}._._._,_._._._.-._. ml FOB Purposes) FOR DRILL OHUGKS GHUGKS (For (F0r Identification ldentification Purp0SeS) 9'"T F 154415 .=--~.:..'-"..1- .\=
mnzuslous or of .1Acoes mass a0 om um mzns nrrnensrons rneens SHANKS/SOCKETS (For Purposes) SHÅNKS/SUUKETS (101 Identification |U9m|T|C3l|0n |"UlP0395) Morse Taper Shank 9.01; .-_' 1 lI'\>Jl\J'\|JD IO \I % JIU1 ._¡..|..._1; _; w-I 01101 1\TI|'\3 '\l"\l §à--_a_L 1.51141 p52} 31 _. _. 31 24 52rum*{J1U'lŠJ'I 0: DIN Tapered Sections are identical
with the lollowing lulluwing Morse Tapers : ntgg: B10 81& B12 for tur Morse Taper No.1 B16 81& B18 for tor Morse Taper No. 2 B22 81& B24 B24101 im Morse |'vi0rse Taper Táper hie. N0. 3 The length of each of these tapers is less than the overall length of the corresponding Morse Taper. Each taper may be regarded as corresponding
approximately either to B1 0 orto the part nearesl that part of the Morse Taper nearestthe nearest the smaller end, e.g. B10 nearest to the large end, eg. Bi 2. l"@'fif9°e"d»°-9-512- „_ 1354 . PRINGIPAL DIMENSIUNS DF MILLING M/G ARBDRS/SHANKS Identification Purposes) ARBOIIS/SHANKS (For ldentification 1so/nr isoznr 01112030 0012000
Taper rage: _ - 1-11 ' . flifi "\. F/.É i I 13';5 'M3 Z"_1~"\ 4i1911 115151 1s0/111 ISO/NT 01 D1 \I 01 1 Dal p LL § M M 1 U) \I UI Qi I _ U 1?' m * 09 :Q MAS/BT U .. U urns/er, 01 , 02*) 05 I 3 »S „u ...L 30 bi C 35 __40_ 0:: 46 55.141 50.14 u A0 _31.7_5______ 1_ 53 165 55. 681 daoo _ I\J 11 I -up 1 _ 45 4% 0-1owl-:>o1">7"' :*=~9°. _.,4>_u-1U. -«owo
35mawa 50 Q': 55'_ oo0'1 p 100 100 HSK 0111 DIN 59393-1 69893-1 11s1< Form A Taper -DO1 @(7 01-|=> 'L A4 J I % -il- _:_ U1 U1 101.13 101.8 B1 50 flllflä €= 63 _ CBęC:= 3.7.0 ' 45.0 \I CD '-lCD U1 L11 (A) @CC CT!U'l-l>à- CDZTD U7U' _ 7 33.3 , f_000 __. S°_ 3 109.7 _LCO3 CDË @_CO _-L 3 \I \I-¡> I\)|\.'I UTC
\I "\l'\l-|>~ OOI\Jl\J l'\JU'l€ \I -\I "-.l "\l ez*_ 922 ?"_ I1 "4 -'3 17' 1 'PT 2_ 7 O)I I\3 PO I'\CD I\2PO I\'JCD ;"%~'2'» ": -' -' 5. -:. ,_:- j-1 '!_._c '.___.. .3-:-,_ -9,,-1 :.,_;- 4;: 5'"-. -. -_,_.- -;.__-F _-. -: 1 _.s. I\J __.1 _.. : www _;|._1|._L|. >Ä'~-—*Å @CD @CD ODCD COCD f 5 `». 1* ii. "!\-"uF(J1w^u°i.owo Iocnuio co ocu w .\' LO CD _à (Ð -u-L |'\) |\) G Z
S T (thread) 16.1 16.1 M12 M16 M20 _M24 M E-I _. -»—1———_.- ___ /1\1 _ Z 3 . I17 0* 1 1 _ _-L L-_Å Ö L if f L- Hfif r iii? nimznsiuns Dimensions 111 In mm mm T (thread) 1 T1lI1read) I Metric inch Inch 1MeIric` Ausl/cm IŠ ANSI/CAT 0, 01 1 0, 02 G an E 1 -r!\" co Q 5/3*u1\1c gap 40 __44.45 44.45 _(53.55 72.30 50.4 I 40.0 1 15.1 1 1115 M15
15/0"uNc 45 _ 5715 1120 (3/4"u1\1c 57.15 _(3255 52.55 _ 91.35 02.7 j 51.5 19.3 1 M20 3_/4"uNc 1017 1 75.9 75 25 1 111124 1"1\1c 501:: 59.05 i 9345 90.45 107.25 101_7 25.7 M24 1"uN0 5935 (D 7'.rxa 0-1 R8 Ta er Keyway p___ 101 no Rs Ta ar Keyway 101.00 *if* Cl! 'L 311 775 23 81 5 7.6 20 70.20 X '"|'\ _ Type Ena 15113 _ SH* RBIIQE 11 _ ze
0.55.01 0.5 05-51 F_3 QB_3 1.0-13.0 ._ 1.0-15.0 1 2.0 - 20.0 1 ' 33.0-25.0 261 1 ri1: i 5-1,. 1. ų_. .2 _ 1% 15050 5.0 -34.01 ER 50 W50-34 ëšë 1 ' ____ 5°25'30"8 25 30 _El 1 EH11 _0.5 7_0__ _11.5 ER16 _ 0.5 -10.01 17.0 ER 20 5520 ER 25 5025 ER 32 51132 "40 5040 ER _ lit; _ 11,1..'"' _._._ '--.lU'! Š'-L i"1[?'I7 " 3 ;1___________________1__________ E :
—'Z1"-Z En collets L ///3 3 _ 7/10" UNF °fO-'I!=5M12 1 nn' 35.4 47.8 Xrnfii @Ë- J 'A I _ Š 7!Q0f551 piis 0&2; —w 91 1 _.iiEX_i-I1 M18×1.0 111131110 l\/lonm M20x1.5 _ ....._.,„ ___.. 0:I M24×1_5 M24x1.5 47.8 68.4 "\l 24.11 1'3-_->1 1 I _ 7" 2 38 deep M12×1.0 U'U1l-I -'=| ~C10O\! U-C.17O|\Jl\J>-lJ"5- 1'- " -W I l./l10×1__0 M1011 - M12X1.0 If W;
M16×1.0 ___ (JD (TI.l>CCD 2CDI' U"lJ1' :- \'> , T (thread) __._ S i 7230 \I I" ne o 9135 _ 02.7 __ 50.4 _ 19.3 _ 91.35 S 107 25 I 101.7 1017 73.2 25.7 107.25 o czlu-1!".°°F:' cnu-1 : 0-10-to I-B Z ËOUUI ËCDËUT : LS2 *--\i10') 1 -_'--; '-: 'fi"' '3 " ' 1513' {'1' 5° -1.3 -:' 9. 1 69.82 0 M reN @ _ I_59 _ 59.30 44.20 20 W100 wide ' D1me1's10ns Dimensions 111
in mm n111 _ 1:11 1'/>ž: 1|_L'.__L X'-Z š $3 _.L 3-,I- .B 7 7 59.37 SD 7 72.3 72.3 7 UI -Ilä'>flaüfifl 03 @®@ L___ 1_¡00 bi _ »E T___ 3.'? \É Ä E3 |'\j_L Z6') -_ 57.15' o"_:cn.1> woo-1 57.15 mi A l . '17igié 0 M3 -5'-_______--f* $G É ___ Ć :- CD . _L CA3 LTI i _ 11 §.=.=' 93'?' uË :aI-O ll 09 IB IHÐMBIÐBNB 5 (3 :1 177 'AD \7 -2 40 E l1\a .00;-L
"25.7 M24 r\19" -\1 _ 70.0 70.8 _ Ö M12 _ _ 19.3 19-1 11 _ _ma M20 cn 1_-. 16.1 - .L .mw9150|\:i\: 45.2 E" oo ` 53.2 co82.8 58.2 V/ :I:en := HSK 33 Dimensions ip in mm l\l'\f\ _._ _ 1 ANSI/CAT ANSILCAT Taper Tager u E: 5s 17111110 1T(*"'°"'), 15.1 111'IL" 10.1 1I 111" cam 919" .:>4> 1 _________ 65.4 cc __. _. rmMoo 119.02 1 (119.02) G? (D T U'I
5 C! 75.501 75.68 100.21 Ž 1100.211 63 .1:-no:"=',P°-1:-1mo—~ -hrhiZ01 G'l'l Z I—f\Jl1 _I 1 I ZM :I48.4 32.0 40.4 32.5_ 56.4 _) 39.2 ` -l>-'c-n5c100aca GlQ1; là-åfiú Q1 $U'l$Ë lll r- 1:G1 Nhi 3 pl- _L _1_ L} 141 U% 1 U D1 on kl (J1 31.75 44.45 -7452. 3 _Ë _, 2_ Da I11 mm DimensionsS in EZ z G'I|'-Tl ZZ HÐUI @Š _ _, _ 2.1 líå -B(D -B (J1 3 @ D4 02N 03
04 57%! 1 ._| 1 M24 . 1"u1\1c 1"uNc_39.5 59.05 97.5 _ 101.3 1010 70.5 25.7) 11124 39.5_1 59.351 97.51 1/4"o1\1c7M30 (111/4"uN0 50.2 120.0__p_ 25.7 I 11130 00.2 107.95 155.0 151.3 1510 120.0 MAS ~54B" M 4„ MÅS 403 BT Taper Tager _ _ 0150 1 T (thread) _I Metric; lnch 4 sS i : 4»----_~.--4'g1--------_ 1/ $33: 113' p 11112 Ii 1/2" uNc 1.110 16.1
11/L_1/2" . _z _ _ I 32.4 I 15.1 31.751 50.0_ S 43.41 L (11115 5/3"1.151c M15 5/0" UNC .1 44.45 (55.44 45.0 31.1 44.451 753.0 53_0_1_55_4_ 1_5 M20 3/4'1 3/4" _ųrg 57.15 00.0__ 02.0 50.0 _ 19.3 ?11120 57.15 80.0 -Ä r1iéi'11ir"7' Dimensions in mm Dinrensions _ ii 111 __ Ž 4 14.4 , : 02 Dz _L _17.4 7 7f_5.3 25.3 1 32.4 32.4 èàbå-5-RCA)IUI'-FËIZËZ n
D @#351 _ 7 1 ——>—-4 PL 1 DIN 69871 TTaper Q pin.5. I pi"- _ IIINGIPAL DIMENSIDNS DF MILLING M/C Ši 'U UI ünå/SHANKS (For ldentification ARBDRS/SHANKS ldent1f1cat1on Purposes) 1 Q3_3 Dimensions DllTl8i'lSl0flS inIN mm 1_ __ Number of Cullels in _Collets inSet_ 13.5 9 18.0 13 27.5 _ 21.0 31.5 _ 20.0 34.0 33.0 40.0 3 45.0 41.0 52.0
50.0 _1._1. 0301) lUl\7|'\D @CO-Å _l—~r\: r\>—~-\I 1c:o _o-c:no.> _ 7-Q 3 1181 T.,.. .»._.- »_,.,..._.4.. ,_ . . . . . " " - 'f~ 5'' 1- 1',1 F"-=1 --.-7 »-4-. .4 \. 5'< .1-. -- . 1 3 -E .-.- 6 n* '"-' -t-2-'. '.--- '. ;.-.,1' -.>»,. ,,~ 21.,-:1-'1..:-"-'5...< 1 " ' ;~-'==-'- -"-'-'; 1: .;-'1'-.5 fr;'_'r ' 1'-:£ ' - '' :-,-1 ' ' '- '- -5.!' .-.* 1' _ 1- :1 1- ;—. -:%'-.-1:3? 2-Q22 551?. smnnnnu sninnnnn PULL
1>uLL STUDS/RETENTIONKNDES5 s_Tun_s/nsrinnon Knoas 1-:{;',;: -_;j'. -f;_,';':;_.;t_.--1,, 's .'_t '_ 1- j. »'I 'E1 ,_ STANDARD Ih I: I: lbli I: T-SLOTS -.-I10 ID -|lk __ _ Qor 1|'0|' Identification IOBHIITICHIIOH Purposes) FUTDUSBS) i MAS 403 L * L L Standard iti METRE, 81& MÅT-Slots INCH T-Slots -11*" L173. Ci Lotta Q 1..1 _.~ê.. Q 1.5%... A L132...
1.1:1ä..2.=1" , __ .5.Lp0l . -l 1 =34 .. 414 .. 515 .. 45 60° °° L Dimmonsinmš Dintensions in mm 'Taper? Taper 30 an _ 40 40 50 50 A 0D 11 15 15 23 23 T e1-45 T B1 - 45 A 1 11 11 Ä TT e62-60 2 - 60 TX? FW T e3-90 T e 3 - go /22 \ 1/4Š* 01D1 02 5050101': Dz 1 i.r" l iL1.1 1711111550)' 1T(lhraad) ånfllr Taper N0. 7 _ 155 M12 'Type 16.5 _ 431131 1 10
11/112 :1;ăŽ'N°10 E5 10 123.0 23-0 __50123 _ 28 @G z With/without With/withoutthrough through coolant hole 17 35 35 M24 O Ring 17 133.0 . 38.0 006:-:> 35 M24 z With/without With/without With/withoutORing l / ŠJIGQJ I0 DIN 69872 __ L__* L L L1i>1 L1 I \\\\\ / \\ Y 111111151:: 1_5{1111:1:1 I _. I _ 1 ' 1 -1 to '111||II 11 -1 15 1M-111515: \-/ 15° TypeA
Tygeli D¡me,,s„,,,,5 in¡„ mm 51mm-1on5 15° (Furtools with axial coolant supply] suppiy) (Fortools T1938 T[QaB M91713 Memc T'-$1913 1331015 (For tools with coolant supply via the flange) Taperil _ Taper 0 1 01 1 D21 021 L l. L1_1T(thread)| 1.1 1T(i1nzzu) ' 30 1 24 1 11112_ M12 j ël'L'Y= 30 _«Č1 13 « 5 1-3 6 Taper No No. —i—1 ._L CA3 14 45 23 1
17 451 |'\D _L l'\.J 1 l'\3 U'! 25 |\3 ..L QJCD ,1 17 21 .._;4} CD _|._|.LO "'-|_\. "'*-J fll 20 1 21 5su _ l\J -5 M16 M15 U3 LTI QJN: @Q7 30 11MÄ) M20 `|"'cJ'>-U-I'|-à --B kih-Iää na .:>-l'=~ OJ Š ru .¡> , Type ' L' wnn/wiinoniinmugn coolant 6601561 hole 11616 0. Witl1/withoutthrough L _Ž ._. I .- .1 1 i 15151:11.511. 3* ll1§i:|:=1 ° *K..i'I5'"15|' 11=i'-11., D .
il|1 Hnii . IE-il T "'1 |l._» -1 ,_| 75%: I-I 45% 75'L_* '-' Dimensions in mm ' I E55-T_l— D1 1 Dz _l.L D2 40 A _ 19.0 1 _ 14.0 14.0 17 n_l191.0 17 40 __?_3_ B_ 13.91_12.9 18.9 12.9 17 45 _ A___ 23.0 2_3.0 1_ 17.0 17.0 21 21 45 __ 16.3 31 24.0 ' 15.3 21 28.0___ 21.0 _2_1.01_ 25 2_5 A 1_ 230 (Il Š 50 G>W> 25U B f 29.0 19.6 l'\I 44.5 26-9-l.41.3 ..w.4_ NHB
26.0 _Mig 1541 M16 65.0 730.0 30.0_ 1 M20 M20 7*_ 55.0 1 56.0 156.0 M20 M20 20.9 1... I1ŠEŠ'"°' Sneciy: , ANSIZCAT L E ' U- »1._ D6 L 0 - ----- -1 g~11f-U«,f1g11¡1l 1-55531 4% Dimensiunsininm Dimensions in mm s c 01- 0, . 75° IYFYI I I I | i| 0,, 7- 'T ni =.. otr 4 J I An nų i 01-1102----~~ 7 I ._ 1'5-.'-.-.'-_- ;--:. ___.-.,¡„„ Dimensions in mm .W 'B'
Max. M510" Min. 7i1 Max. l . „_ ..._ 40.00 1 zu.uo 20.00 ze.uu ZH.UU 50.00 26.001 26.00 36.00 8 22.21 '1 37.00 lI'I . r\r\ r\r\ 4U.UU an 1 an /1") OE an nn OU.UU lL.UU 72.00 DO flfl 42.25 "IL.Ld an 1 ._ -1 15.00 1b.UU 1/4" 1/4~1 _-1 15° i 077 50 —— 1flM1BflÐ1 1BO01ÐB1flB1Il ..1; 'VP | , 1 1 .344 -_ l1 .354 35470'I .594 504 tn! LI __1 1 .656 656 .- 156
` .155 6/sf 0 7.436 .446 .719 1 .731 781 .219 M3»/X3" .433 .443 1/2"2_'_'______ .552 _ 562 .572 .906 A .939 .969 it .312 _______1__[.5727 .905 I A1 .666 1. .593 696 #1133 1.1ss11.250_ . 438 1 5/0" _ .533 . 5/3%' '1.250 .433 _a/4" 1.312 1.375 1 1.459 1.469 .562 1 .012 .322 622 _ 1.375 .552 5/16" 5/16" |._____l._ 1, _-AAA 25.00 A 28.00 25.00 23.0?
32.00 1 35.00 on P 1: c 0 E' c ca 1 .438 433 - .562 .552 .688 V .533 . 875 n .375 1.062 1.052 .D, 5|-1|! U Illlin. Min. 1 Max. .203 .20s__ .234 .234 .4 .255 264 1l 266 93 2| .207 .297 1 .328 626 .s91 .391 .453 .484 _ .453 .434 .594 .525fi .594 1 .625 .359 .359 1.250 .781 .828 .B28 1.031 1.094 1.281 1.344 1.072 _1l50 Jlöü »: .. 1,r:-.'_ _..: -.1;-;.-.'- ;-~.;_, . -. .1.-_
.750 55 W' 1.312 1.322 212512.219 11/4" 1.322 100011.552 2.125 1 2.219 1.000 1 1.562 1/'if' 1.312 11/2" 2.532 1 2.555 1.933 1 1/2" 1.562 1 1.572 2.562 2.656 M 1.250 1 1.936 1.062 1.844 1- -_- --_~ 1-.;_' 1.__;_ ;l=~. _ , 5 _J Dimensions in inches .x. .Y. .c„ M1112} Min. 1 Max. nzx. 1 Min. nnn. l1 Max. nm. I Max. Š naF
232 292 500 552 202 1 .292 .500 1 .562 .125 '_¡. NUI I .375 ba\I Q1 ' G21; 1 _' 'Y' .l\ .,.. . ___. B.UU | 1 15.00 20.00 1. 22.00 22.01? 20.00 1:»-1 nn 58,00 J0.UU 39.00 7!'! fifl 68.00 UU.UU inch 1331013 T-Sims ""311 "IZZ--I 55.3125.2* |\: U1 65.3 07150 '39.50's2.0' 139.50 32.01 25 01150 25.2 M24 11/124 I " A4') flfl 42.00 "l'L.UU "nrninal Nominai
IIUIIIIIIIII 7-311113115 T-Boli Size L 1_!. 1. Tannr Tannr 1 nI: n1 11 1"rm,„„.11| .., . llhrnad\1 \...„,...., ...|--. E? I D2 "ANSI/EAT 40 16.05 18.95_12.9§ 6.4 44.5 . _ M15 J;'15==l= Ansi/cin 40 _ 12.95 _ 171104451 _1 16.40 1v116 SME '— 5 v Taper N0. Ansi/cin 45 ._2405 56.0 M20 1/120_ 0°6 "WM" _ ANSI/CAT 24.05 16.30 ._ 21 2095 Ž.. _ .._45 ' 1830 20
95 5&0 Wnh/witimutthrough With/withoutthrough coolant hole T1431./GA1' 510' 2910 19.60 25 25.55 55.5 With/witl'|OutOFting l\)|'Q 65 5 __ M24 111124 0. wiin/w11110u1oR¡ng A_NåI_/GA_T_5_0_29.10_19_.60__25.55 _._ : km-^:l? 1 53.0 17 53.0 35.0 M 15 L (JTT oTT_40 40 l25.o0_21.1l 25.00 21.1 25.0 M16 |¡ I nn nn 22.00 22.uu
With/withoutlhrough v With/without through coolant hole With/wiihout O Ring ¢6 With/witl100tO Fling _ L nn A____ (U mm Lu mm .c, 'c' 1 Max. Min. 16.00 7.00 11.00 15.00" 7.00 11.00 7.00 1 6,00 3.00 1 13.00 18.00 14.00 9.00 7.00 ' 0.00 8.00 21.00 11.00 I' 17.00 3.00 21.00 8.00 A 9.00 9.00 ' 25 25.00 . oo 12.00 19.00 11.0ĹL 9.00 11.00 32.00 32 00
15.00 16.00 1 24.00 24.00 12.00 14.00 8.00 3.00 QR I\\1\ 36 mm uu |||||| 74.0 34.0 34.0 1LM24_ M24 1 74.0 11 53.5 65.5 25.5 25.5 1 M24 M24 4__ f KY, 24 mm 23.00 28.00 ' 23.21 28.21 45.00 N_24mm" 46.00 30 mm A 35.00 30mm 55.00 & 50.00 36.00 35.25 36.25 756.00 60.00 3300l _46._0o 33.00 . 46.0 0 _ 541265562; 1aQ3aa5a4 Q ý O T 8 B -_ 45
TL 1T(ihread) ,1 *L1L1 §T(thread) 54.0 1_54,0 :3: ||._. 1 -I T 9 A - 750 75 TL Type D Taper 1Type1 A With/without O Ring 06 With/withoutORing |_,_ I80 7388[2 (om 5937170) 25 U1-F; -B -5 2'. .x» Nominal T-Bolt Size T-B0ltSize 6mm filnm Min. A Max. Min. 8.15 1'? 14.50 14.50 V 3.15 8mm, 2 10.00 10.1? 15.00 10,00 1 10.15* 16.00 „_ ý_, 7 .7 *5 I ___ l
A 1 10111111 1'umm _12.00 12.13 19.00 12.00__ 12.18 1_19.00 %_12 _12 mm M 14.00 14.00 14.13 14.18 23.00 23.00 13.00 _ 15111111 16mm 18.00 13.21 18.21 30.00 30.00 IQ -5 40 11 19 __ 2 -- INCH SOUÅRE PÅRALLEL It PAnALLET 19'7 KEYS&K——7EYWAYS KEYS & KEYWÅYS 13.3. (B.S. 46:PART1 46 : PART 1 :1953) : 1958) I1 ¡\\wę
\i\N§.§§\ 1 ww\\\\1 \ 1. 3 \ . g T /4 Q\\\\§1 1 2 1 %/X / 39 P ti L_1 ..-.fi /4 //' 'I-I- / \1 _—l-1 // / 1/ 2 išïfš 8-Kivwm ev=»~ KËYWÅYŠ 111-5. (ĚS. 112=*»5=1=' 4235 : FÅËT 1 . 19721 1972) KEYS 11111T1= \\\\w1.1i9\\\\\1 Ih1 %\\;4i"'|j *fi\\\\1 \ 1 1-11—> I 1 \\v i 5 T / . 2/ - 0414 01 . I Keyway in w :-N= 511511 1 (Bore) KBVWBY 11.Hule 111»
11111-.1.-1 11 K51.-' 94! I 1 .fw _ šš 1 1H1 1/4 1 1/2 1/8 3.125 1 . ______0125_ . 0190 3/4 3/16 1 3/4 3/15 __ 1 0.166 $1.188 1 0.252 111 1/41 1/4 IÉ 0250 0.250 0.314 0.314 U1 _11/4 1_____„_ 5/161 'J as; 0.312 0.312 7 1 0.377 ` 11/21 11/2 3/3 3/B 1 0.375 0.4417 1 0.440 1 3/4 74" _ 0.433 0.436 7/15 1 1/2 _1 7777771" 777 77 '-777.77? 7 3/4 1 11/4 1
1/2 1 3/4 2 NI |\J 2 1 21/2 ' 31/2 CID 1-K"''1-1. |\, hi 'A: Q Wnil"""--IQ 4 I I 0.502 0.502 1/2 _n-ml"""--\hi NI 3 177777 I 5/8 ; 5/8 1 3/4 3/4 1 7/3 7/8 1 1 0.500 0.327 0.627 0.525 0.625 0.752 0.752 0.750 0.750 877 . 00.677 0375 0.675 ' 1.003 _ 1.000 1.000 -4 nnn I.UUO 4151 5 6 1 11/2 1'/2 ' V Dia. (D) "la.--1") 1.504 1.504 1.500 1.500 0.060 0.072__ 0.125
0.125 0.060 1 0.124 0.124 I_ 0.072 F H 1 0.188 0.166 0.113 0.113 0.189 0.169 0.094 I 1111.110 0.010 0.088 0.167__0.1_07 0.166 0.033 0.187 0.107._ 0.188 251 0.121 '1 1-0.010 0.250 0.250 0.148 0.146 0.251 1 011.) _0249 0.249 0.142__0.250 ". 11.250 0.115 11.313 0.143 0.148 7 0.312 0.163 . 0.313 0.010 0.311 0.177 __ 0.312 11.312 0.142 I 0.311
01.1 0.375 u.2i9 0.219 1 0.376 0.376 0.175 I 0.0110 07375 0.374 (0.213 0.375 0.169 1 0.010 0.21 3 1 0.375 0436710254 0.433 1 0.254 0.439 7 0.203 0197 _ 0.020 L 433 0.197 " 243 1:0.436 0.437 1 10.0.246 U.£UU 0.230 0.500 ' 0.289 0501 0.501 OË4 0.020 ' 'l.28 0.500 1.1.499 1-0.283, 0.499 0.500 0.224 0.626 0.284 0.020 0.625 0.360 0.525 0278
0.020 0.624 0.0.354 .. . 354 10.525 0.625 0.278 *7 xii" '7 0š9 0.020 u.33:.1 u.7ou 0.450 7 0.751 6.751] 70.436 0.75 0333 3.333 0.749 A1 0.42 0.424 0.750 0.749 -I" .393 .. 0.87510.501 0.876 0.393 0.375 ' 0.50 10.876 0387 __ 0.062 0.874 0.495 0.875 I 0.337 A 0462 0.374 14mm1n;-m -im-\41 n .443. . 0.446 11.4421 "J52 0062 1 1.000 M I0.442 _ 0.999
0.999 0.566 0.566 __1.000 M162 0.557 77 7.250 1.250 0.713 1 1.252 0.557 0551 1 0.062 1.246 0.707 0_707 1 1.250 0.551 1.243 0&7 11354 1 1.500 0.654 1.502 "GŠ7 M162 1.496 1 0.343 0.646 I 1.500 0.661 0062 1.493 16 1|'! IU 1 Q 12 17 -I1' II H -I 1 _> 22 A__S:> 7 n nnn ._ I n_4'4 n __n -i nnn |.UUU Kfifi l.dUU I n gwn U.Jl'L Un)/Ĺ U. ' -I nn-I l.UUI
|1UU| _ 4-'I-._L CJ1C.I'l|U'! 'ZCD \D CD|\-JZ U 43 043 1 Kev Key . I _ Keyway KBVWHV 111in _Shafl 5'14" 4.000 2.60 3.970 _ 2.50 2.50 3.970 5.000 73.10 3.10 5.000' 4.970 4.970 3.00 OD UI 3 hfl1B1l1Bl4Bfl1B1 ilhl flt tfl __.____ IU X D NJ @ >< I i Hole (Bore) Keyway 1"" 13°19 -2 14544.-5-, Width wnnn (Wh) (W11) 0511111 nepin Radius Max. (I1) (hi
if) (1) „.„ | 4.015 1 1.90 3.985 1.80 3.935 1.30 5.970 _ 3.50 3.50 I 5.965 5.9701 5.935 6.000 . 4.20 4.20" 6.016 3.000' 8.018 I 7. 7.98 2 1 7.964 954 4.00 1* 7.962 10.000 5.20 1 10.018 10016 1 I10.000 99.964 99.962 5.00 . 964 5.00 . 982 I 12.000 ` 5.20 12.0001 12.021 12.021 1 5.20 11.957 1 5.00 11.957 11.979 1 5.00 111.979 14.000I1 5.70 14.000
5.70 '14021 ` 14.021 13.957I 5.50 13.979 13.957 5.50 NJ 4 -'_.-'I1'I'l'3%'tE:lZTlIlII.-I Z171.1IT- 1 .,11.~.1-311."-.-ii'13 Keyway in K8111-W111 in SID _1. O') U.lU 5.0151W7 5.0151 2.40 4.935 _ 2.30 1 4.965 1 5.000 6.0151I1 2.90 6.000*I 3.50 3.607 5.015 290 . 6.000 5..-1 10.000 8.000 36 5.-.-.-.- 10×611g'ggË i N W I 9. 964 _ 77.910 . 910 12.000 6.000
38 . 44 .12xBj12.000 3.000 38 44 12118 11957 j 111.9571 7.910 1 56 114". 14.000 9.000 9.000 1 1"'"9 13.957 3.910 6.910 58 116 1016.000' 16.000' 16.000 1 10.000 10000"T6.0001 50 50 56 1611101 1 1 ___:??I15.957 _15.957 1_9.910 _9.910 15.957 58 65 .|8H.|I13.000 ¡3x,_¡116.000111.000 16.000 11.000 13.000 56 117.957 10.390 17.9571 1 1
10.690 1179571 1 20.000 12.000 12.000 '20.000' 20.000 1 65 ` 75771" _; 120.000 _ 1 75 '2UX1219.943 19.946 11. 11.690 890 19.948 22000 1 75 22.000 14.000 227.0001 35 }šxfi ;;HdI22.000714.000 75 ;21.943 13.390 121.943 21.946 13.690 21.946 1 25X14125.000'14.000 25.000 1 35 95 85 ___95 _zsxfl 24.943 24.946 13.390 13.690
24.946 24.943 - __ _ 26.000 __1 .._ ...I23.000 15.000 23.000 26 so 1 000 HU 1I 110 TIU 12511151 ZÖXHI ' 27.948 27.946 1 1 1 27.946 15.890 15.690 27.9481 nn 30 QU ___i _. ii 1 -in -li -It >1 Fl J5 _. O'-I U1 I .2 CPI ili >1! CH CD 1 à -li 1 _ 12113 1 1_1 1 4.0301 4.030 4.030 - = 4.030 3.9701 _ 3.970 3.970 3.970 7 75.030 5.030 5.030 5.030 4.970 4.970
_ 17 _ 5x5 5" 1 4.9701 4.970 6.030 6.030 6.0301 6030* Gn _ 5.970 5.970 ' 22 5.970 5.970 7.000 6.000 8.000 7.000 30 .1 86117 7964 30 x7 1 6.910 6.910 12 . K:_l. .§|'\3 -I |\:-| IUpI0& Up io & _ Widih Thickness wiiiinl Key Size Width Widih ' Depth (W) (T) Over incluinc|u- j didingng iwxri (W) 10 (WS) (W3) A (H) IRZIHIIS K:1 I . —-I § Nominai 3'13" Shaii
I N°'"1"aI _I___ 1 ..\ $5 1 II111 1w 'i fii . vg/\1\. 'ii 1 A "Y? Fladius Size' . Up to 81&1 Key Size" . h1 Depth 5 epiii Width 1 Depth 1«I MMax._ iier ineu quare)1_ . mm/ Over inulu- 1 ((Square) iekness 1 (Ws (wxT)1Thl8|(l1BSS hi 1 lhl 0-1 (ri (H) 1 (WH1) 1 ding 1 (WxT)f 0.066 0.010 ' U.U56 U.U/U U.12ö 0.125 0.125 1 U.U/8 1/B 0.127 ..12/ 1 0.125 Z _L ':1
ýHý1,ý . 1 T 2 \ \\1 _ 17////////1////////w . Dimensions an in inches Keyway in _ / 1 1 'r1` "1 . . ' Key Key \\ 4?-lÍþi 3'\\//////////////// 1 Nominal Shaft 1 NominaiShafl1 {B} 11 I4_ -1 —I \ /I souiiniz 3& nEcrAn5uLA7i1"i57inALLEL nEcTAn6uL4n Pi_i\L|.E|. Ifl |å'¡ SQUARE i IL 6.20 6.00 5.00 7.20 7.00 7.00 7.70 7.70 7.50 7.50 9.20 9.20 9.00 9.00 9.20 9.20 9.00
9.00 10.20 1070 16.00 16.021 T6021 2.60 2.30 3.50 3.50 3.30 3.30 33.50 50 33.30 1 30 3.50 3.50 3.30 3.30 4.00 4.00 3.30 3.80 4.50 4.50 6.40 l'\f\I- F.C r\|\U 0 0.25 0'25 ,. ... 0.40 U.4U 1 I 15.9799 . 4.30 _15.97 113.021I 4.60 1 16.021 4.50 17.979 _ 4.40 4.40 20.023 20.026 5.10 19.974 4.90 19.974 22.025 5.60 I 22 026 5.50 21.974 _ 5.40 5.40 25.025
5.60 25.026 5.50 1249741540 1 24.974 5.40 123.025' 5.50 11 28.026 I 6.60 10.00 127.974 27.974 .C IO U: 0.25 0.40 0.407 u.4u I\lI\ 0.40 6.16 0.40 0.60 E3 011:> 0.50 0.60 0.60 0.60 .-—.1.;» ,- #21 _ 55' as' E?_ E94 Eí sa CD CD C) C) Ei CD CD M'll' K a s Milling Keyways _l9_'iVLY_-2 II V" Ilnl 1-PCD I-I-'S | \Lux Sii /—-. -1 ll III I-\JrI \I|' l\\JJ \\-I
lI'II\U\J||| 5" 57"?" 5] /1?. X = 1/z (D -1 D*-Wz) _ W2 W" 'Approx. Approx. within 1 Also X - ¡¡)10_05 mm/ 002.. .1. X) Y = D .1. _¡. H|.| _(E .|. 2 D = Shaft diameter Shaftdiameter W = Width of key H = Key height × \ \\\\\\\\\\\\\ 1 x\ _K K ~\\\1\11 \\\\% 1 \1 I147\ //1/ //// 6 -> . I i` ii / \__\\ % 4?. \\\\ I Ñ ` \--I . I _»_--¡__-._ |\.v:I vf//,. ">1 _ .I / \ W _, 6-W-1 5 11 | l
6" ~/_/2 \ e\% Ž1 1 EL \lini 1 - .j l'l'l Ĺ In'I I'I g meni from top of key to bottom 01 shaft) 51> :35111 frgm inn nf lmu tn hnfinm nf 9.h.qf1'\ m c::: -1cu E3ču co QD tonu :'__._- E n:: sou/in: nALLEL 1ä men 11*-"4 en c UA Š: (PREFERRED) PARALLEL :I -lien ga H: =ais 5: W::2 E! ŠT'nl 5-L 'U3.::>aa 7, R1 III CD ili KEYS 6 KEYWAYS 61969 ""' 'ii sa 617.1-
1957, 'UANSI ~ 1 1 ' i 1 1 i - KEYWAY F°RM"|-AF - 1' I I'\J ~- ~~~ 1 A K_B! \ . lnch Keflays Inch Keyways Dimensions in inches 1 1 1 a 5 1 " _1 68 10 12 14 _1l._|._|. -KIYJZ 1 1618 W 20 |\JI\J—l—-—*~ l'\DZiIJ'J 22 25 23 Ä B-C.nJCAJI\J DCJ"'l X Y X ' oi3:1)aft!([S'-\|'\an\i2\i \lO'\lZ ')U'1->bJ C >OU1 :0»N _L I on on _4L X T %_ Measurement
from Measuremeni I . - 1 /'I 1/0" |'\ HDR 1 'âfl n l|Qn 1 1 11 T_41} _._. .... -. _____._i_ ¢ 1 1 i 1~_-74-_i--~.4~ CTI '"-_ _T we Keyway in 11 Q0 LT! |'\J I'\D "*- |\3 1 Key 1 K hflfl snan Keyway bottom of'l(eyseat oi Keyseat Dia.(D) Shafl li/\N31 .1 API" -PF-. (P). 1 _ _ f 1 V . Radius 1 .' K 6' 1 . 1 Key Size 1 . Nummal Nummal z Nominal Rams Nominal 1 Up|u&
.(square)1 Wnllh/ 1 Width Dam Max sha"1 , (S) W'dth Ma. ;1 .Shaft' Dver ('RH Depth (I; 0"" hwludinuš (se:"3a::1 (wxH)1rh¡z1me=s1 (ws)8 (11/2) (Hm 1 (116 Dm M11 161 1 016.1011 1 111111111 - u-/v 1 u0.095 I 1 u0.093 1 I 5 n A 1 uuu | I/r. /1. _>1 _u.'A-rig u.-:uu 3/32 UIDŠÐ1 OIOË3 3/64 1 1/32 '~Q'F'6.:~104g3 5/16 1 1/16 0.091 0.096 1 3/64 1/32
9/15" 0.496 0.125 0.127 = 1/16 1/32 5/3" 1 0.517 0.125 7/16 9/13 1/3 0.123 7/16 9/1 0.125 0.125 1/16 1/32 11/16" Ĺ 0.58 0.581 11/16" fl1Q7 0.169' 3/32 7 3/4" * 0.644 ' 3/4" 0.344 0.185 1/3 3/13 0.187 9/16 1/32 '04} 9/16 7/6 0.185 0.165_ 0.187 0.167 . 3/32 1 1/32 13/16" 13/13" 0.708 0.703 7/8" 0.771 0.250 . 0.252 0.25271 1/8 1 1/32 7/8 1 11/4 1/8 1
7/B 1/62 0.250 0.248 0.250 I 15/16" .U-796 0.796 42.2. 0.248 ._ Ĺ 0.312 1 0.314 I1 1/32 1 1"1" 210.659 1 0.359 13/8 _ 5/13 111/41 1/4 16/6 0.923 0.310 , 0.312 0.612 1 5/32 5/32. 1/32 ýw-~' 1 1/13" 1/16" 1 0.926 _122 __ 1 0.375 0.377 0.375 0.377 11/3" 0.933 1 1/32 11/6" 0.965 13/4 1 3/8 coE 1 3/3 '36 1.049 0.0.373 373 00.675 _ 375 ' 3/"Ž 3/15 1 1/32
13/13" 1 6/15" 1.0497 113If 1 .41 .4 0.500 0.502 14 * 1 1 1_1/4" 1.11_11/4" 1.11; 0% 0.502' 1 3/4 N Ča ČN 0.493 0.500 0.498 0.500. 1/4 / _ 1/32 5/16" 1 1. 1.137 3/ ; 21/ 1/32 1 5/15" 12 0.7525 0.526 A 6/6"" 1 1.201 ' 0.325* 0.323 1 1 3/3" V1." „_._ 221 5/3 0.523 21/4 23/4 5/16 1/16 1 il/16"___ 0.526 0.325 0.625 1 7/15" 1.22_ 1 . 225 .- 1 1/4 3/4 0.750
1__2R9 0.753 0.753 3 8 _z\. _A II: 1 1/2" `1 1.269 0.750 226/4 3/4 1 361/4 1 1 -G .3522 5/13 _ 6/2 3/32 1 .0072 62671 .2919 3×3 .2919_ 9.2061 9.2031 _ 5/16 _ 1. 11.5325 6/6 3/3______ 1/3 4×4 447 X 1 .4174 2_ 11.5626 1/6_ `o.0317H .4268 _97_ .0091 .4909 1/3 500912 4X4 4>< 6 _1 46061 4305 22.5697 24.5330 1.109_3_ 57 2121 __ 1/4 A _ .0159
3× 3_____ .4170 24.56602 6 0221 _1 1.2592 '_ 27Ž3427' _1 11/3' Z 5.5/10 337 1 22.2.2576 .3573 62.7 27.64£1,Lj1/6 /_1_5 _. CD01 GCD X 1m11w×Hi1 "'--. _L _'\l 1 Dimensions in inches u-lul lzifaäeatr Key Key Size Dimension Dimension mameteh l:¡¡aš"h°;*'9tl'1:(åyu:¡rze'Š Dlameter Sim |]i|1'|g|'|5ig||1|]img||$i|]|\ Key slze žlllmension1Dime1\slon
i|]iII|B|'lSi0l11|'|iII'lBl'ISi0l'I: of Shaih (Wm) A "'"'1 (D) Nominaishafl Nominalshafl fl (107 Dimensions in Disnest-510116 iii mm 1 5 Class1 - Side Fit CA3 """-4. CA3 Bi Meme 11/166110 Ke_1/013105 Ke111111.10116 6 I W ->1 '-— ---L C3 074710750 1 0.747 0.750 '"6 1 5/3" 1 1.413 0.375 0.875 1 0.373 Z 13/4 1.5112 0.878 331/4 341 _`.4 1 3 3/4 1 H7/3
7/6_Q' \ 32'. _.ca 0.372 0.37 _1 1/_.L\1_;6 51571233 3 31 7/8'*"1` 159 0.872 0.8755 1:. 33?1 5 _.w 1.000 1.006 . . 1 000 ' 1003 1/.Ž ms l ____2 j f _____ 1 1.713 11714 66/4 1 2" 33/4 41/2 1 1 1/2 1 0.997 1.000 1/Z 1/16_1 21/3" 2 1/8" i 1.845 0.997 .1.000 1.345 ;2_$_ 1.250 1.254 2 1/4" 1 1.972 7 1* 1.235*1*1.zs71í 21/4-~ 1512 51/2 -6 =1:@11/4 41/2 ;1 51/2
124711250 1/8 23/3" 1.247 1.250 5/8 2 6/6" 2.021 OI* Q31 '\-.. m1 _L C") O? .Š 1MIH11M1H11M11 l1 _2___2___2 |-,.__ ..._ ___.1 W2 at/z ; '_'._."1 u-..1/z 1 11/z 31/z. 31/2 1.50011.504 1.500 1.504 ___.. 1.497 1.497 11.500 1.500 1 °/4 1 ': 2-"r.__., .-=. .-.-. .-'~, », .-..-». £141 . .=.~.. :.'.'4' _. 1; , .1.-.1 . ;_ -.1 '. 171-'."r-" - . 611_.1, 11..--¢-_-. ___-9.-. .1.-;_.5-:—.
4.;..;-.._;; .- . 121-. :- -' "N-=--'5» . _ 1 -..,-=_. . 1-,-14 --» - ..1/.8 1 W . 7,..11'-I ' 21/2" 1 2.146 2.148 2.2-17./727"" 3" 6" 1 2.577 M- ; .--~ .1' 3: 1'. "1:/-' i _ 77J7777r777rP P —— — — 1 WW4 84 FORMULAE FĹIBMULAE FOB FG!! SPUR GEAR @EAR CALCULATIONS ĹIALGLILATIQNS '_' _ 122.211" 1"TF\'f%\1 Addendum \ Circle .—~f+P~r~+ fm »_ 3 gt
1 712/211 . Hr 111/ li ' 5 'W b in 5 Pr` \~ ' L l._ P ./ T "S?\ ix: P" .i> 25.4 1 1P6 3.1416xPii = U-1410 3?416XPd _3?4i6_ 22644 O PL.-I' 1f1' ______A->_ diameter(inch) Pitch diameter (inch) Pu1:. L -'I P : nj-c(mm)_ = _1. 42:..|2> ..4u.CD >~:>1 00 '-_-L . |'c(mm)_ O0 t _ |i__.-_.--.-.iP.." ipd|:|. = H N X Pi: NXPc R Z -C 3.1416 p n. Š 2. -u_í N 1 n _.1_.. .|:-;_--
1 cC L L .) 3 :1 __ , J _ -'~."'I' ?- xX Module P,_+2a 3.1416xPu pdxp =_ M = Pdxp C 1c `1 110.010.. _2P LL = N15 NxP_ " ,"-.' P.Pc A BM Na + N2 = "I' ' "¢ -.__-_..-:.- '~. "L-' ':1 .- F. 1'5 _-.1'; i'-."'-- 51 '1 lrill 1 lI1l 1l 1l l 1 P la .> 5,. __»_ 'E -__'-'~.-,'?' 31);' _ I _Y -. l.-_2 .1,;".'i': " 5; . L1,, -_-_: :5 IL ' ToothKParts Tooth Parts -+- Full Depth Teeth W
11%|1 I-20° Qn W u o0 A : I::: :- . : F.iiiiA C "U "U -1CD -1ED noup I-'I 'El dana -'ICID -I I> ';\ $\ IE'E 0 :: -I ei: E 4:hf ei:onee3 'El GD 'E El C1ei O O O C: EH I: a g a1 1b1 Workingdepth Workingdepth ink. ihkl "Minimum 0 Minimumwholedeplh1h¡_ M woledepth rhrr Basiccirculartooth Basic circular tooth thicknessatpitchline lhicknessatpitchline
|Minimumclearance Minimumclearance =5 :I -L -Å HD 1 fl I E- €| 1.00 + "U'U 1.000 + 'U'U_L @ C S + P 1.25 +P|1.157-:-P 1.157 + P 2.00 + P 1 5 2.25 +T'- P 1 2.000 + PP 2.157A +T- P _ 15708 T+ PP 1.5708 15708 ++ PP .25 + P .157 + P l I1 Module System - Pressure Angle = 20 O A Tooth Parts Metric M0d0§§§(ystem{. . . m F { H Dimensions in
mm \ lTl Addendum Minimum dedendum 1a1 1b1 1 a = bb = 'Au- Minimum whole depth 1 hihitm = h¡= é hr Basic circulartooth|-. 11 thickness at pitch line T 11 TT = sS == Working depth hi. ¡1ii hk Z ::iii Dania |\i|n\|||nIlnnl l|a§|U ll" btllfll IUUIII 1 x Module 1.25 x Module 2 Xx Module . I | ' ;:-'J. 1--. 5 ~ ' 2.25)g1 Module Mouulie 5 1.5708 x Module |
Minimum cle3M10i:úez I S Minimumc|ie*aE1151ipisj .25 Xx |V|odu|g Module l Tooth Parts -—.§tub Stub Tooth gearinq ToothParts gearing - Pressure Ange_= Angle = 20° 2 0O Find American 1 Fellows Fellows 1 Nutt _ To Findw V 1 ????? American1 Nuttal? al p 1 1.000 r'1;:n 1 noa.1 Addendum .800 7+.nrP 1-|nnn.n. + PS .15.-JU .250 ::-::|.| : |. cu:::::.
5: :3 |.uuu-:-rs X '15 Qflfl .UUU P Numherotteeth Number ot teeth in the gear;N gear N Length olńrack ot rack N no "+2 „_ = ltå P ýeefý u:||u-:r uluallw lafllllfll' UISIHIIUU _.Š l "'"""'_ -0 Outside dia. (inch/E001) ouisiueuia.(in0n/333) 0,, 1 ii r: :2. E'. E:cr::. 5:. ctci _4 ~- 41,:;4.4. diameter Pitch diameter N _ T M1 t ll M z\.41.¡/1 1 1 41 1 'U n 25.4w Ëlll
_= Å pd P ii |V|0du|e Module Pii (mm) P0(lTlm) = _"P 1 Circular pitch (inch) Circularpitchiinchl _ý_ _= @Ž 3.1416 _= pg Pe 1 |'l|'_YJ'JI'|;-§:Tz;'Z':-'& . F°"'"fl Frfitmiiifi M 11 PP A Module 1532012? SE EE '1"I 1',(1 EE illID -'-11 1 _ Diamem" Diametral pitch pitch pP 0 i' 11.} pitChCim|e Pitch Circle 15E5' II!5103 A Addendum Minimumdedendum Minimum
dedendum § Root or Dedendum Circle Working Depth Circle To Find W WTofind 1 A -. »-_-1 -'- 'é.,~.'r roorn TOOTH PARTS PÅRTS -- FULL FULL DEPTH DEPTH TEETH, TEETH, METRIC METRIC 1: 1Ë¡ mooute & sruo roorn cennmo H MODULE & STUB TO0TH GEARING 5 A A DI35 F0 to scotch' 0 { ;-'-_.-= :-: 'L-.=='; "I nuuuuuul . _ . _ . _ . _ >11
Pi;n 1.250 + PS .300 XX P,,. +-:- P 1 1.250+Ps Pz Minimumdedendum Minimum dedendum 11b1 b 1.000 1.000 working Working depth Llephl hk. lik 1.600 +P + P 1.000 2.000 + PS _ CJ1(J1 CD CD '2.000+PS. >< 'U 'U G1n 1.800 + P 11 2.250 +-:- PS .550 xX 1.800 P6 Pz 1 4 Minimum whole depth 1hr Minimumwholedepth ih.. -- ll _AA . . _ _ _ Basic
circulartooth circular tooth _ _ _ thicknessatpitchline thickness al pitch line Minimumiziizaranize Minimumclearance -` . „M . _ i 1.5708 1.0/uo + -:- Fr V Šs s1 ' 1 . . „_„„ .Ñ + P 1 .250 + PS1 .050 XX P,, .200 P1050 Pz PS = Stub diametral pitch, e.g. "8" in 6/8 DP \-'-,- '1". .- _. .1 _-_a r' ._ 1.5708 |.:>/Uö + -:- I-'F5S ..500 500 XX PC Pz -I' ,5 ~-._1:-;._j _. '_
_-. -. V \ ii -..\~. 921 > -.;. .-,_:. J __»- SPIIR SPUR GEARING GEÅRING -|-ABLE TÅBLE 9|: OF |5g|||yA|_E|q'|' EUUIVÅLENT p|'|g|-|E5 PITGHES l CALCULATION Č GIILATIO DFSPINDLE LE SPEEDSI SPEEDS/ J Diamelral. Circular_1 Circular 1 _llllo'dul'e Module I Diamelrafi Circular 1 Module' Module Diametral. Diametral! Diamelral1 Circular1
Circular Module Module Diametralg Pilcli §Pitch(in.)| 1Pilc|1 (in.) mm. Pilcli .; Pitch Pilch(in,)1 Pitch (in.)1' mm. p Pitch Pricu 1Pitch(in.)§ 101100 110.11 mm. mm. 1 Pitch [W 41 ..__.__............,..' _ ._ ' 1 1 .1___ | 1 1 I 1 1 ' ' "T ' .' "' 1 1 1 1, _|__ . ;_„._......1_ 1.5875 . 10 10- 1.9790 4 113/4 3/4 11.7952 1.7002 .. _ _ 4.2333 1 1 1 4.0003 4.5696 14.0143
14.5143 - _ 1 ' '1 _____1____.__.____.____1 . I 1 _ 1 I .. . ._.. ...-_..-_il -—- - 3 '@ ' -5-C10 . . , . - 5 t_.- _..-.. - _-'_. 1 1 `1 5.5000 17 0.184 oron I 1.1. r 11 1 . -.-.-. _. _l'. _._____ . . I-C --*-4CD-5-DbZ-A- .. . _,._,_-...... .. ,,_,_,1' . < 1 . 1 FD Ll'! LI'! CD CD §h 1 1 1 _2_., .._-___ ...».._,_ ..._..3 __.._ _._-..1 ' . 1 4 -U1CDC5CD . . . ' 1 ' 1 - 1 3 ...- ___-............4...___ NIJi- $23
-L CO CD C113 CD 'L11. CO1 . _..._-...1M_1 . 1 --1 1 . ; . _...,_...__. 1 ' 1 1 1 1 1 1 1 1 1 1 1- . . 1 2 1 1 1 :5' 1 1 ,0 é - 1- S . '11 1 1 . ;_;-5 _. ¢.:- _] _2 .7 .. -.-.--'.. ; - _ _,_,E H ->-- . . -.-.-.*.-;,.-.-'1.1.~-; _1- 2. . c . ~.4.= .~- .u~ .'1.~ 2"-= « .-_ .1_ . -.--. D22 = _ 02 \D2 N1= DDQX zš NN22 N1 D11 ÐZX DQX N2 N1 D1X N1 D1XN1 N: N22 N2 D1X N1 D1XN1 Dz D2
Comgound Compound Drive 11111 5 N1 N2/ N2 / N3 \ N4 \ \ 1 1 D D Fd;_Kw';v__€_¢:§_..:J_;.¢.¢.......01;.,;.i,...0L..._.,_; . ~ _ *1' D ~. M \D4 Nole : Speed(rpm) N2 always = Speed(rprn) Note Speed(rpm) N3 Gear Drive E15'llh ._=I' >1 -1 'EI :5 C: :5. EE. li! CD as' :Š CI _.-d.o 0::::. na II E CID IIIII=3' Di 'ED CD EEI =5 :I (CI CID Ql -u z1XN1= XN1 Z1
Z181 Z3 = No N0 01 of Teeth in Driving Gear 1 228124 of Teeth in Driven Gear Z281 Z4 = N0 01 .,,.u. .. ..-__-I n..:...- n-,.É: Fl'CDCI II "CI -0-I' u| UIIVUII |.m\r\:|| Ulfldl uuul C: —h-z. ailllll lplll UI S A >1 ||.||l 35' \I I|I\I Q' n1n1:ll-nun. I'\-_-. ZZXIIIQ ZZXN2 N181 N3 = Speed(rpm) Speedlrpm) of 0t Driving Gear N1& 1112811114 01 Driven Gear N2&
N4 = Speedlrpmi Speed(rpm) of Single Gear Train N1 N2 rN'__'1Q'1/1,. .' - . 21 : ZQXNQ Z2XN2 Z1 = 5' N1 N1: N1 = ' ZQXNQ 22 Z1XN1 Z2 == ZLL1 N2: N2 : Z1XN1 N1 \zl \Z1 7"`^"' \zz \Z2 N2 N2 Double Gear Train N1 -.-1-----._ V__\D2\D3 \|32\D3 2181 Za 1 Ii 111 1 1 1 1 IHM —D \DT \[}1 D NN4 == NN1 xX _ _ 7-l xX i -'-5:.-.-.»,_-.-.-.1-==e>.0,;.01.-
= E: FD CD II!_-0. IZ 5: :: 1_i _ Šš-U1.3 I 7: 01 -. Q L-. 7.'=.O _._ 'J=-Cl!cx: V \D1 -41lt\J ' . . _:.....,.:...,_,,. i $.71 CD J:-. 4:0 CO 24 1 1 1 ____ ___ D1 = .._... mi N18. N181 N3 = Speed(rpm) of Driving Pulleys N2& N4 = Speed(rpm) 112811114 Speedirpm) of 01 Driven Pulleys N2 . 1 1-H-»_¢,»r,--... »----J 1111 N1 . 4 -. -——f—- I -L I'-'D -.01I'D 'F-JCD Ifi Single
Drive . 1 , I 1-..; 1.;"\- l_\D IIIII D1XN1=D2XN2 DZX N2 1 a ç>c01Noncu 1.0143 š 1.7310 1.7315 -.14 5al 0.6283 5.0000 777777777 Éóšíf 018...eo 0.1745 1.4o--u: .=.o"l_14 1445 74' 1 19 0.1553 1.3300 ' 19 0.1053 5.0205 7 5/8 57/0 7715053277 1.9333 Ĺ 11 0/0 5/8 I1 13.1302 1.0333 5.0265 5.0532 0.1571 11 1.270; 'NI-1-is-r= 20 0.1571 5.0000
70.0104 5 13 1 1.9538 1 1.0070 1.6079 1.0030 113' 570800 0.6184 -1 22 0.1428 1.1045 1.1545 1 5.5051 1 9/16 9/10 l 4.5478 4.5470 1.5708 112.7000 22 ` 1.0700 2.7.000 5.5851 0.1420 N -iz P _.zaQco _. c01onna 1 2.0944 3 1 1/2 12.1276 5.6443 0.5566 4.5000 _. __. _1....... -. 25 25 0.1257 0.1257 1.01100 1.0100 2.1167 31 1.4842 12 0.5236 5
0.5230 4.2333 4.2333 12 1/2 .1327 25.1327 1/2 1 4.0425 4.0425 21/4 £13003 1 1.3963 11.2002; 6.2832 21/4 25 11.2892 1/0 11.0100 1.0100 1 25 .4000 0.1237 25.4000 012371 3 1 11 2.2040 6.3500 0.4947 049471:'44 11.1170 2.2848 1 11 3/0 3/8 011.-41170 . 1'1 20 0.1208 0.1200 1--I-'0.9709 2.3091 1.3605 77 0.4-488 26 D';9769 0.4400 š 23.0200
3.5200 11 ' 20 1701122 28 0.1122 J0";-90-71 Z 1.2500 10.1000 7.1000 ?./1. 7/155 3.0372 3.5372 1 21/2 21/2 "Ĺ1.2s55 10.1500 1 7.1808 ' 7.2571 0.4329 30 0.1047 30 0.1047 0.0407 . 0.4329 13.0000 3.5000 2.5133 1/4 110.1062 0.1062251331 111/4 _ 2.5400 '11 1.2368 1.2300 10 0 0.3927 3.1750 3.1750 0.3927 2.5400 ' 3/3 1, " 1 23/4 1 1.1424 1.1424
9.2304 3/0 3.0319 23/4 _9;2364 0.3770 P-J CD CID -IlaJ. ; 5'3 SE! :iinGD - GDcio -1-I: DI>< -1-1 'EI 1:: -m CD :I Cl C! :5. IE. -=:no 1:{II ::| :I 'U "U Eí El EF E? H:-=: -5: :5 D, Diamelers ol D1 &81 D3 D 3 = Diameters of Driving Pulleys r'\ &.. D4 .. —_ Diameters n . . -..4-...-_. D2 Driven Pulleys U201 U4 = UICIIIIIUIUID of UI UIIVUII I'I..IIII3'y'O
.,______li___ 1 . I . 1 . l'\ U X --L C0 PO -_ „Č1 7I_7Z1_77ŽI . ' ." .1-.. I".4.6182 1./9:12 1 113/4 1.7052 3/4 i .1_.-0148.3 ^.6$03 14.1453 4.0102 0.6803 ——— *~"""** *;————~— "-1 1 1 _ ..T..._>.-_,-- 0 I.' 9 P _.0., az ooon 4.1888 .1 _ _ _.L L..|. , V _r__ 1675577 17/8 7/8771101005 15.1595 1.6755 . 1.6933 1.8553 1 1.0033 1.0503 W15. 15 I' flinmnlnr
rum ni uu: nrin E 5» :3EE-cu -In vA:1: -Il:yu: uzumuwu uu I: II. E5.::|_:_:: 4::1:: 'U EE FF U: 'PE: 3: :3 E1 '= . 9.0957 0.0007 0.4007 0.3711 1 0 3 7 0.3491 ;1 2.8222 2.0222 0.3491 1.1132 1 L.Q0 1 0 .. __ 0.31421 10 0.3142 2.-5400 2.5400 f __ .1 0.400711 . . . . p 10 1.0472 0.4007 2.5266 1 0.0051 10.0531 10.0031 1 5/16 5/10 L 2.5200 10.1600 0.3092
2.0000 0.9095 š 0 003.05% 10.1000 ' "'T"'",-i-'i"\ll"i*l 11 0.2050 2.3001 2.3091 0.2856 15/16 15/10 .f' ' 7.57.97 7.5797 0.2010 12 0.2618 121107 Ž 2.1107 0.0970 1 7.25-71 7.2571 12.5004 1/4 12.0213 ' 1/4 7/8 7/0 7.07-44 7.0744 -1 2.0213 11 0.8658 12.7000 0.2474 0.247-11 2 0.0050 17'. 7 ' . 12.7000 . . _ ____._ 13 1.0030 1 13 0.2417 1.9530 0.2417
13/16 13/10 6.5691 0.5091 1" 11 14 0.2244 1 1.0143 14 0.2244 0.0040 ; 5.5000 -40.8040 0.5000 i77"_"I".'.' 15 0.3000 \Iaiu143 9'nauaoo T7 2.7925 1 111/8 1/8 2.0222 , 3 3 11 3.1410 1 3.1416 3.1750 3.1750 i 3.3510 2 1/2 20.21 20.2127 1.2566 j 21/2 3.3510 27 31/2 1 20 1.2700 = 2.4737 20. 31/2 1.3003 § 2 1/4 1 10.1014 3.5904 3.590U 1.3963 21/4
18.1914 1 1.4111 f 2.2203 3.6286 3.0205 1 18 5 2.2263 A 10 3.0005 1 1/2 E 2.0944 .116.9333 6.-.9333 3.8666 __ 3.9070 1 1.5708 2 3.9078 1.5703 5 16.1701 1 10.1701 _ "T1 "-"7'*"" ' _.__. . 3.14100 3254000 1 Ž 3.141 25.4000 2757 3.0921 7 25 1.0100 2F 3.0021 11.0472 .0472 33 51242552 24.25.52 1.1424 223/4 1.1424 3/4 1222339 2.2330 11/4
52.2.5133 20.3202 5133 ' 3 1 20.3202 '1 -2 _NIIMBER 0F TEETH=:Š IN GEAR uruvlza DRIVES _ É: 'Šš> ui'_I'|| I{Ul'II: _:T :.„, BEI.T/ Š::511: I umu: Be" Bell Drive Drive _ N2 / N3 N2/ Na \ ' I 22 Z2 N4 „iflłm 03%» \._„_„ $ 2121 »5 77 % '72Z2 7" Z3 za Ž1 Z1 ' 1vN 4 % 'z..Z4 : N 1 X 2 _T Z2 X z _3 Z4 Nole:Speed(rpm)N2always=Speed(rpm)N3 N°|
flfllfi1m)N2flIWflvS=Si>@@d(f0ffl)N5 / \ _ 7.'. 1- *;_.": _-, 88 | _I '. '-.-_c '-.--.< L T-..1 »_'.-_.~.' .1 ':"|Y_ -,_.1 In-.1 12-,-' 1/ '_ e. - my >¢.'»':- 11- '» -: '1-1' 4 , Conventional & Narrow Section V-Belts 1.401001 (Ac/ua/ Size) fi _1 Š Š1.54 1Q_ 11 1< 1? »l 77' il 1< 17 >l Il 77 l4|< 22 9? II Conventional 1Dimensional Data} Data) Conyentional
& Narrow Section V-Belts {Dimensional >l 7" iii? ki- IN \M ——>l iu 1 124222 1 1211 l % l / 9 |< 10-fl5_nT1 // SPC gíšfi 1_: 12051 1% ="\3 L02. 25 2551WT __55_i,| _I To determine belt length required given pulley diameters and centre distance, use the following f0fm„|a ; iormuia; ___ _ 2c+T+1.57(0+0) (D-df LL =_ 2c+(1'i)2+1.5r(0+0) 40 where _
202233 i____ËËÑ T35-I 33 -I>~CD 5* 1' I" J?c 7777 7477 7 o0 O30'! I'\Jl\'J SPZ/3V _ i V ýSPZ/3Vý SPA 5?'! _ SPB./5V sve/sv SPC i -I':-I\) '2 :»' 15'-. .1' I = Pitch length of belt in millimetres. = Centre distance in millimetres. = Pitch diameter of large pulley in millimetres. === Pitch diameter of small pulley in millimetres. 1:.d *-J-I'- -03 0o\1-¡> C0c1J>\I-
^"\l G>|\7|'\>l'\>0ú O0 |_ r; D @ C1l— _,J 2 . -3-. _=;,¡-2'_l.-_"-'z j_.l, :.=_~: 2.} -;-:_ _,=> if ,3; f_-'I___ -.;-:_ . " RMA/MPTA1l 1 J1A 1 V-Belt in Pulley _Ë__c°m misu" chart cha" comparison . 1 Dimensions in mm 1" — 3710102 0 1 0 0 seci 'SPC [WC - lair sv . i ..01 S _ (x|=c) 51:1 5v 1012 0v 1 l(5VX)f I 15vx1 1 ;(8_VX) 1 (svx) (fix) (0x)1(cx)11nx1 (3vx)
(AX)W(BX) 11 (CX) 1 (DX) I(3VX) I 25 9.0 1127 16.3 15 22 p 25 4 10 1 13 l1 17 1 22 I1 32 ~ 9.7 1' 3.0 12.7.1 163 . 1 15 ____ 1 _ _ . _ . _ _`I "MA/MP" f = TopofBell Top oi Belt W. mlwl widmlwl Pííuħ 'P1100 widmm Width [P] 1 Height H'n "9'!""°'of Bel LU" I I 9°0.501 l1 11 '1 14*?*— A 0.5' ' 11 14 I' 1 19 1 27 l3.5l 10.51 19 l 235 23.5 . 1 14 10 74 7 14 20 0
0 0111 1310 7 23 0 7' 10114 10 7 141313123 I l l_l l Na I\J O')U1 I 00 ro0°—'ml l -I3-n . _.L|. r\N —*-l.>>za I'\J_L \A-IA (O f]'l ui _|-.-.5\| S37' ru S'\l (_Q 01i\J to l 2M I\D CO N 1 28 E" cu 42 :Äru p . 4215'/'32 F N: Š" \l .W M I ' ' ' .'1'f'I9"II"I ' . ' " " 50 ' 71 `112° 170013551 03Ti 1 03 1 90 14% 1%' 22$? 224? 1(112) (1001 315 -r:-oo ' 014-iP4ii(40)1
(_03)_(90) 1 1 1 1 (71)ll(1i2)l(112)(180) Heigh .- .- .E Minñfizy Min. Pulley 7 1=¡10|101z.[P01 P|tch Mmr Max. iI NRHDII tBell E Smdm/S 1 Speed m/s ' /Q-._;_ 30 no.r=-.0Q-1 cc: ~ 1 1 7 3N 0 3400301 40140140140 40 C'caca =~='30140140 'D0*2.0e01. Garcamoo 4: Govca -i:>cnoo QcoQ -r=~—l-(2 40 40'4040 30 00*a~0_cano-L Q'c-D-7._».DEm _ I
i._T'"" -I-ensionin Forces Tensioning Forces --A-i NOTE : See Comparison Chart on page 89 for other Equivalent Symbols l\ I I Cfllüllflfilfill iii 01 Calcuiation bflifiiliaiiflfl Centre Distance Calculation P|tch Pitch Lengm Pill?" S 1. P¡i'¡|1 |-Bfiillll Lflflfllh BXIIBBIIS 0109099 Section ec 'on 3 inside length bymm.y by mm. Pitch Diameter 11 A4 elcloisezl
010lns1= z sPAsP0 lz SPAiSPB= 1 1 1 1 _lZ&lLXLlBXl 7 ("XV_0.1_; ×P2> _. 10 ; 13 1 11 22 32 sez SPZ 'SW 13117 sPA seal sP0 . (x10)_l (x1311 (X11); (x22)1 (x32)1(xl?_z 1| g_l(xP4)1xP01 (xPA) M [XPB] _(x1011(x13)1x1711g22)1(x32)1(xPzL ' es/iso __ ËËË" DIN Dm -2133" 'UW ::Q:ai:-'=l',, av/ 0 fg__»1 %(5% . '%_4 10 T' i W7777727 2211 I A 51%|
1_15_71 I 0 SPBQ4 .4_1 _i I \ 555 2/" 'l 1) LO I '*1 11673_71 12.7 mi. V' 0410 l4___ : I'll'! ¢ _N at/%' ~11 42711222* \@L @222Z2?Q14 A 022222./"1 /// [199% V-BELTS cnoss GRDSS SECTION SECTION V-BELTS DIMENSIONS DIMENSIONS & & COMPARISON GOMPÅRISON CHART GHÅRT _!-BELTS CROSS 00058 SECTION
SEGTION DIMENSIONS II-BELTS B elt Belt BeltTensionlndicatorapplied Belt Tension Indicator applied tomid-centre distance to mid-centre distan ce 1 @005.) _ I /4\ /K 00% Aj 018006 G"? '7/905,08 \\ ×\ 1-I. ` \_\ \ _. ..... ........ -\__ ...... ._ ,_ /1/' `\\ !_ _ \ \ __%___ « J IBMlIÐtBl lHMlÐÐlDBHl MlI 1% 41 . _ _.w.__ "' 1000 16mm Deflection per ,09r1000 ct
Span 0150011 . deflecl belt bell I Force required to deflect 16' mm per metra an l_1_6_ metre olspý oi span Small Pulley Section 'Small Pulley; Newton Newmiiogram: Kilogram - I I Di'fl- (mmll1 Difl-(mm) (N) 10"* (1190 lflfcfllkflll 5610 100 l1 5to7.5 ___g_g,56to10l1 5107.5 00.5fo0.8 . 510 0 . 8 -1.0 I01..5 0019140 __' .101015 1101015 2.. _ _ 0010140 A
12510200. 3.1 12510200 201030 201000 '. 2.010 201001 __ 20010400 . 100.1 1 20010400 if l1 4010 00 _f_ 41" 4.1105T| 35510000 l 7010105 17.110107 L__f_o_0 .135510000 .7.11010.7 1 131020 13102.0 501095 131020 Sp 3y 1 _.501005 5, |íPZ_/av l10010140 1 10010140 201025 2010251A 2.01025 201025 I 001013' 25_1" 25.103.0 "| 8Dtoi32 3.6 '2
1 251035 '__035 '2.5t0 onsm E _ 14010200 A E__ 14010 2001 351045 3.010 3.510 4.6_ 4.0 11210224 su/sv I1 444 1121o22_4_ 451005 45 t0651H 4_05>_5.0 I s|=-35v - 1` 40100.0 00m07 _ /_ 123__010315_ 23010315 1 051005} 0510051 00100.7 . _ gpg 8- 7 lo ll-7 . SPC 1.20 1 224 224l° 35 3555 _ 0510115 5510115 .1571011-7 W CITPINI fiw>N
37510500 'll5'[0I50 11510150 11710153 ll.z'[0 l5.3l 5375 I0 559 »: :.- - 5-'. ~ _ »,. *--2 :» '-f »-.; .>-, -: >--. '_ _~. :-' -. :. -'1 » . ?' \ ggl ,gl 1 GUMMON WORKSHOP BOLTS lJENTlFlIIIIIII'II'INlll";1IIlIlIlIIgIlIE\IItIIIlIIIA?.IIPIIlIII0PEHTlES IDENTIFICATION & MEGHANICAL PROPERTIES Common METRIC Steel Bolts /\ ,/\ Identification ldentification /'\
,/__ U09 7 Mark Mark 4; \/ Š /'\ /7\ W V \/ V \/ 1 MJH2-9 Cl ass 88.8B Class 1 lmmmiuml Low/Medium 1I Low/Medium Carbon Steel Garbo" Steel_ Treated 1 Carbon Stem Heat Treated) Strength 400 Mpa Tensile Strength? 520 Mpa (58000 psi) psi) ll (75000 (75000 psi) psi) Minimum Minimumń _W I (58000 Yield Slrength 240 Mpa 1 420 Mpa l 040 640
Mpa I' 3401/10 940 Mpaa Mlmmum YIF'F's"°"9'" Minimum LUV!) IIIUUIUIII —~~ ProofLoad Prool Load 55 ness I I Har Hardness Max i lVI3Xl . _d Compatible Nut | 1 l li —i HRB-95 HFIB-95 HRB-95 HFlB—95 Class 5 Class 5 _ 1 i~ 0001100 000 Mpa 1 3301/100 8301 Mpa HRC-22 HRC 22 ' HRC-32 30 32 I HRC-34 HRC—34 HRCý-39 HRl_—39 0
Class 8 HRO39 v HRC-44 Class 10 Common INCH Steel Bolts 1* - . _ I I Stainless Steel ' /\ Ö //Š Mark , së /íáqàltšže iliti 0 - _ Cene Type Look Nut \M Ktí/ Decorative Wheel ""1 Nut Wheel _ 5 7 r W tzfl l)-l:;:xag:?ur1t tj i Llj ' x\ V ;1 001-ne Home 0 Snuare N"I Gàfö :Ĺ \Ä Llj I Standard Nylon Insert Standard Nylon-insert Lock Lock Nut Nut (type (type P)
P) _ pi 9 i . t.t \]J1 1. I (NIII Nut " iiiiiieei Nu} za Ñítil W" 5 W äkl 1 1 GIIIICI Be 304 '\\ 4— 0 IT Slotted Nut Nut Castellated Q .l _ Nut . _] < _ Stmnss Stniflm \ stainless stainless 41 five ' eš000 120000 140000 140000 35000 (1 35000) " (33000) (74000) 120000 (135000) HRC-38 HRB_80 HRC-33 HRB-70 RW::-10 HR0-sa A Hec-sa Min 1 HRB-70 HRC-19
Hardness Maxi HR0-34 HRC-39 Het;-se HRC-45 HR0-45 HRMO Max HRB-95 H30-34 H'"""°" Grade 8 1 serrated Nut Thin Nvlon-Insert Nylon-Insert Thlfl Luck NI" Nut (Wile (type T) T) I-0" 2.` I ' ili 4 i 0 Ë 0 » l 55000 Proof Load [psi]! Proot [psi] (33000) Compatible Nut 3 Mild Steel I) Grade 5 . I_ II" ` ""1"?-T-'" Flanged Serraled Nut l ' _ Steel St 31001
s1 1 Heat Heat Treated 304 316 Steel Treated* Treated* 304 §I Sm Treated 7 Treated 1. ___ 1 5 _. ii, (ISGGGG '1 180000 Strength ' 74000 ' 120000) 150000 l 1 Tensile Strenglhl 05000f' _ or:nnn 005000) » 070000) 8500" Minimum [psill [psi] (00000) 3 (105000)((Minimum l(170000) "'"" 162000 91000 ` 162000 20100231100010 Yield Slrenuth l
01000%5'" 57000 (81000)) 130000 130000 I (153000) (mono) 35000 35000 35000 Minimumýlpgl Minimum [psi] _l_(36000) (31000) K' I \ 'H' .4 M tlenntes llletnc Thread IZ (>3ý4-11;2)(>14-1)/2) 1/441/2 (>§/4-it/2)' (>1 Low/Maa I M Medium edium M Medium l Auoysteel E edium Low/lvled Stee . ' Carb. Steel Carb ee ll1 Alloy Carb.. St Steel 0 Carbon
Heat \ Heat Heat Material (Square 511"" Track Nut T"~""" "I I otesl ________.Ĺ _ _ ,_ ___Ë"l" ,"}ËË'?9*ËP""°"T"ËL l"""'"—'*—m—i-"7 H d. Stainless, IIIIIIIIIIIIIIIII7, Starness -II'T'I'T'.III|IIIEIII Stainlessl Stainless Product .G IL, 1 P 'L5 L r. [LB Soc. Hd. Specifications I "Ia'e" Gradez § Gradeä Cap Scrs. Steel Steel 1` Steel Specifications Jraffifil Grad" JILL
;Cap \ Nom'nal 1/ --3/ 1/ -1 1/ Nominal S' Sizee 1/4 3/4 1/4-1 Range lj Hexagon Thin H1;:|1r' a51(g|o)nNTl (Lock) Nutl1'in Hcmgtion g 970 M 00 Šš \V tj ti Hexago "'".'a§°" i i ehined II_IIaBhI"Bd Nut I 1100110 a 91 iii{D :U:I::va:I: GD 'U :: 0: -|ID °°MM°" "'°'"'s"°" "ms n 22011/100 3301/100 2201/:pa l* 300 Mpa HRB-67 HRB-82 HR 07 I1 HRB 32 I I
identification ldentilieatiee '2.„_ Class 12.9 12 9 1 Cl ass 10.9 Cl::klH Ëcreeęs Class 10 9 SSocket Headd Cap Screws Medium W Alloy Steel Alloy Steel Carbon Heat Carbo Steel Heat . Heat Treated Treated' Treated ' Treated Treated_ 830 Mpa 1040 Mpa 1220 Mpa (120000 p5i)) psi)1 (150000 000000 psi)| psi) (176000 (170000 0% psi) (120000 Cl ass
4.6 GI ass 55.88 Class 4 6 1 Class Material l " Š 109 J 1 _v_*_ 1 ,—._,-` Q9 Ž 7 1 Š Š sin) § \ __ 8.0) _v___,0 Pmdum Product .. . Specmcamn ecmcamm /'\._ /\ 99 .1 l IÐ E: gš:ŠI: :: HFlB-80 l , K' 31 6 316 1 0 * ' U" (piloted) R Hexagon H3X3§"" (P553135) Weld Nut "L NIII 3'" (1 I W es K% Q 1? I Root Root l Nut NUI Uilfl t1 lllfl lt lfllt l l Reetanflular
Nui' Nut Dnfiiunnlulur Illa-I-Ill-lllulllll-ll n Round Rfiiiitti Weld Nut l WBIII 1l | tj 1 k\\+;;OĹMIË:::j Structural Nut ({H 1? fŠ, Ll.-u---03.0 |";),qg|_||| Ë.9. Pressed Nut aqiiareipiioieoii 1 WBICI NIII d @Š I wing Nut ,__r_ aqijafe Pressed Nu) 1 1-cl 'I = 1: ii: 1" ;-.=-:~if". 41;"-... J" -. 2|. li š Ñ IO I en i I Ien & I TYPES en :E -I & ID SCREW en51 i — HEADS
COMMON :15:5::Šc: :: BOLT COMMON GDMMDIJ SCREW SGREW HEAD DRIVES DRHIES Bolt 8|& Screw Heads (Metal Threads} Threads) Standard Screw Head Drives II I _ III I-I Ë ,,=. é 0 Š % E Š E ,_ . S a =-= a ===' E .Q 0"? Square Sflllflflfi gi' I ,Š === a gs:-= 1% ' ää É:-H* ;% 0'? .GP Hexagon Cup Round Rflllflfl fä-P' R . _._ *l..."'—'.... _ 1lII
1111) g 10111 g .Q së 0? Flat Flat Countersinlr Countersink ,6 :Š fålš Raised Raised (0val) (Oval) Countersink ,sz g Š .zur $5 (319959 chefisfi 2:: -r=3' -1Cll fill E2: =I I-fill Self-Threading ' HGXHSIOI1 Hexagon ti ll Š š ;="'?=== §'=`?> š-Š ii' GE!' š Š" =|==* .=? 0':-f' Button Butt OTI Head Socket Screw Socket Head Cap Screw ll l i í =s= .== Š, .sv 41:
us .=== - Q 't Pan Pa" 0 '\,/ I -£5 §$' ¢===IF I W ÉËË .__., É é' 99 žäïë Fillister Flllister 9 4_» -I0 G Poz|on|ve® '` POZIDR|VE® 'a "5- fll) l iaé 5, "Ë 9: .Q Q 9 W Hexagon Washer Flat Countersink Tvoe me AB Ae I Bugle Water z1\\ 1\ \ | 0111111 n111\| PH" " B /Tvoe Z Z I Tvoe Tvoee/Tvnez -2 9 Use:Sheet Use : Sheet metal applications. applications
Type TT/Type / Type 23 i Type me BT / Type T1Lpe 25 Use : Plastics & composltes composites Use : Soft metal castings. Socket Set Screw ánr 35"'-5 M .===~ Ž @ atŠ -=" Half DUH Pflint @i:i¢»emi1 Cone Point » canipaiif igís' "az E .í m åäš Š $15 55$ Š Ĺ? %F i 1 S I Use : Against hardened shafts. 1 ã'='Š : . °'" M "— 1? í V T' ".._ . r"_________ .._.' I ri..-
. r........ ....+ limit» llllllllllllll USE USB Ii Piercing P¡el¡flQ Light metals. Use: Use : Self drilling applications. O IIIQ 5 A 'N Flat Point rem Knurled Cup Point í é':-="-5 Š" M N S li a $5' ¢|==* ;= A Ž' i "as N ii-.. . um. nnnn f'|F+t'\ N „Š .sz $5'-'9' ,ap -===l'= „zs = ..-» §$ Ž 11?: *i* 1.; ..... I llen ' Fnr nermnngnt '.\ Til; I.i' Iltil tl l li l llllllll """" - soulms
RECESS necess (Robertson (n0oens0n®) SOUARE ®) TRI-LOBULAR TRI-LDBULÅR Q0 Q 2: as -|ca -I :u>< ® I'f'I ID in 12 .EII :E rn :H ab =:š. -< =2III CD FR l'I'I Cf) :E I: :Š rrl l'l'l rn l'l'I I!'tr' ® Q5 ONE WAY mi-w¡no® 9 er? TORO-SET rono-sEr® -.- e .- ríš ii in Q * W . r-.--.,_.,._ ».,» -: rag," - -._- Dl:nln_' |C||||||G| |fl||||Ë| l'\B§|§lfll|l HËŠIÖEUIIE IHI-
WING" li iii 'r..-..... n-..:..n.....e Tnlunnnn 67 m Iii 0 II Iii ;?=§ É E ===°' E *==" =:a=$ e O T0nxAL|eN® TORXALIGN® 1,? Dog Point Forfrequent Use : For permanent adjustment. location. adlustment. COMBINÅTION SLOTTED SLOTTED// HEXAGON HEXAG UN COMBINATION Resistanl Screw HeadDrives Head Drives Tamper
Resistant Drill Point . \l'h'llGlU pal -"-"-' '1 '"' l"""' "Use : For permanent Ubti tise .: FUI For pullltallult permanent UM? tlse:Whe.'e partsLa '` 115% F0-'Pe-'l`flëfl@fll' location. f location. location. location must be often reset. _` USU . l'Ul lJUllllc1l|t-'Ill ii O qäš TlJRX® Socket Set-Screw Points Cup Point Oval Point ® © Use:Shallow Use : Shallow holes
in' in, Use:_Selt-drilling Use : Self-drilling in CUlTlDClSII6lTlE1IEl'l'EtIS. thin metals. cornposite materials. i¡ Needle Point FREÅRSON FREARSON HEXAGUN (EXTERNAL (EXTERNAL DRIVE) nsxneou DRIVE) asiaaselitam aw MNW Use : Sheet metal applications. | :1" HEXÅGUN (INTERNAL DRIVE) COMBINATION PHILIPS PHILIPS// SLOTTED
Ct'.'lR'iBiNl'\TiON Tvoe 17 rvne11 '|'|'_L__" O HEX_A_EDN (INTERNAL DRIVE) Ii SLOTTED lllll k Acn POZIDRIVE Pozlonlvla gm, ŠmACR iii Truss l lll Ill". ACR ACR" Acfl PHILLIPS PHILLIPS PH|LL|Ps âw '-I A P Z Tvoe rvoef l . I PHILLIPS® PH|LL|Ps® E2. :5 IIIIIno Ci -1 eaE: It CID iii Ii. 0'! GP G0 Screw Heads & 'UPoints "l_ \l\2:' I\l\l \\\1 i\ li Š iti)is11111 IQII
_'*~*~_* E E '$ A E Q» _. ai* ' as =:==* 0? 0"=_!=' cíaa % ill:) 11 11 /v-v-v-N MAJA L"-31 INTERNAL HEXAGON Resistant HEXÅGON Tamper Tflltlper Resi stani . . \.. lw. ;: 3, _-. > __ _:'.. 1- at _-;_-. -1___;. _-i _-. . ——-————~ 7 _ I 17?... 44-I WEIGHTSOF WEIGHTS DF nouno, ROIIND, souiiitea SQUÅRE & HEXAGON HEXAGÐN STEEL ŠTËËI. &
BRASS BR!-\SS BARS BIIRS 1.' i,7 Steel _ l I _f,,í_. 2%- § 05=>-)1+ (inch) inch) IRDII IIlCh (Pounds perlooti per toot) í ýr/ T1'-"—'% Size - X I Brass Steel i Steel Brass 67797916666 '"1 u.u| u T_ . L. I —I hil Cal hi Q il n nnn n nnn I n —n'\4 n nrn U.UJU I 8.648 5.550 6.550 10.149 0.149 10.676 _ 10.575 O E/IO U.U"I'U '_i | 'Ifi 'ITII -in-17/I IU.I1I"'I' |u.|¡'-
r 1-t'I fl'IQ n1:: l.U IU ||.u|u 8.800 I 6.617 0.017 10.328 0.328 0.864 10.864 O Oflfl U.UUU 1 7 _ ___ 6.005 4 ___ 9.373 I I _ 89.373 7.. 47 9'__ 7» 111.41? 511.30 -. ,1._i 1 -. .3. ;.- -1 12, -~ r ::...; ;_' -,_-' 3 -- .-,. 7,.-._-_ -.---_ -~_ ;_.-.; 5'_ ;._ .11.; .; =1 ig -3i.-7-;-I-'7 5-' ' I . - 7-». 1 -._ ._._ . _... - - /... ,_ ;_-_'-,_ - . -~ / .; _. _ IE 'Ë1 @_///" \i§.;§;§4 W . in liilegrams
Weigtil kilo Ql`ãIT1S. per DET meére ITlGlË€.^ eiglii I I-ll('I 00' I Cl 0 .4': ,,,-I I Steel Pipes U ili Nominal I-"NIT HEAVY Nominal Outside . LIGHT __ MEDIUM HE" Bore (Diameter Diameter? Wall . Wall _ W . wanll Weight Il . \ W ht . Weight migkgessi mg 1 thickness II1!GI(_!ll;!SS thickness wmgm thickness wugm thickness r (mm) l(mm) re) (kgs/m)
(mm) *(kgs/m) (kgs/m) IITlI'ill * lntm ligs/m I ifieial (mm) I(kgs/m) l (kgs/m) {mini \ . 9 15 I 21.3 I 20 _Ñi 25.0 20.9 3.9--1... 33.7 I_ "' I 32 WI I 2.00 0.962 2.35 1.42 g 2.65 zgr '3 FIR r_.uu ') fl/I r_u—r Q OI-I u.(_u l1 42.4 'l2;4_ 2.55_ 43.3 48.3 2.90 50 . 50.3 60.3) eońll 00 100 i 125 l(150 l 65 {0.1 70.1 00.9 33.0 114.3 1139.7 39.7 155.1 165.1 in-pi-1
2.407 2.45 3.15 3.15 3.51 3.61 3.25 2.51 A 3.25 3.25 3.27 3.25 3.25 2.90 4.14 3.55 5.34 ' 3.55 3.65 1 5.53 6.53 3.25 l 3.25 3.25 3.25 4.05 4.05 4.05 4.50 4 50 4.50 4.35 1.22 1.22 1.53 1.58 2.65 3.65 . 5.10 8.48 l 3.43 l 1.45 1.45 1.00 1.90 2.99 5) 2.0" l 3.05 _4.43 4.43 0 17 6.17 U ` 7.92 7.92 10.10 10.10 0.07 ' 4.50 12.10 . 5.40 1 50 5.40 *14í 4.5011400
4.35 4.85 15 15.20 170.20 I '5.40 540 l 17.00 1790 450 l 1730 . . 4.35 19.20 10.20 5.40 540 1" (21.20 2120 4.05 6.86 3.65 4. __ . 7 llleigiit Weight lain kilegrams kilograms per metre matre 7 '11 Aluminium Pipes 1 i Brass Pines Pipes A I I iii* | |.OutsldeI °"'S¡fflfl wan Tnielmess (mml ma W3II_'_I'I'lICIll'lBS_S f vWa||TI1ig|(r|g33lm_m) \El Thickness
(mm) Dia ~ .ý r _'f . _ 05. 03'10l15 0.0 10 15 20' 20 05 07510115207 iiriiri,'1 0.5 0.75(1.0 l 1.5 _ 2.0 0. 019 0.020? 0.029 lg 5 J 0.010 _ 0.05 0.11 I1 0.14 I 0._023 00.035 .035_ 0.042l . 2)____ 0.07 0.07 5 0.023 013111118 ' 0.20 '_0.042 0.042 0.0511 0.051? L _ 5 __ 70.00 0.09„ 0.13 0.15 l 0.22 7 0.23 0. B0 f __0.032`0.o49 Ilfil-032 0. 0 _0.050 . ,0083 13
. l 0.10 _l 0.15 010_r.' a`_a ' 025 i O.O 1n [1949 fl7R I n -inn n0.130 10¢: n013 15: 0.040 Q_l1R.'Il 0.003 n0.070"0Ž100 0.19 1 no/i 0.24 ll nbn 0.34 I @GG 91157135}-sn I .313 | _ " \J\|\J lntlqklkl U | \J'| I\i\J 7 LI. IL)\J I7 Q, |\J __0.049_ 12 77 I.-.040;0.075'0.003l0.134 . I 0.0701' 0.093 '*0134)I 0.170 0.14 l.053 0.083 0.102 0.187 13 0.053)0.003 13_ 0.102
0.146 . 0.1 07 ' 7' 0140 41 15 16 18 L062 0.096 . 0.119 1.172 ' 0.221 0.002_0_090 0.119 I 10.172(0.221 10.055 0.154 ` 0.233' 0.000 1 0.103 10.127 (0.127 10.104 0.230 0.074 0.115 0.144 ' 0.210 3.210 . 0.27_1_ 0.074l0.115 0.271 __0079 _ 0.123! 10A0.070 "1123 0.153 " 1.223 (0.230 0.1s3_70.223 0.288 20 _;. _ 1130-0151 . ._ 0.101 . l0.235 0.235 l
0.305 f0.083__ý0.130 0.305 22 0.091_ 0. i 146 0.178 i, 0.339 7 3145 .251 0.170 I) 0.201 10.339 25 70.104 0 .164 0.204 10.0zfl1_54 1200"11 0.390 0.300 0.204 _ 70.299 ___ I __ 28 0.117 Ii .183 0.220 0.117 0.133 0.229 0.337l0.441 (_ 11.3371 0.441 I 32 30 i__0.125 0.240 i""'1""'L2 0.303 ? 30 0.125 T1353 . 0.475 Y _ i 0.199 B'i.199 0.246. Q1 32 7 0.214
0.509' .214 10.203 0.263 I 0.303 3.38811 0.509 I __, L4 'L41 l: J .. ..- 1. _.-..-, .;. -,1 . ., ., ..1 .14. .2. . _. 4. ..._- 1. U-U"? 9 I'\Jco 0.53 PO 0.50 0.59 0.37 9 co \l l 0.54 cn -1: 0.50 0.69 0.40 00.5 0.69 0.40 0.50 0.40 1.58 0.74 0.45 0.50 0.85 -I5 9 0.40 .9-0-oo (0.70 1: '\lc: 0.90 0.00 10.5 l 0.74 0.05 70.51 0.96 I 055 0.50 0.02 1.07 I 054 04 1.23 0.64 -22 00.94 0.72 _g 105 1.00
1.39 0.32 .9 OJ I'\J 0.46 (:1 -12-C5 C) ' Z C3% OD l l l l il l l IU|\7-Å O`)l\3CD I 0.29 l F0.42 4>- 0.23 L4) _(*1 1:9 EIJCDOJ U'-L"I' (L 0 |:0n 315g' cr._J 7.217 7.050 _ 8.344 0.344 7.217 7.650 11.103 A 11.040 2.929 ' 11.183 11.940 12.929 12.550 111.704 1 .754 300 7' 12.500 13.000 9.860 3.600 7' 1""l573"'"," 7.043 67775377 77.7657 1 3.073 0.970 lT
0.702 9.792 . 7.755 7.765 f 3.470 5.470 10ee 7.643 10.870 4.004 _ 11.973 11.073 - 12.970 10.370 _ 11.770 13.347 14.994 9.0 07 9.824 T 1 3/4" A3174 10.413 57 0.007 0.324 8.174 8.915 3.015 1-0 15.896 7.213 13.75 I -{_ 14.889 3.750 14.339 172.479 13.512 13.512 17.213 12.470 £22.. 6.976 15400 15.551 16.681 _ 10.525 19.625 i 21.250 21.250
15.075 118.381 3.331 15.405 . . . .._ ____ .4 12.831 1 4_.8331"1 I "1 1.764 I 12.331 13.600'7W1'4Z33'3 2" ' 10.575 10.070 3- 11.544 11.644 li 13.600 2" 1 1/2" 1/2" :. '.-...\ 1-..;.;.~.1 E1 I W17 7 051:" not: 7¡ .suu .Juu ..._._. \ -iE_' Wlzdt I .--. ».~ '.. %>%T"1'lf,'Ä NIN! NDË | _..-.-_.-1-».-_.- i"\ fifill _l_ I \-I]\I _._. -...»,.-.- -.;.-».=--. .-.-:.- -_ WEIGHTS OF
ROUND STEEL, ALUMINIUM ÅLĨIMINIUM 8i & BRASS BRÅSS PIPES Brass Bl'3SS no!) . I'"l one 1 n 41.4.1 n Pm: i_.i..;uu 0.265 | 0.244 0.306 ._..P'47"' ; _____._';4££....J . U»_2_2_%__ 0.240 I n0.283 0.232 0.134 0.200 0.184 1/4" 0.167 0.182 0.213 0.213 __g232 1/4" 0.107 0-' . 0.352 I 0.237 0.313 0.287 I 0.313 0.284 0.332 .0302
0.332 5/15" 0.261 0204 _ -__ §Z.157T.-.-..._9-251 0.471 i 0.544 0502 0544 ;p 0.435 W_0.471 0.L_ 94 0427 7 0.502 __W* W 0.304 0.54527" am" n '57; l'I A752 0.4147" 0.451 __ _f:0.451 0.470 0.521 1 9_-*l 0.409 5 E _ 0.521 3/8" 0.409 1 _4 I I 0.375 0.079 0.679 0.735 0.705 7._T_ 0.850 10 0.616 0.785 0._ýv '010 ' 0.667 0.007 0.614 __
0.553 0.533 l 0.514 0._710 7/15" 0.511 0.511 7/16" 0.557 0.651 0.351 - 0.710 0 . 557 0.9 78 1.059 059 1.130 1.224 0 961 0.887 0.961 1.130 _ 2151-444 _ 1,/2" 1/2" 70.007 0.720 7,l7"0.050 0.667 0.728 0350 1 0.927 0.027 0.735 0-BL.1 0.302 _l 1441 1.331 1.441 1539 . _'__ 11.000 . 555 .3 31 . 1.539 1.200 - _ 1.303 1.393. 1.015 1.173 1.076 1.173 5
0.0531g+_g; gg1.015_g_g 0.931 0.921 1-51.075 0.344 ~'-"i. =2 .9Ĺ15Ĺ._ U-34í__ 0.021 1 520 2 1.654 1.766 1.913 1.528 1.913 1.307 l1.501 -5.9.1- T750 . . -1-387 1.137 1.140 1.253 1.253 f 1.137 1323 1.320 ; 1.440 1.449 _ DE 5/0" .3040 1.043 532.1 1.700 1.730 _ .w 1.570 A gg1.5739:" 1.703 2.010 _ 2.176 1.738 1.882 _ 1.920 1 .902 2 1_25 1.928
2.269 2.457 1.962 2.125 1.781 2.200 ' 2.382 1 1.007 52.11-325"" 2.162 2.754 2.302 1.997 2.543 54 22007 . _I 2.-7..., -.. 2.054 2.451 l 2.225 2.409 Il 2.334 2-834 _g__"_3.050 __9llê.9__2451 3-554 1.913 1 2.03577 2.000 3771.554 1.054 1.637 1.913 1.304 l 1.501 3F.% _ 1.501 l 2.465 2.405 ' 2.669 2.009__| 3.140 3.140__*3.4_00_ 3.400 2.716 2-716 i
2.941 ___I 3.286 2.983 3.559 Z 3.799 -_ 4.114 4.114 W 3.235 3.229 0-730 \I \ U; 2.229 2.450 ' 7/3"l 2.043 _ 2.220 2.603 2.503* 2.330 2.0397) _ 2.252 l 2.455 1 3.540 3.549 3.843 4.090 3.911 3.343 4.522 ' 4.896 3.9 11 11 i 4.235 I 3.351 I 4.170 4.170 4.906 5.313 3.851 _4244 ___*4.595 1 5-013---_-5.444 ..L _4-505 2.0097% 2.911 777035.I4003 3.400 '
31700* 241 .9 sg:: 1-1" 2.330 37703' ' 2.041 3.208 7 " 7| 4.492 4.492 0.197 4.864 6[5.723 5.300 _ 6.197 I 4.950 5.350 24 ' 5.764 N 5./54 55221 '"71 _.. .-.- -_5Jb4 6.664 5.324 T _ 4001 .   i t 3-. 4 411 4.060 3.378 _ 3.534 3.684 4.303 _1 4.093 4.303 41503 1" 3.722 __ .111/8" 11.3'? 3-378 4-OK 6.617 . 5.540 O .5.-995
6.005 7.065 5.545 7.055 _1 7.650 ' 6.111 5-51L. 5.0126 I 4.549 5.313 `1 5.794 I1-L_1/4; 1/4". I-'4.170.'-U" 5.313 5.012 4170"" I 4.549. ______ I 4.595 „__ 0.066 O.IU'-I 0.330 | 6.310 0.310 6.833 8.038 8.704 6.953 ____7.529 7.395 8 007 7.266 7 'Ñ 8.549 0.257 I 7.395 8.007 77770711 8.549", 779.257 6.711 "77.2007 7.0111 -0 5.560 5.0407* 5-5.94
6.428 5.0559 5.504 4428 7-01. @Jesi J1 3/13"" 2.65-9415 7.549 _|.I' . 8.174 I 79.515 9.616 10.413 8.318 900' 7.549 0.413 -7 3.313 0.0077 GI f"..'í«'.;.zí.r1. ;:.;°«` 5.... .2. , .-_.» -. -.» -.1. 4- -.. :.-». . ,-- 1- .- :._ _ . . . U'! O7 O1 1 1 . 1111:) _ an _ t:1 I I'\J . \ 077 n77 1 14 "- 1.50 7 "..' _' ' - '114 0.83 1 1.22 ' 160 1.60 - 1- :': .4.'.-.";.-I I1 . . -:-.-.:-. -. .-.-"4 7. . . -'
707171111113 ,E weleurs or of SHEETIMETAI. sam METAL s1e|:L,ALuMm|u|v|, come 3. nn em: STEEL, ALUMINIUM, miss, BRASS, COPPER&TlN PLATE _I 1. _._ Sheet Steel (inch) 6 I1ne:: u:: 41: .5'-E. (mm) No__ (inch) -._-.i;_.J_ 5z5Pu:i 1 Sht. teel (mm) Sht. SSteel (mm) Al, Brass, Brass. CopperSheet Cugper Sheet (mm) sheet I'Co"""er '-^-

'515l=1"'¡°"'1„"e1-mi sm' Ala .-115 ' Ifirass ness gr9 Thicknessl I151333155--ar 1 Thick-I'W"I?II_lll 1 W 1. uz:/112 kgs/mi ^ kgs/ml f kgs/mi kgs/m2 1 ligs/ml Lbs/ft' A (mm)1 kgs/mi' kgs/m1 ITQS/I112 _. (mm) 'I""II _- . -...I"'£"I. I {ill =5' It i 1 1 '71 1 0.181 1-44.. 1.44 „fl_-1L 010 1___.0fiv0_-89. 0.85 0.89 __ ____ 0.31255 7.933 1 12500 0.3125 7.033 12.500 i18._1. _ 0.20 1.60 -1-1258 ?gU.2UgIfi'Ii.6U U15 if ff __'I.28 1.34 0.15 _ .J-28 _ 1% 111.250 ' 0.2812 5 7.144 _.__1i:?_3J.?..j 7-144 - _ 10.22 0.221I 1.766 _0540 1.70 1.73 O20 . 0.540 170 . 1.78 0.20 1 0.2555 1 6.747 5.747 110.520 ez ~ 1.02 0.25 7 1 0.24 1.92 0.25 I0575 0.575 2.13 2.23 2.237 02500? I3-359 _ Ë;?_51°9. 5-35° 1 10.000.40.20 0.23 2.24 .>= _M0.3_0__11031_01_2.55 0.30 0.310 2.55 _2.57 2.57 0.37 II_1 0.32 0.2344 . 5.053 5.953 19-370 032 2.55 0.35 2.03 3.12 0.35 10.045 » 0.945 #293 3. 12__ .19-E94 0.2137 5.555 5.556_18.750 3.04 3.750 0.38 0.33 304 . . 3.55 0.40 1 1030 1.030 340 3.40 3.5 5 040 0.45 3.33 3.83 I 4.01 4.01 0.45 1 3.52 5.159 _Ñ __ 3.120 0.44 012031 . 9.-2992.1 Q 2 4-2 -L 13333 CAIN? - '4- I ,9? .4 7.350 ' 21.25__1 4.45 4.45 0.50 71.34-,5_t*71.25 4.1111 7111557 0.1375 4.762 7.500 "-5" ._Efl-1'7-ll"'lI 0:1.5Ž_Ĺf1lfÈ2 ' 4.53 4.537 4.90 4.90 0.55 0.55 0.56`1 4.43 4.48 11U.lIIU[0.1719; 4.355 4.366 u.oru 0.63 1520 510 . 5.34 0.60 __l.620 . 5.34 _1 _5.10 smo . i 0.53 5.04 5.04 3.050 9 10.1552 3.959 1 5.250 I.0 '-lU'DU'l-F- 0.501 iQO'?I'\ 4 3 __ GD I\J -L $ Q 1 f\J 7?: \li 1 Name Symbol name Actinium 4 'J Ac A0 A9 Al Am Ar As At Au B Ba Be Bi Bk Silver 111111 4 ~44 I --_. .______.. 0.357 4' 4.. 11 ' 1"lHlB Pizie 1' 4 1? 4. Tin Tin Plate Piaiz intro'(mn-11 1 Piziz Wl. g ___ I 7 :nn I I II Kl I I IIII FIHTB Piaie l_1 WT. WI. kgs/m21 (mm) _ kgs/ml {mail (mm} '1kgs/mi lrgs/mi! kgsfntz 1.2711 0.35 '1 2.33 _ 0510 1.27 0.531_ 4_53 4.53 WI I 1 Q3 i I 9I 10in .503/I0? § 30 0500 ~ImmI 307 0.0125 š1 0.318 0.313 .U-50° 0.15 31 #010100 . .0 0 . 273 0.438 _0.273 4.99 0-438 |]_1g 0._19 1.54 1.54 = 0.37 0.37 1 2.96 2.95 0.54 .;1_g9 l „.."'7`-'Ë{„Ĺ`}-."'.{`Ž-. .-..-„ I.ID UJI-I 0.110 U.UU CI. IUL ; U.£-DU U _ 430 5.15ID I 3.40 u.uu I_ 32 _U.U 0.0102 u.4uo u." UÄUO :2; U.LĹ |.lD UJH 1 1.92 0.43 3.39 _1 9-70 .9-4Q . -r:cu-. 0.24 9".9.|>ov I33 __§.0094 0.375 _ "-24 _*Ë 99.094 . 9.-338. U-238 _0375 027 3.6331 0.757" 0344-4 M43 0.27 . Z-J22 2.15 _ 0.46 _3.6 U-75 _ 5.35 5-55 Y _0.0086_0._218 J4- 5.9-9939 I 0.21 10.3 2.24 .9 c.riQ coQ 6.24 0.50 -~ ~ 0.28 0.80 '3.90 .9 77r .u:. M 0.00737 0.103 35 0.0078 0.198 0.313 0.313 -4-"' ' ' " 1 in0." :Q fa 11 no'it .39. 931 '55: 2.43 . -1.11 u.:ru I "A 35 35700070 0.179 0.231 EI 1132 0:32 2.56 1 0.571 0.0070 0.1703 .9at -1 4.50 1 1.00 7.80 I (mm) .--.1 4, '-39:' 1 it I n nrn 8 A l'\ Ann 4ll'\f\ n l\I'I nn l'\ F? ?_ I 4 -I in W!" l L.-'TU 54 n I-I AA |\ 1 A nn An n Ii on FD (I1 F0 1 '1'-II /'1'11 fl DI1 u.;Iu ' I1 '11 u.u| 9 I ._. -fly; . ..._.. -;i.-~."",. _ *\--.1 ., ._._-11._._»-...;-, 1.-. /' c >111-_-._>1, .~.,. -..-;.'-; -1. if -1 15.-r_ -,>».1, - , -. 7..4 -..,. .: '-1 .,, :-~'.' .. _ . -14.1.4-4' -4,.-3': -1.1. -77>" if- .4 '2 Y\'.4-2 4-_.-= .'. 2. 34." .1.'.1; " æszg .: .>_;. ,. . '__ . _ 1 ._.. :11 6.. .1 1 1"' -r"».3I'?"?, 3 ' ' F -tr li Ii E IS ,. A _1.-1.!__IH§LdLIIIU 5' L1 ? ,_-'5 4 eisminh 31311111111 Berkelium Bromine C Carbon Ca Calcium caiaium. Cd Cadmium Cerium Gerium Ce Cf Californium CII Chlorine Cl Cm Co Cr Cs Cu Bu DV |-.. I-I I Curium I Cobalt Chromium Caesium 1Caesium Copper 1C0pper Dysprosium 3.(- He Hf Hi Hg 3 Ho 2 g l1 3 in In f lr K Kr E >.5-r .5 La Li Lr Lu Md MCI Mg Mg _ Europium Fluorine Iron I iron Fermium r.._.._.,:.._... l'ldIIbI|.IlIl Francium Gallium Gadolinium Germanium Hydrogen Helium _Halnium Hafnium 1 Mercury 1 Holmium Huimium 11150153 iooine 1ilndlum indium 111m11um iridium Potassium lPotassium SymholI Name Symbol Name Mn Mo N Na . Nb Nd Z Ne Ni No Np N0 ` 0(D Os P Pa Pb P3 Pd Pm Po Po Pr 1_Krypton Krypton 11Lanthanurn Lanthanum 1Lithium Lithium 1Lawrencium Lawrenclum Lutetium Luteflum 11Mendelev1um iviencieievium Pt Pu Ra Rb Re Rh 1-in Magnesium Rn Ž Symbol Name Ru Ruthenium Manganese Hu Molybdenum S S I Sulphur Nitrogen su SI) I Antimony Sodium SC Sc I1 Scandium 1 Se 56 Niobium Selenium 3¡ Neodymium 51 Silicon lit...-.._. INGUII Neon 1 Sm sm Samarium I Nickel Sn 5,, Tin I Nobelium Sr 1 Strontium I Neptuniurn Neptunium Ta I Tantalum I Oxygen Tb -l Terbium TC 1 Osmium Technetium I Phosphorus lg Te Tellurium I Protactinium Th Thorium I ' Th j Lead Lea CI T 3 . Titanium Paiiadium ' Paiiauiuiii Thallium Promethium § TI T' I Thulium Polonium Tm Uranium Praseodymium U 1 Vanadium Platinum fV I Tungsten Plutonium W Xe Xenon Radium xe Yttrium Rubidium Y Ylterbium Yb Ytterbium Yb = Rhenium Zinc Fihodium ' LII Zn Rhodium Radon Ë-1 Zr Zr _Rad0n Zirconium 1 I-.1 CT 'BA-l4u.r.-.'i\ I'TnrI-\I||v~r~| IUIUIUIII E IF _||_ _I! __-_ 1': r. K 'Q 2 Thixotrngic : Describes materialsthat materials that are gel-like (e.g., Toothpaste) at rest buttluid but tluid when agitated. Thixotropic Centigoise (cps) (ups) : itlt is a relative comparison Comparison between the viscosity of water and a fluid. fluid. Water is the Centipoise is 1 cps at 21 21°C standard by which viscosity of all fluids are measured. Water is1 °C (70°F). Fluid Approximate Aggruximale viscosity Viscosily (cps) (ups) wa1er@ 21°C (70°F) (70°F) Water @ 21°c 1 3 10 Kerosene / Blood 15 Ethylene Glycol / Antifreeze 65 Com Oil Corn 150 30 / Maple Syrup Motor Oil - SAE 30/ Motor Oil - SAE 40/ 250 40 / Castor Oil 1000 Glycerine Gycerine 2000 Com Syrup /' Honey Corn 5000 N|0|äSS€S Molasses 10000 Chocolate Syrup 50000 Ketchup 100000 Sour Cream Peanut Butter 150000 1000000 Lard L414 5000000 Caulking Compound _ 100000000 Window Putty chan 9 elntem NOTE : The abovetabieis abovetable is intended is intended as ageneral a general 0guide only.V.Viscosi Viscosity varyY with change in temperature NOTE:The uide onl W values var P erature Milk i. I -. lliscosity Viscosity Chart tor lor Common Fluids 5 me 23 -0000 10.0155 0.397 0.397 - 0.625 .21É 10.0141 0.0141 1 0.357 0563 \ 'viscosity: flow (usualiythrough a specific oriiice). iiiscosig' :AA measure of oi the resistance of oi afiuid aíiuid to toíiow ._ . z:-t1. Symbol; Symbol Name 1_ Erbium Er I` Einsteinium Es Aluminium '; Eu Americium F Americium Fe Argon _ Fe .5. Arsenic Fm Astatlne Fr Gold Ga Boron Gd Barium _ Ge Beryllium H _l _-4",;,. '-_1:¢' :-' -." SYMBOLS FOR ELEMENTS Br 4.00 I ZMIGÖUIÖËFNŽ-\Š GU, '_;..:.'_:_ :1 4 -. ¢. ;r-.'.f .- -.";'~ .'1Li;'. 5.1.- I1 IIIIII IIII M . -1: --F .3 ;.-'-._..~.' ~:- =11 5 1&1 Y! 1 ,,-._ _. 0:--1.1.-"2.1--; .-.-1 -I-.,.-'-'.1/,' -'-,--'~' 7.1 . . -- .: :4.;- 5"' ~;11*. -"5-:4-1"1--- -:-.- 1 E i — .- .-»-, .r .» I i7 i 31g "1 Wflillhfi 1_ Wfiloltt, gms. lbs.1 lbs. 1 °"'s' er per Pfllj per METAL/ M5ri1u.o1o METAL/METALLOID Point P0 int ce C" Brinell CConductivity Bnnell onducllvrty 1 Expansion Strength?Hardness" Strength Hardness' Hear 1*ere .1 percent pa: 1 "°'°°"' (approx.). (approx.) par F" F" tonsfln." tonsfinf HB OU -100 = 100 ' 100C 100°C Cu - BRONZE (Cu 00%, 90%, Sn Sn10%) oeonze 10% 05 35 125 1 _20 20115717 0.30 7 S3 28 100 _lIflfl Phosphor Bronze (cu95%,sn4%) (Cu 95%, Sn 4%) Tobin Bronze 11 1 5.3 550; 550 1047 1942 8.8 1942 E 'UH LNIIUU /0 IU/U; 3.41 5251 $20 J'; '-_-4 c1\ow1|uw|1cu) CADMIUM (Cd) l-'-I1 I'-J (J1 960 GDCDCD 1760 . .¢ "-~lCD CD 3.5cn 540) 321 __610 .r=~.c:1 021_ 9° 01 7 1 1.6 1.5 101 101 850 1562 1552 cAn3oN(c) 1É 134 055010455. 3550 154551 CARBON (C) 2.21104 Ë1í1oMiuM(cr)" 5.7 1í'31 1505 1Ë7í° CHROMIUM (Cr) I 6.7 4191 1505 2740* 003411100) 3.3 550 550 1483 1453 2700 coerur (Co) 2700 8.8 COPPER Elect7olytic' Ele 5rm|y11z1cu)1'5.91557 (cu) 1 8.91 557 1082 _ coeeen 1032 1981 . 00042070110 {Cu |ou1=..fl.1.ur4.1r4 (59 4.5%, 4.5%Ž 11 ` 1?1 Mn 2%, Mg, s1, 501. Al.) 2.01174' Si, Fe, re,r>a1.A1.)_ 2.5 174 00011112 500 11112 5oLo (Au) (Au) ' 19212041 1050 10715' GOLD ' 11 060' 1945 ouužmem (cu 00%, 33%, 7 O oun menu (Cu Q11 199/. 7n 2%) on/.1 Sn10%,Zn 1 8.5 534 1036 19001 _'1"-'L 1 mon (Fe) (Fe) IRON 1 7.8 490 150512705 Pure Iron 1535 2795 7.0400 Wroughtlron 7.7 480~ 1510 2750 Wrought Iron 2750 , 7.714001510 Castlron 450 1259 2300 Cast Iron 7.2 4501125012000 Malleablelron 7.4 462 1250 Malleable Iron 1259 2000 y A_ 7.41402 2300 LEAD (Pb) (Pb) 11 .31 707 020 LEAD 11.01707 326 020 620 nihouesíííŕhí) ' 103* 070 mnonesrum (Mg) 7 " 1.7 '10s' 670 11240 1240 1 70147511220 22401 110000000021045} 144054953: (1411) 7.5 1 4751 .25.7 Š;/1:. „2«„ noweoenumimo) 10.4 651 551 2500 2500 4532 MOLYBOENUM(Mo] 104 4532' MONEL Moon (N167? (Ni 57%, Cu cu 30/ 30%, 1 1 c3%,1>z1. rz,iv1r1,s1) 3.31551_13152400 83% bal Fe Mn SI) 88 551 1015124001 (J1 Q0 CJ"l u, I-Ill-1U, C11 C10 .1':- -L CD C0 1 P T'i;_7.-__ 9~ .. __ 'cl MUNIL IVIhIPlL1UU IJ'U'15, 26 1% 100 - 30 Lil 1NlCKEL(Ni) 0.0 NlCKEL(Nl) 8.9 550114542050 55611454 2650 PHosPHon0us(P) 132145 44 44 111 1111 PHOSPHOROUS (P) 1.82146 '1PLAr|rírM(P1) =u1r1nun111=11 121.01100011770102121 *"121.313301770132121 "-1 '.3: '1' '-1' 1. 1', 91,, r. .5 -.'.- ~,-.,'r-_-.',-.. -' 2- '. _.__ 12. 43 -la.DO _ 4.r=. 20 34 23 1_04 0.30 0.00 55 55 18 A._ 16 0.08 I 0.00 16 350 125 30 30 30 Hr 100 1 100 100 0.18 25 25 30 25 9 - ` 29 26 31 (JO _1. . .:__'1_- .. -_ .1' .,1 __, _:'___1 ___ . .. .. _ .\. ~- < ___ 25 34 42 7.8 490 1371 2500 12 45 800 300 40 J> O 1427126001 7.8 490 1427 2600' 7.9 495 1398 2550 7.3 458 2321450 7.37Ž15372327' 450 1 30 50 217 140 160 ___ . 1l _ . 1 _L -I5I\J 4124 1-01.6 l1 0.06 0.19 06 0-19 _ 1061 13.3 14.5 1 13.3 i 14.5 13.3 14.5 1 0.12 0.12 0.12 - 1 0.12 1 (I) Z U5 'L (II I\.'J _ 1 130 170 201 7.9' 2450 7.9 495 1342 134212450 1 7.8 490 1427 2600_ 142712600_ 1 1 _ 111 1 7.8 490* 490 1483 2700 7.8 490 1427 2600 142712600 rm (Sn) I 4 {fw 717 57710100171)7777 if 4.5 02 r|rAN|urvi (ri) 4.5 20111000 281 1800 0270 3270 runesfiări (wf runosren (w) 101110104. 19 1191 3400 61521 _ ge->ææä VANADIUM (V) 5.1 000175010102/ 330 175013132 'vanAo1urv111r) 10.1 ZINC ZINO (Zn) (Zn) 7.2 447 4171735 13 724471417 700 710 - - A -15 1 10 16 6 _ 0.2 0.2 17 13.5 17 0.12 0.12 0.12 0.12 0.17 0.17 0_, 0.21 OĹ 200 -230 0.08 204 0.04 294 I 42 31 - .-10.10 0.10 357129 3011 0.00 0.33 05 120 00 Common Chemical Compounds - 0.22 Common Name Baking soda Black lead Dlnunhinn Bteechirrg nnurrlur pe'-:der Blue stone / vitriol ltlue Causlio Caustic Potash Causlic Soda Caustic Limestooe Chalk, Limestone Chile Saltpeter Crystal: Condy's Crystals Epsum Salts Salls Epsom Vilriol Green Vitriol Laughing Gas Lime (quicklime) Limewater Limewaler Liquid Ammonia Lilharge Lilhargc Muriatic Acid (Spirits of Salts) 0il of ol Vitriol Oil Red F.erl Lead Sal Ammoniac Ammoniao Saltpeter Saltpeler (Nitre) Slaked Slakerl Lime I|II\I'l\I|lIIu 34 _ 3*. I 71 -L 1 'CD J3 1 45 147 ._.|. -5-"\I O 125 -I=~'lJ'I il- l'\J (J1 00 60 05 85 _25 00 30 -_ 11 1 fr;.,--4. 5,'-' -"1' .»l' "...-? "L 1 .O.___ na 0.13 13.411 - 1 JåŠ 63 - 4.4+ 77 \Ico\r.|> 12 57 20.6 20.5 67 10 100 15.5 100 5.5 15 1 180 150 150 12.2 2.2 24J:-U10nI\:r 110 113.31 110 3.3 5ou ¡\-,_a_r1._r_`. PF' co 1 8.9 40 '40 1 1111 50 200 58 ro*Ã1:::°c: c:c> - -3.2' Ï-5 0.21 981. 0.12 0.12 1 25 _ 60 1:*-.;'1:.1; " .. '-.»_" 3% Ii '-§_-3' 1: ¢1'-i~.'- Z11; F. _ 29 __ _25 (>ne @CD 1 ,. -I' =1 17.51I 17.5 15 15 2.9 -- I" CD _ nn\I , 113.530 0.12 0.12 0.11 0.11 0.11 $3 Ĺh)(AJ 1:.: urrun coco0- - -0 0-J. 0.12 0.12 on ® Ca-J *-J 1 6.7 I .._; 3., -:._.. -'-'-.'- _ 4.8 1 4.0 ý4.8Ž 4.0 _ 2.4 1420 25001 25861 y -_ 2.41147 1-420 _10.5 110.51._ __.i_ 055 15 _30 00 555 000 950 _ 1702, 1752 1 ___ _ STEEL Low Carbon Steel Medium Carbon Steel High Carbon Steel Manganese Steel [Mn15%,C1.5%, (Mn 15%, C 1.5%, Si 0.2%)' 0.2%): l Nickel Steel (Ni 3.5%, 1 C 0.25%, 025%, Mn 0.8%) Cast Steel Stainless Steel 0.21 45 'w1unrzn15n1L(cu50%, ` O 1211400.) 0.415251 zn40%) 341525 000 900 10521 1552 22 22 I 'I 1 21 21 .. _ —_ -L CDCD CD 1900 (011 _ SILWËR (Ag) SILVER C40 Z 25 1 511% (ca) .°"'L°"i-- \.llll 0131 _ 25 8.3 517 930 17061 1706 (cu 70%,zn.3o%) 7n 'JflU/ SILICON srucon 0.26 _ _ U-|._LIU1LO 11 (cu 00 fprr 'H10! 47 47 QTIIIII U I l-I-l- ANTIMONY (Sb) ínmonv (so) BRASS Yellow Brass (Cu 65%, Zn 35%) Carlridge Brass Cartridge 55 155 -1fl"l'jI 7.7 481 10401005 1040 1 1905 T4 -4 401 1 . Manganese Mangarrese Bronze (Cu Mn 1%) (50 60%, 50%. Zn zr) 39%, 39%,iv1n 1%) 8.3 3.3 522 522 87111600 871 1500 '- 'a' rel="nofollow">_,, 23 23 -_ ; 1 ,1w',. :_ ,.:_ ,._,. 7WBi_! _l0Ii1 Wl?¡_9|IË__ Melting Melting Tensile Tensile 1 Brinell Conductiuity1Expansion Conduetivity1Expansion lbs. Strenglh HardnessmElect.1 *Š gms."'lhs.» Point Strength1Hardness1 — perper cent gms. per per ;?il_approx.)l ?2(approx.) (approx.) (approielí 1 per per1 cm"1cutt' no Cu ==100 100 1 100C ° cm' 1 cutt C" C° F" F" tons/in.' tons/in." HB 100°C METAL/ METALLOID METAU METALLDID 1 7591. 1'0.25 Pure Aluminium (Al 99%) 1 2.6 1051 PureA|umil1ium(A199%) 165 050 1220 660 , 1220 Silicon Aluminium (Si 5%) 2.5 160 6301165 630 1165 Silicon Aluminium (Si 10%) !'°!"'!\° J2:-U"lO'!I 155 IJ\J1JDU1IUl'J1 580 1 1075 -IL'): 7 (appmx_):(appmX')l I'IB3I EIBCL1 Cl ALUMINIUM ALUMINIUM (Al) (Al) _,_ _:_.:; -. . ._, 7'7OF '7" PHYSICAL PHYSIOÅL PROPERTIES OOIVIMON METALS/ METALLOIDS COMMON METALLOIOS 1 Melling Te Tensile Melting nsrle 1 P _ cm" cult cu tt °:l:l\l_ llnnnflninl-n IO} ciflflf IJIIII.|Ulll"l1lIlllIIIIl.llll LOI lU.r"O W __.;. TH,-__ -.-. _. _ . -._._. _. I PHYSICAL PROPERTIES OF PER 'I. COMMON METALS EI _1___, šl > I-rrr E! " =,__Uen /_ METALLOIOS EI þl ,..¡..E! :Iua' ra É!, E ___ I _..,,. .1 1).;-+'= .-~;'F I;'_.'1'_- I-I -;'..£- -.1112: fl -. :1 2 0.00 .Qooo 0.25 _C>Nur „... ¡ ('I17 f\17 U.|r P Goz 0.13 {:1ca—~ E:co or 311.31 15 - 18.8 0.13 - _ '13 18 FD Z CD _ 15, 0.09 (J'l' Z'I I1 l1 l1 l1 l1 l1 l1H PU""U' „mm Vinegar w„¡‚¡„„s„„„ Washing Soda Chemical Name Formula NaHCO„ Sodium Bicarbonate NaHCO,, Caroon or Graphite 1C Carbon Calcium EZ ca ::». "2,2 Ca0Cl. Calciurn Chioro-hy Chlerozhypo Chlor¡".e1 1:: 1:: CT) CuS0.,5H20 Copper Sulphate C')coC7 CDCD P Q2 E: Z KOH Potassium Hydroxide KUH NaOH Sodium Hydroxide Na0H Calcium Carbonate 1_ CaC0, Sodium Nitrate '` NaN03 Potassíum Permanganate Perrnanganate 1_ KMn0,, KMnO, Potassium 1 MgS0,7H,0 MgS0,7H2O Magnesium Sulphate FeSO.7H2O Iron Sulphate 1 FeS0.,7H,0 Nitrous Oxide N20 Calcium Oxide Ca0 C00 ot Calcium Hydroxide _ Ca(0H), Ca(OH)2 Soln. of NH,0H Ammonium Hydroxide .1 1111,00 PbO Lead Monoxide P00 Hydrochloric Acid HCI I-I' EQ1) Sulphuric Acid Trinlumhir Tnłmviǹn Triplumbic ...,.,„.„.,„.. Tetroxid .„..„.„..„.r:|u Ammonium Chloride Potasslum Nitrate Potassium Calcium Hydroxide Acetic Acetie Acid (weak) (weak.) Sodium Carbonate 1.~.~\x.»'~;1.=- 1171,-' ~. 4 I\Jcn H,S0, 11,00, H I u3u4 .Dh „M 1111,01 NH„Cl KNO, K1110, Ca(0H)2 Ca(0H), 1 CH3G0OH CHSCOOH 1 Description White powder 5 Black powder chlorine-smelling powder White chlorine-smelting Large blue crystals White deliquescent powder White deliquescent powder White powder While crystalline substance White Small purple crystals coloudess crystals 1 Small colourless Green crystals 1 Colourless gas White powder iiquid Clear, bitter liquid iiquid Strongly fuming liquid Orange powder Strongly fuming colourless oolourless . liquid iiquid oolourless, viscous liquid iiquid Heavy, colourless, Eirm hzmuu mfl n/\unłzr .„„,, ..,.„, .W ,M-uo. ` White crystalline solid Colourless crystals White powder [inn I1nq\ru |"nrI r'\urInr IIIIU, IIUU-I, IUU PUTIUUI Brown liquid Na,C0,10H,O Na.CO„10H,0 1 Large, white crystals 1;. .;. 3' .- .'«f«..'»»w.--í»„1»1..v._1.- ~..- r: =-.- '-.-1: r"-= 1. c- _ ._.-". = /.. ,1;-"-.1 J;74- '1. 1 _1 15 12 1:1 _ Sheet--00070-5 Sheet-Gauge T 1 7 SHEET METAL BENDING III I l'l'| l'I1 -I iš Ifl -|I> ,_ II I'l1 I: EE IZ Ih ALLOWANCE Ih ,_,_ G: :EIh I: {Ð I'l'l Wire-Gauge To calculate the Flat Blank Length (L) - 90° Bends '.„___uss1u.' ,,___ Qeiaiaanrzee lezlrizrłized 1 722111117777315517 Zinc" *I Sleel Briiish Music 'm"" Sheet Sheet if Sheet 1 Gauge 1 W.ire Wire 1 Std.Wire Sid. Wire 1 or Piano 'Å_ýGaugel, 1, I W ñ0auge(l.l . '_G 1 Gauge _ ' 05095 atge- . rszugze(SWG' (swe).11 W119 wire . 9-199 - --2_;--..69"9e I ii_~----- - - 1 10.233 1 0.200 _ 1 I 0.187 -0.187! 1-._ - 4 ._ - T21. 0.-212. 7-19 ý T .l____.l 4 1_____i'_ - 1 . 1 10.168 . .42 777-7117177277 0133" 77 74.27 -it _.41L0.132{4.11 0137' 00.41 — 0.162A 4.11 A 0.016 W _- 1rii-4-4 1 0.130.4.0310.o20Y0.511 0.100 4.00 00201 0.51 1 ..51 71-_-42-41 17 10.056 0.058 1.43 1.46 0.050 -17 0.053 1 0.0531 0.050 1.27 1.27 10 10.050 0.0521 1.31 110.0551 13 0.055 1 1.40 11 197707044 71014101131 0.0 41170.040? .043 1.10 .1 10.000 0.060 1.52 1 ?.L&937_l°fl. 1 0.0371 0.040 1.01 . 0[0W7 . 9197" 173 178 1 0.0341 0.0371 0.93 1 0.0301 0.000 203 21 10.034 2.03 ' 22 22_` 003110.034 0.031 1 ' 2.29 _1 1 0.0341_ 0.33 0.000 2.29 0.05 0.090 za 10.0234 .020 0.031 0.73 . 23 0.75 0.100 0.100 2.54 2.54 72-1 1 0.025; 0.0231 0.020 0.70 24 10.0251 0.70 0.125 0.125" 3.18 3.10 257 0.03 1 - 1 21021 51; 0.022Č0251 .02 10.02 5 0.331 20 ,..10.o19l0.022. 1 23 0.55 0í1sT"0.022 10.55 _..1 __ .- _1_ an _: '.._ 'nnn;1_n-.4.-4 | -_ ...2_i_:. . 1_21___. _i ___ .2 . 1 . 2 _.,.__Ji__~44? . . _ . 1.. Q.-1..-Y 1 212.". . . .. ..__1__.._.. _ . 1 0.054 1.37 1.37 0.053. 0.056 1.42 1.42 . 0.039; 0.039 0.054 0.048.1.21LV0;048 1.22ý3.ý041 _ 0.0431 _1.21 1 0.043 1.22 00411 1 0.0411 0.040? 1.021 0.043' 0.041 1.04 1.04`0.040 1.02 0.043 A 0.035 0.035 033 0.00'0.030 0.911 0.045 10.0373 0.917fi45Y 0.032T1.01 0.032 0.31 *0.047 0.0321 0.31 10.0321 0.0471 0.02900.73 0.73r10.028v 0.71 0.049 '00291 . 1 0041 . 9 '0028 071 70.020" 0.00 0024" 0.01 1 0.0511 00230.33 0.0241031 0 .51 0 Z5 _» l i - - 1 < . Corgection 'O' -"1'?11'11="~ 1*'1.T - per bend Faelor 'Q' Correcliun Factor Examgles 0.99 0.99 1.04 1.047 1.09 1.09 41* ?—| [_ .5 _.,_1 ~:c\'%I§-»,\;'5Y;- . 1.147 1.14 LlT..T'i _"1 '>1-1 11 11 I _-L |. no 1.19 . 1.24 1.30 1 . 30 L.=25 L-.=25 L2=40 L2=4U RR=6.0 = 6.0 TT=4.0 = 4.0 From Table, Q0 = 8.5 L = L. + L2 - 0 1_=1_1+1_2-Q LL=25+40-8.5 = 25 + 40 - 8.5 L = 56.5_F|at 56.5 Flat Blank Length _ 10.02-; -.0 591 1,517 0.0200605200201 05210020 051 0.51 n0.059 1.50 0.013 0.015' 0.43 0.40 A 0.013043 0.01í10.40 0.033130 0.063 1.60 '__. '-"' :~.?'€1.-:rI-?.': -P1; ':';;;.'~.'~L£ l.1=25 L1=25 2 :1-1 4 TI.'-1 117$ 1.2; CU. CD L2=80 L1='10 L1=10 L4=25 L3=25 l_3=25 R=6.0 T= 3.0 T=3.0 From Table, Q = 7.0 I L2=25 L3=80 Lg=25 1_3= OD CD L5=1O L5=10 R=-4.0 R = 4.0 T=2.0 T = 2.0 From Table, Q0 = 4.7 1..=1_1+L2+1_3+1_4+L_5-4XQ L=L1+L2+L3+L.+L5-4×0 L=1O+25+80+25+10-4114.7 L =10+25+80+25+10-4×4.7 l =_1_1-1-1_g+1_3-ŽXQ |_=|.1+L2-1-1.3-ŽXQ L=25+80+25-2x7 L = 116F|at 116 Flat Blank Lengm Length L= L = 131.2 Flat Blank Length 1 ii _ u-u-H.) SD (D H '1/1 = _ DC40O-l>~ [CD C C. flfliei '7 flflflfl * Also known as Washburn & Moon, Moen. American Steel &8. Wire Co. 00. 818. Roebling Wire Gauges. II 1 1 Mater1alTh1ckness T .If li _ Material Thickness 'T' 1 Malerial 1'e"a _0.30 0.30 0.75 1.00120 2.50300 5.00300 0.30 0.40 0.50 0.60 1.00 1.20 1.50 2.00 2.50 3.00 3.5o_4.00 3.50 4.00 5.00 6.00 M 1 . I 1 i 1 1 I 1 1 1 ! 1 1 V Soft Brass 1 1 1 1 S°fiB'aSS 0.0100 4.0 0.0 _ 0.0100V Copper . 0.0 . . 1 . I 1.0 . 1 1.0 . i 1.511.s.2.5 . . 1 . I 2.5 . . 03103101-511011011515125125 40. 4.0 40. 1 4.0 4013.013.0110.0 S0.ftConner 1 1 _ž 1 fiflfl NOTE: The above Gauge Nos. are provided for ter reference re ference only. Much contusion conlusion exists exisls in the ihe use oi ni various gauge numbers and ihereiore lherelore itil is beslic specilylhe exact decimal size in eilher best to specifythe either inches 0r or mm. Minimum Bend Radius 'R' 'R' | CD 1 __ 1 0.023 0.58 0.5810.022 0.055 1.40 0.0231 1 0.0221 0.56 0.0551 ' 1 1 — 4 . 21 100170.020 - 70.01710.4410.01310.42§0.03711.701 0.017' 0.020' 0.5171 0.51 0.017. 0.440.010 0.42 0.007 1.70 1 Ë0 28 10.0161 0.019 0.47 1 - 5 - '10.01610.41 10.015 007111.80 0.016 0.47 0.01Ë0.41 `0.015" 0.38 0.3 0 10.071 1.00 . 120104' 11 .0110.017 - 1 - 0.015. .5 007 . 511.911 0.014 60.017 0.4 0.444 0015 038 0.33 0.01 0.014 0.35 0.075 1.01 4 03 Aim 30" 10.012; * 0.012 0.0131 30 - 1 - __._. .. 0.014; 033100121 0.310.03012.03 A 0.016 0.40 0.40 Z 0Ĺ014Č0.30 __a__0.01T0.31 . . _ 1 0.00012.703 1 É 31 30.01110.014' . 10.012 0.011 0.014 0.36' 0.30 — i - '0.013i 0.0131 0.34 0.012 0.2910085 0.29 0.085 2.16 .32 132 A 171$1 (3 nnfl" 0.0... u.u:Iu 2.251 0.013 0.33 u.u1| .... 0.21 0.2. 0.000 2.20 1 Where OQ = 0.43 xXRR +1.482×T + 1.482 x T Material Thiekness 'T' 'T' 11"" 1431-1112111111-1111111113 nn'7fl1—|nninr\-:n1 I Etc. Radi" W 0.30 0.40 0.50 0.30 0.00 0.75 0.15 1.00 1.20 1.5072.002.50 1.50 2.00 2.50 3.00 3.50 4001500 0.00 Baum 'R, 0.30 3.5ol4.0015.0ol3.00 47155152177 92 0.6 _ 071091101121141171201 25'32'35 0.9 1.0 1.211.4 1.7 1 2.0 2.5i2s.5 4.7 0.5 02177 „_*_02 o.911.o11.2,1.3 1.51 1.9 2.21 2.7 2.7 3.4 1.0 0.0 1.0 1.213 1.5 1.0 2.2 3.4 4.1 4.1 4.91 4.9 5.6 5.3 1 6.4 3.4 7.8 7.3 9.3 9.3 1.5 -1.1112 1.1 1.2 1.4"'1.5 1.4 1.5_5__1.0 2.1 2.4 1.3121 3.5 4.4' 4.4 5.1_ 5115.3 2.4 2.9 2.9 3.6 5.8 6.6 8.1 9.5 2.5 1.5 1.711.0W2.0 1.7 1.8 2.0 2.2 2.2 2.0 2.2 2.6 Q 2.9 3.3 4.0 4.8;5.516.3 2.5 1.5 4.8 5.5 6.3 7.0 8.5 10.0 4.0 2.2 2.3 2.5 2.8 3.2 3.5 3.91 4.7 4.71 5.4 '101 72.2123 2.5 2.6 2.0 233.21 3.5 3.9 6.2' 6.9 5.41 6.2 6.9 7.71 7.7 1 9.1*10.6 9.1 10.3 0.0 _1 3.0 3.2133 3.5 13.7 4.1 3.0 3.0 3.2 3.3135137 4.11 4.41 5.51 3.31 7.3 0.5 4.4 4.31 4.01 0.5* 0.3 7.0 7.0 3.5 10.0 10.01115 11.5 4.9 5.015.2 5.3' 6.11 3.11 6.51 3.511 73 7. 2111.713.0 10.0 14.7 4.7 4.0 5.0 5.2 5.5 5.01 . 1 eo . sa . 05* . 10.211.713.0 15.0 13.91 0.9 7.0 7.217.3 7.3 7.0 0.0 7.0172173 3.01 3.2ls.7l_ 3.21 3.71 941021091161124139155 9.410.210.9111.51 _ _ . 12.4 13.9 15.5 20.0 9.0 9.2É*0.5 19.5 A 9.7100 9.7 110.0111.4T1151.3712.3 10.410.311.012.3 130113.31 13.0130 14.5 14.5`*10.0`17.5 16.0 17.5 1 I "T ' 1 __i-,__ 1 Table for lor Correction Curreclion Faclor Factor '0' 'U' (per bend) l.D$ 69% -- - - (1Bend) (156110) 20 (2 B0005) Bends) (2 Bends) Also 1.L == 1.L.1 + L2 L2 + 13L3 ++ L414 - 30 30 (3 31111113) LgL2 4 1 —— 10.1531 3.3310022 0.156 0.1531 0.153 3.39 3.89 0.0131 0.018 0.43 0.46 0.1431 0.1481 3.77 3.77 0.131 01441366 0.022 0.53 0.56 101M11f1141 " 0.1351 3.51 "0.020 0.51 0.1351 10 0.141 10fil'73.51 0.135_ 3.43 _ 0.123'3.25"@!11f31 0.120 A 3.25 70.024 0.01 . 11 111 Q12510123 '_ 0.120 0.123 3.13 3.13 0.024 . 0.024 031 0.01 01 .2 1 ' 3.0 0.121 3.003 0.1160.110 2.95 2.05 1 0.0261 0.020 0.66 0.00 10.1091 0.1031 ý0.109 0.100. 2.75 1 0.023 1 0.71 0.100 0.104* 2.04 0.029 0.74 122.00 10012' 91074 1. 12 -2 . 2.75 0-1°21 -681 -141 ~64;°-02 1 1 . „1:4 13 .....+__ 0.0941 009L2.37 1 0.101302;* 0.31 0.031 A 0.79 A0004 0.093 2.37 ŽÑ32 0.31* 10.092 0.092'?_2.32 2.32 T" 0.092 0.0921 2.34 0031 0.70 14 10.073 110.078 0.0701 1 14 2.03 0.0301 2.031o.03310.3-4 1 1.99 1.99 10.0331 0.0361 0.91 0.91 0.0301 _.1_2. 1 Ž' 0.080 2.03 0.080. 2.03 0.033 0.841, „ -.A0.079 1 -ion n 4 71' /1711 ' 7 1.02 1 n 15 1 1.uu 1 0.0-rui 15 0070 ^^71~ 1.00 0.0401 1.uL 072 1.83 1 u.UIL1 0.072n 1.33 0.035 U133 0.69 u.u1¢1 1.00 L001 U.Ud3£ 42 . 1 __ .,":.. 10 1 0.0321 0.002 0.034? 0.004 1 1.31 1.61 1` 0.045 0.04515 1.14 1.14 0.033 0.063 '_1.59 i 1.59 1 0.034 0.064 1.33 1.63r ' 0.037 0.037 0.94 0.94 1~~------i RR 0.233 7.19 10._300A7.021 0.300; 7.32 0.0101 0.25 A l l_=L1+Lg-O 1_=L1+|_2-Q Also LL = + 1.3L3A150 = L1 L1 + + L2 1.2 + I 7470219 1 0.219 1___Wj10.2031 0203 if `lG-1rmUl&uC-¡15:I\-7c.o1M T 0233 10.2731 0 *77.01 1 0.011 0011 0.23 ,Q1 263 21 63.37 ' 67 _,„:?.761..'m__.:. -- 0.0031 0.15 . 0.2441 3.19 0.2521 3.40 ' 0.0121 0.30 02441010 0.252 0.40 0.012 O-°°.U»15 0.008 0.20 0.225 0.008" 00.0131 0.33 0.225 5.72 5.72 0232 5.89 500100173 033* 0.010 0.25 0.207 0.0101 0.014 0.330 0.207 523102121 5.20 0.2121 5.331 5.38 *0.014 0.36' 1-7 170.0121 '0.012 0.30 1.. 0.1921 4.33 4.00 0.1921 4.88 . 070131 0.0161 . Z 0.307_10.192771 2?" .2 A 0.41 0 0.014 0.36 0.177 4.50 " 0.176 0.1T450 0.1701 4.47 4.47 0.01810.46 0.0151 0.40 0.2501 -- _ . 122.19... 0.234 E3 ru no L- 1: í'L?>1 1'1::fL_fi (mm) (inch) 1 (171111) 1 (inch) (171171) (inch) (mml 7 (inch) 1 (mm) 1 (inchlllmm) (1...zr{)1m...1 (nicr.) (mm) 1....~..) (inch) (inch) (inch)1(inch) _a -L W_ý1ý0.281 07.231 F O "1191. -L SHEET-METAL ËËiz.81 WIRE :E ::Iin GAUGES 1:::>1: ininua rr~ Hi1MHlM1 1MlH1l M1 Hli Al ' ' Aluminium "m"'"'" Soft ęofl Steel ' _ _ = 7 1 marl-ii ' 1 ' . 1.0 1.5 1 1.5 4.0 4.01 3.0 3.0 10.0 10.0 10.0 15.0 15.0 10 1.51 15115 15 2.5 25 1 2.5 25 4.014.0 6.0 6.010.010.010.015.015.0 0010 051101. 1 C0111 HD1181' 1.5115 10.010.01U.U15.D stainlessstv 2.5 2.5 4.0 4.0 4.0 6.0 10.0 10.0 10.0`15.0 15.0 20.0 20.0 Stainless St. _ 1 » 0 1 I I ' Minimum Bend 3111111 Radius 115111113 'R'n 1. 1 Minimum :11 -. M .125 I-.'1 .- : -_-.- I '-.' .;-.- ~;-_.i :. :3, ;._-, 5- l t; .» - _ .- _. 1* :EGD ::I:I:en::|: 1:'U iš I'l'I -IIh ,_en COMMON METALS en S: EË:Š1: :: WORKSHOP 7075 D2 Bronze &8| Brass M2 Tungsten Molybdenum High Speed Steel with excellent toughness and cutting properties. This standard grade has a wide variety of uses tools, cold worktools, etc. including drills, taps, broaches, milling millingjtoolstcold 414O 4140 Suitable for tor applications requiring high strength & good toughness, particularly in medium to large cross-sections, medium to high beflame stressed parts, can be flame or induction hardened or nitrided. For applications requiring high strength & toughness. Molybdenum addition prevents temper brittleness. General engineering, automotive & alrcraft aircraft applications, applitzations, can be flame, induction hardened or nitrided. PB 1 Bronze: Phosphor Bronze very good corrosion resistance good toughness used in gears, bearings and bushes. Brass: Free machining Brass used for repetition machining, high speed turning Sthreading. &threading. Bright Mild Steels shalting, can be case Cold finished mild steel for machined parts or shafting, hardened andweldsreadlly. and welds readily. Medium tensile steel for shafts and medium stressed parts, can be welded if precautions are taken. The addition of lead to this steel gives increased machinability, without marked effect on the mechanical properties. For use in automatic and semi-automatic machines torrepetition for repetition parts. 1030 12L14 l ——— 'High Speed Steels 'High Hioh Tensile High 4340 Key Steel _._.LCD L ËDhi NJ FD_GH_.LCBGrbCD CD UQ CD A 1010 -L CD CD -L A tully fully killed medium carbon steel, suitable for medium stressed parts in machinery & industrial tools. Can be flame or induction hardened. beflame Soft ductile, easily welded grade, case Main usage usage Qtilltildl general DUILUU ' IIU, tfidtilly WUIUUU gli:tUU, Udtitd hardenable. ll'ctlUt'JlldUlt'J. lVl'ctlll tabrication. fabrication. Pa-IL Juctlln In-H-1l....a.-.l-l.t...l -...-._l,_ ____L_.. _|_. _l_l_ ll_! _ _ . _ . _ . ÅISI 01 AISI O1 Accurately ground round bar that is used for a variety of applications Oil/waterhardenable. such as shafts, pins, etc. Oil/water hardenable. H Silver Steel ~ . _ _ ._l Stainless Steel improved carbon steel grade, universally unlversally used to reduce machining i time, good weldability, can be case hardened. 303 3C3 l Case hardening chromium-nickel steel for applications requiring high tcugnness 8. ccre strength, particularly in large cross sections. Suitable for tor highly stressed parts, gearwheels & crankshafts. crankshatts. ¥.f\||r|[i-\rn.n D nnrn n'l-rnnn-|-|-ta nnr+:n||||\r|\;:n|n1-run nu-Ann I-\I\l*|':\|Pl|-\ LUUHIIIIUDD Ul L-Ul G DU UHQLH, pal Llbuldl |y ||| 304 f'||H-n|r\|n Cast Iron 358 35B Essentially a Pearlitic grain structure Grey Cast iron Iron with excellent wear resistance and good machinability. Used for tor Hydraulic & Pneumatic piston, end caps, support bearings, etc. eto. Chrome Bar 4140 ,AA hardened and tempered alloy steel grade suitable for highly stressed i mechanical - parts.i it A Suitable for plastic moulds and holder holderblocks blocks forthe plastic processing, die casting industries and components tor for general mechanical engineering. Can be case and flame hardened, gas nitrided and chromium plated. Case Hardening Steels EN-36A A MZOO M200 Carbon Hollow Bar 20MnV6 2BMnV6 ltit is manufactured to close tolerances and used extensively extensively' in the manutacture ot shatts. manufacture of keys tor for shafts. Plastic Mould Steel I Carbon Steel 1045 Dimensionally stable, high carbon, high chrome featuring excellent toughness can be air hardened or bath nitrided. Suitable tor for heavy duty cutting tools, blanking and punching tools. _ punchingtools. flnnnnr --==-. Copper A sulphur bearing copper for tor use in automatic & semi-automatic tor repetition parts. machines forrepetition B14700 014700 Bronze: Leaded gunmetal Bronze, excellent machinability used in bushings, bearings, pump/valve bodies. Also available in Hollow Bar. 1020 _ Aluminium Strong alloy offering ofterlng excellent machinability for the manufacture manutacture of ot machine components and suitable for high speed repetition machining. This alloy offers excellent machinability combined with outstanding wear resistance &8. excellent polishability. LG 2 038510 638510 M IE!-t. _ld Work Steels Cold Li Description and Uses 2017A _ 4 Description and Uses Designation The following is a compilation of metals, commonly used in day-to-day engineering applications. its metal's properties and Its aim is to provide a basic knowledge of the metal's general uses. it is always advisable to seek detailed from the metal supplier. deiaiied information irom suppiier. Designation A COMMON WORKSHOP METALS couiuiou wonkslior |v|E1A|.s 31 6 liltiilltliil ill ll ll 31 BL Free cutting steel tor subjected to corrosion in mechanical for components subjected plantengineering, and plant engineering, mass produced items such as screws, bolts and bethermally nuts. Cannot be thermally hardened. thermally thermally hardened. offering good corrosion resistance used in tood food Marine grade oftering processing, chemical, fishing, hospital and brewery equipment. Cannot 'bethermatty ne thermally hardened. General purpose austenitic stainless steel. Frequently used where welding without subsequent neat heat treatment is involved. he weiding invoived. Cannot be Walla'. Material Comparison Comparison Table on pages pages 104407 107-107 tor , E: Tame on for Equivalent Equivalent l Nattonal Material Designation Numbers. National 7 ..-:»._ * .1' at 1* '4 "*1, -"-.'-' 5 .1-'1. 1;", '*4 ¢-.--141¢, . '.;'=:-22'-1-3-'1 - 104 1241 '__ 7 COMMON 7 7 MATERIÅL WORKPIECE MATERIAL W COMPARISON CUIVIPĂRISUII TABLE TĂBLË I 150' usli 1ISOi U54 AISI/SAE MHLND. Mat. No. PI Steele DIN DIN France Standard BS ÅFNUR 1' BS. 1 nrnoa I 1|-I" LOW ALLOY STEELS 1.5710 36NiCr6 14NiCr1O 1.5732 14NiCr10 1.7218 25CrMo4 1 1.7220 34CrMo4 ' 1.7225 42CrMo4 1.6582 35CrNiMo6 17015 150r3 1.7015 t5Cr3 E 1.7131 1 .7131 16MnCr5 1.0841 S152-3 St52-3 1 1.7033 340r4 34Cr4 1.7035 41014 41 Cr-t 55016 1 1.7176 55Cr3 1.8159 50CrV4 NlCrMo2-2 1.6523 21 NiCrMo2-2 1.0904 55517 55Si7 1.6511 36CrNiMo4 3135 3415 4130 4130 4137 4137 4140 4140 4340 4340 5015 5015 5115 5115 5120 5120 5132 5132 5140 5155 5155 6150 8620 0955 9255 9840 . .. ._, L `040435 540435 1717cos 17170DS . .. . -_..;: 1 .- ._. 4;..—,' ».::.-.t-._- . /-; .- .-.-3 .~.,-2-~. .-*; -1 .' ;- :5 ,4-3-1 __, . . _ . _ ._ . _ _ _, 'r.-' 2': >- 2' » -_1 4-J1 _-L IP . -7? S500 C/JCH O C) '11325 1325 1957 1912 1914 5 1914 i 1926 12912 2912 *STKM12Å 1311 STKM 12A 1311 1 2142 .Y105 1312 11312 1880 11330 2900 SK 3 Q'4> 25>= 700 cnSUP4]|LNJ 52100 52100 A182 4102 A204 4204 A573-81 4573-01 L1 L1 L3 L3 L0 L6 02 O2 4400 445 440 A2 42 4353 A353 Steele 02 D2 03 03 04105) 04100) H11 H12 H13 H21 HW3 Hw3 M2 M35 M42 P3 11II SCMn1 1 Smn438(H) 2120 iY105 |v-ion .1--1..-..:= 1.4..-. ,--5 .- :.- >4. , .. 1.3505 10000 1.3505 100015 1.7380 1.7300 10011/150-10 10001109-1 0 1 1.5415 1.5415 15Mo3(16Mo3) 15M03n0M0æ 1.0144 S144-2 11.0144 sk44_2 1.7039 410184 1.7039 410.34 102o.0 ,1.2007 1.2067 102015 1.2713 55NiCrMOV6 1.2713 55Nm.M0v0 eomncno 1.2342 90MnCrV8 1.2842 1.2542 45vvc0v7 45wcnn i if W France is U.K. u.x. 1 'France flsramram I Standard 1770577 r\F,|i |;o|=r;_, BS AFNOR . tartan Japan Ĺ 1 1 2258 . 2218 2912 MH400A 1412 SMH400A va;_ 2092 1 SKT4 2550 .skT4 7 1 534400 10006 534499 110005 11501-522 12CD9 10 11501-022 1200010 150124011503 1501-2401 15D3 114300-4301 4360-430 1 E28-3 1524414 lets Y10006 Y100C6 513 JIS ns 1 SUJ2 SUJ2 1 55NCDV7 55NCDV7 ' 90MV8 90MV8 B02 302 H 551 001 1Sweden i-ss 1 ss 7 A S1 s1 2710 _w 12710 HIGH ALLOY ALLDY STEELS (TOOL & DIE STEELS) srens) 11870 11070 SUM22 SUM22L 4'4.1 '. 1...3'- Wflountry Country Wiw s1 11140 140 1650 1674 1655 1 ___ ;.-. _-. -1 .'- 1 111 1 USA 1 'so Germany 1301 usnr 7 I ' .2'rt|.s1/sner Mat. N0. No. om MSI/SÅEÅ Mat. DIN ;1450 11450 SMnC sMnc 420 11410 `1450 sS25C 25 c 11450 5350 1550 5350 1550 35MF4 S250 S250Pb S300Pb 1 20M5 40M5 11553 1583 E24 2 Ne 1E24 NFA35-501 E24-U E24-U ' _. .;_-_ . '-_.-' '1.-' -. .- SS I 1160 1265 , 1370 c.o -4|ca S10C 0055 CC55 X0100 XC100 i125co4 25004 35CD4 135004 42004 42CD4 354000 35NCD6 1203 IZLJS 110Mc5 16MC5 20Mc5 20MC5 3204 3204 4204 14204 5503 15503 500V4 150cv4 220Nol2 20NOD2 5557 5537 40NCD3 40NOD3 ' " 5'5 cnS15GK U1c:cac":>< Oflflfl Luuu 1.4125 1.4740 14749 '12353 12303 115002 1.5552 1.2379 11.2379 11.2030 1.2050 13M3 1.3343 1.12435 12430 1 2343 ,1.2343 .12000 11.2505 1.2344 1.2531 1.2551 1.4715 14n0 1.3343 13343 13243 .13240 .13249 12000 1.2050 1.3355 LJJOO V1 nrzm-3111-.-17 7 71 i 71 nnnmv X105CrMo17 21000017 X18CrNi28 X100CrMo\/51 BA2 Z1000DV5 X100CrMoV51 z10ocDv5 X8Ni9 1501.509 1 501 .509 X1550rMoV121 1 BD2 X155CrMoV121 1BD2 z100cov12 Z1600D\./12 l\IU@Q||'|\.|'|| .1 SUS440GC3 1 is UH446U3CD sU3 7:0:C: ODO0 C3 CO IE -L_p,.4; PO |:J; L 12250 KD12 ` r\: PJ Go CD 1 X210Cr12 X2100r12 6-5«2 S 6-5-2 X210CrW12 X38CrMoV51 X3BCrMoV51 X37CrMoW51 X40GrMoV51 X40CrM0V51 X30WCrV93 X45GrSi93 S 6-5-2 S 6-5-2-5 S2-9-2-8 X210Cr12 3 18 01 503 BD3 4959542 4959BA2 BD6 B00 BH11 'BH1i 1eH12 lBH12 BH13 BH21 1BH21 1401845 1401345 BM2 BM2 01435 BM35 1BM34 BM34 1 BD3 1503 B11 eh 2200012 12200012 24005010 24003010 , Z200CD12 ,2200c012 l23500v5 zsacovs z35cvvov5 2350vv0v5 24000v5 Z40CDV5 Z30WCV9 230w0v0 Z45CS9 245030 zaswocv i255w0cv 0-5-2-5 l1 5-5-2-5 2310 zs KD1 1SKD1 Ssuns UH3 ,SKD2 SKD2 1 2715 12312 2312 sk051 SKD61 SKD5 SKD5 5 uH1 SUH1 12242 2242 1 11skH9 SKH9 1 skH55 SKH55 1 Z200C12 12200012 1z00vvcv 1205vvcv 2722 2722 2723 2723 1 l S KD1 1SKD1 1s KH2 1SKH2 2710 STAINLESS STEELS - AUSTENITIC 135400 735005 14Nc11 140011 ,705A37 700437 .7o3M40 '705M40 1017M40 1517M40 523015 l>ZéIV|l0 527M20 150M19 530A32 530432 1530440 ,527A50 ,527400 1735450 735450 805M20 3o5M20 250453 ,010M40 ,e15M40 Sweden isweden g .115 JIS Fd5 VP dfl Au ru XC10 00 12 CC12 00 CC 20 20 M5 20M5 XC 25 X0 0035 1 35M5 35MF4 CC45 X048TS XC48TS 1 g , Japan 1 PLAIN —- UNALLOYED STEELS i .1.o2o1 sise 1006 1005 1.0201 3135 1010 1010 11121 0210101021 1.1121 041010109 045 M 10 1015 1.0401 01151015) --L-L 01c: 1015 11.0401 cacaq>4>cacn 080 EZEZ M 15 04151015 .1.04o2 1020 1.0402 022 .050520 050820 1020 111133 1022 1022 1.1133 es20Mn5 1201110 120 M 19 0s20Mn5 1025 1.1158 0225102521 0 050 .4A 20 20 042510259 050 1025 ,1115e 1035 11103 035 1035 1.1183 060 AA 35 35 050 1030 11157 150M36 150M36 1039 11157 40Mn4 1040 1.0726 212M36 1040 1.0720 35520 .212M38 1045 1045 1.0503 045 1.0503 ,080M46 080M46 1050 11213 1050 1.1213 £153 i05oA52 060A52 0153 1055 1.0535 1055 1.0535 055 070M55 070M55 1050 1.0601 c00 1060 1.0001 050 050452 080A62 1005 1.1274 1095 1.1274 0x101 050405 060A96 04101 1115 030A04 11.0030 1.0038 0x15 1030004 ck10 11.0720 1140 1.0726 35320 212M36 35520 |212M36 1213 1.0715 11SMn30 11sMn30 1230007 11.0715 230M07 12113 11.0710 1.0718 11 11sMnP03o SMnPb30 12114 11.0737 12L14 1.0737 11sMnP537 1.1170 28Mn 1330 11170 150M28 20Mn06 11107 36Mn 1335 1.1167 30Mn55 A204 GrA 1 1.5415 1501-240 15M03/10M03 42040r4 1.5415 15M0 3/ 16M03 1501-240 4570.30 i 1.0038 1.0030 RSt.37—2 14570.30 33537-2 4360 40 0C 1 4300 4572-00 I 1.8900 1 0900 S380N I A572-60 4300555 33004 1 4360 55 E 4573-01 1.0116 1.0110 St.37—3 A573-81 4300 40 40 BB 5137-3 4360 vv1 1.1545 0c 105 W1 1 1.1545 1evv14 W1 BW 1A 105vv1 iuiro1n nrriro vv210 i 1.1545 1.1545 0c 105 1mN2 105vv1 W1 IULINJ I 1Š u.x. U.K. -.~ ;.~.-.-_:»-5,-pr»: ;,~_.,_.,.,.:.>-$4,.. -;._._-. .. 7 ' WORKPIECE 7 __'_—_——_l@ GOMMUN MÅTERIÅL 1% COMMON MATERIAL COMPARISON TABLE CUMPABISON TÅBLE ' A» Country Germany ; F-c-,E -.2''-; -"-. 4 0'" 2.,9 1;,5 .-5.4 SNC236 SN0236 SNC415 SN0415 SCM420 SOM420 1 2225 2225 12234 2234 2244 12244 12541 2541 1 SCM440 SOM440 scehs bUl'41ü Stee Stsee 2511 12511 12172 2172 BS S0r430 SCr430 56r440 nnafl rmar: LLWJ LL'-hJ SUP9 SUP9 SUP10 SUP10 '2230 2230 l Ol"\.»AAfl 1 Out'-H-U SNGM220 SNOM220 1 2506 2085 StSta essnan t1li tMliI1l Ml 1il i1l 301 301 303 304 304 304L 304L 304LN 304LN 305 308 309 300 310s 31 OS 316 315 316L 316L 31515 316i_N 31511 31 6Ti 317L 317L 318 315 321 347 14310 X8CrNiS18-9 x0crN010-9 1301321 1.4310 1301521 1.4305 X12CrNiS18 1 303521 X120rNiS18 8 1.4350 1.4350 X5CrNi18 9 1304531 l 304831 1.4306 X20rNi19-11 11.4305 X2CrNi19-11 ' 304512 11.4311 X2CrNiN1B-10 304362 1.4311 X2CrNiN18-10 304862 1.4406 X10CrNi18.08 11.4405 1 301821 301321 309324 1 .4828 X15CrNiSi20-12 1.4525 309524 1 .4845 X12CrNi25-21 11.4545 310624 X5CrNlMo17-12-2 316816 1 .4401 X50rNiMo17-12-2 i14401 1.4435 X2CrNlM018-14-3 1 316313 316513 1.4435 X2CrNiMo18-14-3 1.4420 1.4429 X20i'|'\ii|'v'|0|'\i1 8 13 ÅĹLzll` Il1VltJl\I IU IJ ' ;1.4571 320317 X10CrNiMoTi1810 I 320517 ` 1 .4571 X10CrNiMOTi1810 1.4435 1 .4438 X2CrNiM018-15-4 317812 317512 X10CrNiMONb1812 1 .4583 X100rNiMoNb1812 1.4553 YRf`rI\lTí1R_1fl 1.4541 ,wv..1...~.v 1 .4541 XOCrNFfi10-10 l 321312 012.091; 101Q19 X6CrNíNb18-10 1 1 .4550 X60rNll\lb18-10 11.4550 ~: 4- »1-r 4-. 2 . -:-__-- _. `z12cN1707 212001707 1303301 L S301 Z10CNF18.09 S US303 21ocnF1e00 JS303 Z60N18.09 1250111500 11 S US304 JS304 1Z2CrNi18.10 S CS19 l22cnw1510 1Z2CN18.10 S US304LN 22cn1a10 .S304LN 1Z1NCDU25.20 S CS17 12100002520 1Z15CNS20.12 1 SUH309 12150052 H309 U3 1|.--LLO "*4 CtUC3 Z12CN25.20 Z120N25.20 Z6CND17.11 Z60ND17.11 Z2CND17.12 ,220N01712 1w-nranur-54-I Jfl LZbNUl/J6 1ĹĹbI\IlJ I I. IJ ,25cnr1310 ;v».«....1u.ru 7RPMT1Q1fl 347S17 125cuu51510 Z6CNNb18.10 1 347517 J .-_ SUH310 CDODUDQQU300 00U3 JH310 SUS316 SJS316 isSGS16 0 S16 bUbÅš IDLN SuS5i0|_iv 1 !\l|r\r\4I\l 1Z6NDT17.12 25n0t1712 220001015 SUS317L Z2CND19.15 Z6CNDNb1713B1 Z6CNDNb1713B' .»-,.-4. :- -: 2 12331 2331 l 2346 2332 2352 2371 2370 4-... 1Q 1v 1SUDCD CZCZ _.I CICI CA3CA.) w \¡ \J_+ wc.) JnlJiro nu 2361 2347 2353 257:3 2375 2350 2367 l\I\—1I— 2337 2338 I\JI'OJCO \'J CA3CO CD "Q ' A ,Mi 1e :. t";;--I;",: I; 5»: 1'-:.~'_:';1 1 _. .._, comrvrorrwonxereci common won|n>|EcE 11111511111 MATERIAL |;gMpAr|3gN TABLE comnnlson mn: i :nm GOMMON WORKPIEG MATERIAL CBMMHNWOHKPIEBE ÉS"„-5 COMPARISON TABLE | fiüffiPfifiiSüN Country 1 France 1 Swed 1 Japan W_1iSweden1 1 MAHTENSITIC STAINLESS STEELS - FERRITIC / MAFITENSITIG AFNŐR = 7.113 ns A German Germanyv 1USA1 USA lso, I81]? ~ 4 U.K. 1 llK2 Standard Shndard AISI/SAE íMa1.N0. DIN E131/snzd 11131.11». um 403 403 ' 1.4000 Stessee Stan X60113 X6Cr13 u4nr\..n| AIUUHMD _?_1CI.) X10CrA1S113 X12011 X12Cr133 X12CrS13 X6Cr17 X60117 X14CrMOS17 X140rM0817 X17CrNi16-2 X17CrNi16-2 X6CrM017-1 X10CrA1Si25 X3CrNiM013-4 X53CrMnNiN21.9 X80CrN1Si20 X80ClNiSi20 1 1 -| A-lfld Lqléq A1|"\l' 405 410 416 430 430F 431 434 446 CA6-NM EV8 HNV6 1.4724 1.4006 1.4005 1.4016 1.4104 1.4057 1.4113 1.4762 1.4313 1.4871 1.4747 QUU BS K { 1: Gas „.« 5„.M.« ..1"-33 3 x=;r-a,\»' V .A 1- -r-rnrmrn LIUUIO 42501 1 349854 349554 443865 443565 < «,~ W- No.20B 0.200 No.258 1No.25B No.30B wN0.30B 1N0.35B No.358 'Ne.45B Ne.45B No.508 \N0.50B 1 N0. 55B No.55B 1 A436 . Type 2 0.6010 0.6015 1 0.6020 0.6025 0.6030 0.6035 0.6040 0.6660 U1 14. 3 .-;{.,:'t .„,. 'l \ -'-» T-= ..._.'.-.. _. \ -'-» T-= ..._.'... .: FC1so 1 1 1 El 0110 0115 0120 0125 01311 0130 0135 0140 0523 'Tl"'C")("D 1"| _-..;L U1CD 3CD 1FC200 1Fc2oo \Fczso 1FC250 ąrcsoo gecsuu 1Fc3so 1Fc350 Fc4oo 1FC400 1 P440/7 P510/4 P570/3 P570,/3 MN450 MP50-5 MN650-3 rcmwsm '' FCMW370 FcMP49o FCMP490 FOMP590 FcMPs9o 0852 0854 0856 GTS-70-02 0.8170 GT8-70-02 P690/2 MN700-2 FCMP690 0862 . 1".-' ' ;'»"*" " 1: .t.::;. 0.7040 0.7050 0.7660 0.7070 GGG 40 GGG 50 GGG-NiCr202 GGG 70 .-.-:.-.-. . 1. - ~">:\_'-'|\ : 2-.,(t=.T:_=:>»:-*I.':=:I.T. __}:=:I---r- =~=-'1' ;=;=. .\.-.4:-> .-:-.,-.;. ' :~"'.\'-' - ~ -.-I-.'.-.;- -' ,'.-.'-:- _'-.,-;- -' ,'.-.'-:-_ '.-,'~ -. .:-»,' ~. .-.- ~z.„-,-f_._r 1 71360.2 A3602 A413_0 . %§1A413e i1A4131 A413.1 A413.2 R'? H4 HL OI AZ 61 AZ 91 AZ91 1 A199-5 A|99-5 A|ZnMgCUO.5 A|ZnMg0u0.5 G-A1811 011/1g(0u) G-Å1S1101V¡g(CU) GD-A|Si12 G-A|Si12(6u) G-A|S112(Cu) G-A1811 G-A|Si122 3.0255 3.4345 3.2383 3.2883 3.2582 3.2583 3.2581 n CO-lfl OJJOIL 3.5812 3.5912 r\ I I.-. A 107..-1 U-IVIQHIDLII I G-MgA16Zn1 G-MgA19Zn1 G-MgAl9Zn1 ~ 3-, .»._ .;. .1 -.,-~-._.-4; 1--~'.>_¢-__ .~.-I '-: -;_.-'il-' '-:_»;-"-;- ,' , 132:1: 1:1:-.-E-I 2- F3'. il-.ę`?: ::_1':2. .FCDŽ/00 .FOD700 1 z~;z;::; ;.~:-×~- 3-. .-.-.-.~.-_4_r.-. L31/34/36 L86 LM9 0717. 02 0717.02 0727. 02 0727.02 0776 0737.01 0737. 01 1 ... _. . f - - - _ - -- -- - He1;sat-Res A590 50C 506 AZ4GU/9051 ' 4233 4253 4247 » 4260 4261 LM20 LM6 llflf'-I IVIHUI |'v1AG1 MAG7 | -.-.\~_.-.-.-.~.-.-.- 'P".°- 21 ou:N _L J>I>3>:I> GDU3 G3Q3 - 0.51- _ 1 « F-' ¢\-1. -.1 - CC 102 ACC102 1CZ102 CZ 102 CZ106 CZ 106 'CZ108 CZ 108 CA 104 CA104 8 CC1-FF 1 LG 2 GHTB1 HTB 1 1HTB1 HTB 1 1CT1 CT 1 Pb 2 1Pb2 LB2 1LB2 LB1 1LB1 LB1 1LB5 LB5 1 AFNUB Arnon 1 ss 1 1 1 Ofl G0 É G-TRBZ2 G-TR3z2 je-AG225 G-AG22.5 1.. 1 2.4685 Hastelloy C 2.4810 04 A Hastelloy C4 2.4610 1 |nr~nnn| QOC . 0 /|CH-GR 2.4856 mesne! 625 Inconel690 |ncene1690 2.4642 lnconel718 lnc0nel718 2.4668 |ncone1X-750 |nc0ne1 X-750 2.4669 1ncone|751 1ncone!751 2.4694 lncoloy Incoioy 825 2.4858 Monel 400 2.4360 2.4375 Monel K-500 1.4563 N 08028 N 08800 1.4558 N08031 . 1.4562 N08330 1 1.4864 2.4630 ; Nimonic 75 3.7025 1 R 50250 R 52250 3.7225 R 54620 3.7145 R 56400 3.7165 \-ILL' L-'1"n'L)'\0' 5 à "i MH.1M 1MH1 H1H1 1ĹH G-N¡Mo28 G-NiM028 G-NiMo030 N1M016CrI6Ti NiM016Cr16Ti 111;!'-'J-')Ml.-4 N1C.'2211fl09Nb CD IE CT NiCr29Fe N1Cr29F6 N1Cr19FeNbMo Ni0r19FeNbMo N¡Cr15Fe7TiA| l\110r15Fe7TiA| Ni0r16Fe7T1A1 NiCr16Fe7TiA| N1Cr21M0 N10r21Mo N1Cu30Fe Ni0u30Fe N¡CLl30A1 NiCu30A| X1NiCrMOCuN31274 X1NiCrMoCuN31274 X2NiCrA1T13220 X2NiCrA1Ti3220 X1NiCrMOCuN32287 X12N10rS136 X12NiCrSi36 16 NiCr20Ti Ti1 T11 Ti1 Pd T11 TiA|6Sn2Zr4M02Si TiA16Sn2Zr4Mo2S1 TiAI6V4 TiA|6V4 IIIUILLIIIU U-Cr 0.8 Zr CuZn 15 CuZn 30 00211 CuZn 37 U»A ..1-A 10 N J—E 5 Pb 5 Z 5 u{sPbszs1 U—Z 36 N3 uzasna 1 11-3303 0L3sN3 1 ;LE121' .u-E12P A 0E7Z5Pb4 1u{7z5Pb4 1u-E1oPb1o 1-E'H)Pb10 1uPu1sEs 1661553 L#Pb20 1u-Pnzo A kI Super A laoysnt 'tant Al Super ; =_=.-"1.-1; --~:1.1; -.1 *:'>.7.7'§I';F;'E.-'"£?;1-'_?1?' _ . , _ - _~¢;-.-;»- --1 1:I.~:4:I 1: :-. =':':5;1'.>';.€_:_-1 :5; ; _; ' - '-:3.::-§??3'5§':¥'-3.1-§5".i'§§-. .i*:'"I'.""t.-1.5.. .. _., . -_-c.,.~. .1,`E:;}_. -->1. -=-=2---=-~»---Er;.-1;'-"-1.:-'-s _-1-;-.51-"=1-Ir? .- '..':'T-'~?:1:'_;¢. _: _:.->23;:'; 1 > _. .-5-;-F.-_;-41::---.:-:-;-r-: _-:-_;-.112::-t-fr-:-'-;:";;>~;._ .4 - --- "----"=1 -.-.1.1;_-.-__.; _._ - \\$¢-.-.-.-. .\-.._. _-.-. -' 1 1000 §§§%31o0u `Fcn4oo 1FCD400 rcnsoo FCD500 FCS400-12 FGS400-12 FGS500-7 FG8500-7 8-NC202 S-NC202 FG8700-2 FGS700-2 . . _ oys ..;.;; . SNG420/12 SNG500/7 Gd. 86 S6 81110700/2 SNG700/2 1*1Sweden Sweden MAG6 MAG1 2 MAG12 I Y-$I Hastelloy IB .-=1...»V ,;„„„ .Šš. GTS-45 0.8145 GT8-45 GTS-55 0.8155 GT8-55 0.8615 GT8-65-02 GTS-65-02 " 7050 ?'705o ' Hf . -_..,- = _ 1 L»- :1:V i "F\[\J||\]| ..z. _ 2 ..; .. . .. , . -_>.\..\. 60-40-18 80-55-06 A43D2 A4302 10020.03 100.70.03 3 1Fc1oo F110D F1100 F115D F1150 F120D Ft20D Ft25D F1301") Ft30D F135D Ft35D Ft40D L-NC-202 ..~- 40010 50005 A22070003 A22080002 .'< . .;;. . l.'.~.§".;->1'; ;_ ..>,.= -3. 3 1 2., -.,.=...=> '.: _- xJ.:;..."'. .- ...-. -3 ¡ .;-_. —___'iI1-Q-' ' G') G9 W i CuGrZr C 18200 1018200 A 2.1293 0u0rZr 1 C 23000 2.0240 CuZn15 CuZn30 ' C 26000 ~ 2.0265 0uZn30 0C 27200 1 2.0321 0021137 GuZn37 C 63000 2.0966 CuAl10N15Fe4 CuA|10N15Fe4 2.1292 G-0uCrF G-CuCrF 35 C 81500 2.1096 G-CuSn5ZnPb G-0uSn5ZnPb G-CuSn7ZnPb C 93700 . 2.1176 G-CuPb10Sn G-CuPb15Sn C 93800 2.1182 G-0uPb15Sn C 94100 2.1188 G-CuPb208n G-CuPb20Sn 12.1133 Š Imam" slmr: \]"I\l'f III|' \I\l]' II SUPER-:1::.-ALIF' E5 , lã - |\4\I| --3 >1- GG10 GG15 _L._.|. (J1C) GG GG20 GG25 6030 G630 GG35 GG40 GGL-NiCr202 FD CD CD _¢CD Z! = =:.==' 1~ -< - --.- -- "BS BS DIN 1 0 A 5111118 France U.K. C' .4f"|_E -t;;:;ff;: ; zf 'a' 'é12=:;§-.-.; >§'~i .,,1%if 1%. . .. -".3-.,>.;, £.$x=',¢'\.;i3.I 10:3"-L;s'w\I.--aww-...-=.-3-.. 1Ĺ Mat. Mal. N0. -. Standard Słandard C F' O"l'U\J av-av 431839 431 S39 43481 7 434817 - Mgsfisznzzn A es10s 3.5103 Mg8E3Zn2Z!'1 3.5106 35106 G-1111gAg3§E2Zr1?* G-MgAg3sE2zn EZ33 A EZ33 QE22 QE22 2301 sus4oa Z6013 Q 8403 12301 Z6C13 sus4os Z10C13 Z10C14 45410 7 2302 sus41o 18416 .2330 2380 sus41s Z1 1 CF13 Z11CF13 2320 sus4ao ZBC17 Z8017 JS430 .2320 1R4anF "2383 2383 sus4aoF Z1.00F17 Z10CF17 sus4s1 Z15CNi6.02 J8431 2321 2325 sus4s4 Z8CD17.01 318434 Z10CA824 JH446 2322 suH44s Z10CAS24 2385 Z4CND13.4M cnwvnc./arcgq crn s'": co Z4CND13,4M mscss 25212111111121.0111 3.11135/3e Z52CMN21.09 =suHswas Z80CSN2002i83H4 Z80CSN20.02 =suH4 403817 403517 Aflflf147 QUOOII 403817 410521 410821 416821 416521 430S15 430815 1 Al-8|/SAE AISI/SAE SS H'_| Cuunlry 2 .-. 5.2""1!V.Germany USA - 1- . "$3 ISO lS0| 1"l_7 M 22 3> PO ZZ]> |\> _.A _-L 1 ZT IC . . NC 22 Fe DC0116 n Åncsorz ; Nc19FzNb NC 19 Fe Nb 1 1 ZIZ ZI"~.'J_|'l'Fl CDC1 C-3CUOJI'-D 1 1 NA16 1NA16 YNA13 NA13 NA18 'NA18 1 1 NG 15 TNDA TNbA NC NC 21 Fe DU NU 30 ` NU 30 AT 1 Z1 Z1NCDU31.27 NCDU31 .27 NA15 NA17 HR5 2TA1 TP1 TA 10-13 Z12NC835.16 .z12Ncs3s1s `Nc2oT NC 20 T T-A6V 1 1 1 mrenenrzn HARDENED rvremrs METALS (wnm: (WHITE // HARDENED HARDENED cnsr15011) CAST IRON) i 35 Bl= lfid 13 S A532 A25%Cr A532 A25%Cr Å25%Cr Ni-Hard11 =MB Met Ni-Hard Hadened Had Ni-Hard 2 1._.i 0.9650 0.9655 0.9625 0.9620 G-X 260 G-X 300 G-X 330 G-X 260 Cr 27 CrMo CrM0 27 1 N¡Cr 4 2 NiCr N¡Cr 4 2 NiCr ` Grade 3D 1 Grade SE 3E ' 0466-00 28 1 Grade 2B 1 Grade 2A 0513-00 0512-00 =.., ,f~ «".__a " 1' na/ 9-= .¢- 1f:\'I ' 108 I_I _ ___ GOMMDN ENGINEERING PLASTICS PLASTIGS COMMON _ _ I-I — it i 1 1 .- 1-,1--.;.~; '-I-_.;,=,' 5.1 '-;';. 1:-. '.' 1-_-'Ky '. 1 i .1 ~_1\. . _ = _t . - ._ =-:--I";-I .'.'_~.~ ..'-' 1* 1 -'- -'1.-~"' 1- """ ' ' i"'_—'lE 1'-"ii common ENGINEERING PLASTICS PLASTIG-S IH 1:¡Ë:Š0N ENGINEERING L The following is a compilation of Common Plastics used in the Engineering Industry for the manufacture/fabrication of components. Itlt is by no means a comprehensive list and as aiways, it is best to seekthe advice ofthe manufacturerfor specific applications. bestto Thermoplastics soften to allowable aflowable state when heated and harden upon cooling. Thermosetting Plastics set or harden into permanent shape and this is irreversible. Polycarbonate P_C PC —- Lexan ® Makrolon® Hyzod® lt is a virtually unbreakable transparent thermoplastic used extensively in safety and security—related security-related applications. Common uses include safety shields, enclosures, safety spectacles, machine guards and bullet-resistant applications. Itlt is easily glued. Polyethylene E PE Acrylonitrile-Butadiene-Styrene Magnum® -EE? 5!. trite-Betadiene-Styrene ABS - i1ilagn1.1m® abrasion resistance, low coefficient coefficienf of friction, very high surface release, itlt has excellent 3171551311 chemical resistance, impact resistance and damping properties. ltIt is used extensively in the food industry where direct contact with foodstuffs is necessary. thefood Acrylic —- Piexigias® Plexiglas ® i_ucite® Lucite ® Perspex® Perspex ® Aitugias® Altuglas ® itlt has excellent wear, toughness and impact strength and good dimensional stability. Addition of graphite and carbon fibres results in a bearing grade with lowfriction low friction and long wear applications. Used in the manufacture of gears, bearings, valves and pumps. Ii 5: This is a rigid, low-cost thermoplastic which can be easily machined to a fine finish. Itlt can be electroplated and is used in the production of mouldings, pipe fittings and products needing long life. Polyether-Ether-Ketone E PEEK - Victrex ® Ketron ® Itlt is an optically clear transparent plastic having excellent weather resistance, resistance. high impact strength, good chemical resistance and is easily thermoformed and fabricated. lt is extensively used for instrument covers & enclosures, safety shields, tanks, etc. Polyethylene Terephthalate E PET This is a dimensionally stable thermoplastic with excellent machining characteristics the main criteria. and used in place of Acetal when machining isisthe Bakelite Itlt is a hard and stiff plastic and comes with a variety of fillers such as Canvas, Paper, Gloth, etc. Being a good insulator, it is used extensively in the manufacture of base plates, Cloth, handles and knobs forthe electrical industry. Polypropylene EL PP - Simon,a® Simona® Gehr® PolystonePP® Polystone PP® Itlt is an economical, lightweight thermoplastic that offers high corrosion, abrasion and impact resistance. Itlt also exhibits high tensile strength and stiffness at elevated temperatures and is superiorto HDPE. Itlt is easily machined and welded. Ghlorinated PVC CPVC GPVC —- Corzan ® Chlorinated This is a high heat, corrosion-resistant material with properties similar to PVC and ideally suited for components where high temperatures are necessary. CPVC pipes are preferred over PVC where mechanical strength at highertemperatures is required. overPVC Polysulphone LSQ Polysulphgne PSU -— Ultrason S ® Udel ® raoiatioo stability and good chemical resistance, often replacing itlt offers excellent radiation polycarbonate whenever higher temperature (in excess of 150°C) is required. Used commonly in the food processing industry in milk machine pumps, valves and filtration plates and for medical components subject to sterilisation. Fibreglass Itlt has a high strength-to-weight ratio with excellent corrosion resistant and dielectric properties. Used extensively in boat building and tank manufacturing. Đensity Polyethylene HDPE HDPË - Polystone HD 300 ® High Density Poifletrafiuoroefhyiene É Tefion® Poiytetrafiuoroethyiene PTFE - Teflon ® Tetron ® Itlt is an economical, high-impact, lightweight thermoplastic with excellent chemical resistance and high tensile tens'le strength. ltIt exhibits excellent resilience, stress, crack and abrasion resistance. Itlt is easily machined and requires welded ormechanical or mechanical assembly. 500 ® High Molecularweight Polyethylene HMWPE - Polystone HM 500® Itlt has a combination of chemical, electrical, mechanical and thermal properties and the lowest coefficient of friction unmatched in other plastics. lt is the most chemically inert of any material. Being non-stick, it is used extensively in the coating of cooking utensils, slide bearings and electrical and thermal insulators. seals, seats, packings, siide Itlt has high rigidity and creep resistance, ideal to use in the food industry in the manufacture of cutting boards, underlays in food preparation and machine parts. Itlthas has excellent impact and abrasion resistance and resists sunlight and weathering E Polyurethane Q DUE _ Simona® Qimnna (3 Ruhr (Q Hapvric (I31 Cobex® Pnhnv (I-23 Polflinylühloride M Gehr® Darvic® Phenolics —~ Tufnoi® Tufnol ® Phonetics Dnltminul El-rlnyirln II U'lII\I' Ill! I UIJI =.~¢ R 6 " "*'_'1'A IQ \Jl UIILI "-' \ul\]llI '*1 It-ILA \" \]\]\JUI\ 'I Polflinylidene Fluoride Ĺ Polyvinylidene PVDF —- Solef® Kynar® Hylar® Polyamide(Nylon1 PA - Nylatron ® Nylube ® Kevlon ® Stanyl 46 ® PoIyamide1Nylon) BA Itlt has high damping properties, good dimensional stability, self-lubricating, high wear resistance with excellent bearing & sliding properties. Used extensively to manufacture gears, bearings, rollers, wear pads and guide wheels. There are many speciality grades available inthis range. availableinthis I A high corrosion-resistant plastic ideally suited where chemical resistance to acids, alkalies, alcohols and halogens is necessary. ltIt has a high strength to weight ratio and is fabncated either by welding or gluing. Unplasticised PVC (uPVC) is used easily fabricated exænsivelyfor extensively for pipe 8& pipe fittings because of its excellent stiffness properties. Itlt has minimum thermal expansion, high compressive strength and excellent and abrasion resistance with a low coefficient of friction. ltIt is used extensively for electrical insulators, bushes, busbarsupports and cable clamps. Poiyacetagigificeiaij i-'GM - üelrin Deirin® Ertacctai C ® Poiyacetai (ñcetait É ® Ertacetai Itlt has high hardness, stiffness, excellent creep resistance &8 dimensional stability with a low coefficient of friction. Used extensively for the manufacture of precision gears and bearings, electrical insulators, and parts which operate in water between 60° and 90°C. 90°13. Hl 1IiflHiIl1tli fl1l Ht1liI 'thermoplastic combining great mechanical strength and abrasion Itlt is a high performing thermoplastic resistance. lt is highly resistant to most environmental conditions and corrosive materials. Ultra High MolecularWeightPE MolecularweightPE UHMVPE UHMWPE New-Light® Simona ® UHMWPE —Saxin -Saxin New-Light®Simona® lt is eadremely extremely high abrasion resistant when compared to other thermoplastics. lt also has exceptional impact resistance even at cryogenic temperatures; it is chemical resistant and self-lubricating. W-.'~..i*.f; 'i:?t-i"'i1E.i.. * 1 1 \ 1 Y , 1l .1_1£]G i I ni :: EE :: II'l ll'l EE :: za ADHESIVES I: ::J :I: I"l'l 52 I:I'I'I on COMMON cã 5:EË:ŠCã :: l'l'lENGINEERING lvl UUU \-I'll lll\I\.\¢\I! \]\Il\AIIIl\l\J' \AIl'~A I-Jl\A\ll-|\-I |||uu.u||-uuur uutuun mu I ll|f\f, | v|Jv\'|v||v I 1% U1 Surface Preparation Prior to Bonding The following is a compilation of Common Adhesives used in the Engineering Industry for bonding components. lt is by no means a comprehensive list and as it is best to seekthe advice ofthe manufacturer for specific applications. always, it is bestto Acrylic / Acrylate : This adhesive is a chemically activated two component structural of types, e.g., General purpose, High peel and Shock adhesive and comes in a wide variety oftypes, meictslnt fnr IIQD on rm metal sinri plastic nlnetin materials matnriale Qnnh ARR Polystyrene l3n|\rQt\rrr=.nQ and and resistant, for use metal, f"tl\l'5tf'l"|Il"'Q ceramics and such as as ABS, Polycarbonate. Acrylic adhesives are known for their excellent environmental resistance and fast setting time when compared to other resin systems. Cyanoacrylate (Super Gluelj Gluel / Anaerobic : Comes Gomes in a variety of viscosities for gap Cyanoaerylate(StLper tilling accelerator./primer. Hardening takes place in filling between substrates. May be used with accelerator/primer. a few seconds and forthis reason are frequently used in the assembly of small parts. They bond most types of rubber extremely well and have high strength, excellent adhesion to a wide variety ofsubstrates, especially plastics. lU\ll\JL\AllL, COMMON ADHESIVES :1 SD gš:ŠGD :: ENGINEERING I'l'I :: EE:z on I"l'I EE :: :n Ih I: :E I"l'I SL' -=rnen ln neneral stens are necessaryforcleaning necessary fnr nleaninn any surface priorto nrinrtn bonding. hnnrlinn general, three steps 1. De-greasing: good quality commercial de-greaseris de—greaser is recommended. Metals - AAgood Plastics - A suitable solvent such as Acetone / Methyl Ethyl Ketone is recommended. 2. Chemical Etching: A suitable acid-based commercial etcher etcherisis recommended. Mechanical Abrading : A Medium grit blasting (sand blasting) using Aluminum orGarnetgrit Oxide, Silicon Carbide or Garnet grit is recommended. 3. Final De-greasing ::AA good quality commercial de-greaser is recommended. ommended. n':|r'I'c~c\I1r\| onn ' nnf+nrr\ E? £0 cocu _mparts should ln Cuall 'cacases, E; ca. be ca" CD ::-bonded ca :2:2. CD rIqc\ c as s:c. soon O c c :5 as no U') possible CI 63" 5'ca_.,CcpID Opreparation. 1:: c: 0") E2 EI G aftersurface -c: cf: paration. Aluminum - De-grease with solvent and dry, clean the surface with suitable Chromic acid rinse thoroughly with clear running waterand water and dry well. Then bond immediately. solution, rinsethoroughly Cast Iron —- De-grease, Gritblast andfinal de-grease. Castlron Gritblastandfinalde-grease. Immerse in recommended acid, rinse in clear running water, dry Copper & its Alloy - immerse andthen bond. Galvanized/Zine_Finished dry &then bond. Galvanized/Zinc Finished Metals - De-grease, abrade, de-grease, dry&then vun-n 2:Q; Adhesive,/Hardener two part compound with a variety of Epoxy 2: Usually come as an Adhesive/Hardener setting times. Epoxy adhesives are widely used for their toughness and resistance to chemical and environmental damage. Hot Melt : These are solvent-free thermoplastics that melt above t80°F 180°F and then rapidly PU-I l.vJ OI IU CULGI D -1 -1 set upon cooling. They can be repeatedly softened by heat which allows parts to be Glass - For normal bonding applications, de-greasing alone is sufficient. sufficient. However, for removed, repositioned or replaced during assembly. A hot melt glue gun is used for dispensingthe dispensing the adhesive. Light Cure : This adhesive cures in seconds on exposure to UV light sources and is specially suitable for bonding glass to glass and glass to metal. speciallysuitableforhohding gtasstoglass glassto Phenolic, Melamine "&& Formaldehyde Resins : These are thermosetting adhesives that offer strong bonds and good resistance to high temperatures. Po ysulphides : lt is basically a caulking type adhesive that's Polysulphides that's primarily used for ceiling seams.`v'iíi1encured, cornpietely waterproof. seams. 'v'v'hen cured, it is completely Po yurethane ::These These are mainly available as two part systems. Their flexibility is greater Polyurethane Theirflexibility than most otherepoxies other epoxies and exhibit high peel and cohesive strength. Polflinyl Po yvinyl Acetate (PVA[(PVA) : lt is intended primarily for wood and paper bonding and is transparent when dry. Polyvinyl Po yvinyl Chloride (PVCt (PVC):: Itlt is intended primarily for bonding glass, china, porcelain and other ceramic materials. Also used for metal, marble and hard plastics but not recommendedforwood. Adhesive) : These adhesives adhere to most surfaces Pressure Sensitive (Contact Adhesivel with very light pressure. They are available in solvent and latex or water-based forms. Both surfaces of the substrate need to be coated with the adhesive and allowed to dry priorto prior to assembly. Thread Locking & Sealing : Basically an anaerobic sealant intended to produce a waterproof/airtight seal between two mating parts and comes in a variety of strengths ranging from permanentto permanent to easily dismantleable. Silicones -Stlicohes : Silicone Silfcone adhesives have a high degree of flexibility tlexibility and very high temperature resistance (upto 600°F) when compared to other adhesives but lackthe strength of other epoxy oracrylic or acrylic resins. Room temperature vulcanising (RTV) forms cure through reaction with moisture in the air. lt is used extensively in the window glass industry because of its high flexibility, excellent adhesion and high working temperature. This adhesive comes packed mainly in cartridges and is dispensed using a caulking gun. optimum strength, the section to be bonded should be grit blasted with very fine Silicon Carbide grit and then bonded. Magnesium_&& its Alloys —- De-grease, immerse in suitable Sodium Hydroxide solution. Magnesium in suitable suitahle flhrnmin snliifinn Rinse in nniri cold water and then immerse ih Chromic anirlf acid/ fihrnmir: 0-hromic Nitrate solution. . ...._. -__._.__---'H ----_.-.--1.. ---..---.--.'. --- \.v|v-wmnv vu-nuq v|||u||||v lIlnlnpsyyo qv|v\|v;|| Rinse again and then immerse again in suitable Hydrofluoric solution. Rinse again. Dry in air blast and bond immediately. hot airblast Stainless Steel —- De-grease, etch, rinse, followed by immersion in suitable Hydrofluoric/ Hydrofluoricl Nitric acid solution. Finally rinse and hot air dry. hotairdry. Steel - De-grease, medium gritblast, grit blast, final de-grease and dry. ÅM Special etching solutions are recommended priorto bonding. Phenolic, Polyester, Polyurethane Resins Resips -~ De-grease, abrade and de-grease again. Rubber- Surface etching/abrading is recommended followed bythorough by thorough rinsing. RLi1bgME— De-grease, abrade and de-grease again. Common Solvents / Cleaners Acetone —- Used mainly to clean and remove epoxy resins. resins, adhesives, contact cement and ink stains. sfains. Dissolves/softens r_n__any ittarly plastics. Cyanoacrylate (Super Glue)' Qyanoacrylate Gluet' Adhesive Remover —- Used in the removal of unwanted super glue from metal, plastic and rubber surfaces. To disassemble bonded part, soak in solution for extended period oftime. soíutionfor 1lil1tiHl 1li lHi l1i1lI Lacguer mainly forthinning lacquers (paints) and also used extensively as Lacquer Thinner Thinner-- Used mainlyforthinning a general cleaner/de-greaser. ltIt is highly flammable & dissolves/softens many plastics. Methylene Chloride -— When mixed with xylene, makes a strong solvent for cleaning ink, gum, latex, oil Dissolves/softens some plastics. oii and wax. Dissoives/'softens Solvent Alcohol (Methyl (MethylyAlcohol1An excellent cleanerforelectrical cleanerfor electrical & electronic parts. Alcoholl-An Denatured Alcohol (Ethyl AlcoholtAlcohol)- Excellentfor Excellent for cleaning glass and metal. TurpentineTurpentine — Mainly used as athinner/cleanerfor a thinner/cleanerfor oil-based (enamel) paints &&varnishes. varnishes. Kerosene -— Used extensively as a general purpose cleaner/degreaser. F 'iizl F! STANDARD GRINDING WHEELS MARKINGS Standard Wheel Markings: For clarity as wellasto well as to avoid mistakes in wheel selection, 1 Standardwheel Forclarity a standard designaticn designation of wheel specification was developed and was inscribed by i ISO in 1965. A typical wheel marking includes the following information: lS0in1965.A includesthefollowinginformation: , ýi y" yt y" yt YYYY 38A 45 J 3 V Abrasive Crit Grit E A l T I? I . Grade Grade Structure structure A Bond Type Bond Type A . *1 EU E_ . Regular aluminium oxide, tough. oxide hard & touch 'II.|A, 1oii, TIA 11A \ Premium quality of aluminium oxide oxide. WA wo, 38A aan oxide, hard & brittle White aluminium oxide FA, FA, 57A, s1A, 89A son Semi-friable, aluminium oxide. 3211, 32A, ooil 90A aluminium oxide. Strong, sharp mono-crystalline alumini um oxide. PA, 41A, SSA aan Pink aluminium oxide. PA, 41A, RA, 25A, nA, zali, 46A 4oA Ruby aluminium oxide, hard and less bri brittle PA. "tile than than PA. PSA PsA ` Special pink abrasive. FSA Fsil , Special Semi-friable aluminium oxide. AZ , A modified, zrrconia aluminium oxide. riiodified, high zirconia ox ide. 37C, BC C, 370, Black silicon carbide. Green silicon carbide. GC, 396 390 AC Blend of A and C D DCl E--:.1 1 in 1* _* Coarse VCoarse . Medium. i' Mediumf Fine Q f5 r_-LU1 > OC:C) CD @ 3 D.E.F.G. D.E.F.G. 1 Soft f sen H.l.J.K. H.l.J.K. Medium L.M.N.0. L.M.N.O. Hard . PCl.R.S. eons. A 11111 llllllli 1 1 1 Sha e 3 - Ta ered One Side Shape 3 - Tapered One Side _ [J J5' ^I lp Ultra Fine 00 1500 200 . 01; 2000 1500 6000 2000 00" 4000 cz:—-Ll- CD OJ C) l'\J CD C 4000 6000 l Q lleryHard Very Hard J T.U.V.W.X.YZ. t.u.v.w.x.vz.]' V - Vitrified (Ceramic) : Most common bond used extensively for precision grinding. The porosity & strength of the vitrified bond allows high stock removal & its rigidity helps to maintain ' consistent precision. Not affect ed by water, acid, oils orordinary or ordinary temperature variations. B5 = Resinoid (organic) for nigh-speed fabrication shops Useciforhi sh OD s & foundries. This bond 1'0r"ani*-` 9 1-I : Used 9"' - SP eed wheels ininfabrication is excellent for rapid stock removal and heavy work. Resinoid bond is used in most cutting-off and snagging-off and snagging wheels. However, ittendsto it tends to deteriorate overtime and, thus has a limited shelf life. HR - Rubber : Used for centreless grinding feed wheels and for precision ball race grinding wheels. Useful where finish is critical and where bi,-rrs burrs and burn need to be held to a minimum. E - Shellac : Used for roll grinding and other cylindrical grinding operations where fast stock removal and finish are important important. forwheels S - Silicate : Used for wheels where heatgenerated heat generated in grinding must be kept to a minimum. 0 - M agnesite : Usedforw grinding | O-Magnesife:Usedfo sp rinoorindinnandtbinwork W' .., andthinwork .. ..,...p'pieces. he elsls de signed fo rspring rw hee si'gn edfor ieces. il li 1 T I ll K _` | H II ifi D l I Ti Jf r:~i' l -Ho *'l "'l" to i_t._] "Ft Shape 6 - Straight Cup Shapefi - Stra E5 l-Es A S pica- T' iix IZTLI 3--it a -»i T' it r k__l 1-- —-Q l-1- LH+1 p-—l —"tI. l.J'_._.__,.___. "I di Shape 8 - Helieved Relieved Both Sides Hulil ' (Standard Hubl I11- 1°i1Qii ll li g51.1 '1 i1 'F A J i 1* eta Shape 12 - Dish Type Shgpe12 —>llN 11115/1 tWi"'/l /Z '>1H1 [TT »lLII /-ll Shape 10 - Raised Dovetail 5l "7 r—/ l Z2; te D ej _,. - -" i I H._L Shape 11 - L .Flaring @pe .252 +r=>Cup it? Díth T 60 1 Q _" "T1 D P T r. l S "l11lil l l i' ` . —'viii'N+ š_gl .ei,titl11 rhmr h-_ I *t A rK .l| F?-—??__ .4-——'—-I'*—b-i Shape 4 - Tapered Two Side Shape 4 - Tapered Two Side _'Dy L lief L C1" F l _i_ I? _,i'lT Shape 7*7 - Recessed Two Sides Shqpe '. D 1 ii I -, '_ _ Oi, SITUCIUIB (Sometimes omitted in wheel markings) Structure symmzim. A »o,`1,`2.`314{5,`si7fsjo 1o1i112i1s;14 Synibol'No. o { 1 2 i 4 5,' e 7 i e pI 9 Eio jii lie fie 514*)' AbrasiveRaRio% 62 so 60 58 56 54 52 50 48 4e 46 44 44 42 40 as 38 36 34 AbrasiveRatio%'62i as sale-4 52 5048 42 40 as s41 Bond C Pond Type Lyi U T"'_"l i ___. _, Y Grade Glade I indicates lndicates the relative strength of the bond which holds the abrasive grains in place. 1 Soft Very sqii 'Pt iv py Ultra Fine E10 240 280 320 400 400E100 10 12 14 30 36 46 70 80 90 100 j6 ?00 800 250 16 20 24 54 60 120 150 180 220,1-500 220 500 600 700 h Shape 5 - Recessed One Side _ Very Fine 1111 ltpilli :3 1L, Y'V' Primary Grinding Face . V Secondary Grinding Face sha "I ' sm" I" Na ez ' U I¡"d';"I Shapet - Straight 1'mPm>¡_y F' Shape2 - Cylindrical > I ' ' 1' ;"` 0 T i -T _!_T Mtr.'s Symbol Mfr.'s Symbol XS '_ STANDARD cmrioinc GRINDING wiieiat WHEEL SHAPES srnnonno sHAPrss L F S Y Abrasive FSymbolI l1 Characteristics - S 11 II _/.z,~.,,«ž./¡„;.;,,g - \' -. .~. -- -.-4,-. w iez @W fz in. -rs."at" . {M s:i „z ' ,.' Pi y u _1 —>i—I-l . V .1/;_ _.1'-'ff; '- ;~_._i.'.>;_.:f;_'¢_ 11' RW STANDARD srnnoilno GRINDING cninoine WHEEL wiiisct SHAPES siinees | l Q H_ il T 1 1% _i _t tTJ\ o H- \ ' ______________ _, ._ ._ . _. _. . QB] L--T i D H' TM E Shape 19 - Plug, Conical End Sha e19 Plu ,Conical Endzý D Shape 20 2O - Relieved Oge One Side D . . D Shape _7 "Sha Recessed Le 23 ŽQ Relieved & Šcesseýdý Same Side ---„ ' iA'i A _f , Fv _ l*'-:.-?U11 *i*-' f T l l l > _t , I 541 _7.. xv knl'I Sha e 25 - Relieved Bgth_Sides Both Sides Shape Recessed One Side Tv_ M A I+H_+l +H» S *- cg R=_ R=š _ R=š IU l t „H Shape 30 - Cut-Oil It Shapiie "\ N23° m°3..\ 5/82' 1-We [ge I 60 S S 0 [_/_J L/-"J D i4— -—Pi K G*'-:U:10 T T e=%s=% J ml ri=— CD-I OO-I _ FR FR ./. /./l'\) °å ' \23° L l,__i L.-'.1 =7 e=—__'15 1jã I"IE? 4 'F2 R=šS=š IU -»W T1' 1::: i~.'.:::i R=T R=T X iv 30° /à *ali 1lti1 l1il1li1li 1l 1 'T d1 I I D 0 ý ~D l l._r_.l 1 Q "m>> M?' R _f L d`" P I X \ |T|/ * íilf/Š' '—~D'i |*H+) 1«H->1 _1_ H- O O C: l /'\ /'\ iii->5? §fi5°7 45 < ZN v D 41 >i[rv.\ Ii)//IE li „im-*'_%íi s|1zpe4o lM"#sia'pe 4o - Mourireu Hrritfiau i Vi N r >:::::::r:::c:::::::: can Li-l-4 _1 HQ :I: OJ—I y—R FR Mi Tr .¡%@, FFE T l\)-I |y| D T F.' i 'l e~%74ie .. 80° 60° / _t Shape 27 - Depressed Cepressed Centre (Reinforcedl (Reinforced) Recessed Both Sides SEE" "tisf D _- Stiape Shape 2S 26 - Relieved Both Sides . \ H '°i__i C D-DZ--»I _ 1I »íi l _1i ųdeadd 60° J:4-—I- Pi -71 T i_ BL_.l B T 8il !I "ii_i Å 600 H _fi Shape A Sha e224 - Relieved One Side Recessed Both Sides LH H RT sit 'ti T | ~l iC-.¢i .il will ~ l Tt . idI itrt\fiR i l i~Fl ,/*R 650 EEH _ 'l 1*_'7777"D*"TT_7_1 v l 1 l One Sfmýeíwý J ' - Side Recessed Rpccssed Other Side -J 1413 ,5 rV\ /» I*'3' T l'\Li[.) '-1i I: R 11 _ :I: --J I\ Lilo 0" ML" > Q 5' -Z;._ _ Shape 21 - Relieved BothSides Both Sides reps 1 i re P i, rlíf lil it l' V' = r T t ii}- I 'ii H ' , ' R=__ -LooCD—l 81 i_i» - ».' If'? :.;_;.- :H 900 _ Shapetfl - Plug, Round End Shape18 Ñ . _J ml')? L_ I I 2; :E InIn ,_ FAGES -11 In InIn :I: I:I: I: en EE :: EE ::In WHEEL STANDARD GRINDING 'ri V Primary Grinding Face V Secondary Grinding Face Sguare Tip Shape 16 - Cone Curved Side l Shape 17 - Cone Sqpare mi B 1'—'lBl'_ D -_.-rt;-_; li U u u cur v _'l ,>i"rl*_\/v ,_'lour1 _'l l* \/ Y (Ii (3 ! . I ! U _W l*'" "IUl'* Z A-Ti?I U 191*_W 1* I 1l =~»» . I ,EI 2~- =-.4: .. ,_ ,~. -... ..»- ;.'l-r ,1_ . > . -.. -'.~' .-< »-.-. . '- . -. 2. -- i. :4 ->>13.': -E 0' ';?'.= -';.»._- 1-,1-1. 1-. -. 'E 1 STANDARD STANDARD MOUNTED MDIINTED WHEEL WNEEL POINTS POINTS SHAPES SHAPES s & DIMENSIONS DIMENSIUNS 1 i _ ii lies 1'¥25_>| l pl 1.sir1Ī 1.1 flit? i=..i A2 A3 —>i 11 0 HAM l¢,l 1:1 A4 32 A5 8 i i A6 A5 iii.i1 as N15 P51__i A1 1 : X21 A21 A22 1Šr 7115* A25 A25 A33 A33 r— 32 1% %—+ il Leo A3 A311 _,(3 U A34 1134 lk 25 zs —1 -»I l'_ i'"25*l T 1 _:: & z 2-.:---ii'-,' c»-1 /_-, ':-'4-.1.-.1-~ -'>-'- V'5:/ ,-..-. ~3'2r;- ,.;¢1-,.-- i A3! A39 A.-1 ~ :fa '-= /I 3,-e£.,-4;'? ' ";'g .'-'..-ext" ' A40 §__I°"Q: H +2; T B91 É š i._„-ôíãrž B92 B97 13 B164 a1o«1 We 10 i Shank niameier Diameter T T (mm) (mm) e imml 4 I1ti1ti1t1i1lI u -vu č II I 'A Domm comm é Z A F od NT ii D 5 T l shape shape Shank Diameter (mm) _l. @ son W225 . W225 wzzs um wzao _ _. cotzncoco motoru ééié W230 I'\J U1 . .N B122 o122 N°' 'Š 5:: 'Š é—l Š-I '5 ãc '5 wios to W195 v71 as w1oc ;_-{F W204 wzo4 Å if W205 wzos 1 wz1s _ wzis _ . _ _ _ _ s' weir" wzflfi wzzo 1 w22o 7 i-J w177 W121 o121 G) _ l if W177 B112 6112 1 mag Fred I 64 W1 E4 W175 w i mt B111 s111 WShapes W Shapes LUJA E'fi;]_i Te Å w1so W15" w1sz wt e2 Om':a0p'ucn- i:m.nce.o: E5iommo °°E3E§ IAHIË IM1 QR II I IJ\l 4-—;5; J Ä. Ir_|í I7 D (mm) (mm) w144 W144 W153 wise w1s4 W154 654; |1 D °' ~ _I ..[UI 1"1 S103 a1os 16% Lg? w11a W178 Ĺ [Z17 B62 W»-w in Shape Snap" No. 16 _i4-5->1 4 $4 Q 9 zs A38 i A24 i+t9+| 'Nto r" , A F Lee*~= .Le ,O F,eNHL* „ A4 ii raid if F61 T _1#_1__it 0 A35 "*1 §;|> Š> 13 B51 L„.:l h_;11 _1 o_-T ti T-"D 121"' A32 |+19 | 35 iii 11 B101 a1o1 _,|€II_L Z5 -f i 5761 var let @F CE16@153: trv A14 A14 _ i L_ A-_~J B44 l"i3*l 1| "r we GU eAss ` gr U E lit s é ¡ł_% A37 A23 A33 ml 1l'l jj R5111 Al__J tr B61 _> L Ë Š i 1+E„` w« :1 w__v_Ā ii tel B43 |1_ |*_15_'1 be iii itii it1 rts mi Qt1 @Q Qu 521 Q ¡ A1 A133 EA B42 I B53 28 L__Q li A12 1L _L :.- 2,' I" ~ ' oak? ii J Q.rirífií Lei" @fr iwjti ¢ - ti1ere 11111 at A ii); 1.- rig] I .____i i,_ ëciă IT/Kin {+19;>tT8 _e-~, ».- '—___T Bi B41 uato ki ;__'_|€l .1 E>] '-I - B Shapes - 3mm Shanks T-16_W t'- 0032I"\3 Ë__1 A1 l 70 l 7g . .i . -_ @ l i i; '.'. .'LYLI. l 4 fi I 25 1"' I-'F it ':'-_'. ''¢,- .-, =.-_ 1 l'_25—*l F\ ' 1, -tfl «n LI _r I4 :1 '4 STANDARD WHEEL POINTS G inrs srnnopn IU MOUNTED unreo wu SHAPES & DIMENSIONS ŠIv:O fa: 2. Z!rn Cl U :I 'Irrrl l'I1 '-2: In -5 i A Shapes - 6 mm Shanks *'I—i:z za ,-..4 '___',.__-.;, '..-._.'v _,| 2,5 .-'-,. i 1 -L C1-J EAJL _..L CA3 CAJCJ1 W1 BB w1oo 13 _.L Ca.) 19 _L LO 1 W1 B7 W187 13 25 ` _ Es? ff"I."'1_ . wzas W236 w242 W242 IMOQR eoo . r.(1~:3-c0.-o7i\Ia\)|:i7\.,~I\-'fi'__L^-.lII\3)|'J7CĹYC\JU'lC1J("l€1.CL)iD€.OĹCD Tl) ruI'\J—\-e-."\JC—"l-'u-c:ico-iz°ric°o-i DJ I\J irn\:>-1r\-r\: r\>o>° U1-o° m (am:nixa \J\.I sa so 50 OJ :3U3 D ne wen _.iC . Q3 25 25 ' primarily for oft-hand off-hand grinding applications and are generally NOTE: Mounted wheels are designed primaiily"'or Aluminum Oxide or Silicon Carbide abrasive in vitrified or nr resinoid bond. They come in a made of Ali_iminiim coarse, medium orfine grit. selection of coarse. ' |JflI TUNGSTEN CARBIDE GARBIDE ROTARY BURRS TIINGSTEN Basic Cuts l Standard Cut: General purpose design producing good metal metal isremoval relativelyand hardsmooth and willfinish. not clogExcellent the flutes.where the metal is relatively hard and will not clog the flutes. Uses: Steel Alloys, Stainless Steel, Cast Iron, Copper and Brass. I I ~ ""' ' . I ,_,-.---.:„ toppyt(ppto~ -.».~.~.~.-. ripeeggs qgyiortovia, AAi -4' - -v -- _ GOO "'a- ed I - Q ' D - ac1 is 1 :-:»:-:-:< "' ' 0 :' 0:0 4AA1%+1ppup :9!' '-. O 4» I Oval Shape t¢ Ball Shape Š°;'.~ _ 1:=:1:=:1:~:~.~.~:»; IO:-2.2.:-2-2.2.2.:-7 or(pi-ape. IQqpo .-,.,.,.,. ...-n-I, ž°2'2°2°Z°;'. _ P-' "°N4' iiior(pp1%(pto0*qp"3 1:=:¡:=:=:1:1:=:=z~ I°:o:o:-:~:o:~:~:ol7 4 000+1A?`,...,.,.,.,.,.,.,.» d§I'-4. {yfi§§cooor1304015'@?AHA 4514491qpggqy.§'§'9"9.0.I" t»2«2~:»2 010 143 14 ANA1%' å.3.* 4-,' 75'-'"3 ___- :~ —L -Pi Taper El-1: Cl cv: =1" cc cc - Ill = I:L ccSEE c: U1 r11 14° Shape Radius End cc: ii ii __ - II! ::r cs cc cs E5 cc can Flame Shag I -1t _ :~ x. F It. =Ž¡:»;~„_ 00+(ppeMyAA "5 D T>00. -00 "'1.0-. Č°2°:°:°:*:*$~» 2/, "Š Chip Breaker: Provides the operator with excellent tool controland control and reduced sliversize chips. Surfacefinish Surface finish wi will bee slightly reduced due to the chip breaker pattern. Uses: Steel, Cast lion, Iron,

Stainless Steel, Titanium, Brass and Copper. ~ - \S SA 110. .\ '- its 3" 3' A to I 1_5 1.5 I~ ågtgizigtztgizš 0or {§,1§orco app(pp if rfli$5, ifii qpygp fisooęaęezz >I~:*Z*$*Z*Z;§ 1:=:=:=:1:l:2ž=z f:~:::«:-:~:«:«::~2;X~2;Z°:;1;:y' J31$1» 55 f1××××××> 'Q 'C' '$' iii' . _ ' 4 4 ~ -0- -Q &_'O._-0 -I» 0 0_ fin"-'n»°4» --0-0» 4» a'~»"4\-' S-0 'Q ~ O __ "0-0'¢an-0' _
Cylinder Cylipdef Shape - with/without End Cut I Cylinder Shape - Radius End åím . Shape - Radius End Tree Shane I5 i Lfžlšfšlšlil:-_ -Q .-.-.-.~.~.».-.~, >°o'o*.°o'o' E$. »-.4°-:-:-. .»:~:~.~.-:~.~.~.».« 4+00&10 arecorapparecorQ55 0+0c ace0 -1'-:vi-v Egfg'; ASKS o At __ at22+!-~' I -Q 911 :v:Q:ą:.:o:Q:Q:Q' Q0 O V 32:2: 2' - . Shane - Pointed Poinfed End ;
Tree Shape 3 I1 1I 1I 1I 1I 1I 1I _:. _ "__" -— 11+ -- -_- —— -—- Standard Cut ("3 g-0- ' I 44001AAAAP _ `Double Cut/ Ibouble Cut /' Diamond Chipbreaker S Cut Chipbreakef nnn 4s,ooo_ ,_ ran 5o,ooo s2,ooo_ p 35,000 ss,ooo 32,000 .15. _§J'I CD CD CID Vý3[16'V"W_ý 22,000 3/16" 7 _e_ 1174", y4y*jy_y_ 10, _ _'_ _ 3/8" 3/a" 12 ł 1/2" 4. 16 ` is/er 5/8" zo
3/4" y 25 17 71'*1" I. 4+ i - i 1/8" if 1/8" O3 :~:~:»:=:=:$:~:=: ;~ -~: -tgigtgtglgtgågizâ 'a _* 0 .6 4- 4» *4» + ' >->4»--11--->~oo~ '> . _ .y _ ' . ' ' I':- 1/15" 1/16" _s ::c.— i Q I . 90° Cone Shape Size_Ž(_l-_teadDian1eter)1 _Size (HBS_t1B.IS!tlSI_8_lII :-t Q:« _, (inch) * Standard lullShapes ll' Iii 'Ill {IIIn ' I : cl:co '-1-1 cc CID -c: ccccca. :D III cc 55:5cci ::ica.
:1:eo Sill -3 eo S131 2:. :: 1.-1.:1: CID Cl! 1: enco::_ co caC? 5: 58:Š ro ::ca. ::c: :U:5:Š III "II 'c::::I eaU! Jr'-\,-_ :D LED l'_J ["III|I' lull IIIIIII II III. III "I i " 60° Cone Shape 5U1 Q51 '¢"1"@-'$4@'¢' ' 7'? 04- F The flute design produces rapid metal removal on nonof the flutes. ferrous metals and eliminates clogging ofthe Uses: Aluminium, Plastics, Soft
Copper, Rubber & Zinc Die Castings. "*~ A _*ri¢*i' i*Agfipgt i" Aluminium Cut: Recommended for use on soft materials. A -0 , Inverted Cone Shape - 2 4 10° to 30° 2 14° to 28° Cone Shape - 4 Q'. :Q S - i - zr A ii',iii yr-ii ,11 1:1 :-:~:»:2:2:»:-:~: $32 .-0 0or 0011 15+ c(pp-1or111' -4»o_,_" £1' > Diamond Cut: Extremely good tool control producing
powder-like chips and increased metal removal. The surfacefinish, however, will be slightly reduced. Uses: Heat-treated Steels, Fibre Glass, Nickel-Chrome Steel, etc. SteeI,etc. --4'E§§§iEiiii§E§§5i5i5 Adto 1 *1?'o(p 1r 5% r 1-_ '01. . 11*' _ _- 4- 11111111'it/Mitt ~: -å°:°:°Z~ It '%"§_ 0 I5Q.l_£- ' Double Cut: Produces rapid stock removal in harder
minimum tool chatter. This design eliminates materials with minimumtool loading of the flutes &the production of sharp sliverchips. ofthe ofsharp iron, Stainless Steel, Titanium, Brass & Uses: Steel, Cast Iron, Copper Copper. ,`~:`-"~`~"" is F' >Ž'I $11 1111' AI1!I 111! ~"-*1' "R II I: :-I.B:Đ "< BURRS II l= II II (Ih TUNGSTEN -II: IZ IĐ IV! -II11 I:
CARBIDE IDlbII EE I: I'l'I ROTARY UU,UUU Ñ 1 I F eo,ooo CD SD CD CID CD ~ 42,ooo 42,000 30,000 1 1 z_5.oop 25,000 22,ooo 22,1000 1o,ooo 19,000 18,000 1e,000 1s,ooo 16,000 14,000 14,ooo 25,000 2o,ooo V 22,ooo 20,000 22,po0 1e,ooo 1e,ooo 16,000 18,000 1s,ooo V _1s,000 1o,ooo 15,000 14,000 15,000 13,fiWí714,ooo 13,000 I 14,000 10,000
1o,ooo I 12,000 _ , Aluminium Cut V_ _ _ - I ii? 23,000 r 15,000 1 271007 112-) aooo C3 ii?ii? @z NOTE: The above speeds are recommended for Burrs with Standard Shank Lengths and should be reduced significantly for Burrs with extra long shanks. The recommended speeds are intended as a General Guide only for Steels Steels, Alloys and Non-
ferrous metals. The Speed for Stainless Steel should be increased by approximately 25% forStainless 25%. important hhortaht lilote Note : Because of the high speeds involved, ihvolved, it is most important that approved alltimesto safety glasses be worn at all timesto avoid slivers from entering the eye. #41 _ SURFACE lik I: II '11IhID l'l1
COATINGS tb IDlb ::'I: IDfh B _ COATINGS SURFACE in I: IS '11IhID 11 (D I: .JINGS IE '% Physical Vapour Ph srcal Va our Deposition De osition {PVD} PVD Chromium Nitride (CrNl (CrN1 processthat verytough A low-temperature process that produces very tough coatings with high lubricity for use on gummy materials, high temperature alloys,
low-carbon steels, and stainless steels at lowto medium speeds. This is a PVD coating and is particularly suitable in non-ferrous applications where titanium based coatings are not successful. ltit has a surface hardness of approximately 80 Rc and has good corrosion and oxidation resistance. ltIt is mainly used formachining for machining Copper, Die-
casting, Brass forgings. Brassforgings. Chemical Vapour Deposition (Ct!D1 (CVD) uiamonu Diamond Coating Itlt is an amorphous diamond coating with extremely low coefficient of friction and fortapping Aluminium alloys high hardness. This coating is specially recommended tortapping with high Silicon content. A high-temperature process that
produces highly crater resistant coatings with a broad range of carbon good balance of toughness and wear resistance for use on aabroad and stainless steels at medium to high speeds. atmediumto -1CID C'! :§ El Vapour II:Iii -'I E: Medium:5Temperatura Chemical Deposition (MTCVD1 -l1 l if E: Tnrnnn IUIIIPU Q9 IIIII C: =5' IED C5 "CI CD C:
nnoiiinn l|\flTI"\|n\ CID PLIOIIIUII 'III I UI U1 Hard-Chromium Plating This E2 5-!3; cn is a medium-temperature process that produces tougher, slightly less wearresistant coatingsthan coatingsthan the traditional CVD process and is recommended for use on gummy materials, ductile irons and high temperature alloys at medium speeds. The tool is plated with
Chromium to improve wearcharacteristics and reduce sliding resistance and cutting forces. ItItisis especially suitable when tapping Structural grade steels, Copper, Brass, OLUUIO, UU|J|JUl, LJI GOO, etc. ULU. c\+nn|c\ Blackenlng Blackening n+n Nitriding Nitriding is a process which is used to increase the hardness and wear resistance of the
surface of a tool. Itit is particularly suitable for taps that are used on abrasive materials such as castings, bakelite, etc. Blackening is a finishing operation that chemically coats the surface of ferrous metals. Besides enhancing the appearance of the components, the black deposit holds a sealant, usually oil, into the pores of the black oxide coating,
where it is held in close contact with the metal and prevents corrosion. There are three types of blackening: 1. Copper/Selenium Blackening - This process uses a room temperature acid Steam Tempering Steam tempering reduces sliding resistance, thus preventing cold welding, which occurs for example during the machining of Steels that have a low
carbon content. Steam tempered tools are mainly used for machining offerrous of ferrous materials. hsrth tn fnfnrm hlarlz nnnnnr rnnnar QP|Pl'lillTl cnlnniiim rnatinn r-nntinn in nnnrnximatnltri annrnvimatelx/1-.R'74 minutes hath fnrm sist hlarir mini than I-JI-4l..|| LU tun Ill MHIMUII Uvrlrdvl vvl\i|||I-l||| \i\Ib\\IlU nu \-\rrr.1|v|\||o||.v'|J I -iv lllluv-
univ- z.2. Caustic čšiščeš¡;`„"t' }iä1írB"-"Äþåfiši šęåšítåi ëþšišïrššéåëäuł 12ić1`ëć"ršF5i r„"„eS BlackàOxiding - A causticiš soda bathñ operating at about 140°C produces the surface ofthe surface oftheferrous metal. a black coating on onthe Oxylate Coating - Itlt provides a high quality black corrosion resistant 3. Black Dyed Uxylate rna ti n n on nnfferrous nrrn lie
metals mntnle without wifhnufi Ici'nn heated hnsrfnrf chemicals. rhnmirzle A nrm/fnrrnlie nvtrlafn coating uvozu-15 vu W. ive.., trrvtųw "„.„.„.„„ using vųrtza rrvctwt. ».„„.„....„„~„.. 1A1 grey giv, ferrous .\.„t\„.~ oxylate w\¡~.w coating is applied to the steel and it is then dyed black. This process operates ai at roomtemperature room temperature. The
performance of any black coating is gauged by its porosity and ability to absorb a subsequent coating of oil which acts as a rust barrier. itlt is extensively extensivety used to coat Tungsten Carbide tool holders, Boring bars and Milling cutters to enhance appearance ofthetool. Titanium Aluminium Nitride (TiAINt NitridejTiAlN1 Tilt and This coating is
applied by the PVD process and has a higher hardness than TiN TiCN. A very thin film of Al,0, Al,O, (Aluminium Oxide) is formed on the surface of the thetool TiAlN which greatly increases the service life of the tool which can withstand higher temperatures especially when machining Cast iron and tough steels. Carbonitride -TiCNite(TiCN1 Titanium
Carbonitride-TiCNite (TiCN1 TiCNite coated tools have a very high surface hardness of approximately 90 Rc. TiCN is harder than other coating materials, hence cutting speeds similar to carbide tools can be achieved with the toughness of high-speed-steel. This coating is recommended for use in all ali steels, cast iron and aluminium. Blue Finish Blue
Finish is aathin thin layer of iron Iron Oxide produced by a carefully controlled steam tempering process. This produces a very thin oxide layer which acts as a lubricant and anti-weld surface. Itlt also increases resistance to corrosion and enables the surface of atool to absorb lubricant in machining operations. Titanium Nitride -TlNite - TiNite (TiN)
(TiN[A gold coloured film of Titanium Nitride with a hardness of approximately 85 Rc Ftc is deposited on thetool which extends tool life by reducing friction and enables thetool to be operated at higher speeds and feeds. ltIt is suitable for machining iron-based materials, die-casting and plastic mould tooling. Other applications include wear parts,
medical and dental instruments, slitting knives. knives, plastic die moulds. moulds, carbide tools, and high performancetorming performanceforming tools. Bronze Finish The Bronze Finish is a thin oxide layer formed on the tool surface and is applied on High Speed Cobalt Steels. Chromium Carbide (CrC1 (CrCl A superhard coating > HRC 80 is
applied to the surface using PVD coating process. The hardness of the coating is the same as TiN but with an oxidation resistance that is 20to 2010 30% higher. RecommencledforRecommencledfor Recommended for machining Titanium and Aluminium alloys. pnnnnr Dr-nr\r~ l1tl1 ti1lfl11 1tli1 li1 Zirconium Nitride (ZIN) (ZrN) lt is a ceramic coating applied by the PVD
process. Especially recommended for tapping Aluminium and Aluminium alloys. :1 1; _._ - g _. _ -.. _ ______._ Z RE II iI Al 2 o :i i!-.3.-4 §i lil + I'\l_-.--_--I m Polycrystalline Cubic Boron Nitride (PCBN) Ceramics - f .| It 1 as ' R I ' I LIZIIDIIIBS Carbides i i Gost/Produutivity Cost/Productivitii Atlvantages .A.t!\.@"i3it€$ iowScrew-machine and other lowcuts.
V speed operations, interrupted cuts,_ low-horsepower machining. _ Priced lower lowerthan than carbide; gives longer tool life, better surface finish. Finishing operations on irons, steels. stainless steels and aluminium alloys. Ceramics Ceramics High hardness. hardness. _ High Hardened work materials in Provides many times the edge 45-70
Rockwell C range 45-T0 life of carbide eliminates tor costly alternative need for grinding operations. Better than 30 times the tool life of oi carbide, carbide. even Carbide inserts toughness. Carhidelnserts toughness. Solid A Hardness Hardness of of diamond diamond MsBi9iii*"fi*"9M and Il"lr1CIVQI1iD Polycryslalliee- ene lncexaele. Diamond lnserts
*7, igDiamond*lfiiserts* -.. K-QIIIJ lll\.l\JI\.\.A|.JILh finishing operations Roughing & finishing on abrasive non-ferrous non-ierreue or materials. non-metallic materiais. . H C TiC & TaC is added for Improving heat improving and crater resistance. ~ f a *1. i Medium speed i l i i Transiierslb Youno's Thermal H M" lnãnsrerset Young's ' ił " ' ' '" i T' iso 5l
ISO lame Grada tttaritness a "ass Rupture up me tŠ Modulu: ooniluotivity Moduius I conductivity cim lCla'ss} (mm) A (NRA) l Zifil-Z'>"\\"'.',' .- 'Z ' . - ';.""' -';1""§_"')'!l""~£'i i . ;;\-.a'_:t.;,;-;-_ \°;»;*-,'."..e-'~.-§'~."..>':1l P ¢ '. §¢.'j.'=')'-., t:-Y' 1 . >2 =;-»v;'._;j-':")f»-,y i -»'>.,~'-Q .. .. . an ,_, l I- Wu, .=:5~'r-.:;,.-'.'g.¢-p----__._-_.- r__-~-- P10 =.=:a..;?: gt .
—"f',:,~¢.~;-.1 i 92.7 92.7 strength 5 (tour/nim=) , , (cal/cm Strength (kg¡mm,) šlllllltq/mm) (oal/cni.xel:.K)i . sec. K] l (Ii(kg/mm) g/_mI'lt',-I (kg/mm') l J > 200 Pz" 92.5 925 i >210 . 1 5 Comnressiiiei Thermal 10ompressiveiTh°"".a| strength iemapsj Ë°X"a"s'°" I stieiigth I .|..... Š5s` 53 i i II I i1 ii i 0.07 i iiII i coeflici Bil! imnieiem hu /,m (10,/,0) «I 460 A
480 l ________.._'. ___-____.,,._.__ _________ „_ .... 6.5 .4- "W; _,¢:.>,:: ;'.;~1_¢, _, 1 Roughlng to finishing finishlng operations Roughing on aluminium aiuminium and other soft or abrasive non-ferrous or non»me'tallic materials. non-metallic ' Machining speeds up rn/min and beyond. to 1500 m./min T'I >< ceptional hardness. i I'Exceptlonal
Polycrystalline Polycrystalline- Hardness Hardness ofol diamond diamond Uiilmonti-Tippfltiy üiamond-Tipped. plus pius carbide 5 PHYSICAI. PHYSIOAL 8: & MECHANICAL MECHI-\NIGĂL PROPERTIES conventlonal life of conventional Carbide grades. Cubic Cllblü Boron B0l'0ll JYI ,\I\1IIIIIY lillll 20 times the tool Up to 2O Nitride NiIl'itIB 1
Pgiunrueiallinn- ' mili-roli resurfacing, finishing tinishing Better finishes at higher Steel mill-roll operations on cast irons & steels. machining rates. l_. ._....'..1 Silicon Nill'i[IB Nitride High hardness hardnessp/us Floughing and finishing linlshing $i|iCOIl plus high Roughing irons fracture toughness and operations on cast irons. z. thermal shock
resistance. i Features šüompositionl ,Compositioni ' 1 t .._ ii _ Excellent resistance to heat, wear. shock and heat. i '*~ +. I , mio -;——> -r _> gpplications and Productivity Advantages Agplications Cermel TiC/TiN Cermet |12s llêí Less TiC & TaC WC + Co +; + is added. Better shockk TiC ++TaC TaC ti wear and shoc Turning ! Stainless Turning
resistance. Mmm resistance, but M _-..'lvliiiing M20 Steel steel ivizu 9 _ i less heat and Heavy cutting i crater resistance at Low speed M40 i than P grades. c Tc. finishing 1 Cast iron I Finishing No TiC or TaC. Hardened t steel Turning Medium spee iTurning speedd . i Excellent iWC WC + Co i mechanical wear .K20 Non-ferrousi Milling i resistance
and metal Reaming _ iReaming shock resistance. '^" Noni '"ĹóQ;n}Hį'lfiš"" Low-medium K30 Metallics Metallica i 2.speed speed Eiii r_i__._.____. ____ii___ . 1 1 M10 M10 Ultra-line Grain | Coated HSS Powder HSS ' material than carbide. 'iie. i -, HAÄRIDNESS HSS _ 1 - --:5-'.:; :1.'".~,;~."'' _\'iI Coated Coaled Carbides ' APPLICATION ÅPPLICÅTION -' -
'_'?-.-'-fr"-':>.'~}i ,.............___.__..... '..2v..-_-.~Q~_-~'-' ':'Ir.f>'*' -i'-:5.-~,;_=\ "'€*~ '-:-.iY§;':"-.t'-f~.~t . ..._. General Cutting i at Medium-high . T Turning l WC vvc —'+. - rm vvu in-' -'.. + . u.".`mg i vennnrl speed Co Steel pzg' Steei , Milling M"'"° y` . . . .". . . . . - ._..i;ric nc + TaC rac P20 Cast steel Threading il Low-medium P30 f i Speed
Roughing ;_.;-'.-:»,»., ~-.1 Typical Applications Applications -. y ' ;I§'-\;'§$°=:'1'-- Prinoipal i Principal Bharacleristics .f` .B.I1@T39.I§|'I§IIc§ A Tougher Cutting i » P10 "'*s~ .. .:..___;__:i .~ . .- ;__;+.>_c._.:;§ =- =7. .aZ'i=-.5 _;. ?_;;-_,§:;-.:5;;-_-_.: -. :_;;-.~,~>_\-.:,¢._.___._. ,3 '_>:~,'.'= "\-.\"-1.7;'!-': ;_ Material 1.; mil. I.PJe=e Coafings coatings '[_'-.-
'.\t'.-. _.. .1 e... , E.-1 ?_'.jt'5'2i'-';$'.$.'-f'f"§?g"; i-i -ir:: 4-—— :: an na :|::: :I::: H1ll'I onon eene -ica c: . i Cutting Cutling * iisoi ISO Mêihüüs Application iGrade 1 Materials .._.-.._ lüradeł mass IVIUIIIUIJS .~?>.-T=:'=l.l'€?éf-':-~'='! --t-gs_;.\.~;14'_.2:"-. - "-D.-;_.-_t_s, 1'_:-,1, 7 y»-:~: " '_-.. ____ -'»=;='e'-1'-T"'_q'~i"-'.'-91> Cermets I ___" TIINGSTEN
GRADES TUNGSTEN CARBIDE GARBIDE GRÅDES ca E! ruiyurysiaiiiiu Poiyerysiaiiine UIdlllUlIl.l Diamond 7:5 (FCB) I'l_l-.'__. '.l_-.II! _.. ' I "Q RELATIVE neumve POSITION Posinon or of 1 VARIOUS vlnnous curriiio ::umne root MATERIALS ivnnennns l A_ .--=-..»;.-_1'.. -7 '- -"£1-.'»'.>»'L1 -'~~.,.» '.._-. ;,~.; on high silicon aluminium aluminium. iite
Many times the tool lite ol carbide. of IĹ; '1.t' ::"';rt=.'i fa:-;':.-it @_ z _sg "1.'.~"~' .- -. »'>~.-'. N;_\'-'.-':'=:=.-"ii X . 1.--'.2 ~';',~,'i 54 0.08 ._ .y._._._„_._._.._______________ I M M20 M40 K1 K100 i K100 i K20. I 92.1 92.1 >250 > 250 5.5 ...___...____.y .... > 330 >330 i 54; 54 0.14 = 440 5.5 >240 > 240 _ 64 0.19 l 620 4.7 > 260 >260 Ž2'..._' |""""` " " "W
92.8 92.3 6.0 i (J1 ip 1 à@ C ---________ ______.__.___i.___ _____ ____._ 480 Š» 5.5 0.12 500 CJUU '` 5.5 0.15 490 .4- ....__..r.._. ._ -. - ._ .. .. I M M20 M40 K1 K100 i K
' > 250 KŠŽU ' 91.5 |\.3U l 62 0.19 89.1 89.1 i 92.7 92.1 l 92.1 92.1 l ._ 2i_ i .1..i 5 52 62 y € {'1 z""(1 -"5 'I-' *a'=«^` 1' »we-«-';.:;-.«r.=y~>;'× „ -'\: .\':i,=:. .1': ;'-. 'F i."'-.-'-' Qt 530 i 5.6" U15CD5 I- 0.19 , 'S.~ *~Ž`>Ë;`. .'$'i.q\_';j_.i ` .. ` \ T i ....i_...... ,........_____ b3U i '0.U b.U , ' _ ».,-' 124| "iii ruiiiiisteu zin »2 izCARBIDE :z I |-|1: :2:uE
:ri::=r: Š = E ilui,.. ra: ci:: GRADES BUMP!-W50" TABLE I |I'I'l I ff {II {Il UNCCATEII] UNGDATED GRADES GRÅDES | 41 .M, .. i ,_is . 31/4,/,UM are A Ĺ/4ų_M T 7!//l!(,~4l0y V4554/It-5 }UN 1 l i I i020Ni |C20N P10 I310 lC70 ~ I070 lC54 |C54 5 I050M |C50Mi P3D 'U CA7 C: i KK21 21 K420 SIP CY31 n Š i S1P "7 N70 CY14 N60 ' lC54 i I054 CY7 0Y7
SMA 0Y7 CY7 S4 CYSOM 0Y30M Si OT S10T V s1oME Ž2 _2 _2_2i ` 370 svo isizoe i wszsn NmZ 'uteotl UTi20T i I l STi20Tl iSTQOT smao isnso N55 ŠCVBOM CYBOM; N52 1 1 1 i GX 6X UTMCT UTi40T l se S6 R4 R4 cvss CY55 N51 i i i K313 i K313 i NP32 UTi1 OT turnoff i lC70 i K68 K68 NT56 _ i070 NT56! UTi20T -erect -i KMi fr noo Neo i, i S4
A42!) M20 KB735 K8735 lC5UM |050M KG K6 M3U A430 I054 |C54 UTQOT UTi2OT EaneiV Ko1 K01 Ž?" É f .-: 1'1" "1 8-1,.' .-_' :i - ICO7 ' I007 Hi0A i HlDA . siP ! S1P a€|'9' - .=§,.-.$:,'._,....:. r _ _; :. _ Q3? ;'. '» - Mt.-3; ST40E 0022 i ruzo TUŽU tx4o TX40 txso TX30 TU40 ; tu4o P40 HX U10E i M10 l EH10 l $10M i S10M i TU10 890 TU20 PVA ' 1
NP45 NP45 K420i urnot K420 unzor i CV55 cvss nai N51 K2885 UTi4lJT K2885 unaor 0022 S60M 360M l Hfi05T KÖ8 Hnosrl K68 Kais RT9005 K313 S25M HX 1 l C D Nu 0023i 999 i EE 'U 7xC) U) CD VC29 V029 CD (D LO V02 TU20 VC2 V02 UX30 VC901 V0901 UX30 M30 TU40 EH20 H2 __ .. , - ..._ i un H1 i H1 TH03 -4:: I OJ Z -I-I .4. .7_ _ _ i _ ._ . I
.L. U1 VC1 ii ' vciiil VC1 05 i V0105 =§:=__*:=~_I i r"7- K30 ' . | I028 lC28 i _:_.,„š„, Er~ i/~i |\| 7-: Xxx l -i HTi20T -iHTEOT§ KMF-i 5 N311 ivan KMF _ l r i r II'\Jl\F'\I ii i i lffi G3 JC5015 IESS LESS C) |\7 tr-- K30 Z O0 Z ! G3 : inz-r- Š GJZ "5:C") _I. -1. _¢ fa l VC101 V0101 I NOTE 1 27 are based on published data NĐTE : The Grade Comparison Tables
on pages 124, 125, 126 & 127 equivalents and intended as a guide only. The data therein should not be assumed to be accurate equivalents. grade s maybe may be obsolete and are included for reference purposes. | Some grades ..~t.;. . G) It nn nnn .""\LiOUUUi -Fa.C3OJ UPI CT) CD CA3 CD Cf) 42>. Tl -L C r. i nnnnn i l i 1 4 co22 0022 iHt3A iiiaA3
875 875 Ĺ C- I'|'l C") CD OJ U1 ._,. i iii-in l\tI N10U SV515 SV51 5 $ V03 I\J "T1 Kzo SV410 Toei s ;TD915 U -I-5.CD C3 :-I organ i .-Fa.U'! l i Toooss Ti sno0 .TD905 T150 i l i 0028 veze 0028. V029 Ei5ŠvJ= ._T. ._._ xerss A I'1iU NP32 G1F z 890 seo smo i ete I010 1 § VC29 i vc29 icio . K313 Kais HTHOTi co2s; HM H`fl10T 0023 l l N30 EN510 K10 T H10T
Him ' ` His isnsio I020 iczo 5 xsa Kes inteoroi V03 Hio i vos li E °, ` ooze 0028 i Hi0 2ZNwAQ ; l N21 TH1 Hx H1 H1 THT c HX l K6 | i H1P KMF NP45 890 Gi OE NP4s 690 GtOE Q.NT. |09015 l A30 Ĉlqzl'l 1 °_____ VC28 i V028 ASUN A30N 2 Z _i CT 2ao N40 M20 A30 i 370 N016 V0111 VC29 V029 FI'I flnflb 0 -U 'ii F ._.J I ._.L LTI H1 OF H10F VC35M
V035M G3 (D C3 i i U2 uz nx i HX l EH20 H20 me H13A iiisA V05 VC5 l. P30 ' UX30 III é "U 8- :- się.-zj 5 i mam, TD90i 5 SV51 5 "I-7" TD9015 GC4025 TP2000 JC110V GMB020 K C9120 K 6020 K C9125i Jciiovieuso25-'K09125 609025 604025 TP2000 UE6010 l0804t3 l08048 T9025 SV41 5 G04015 TP1000 A02000 TT250 TT25000 reo25 TPtO00 ACZOOO JC215V GM20
169015 K09025 K C9025l 1N. o JC215V P20 UE6020 |09015 roots TD915 x SV525 KC 5050; GM25 K08050 601025 TP200 GC1025 TP200 J05015 JC5D15 ___" 1 -_ i-an rririrflrfl -—i- I 7774JC215Vi ih r--4 tPsooo' "teaser T9025 SV525 ` Teeooo K09040 JC215V i GM8035 GMBO35 K 4 1 UE6025 604035 i 109025 |C9025 690 0,uEso251cc4o3s T9035
SV330 moon A03000iTT22 Acsoooirrzzso ,i TP2000 50 rsoss JC325V CY250 CV250 '(3328 K05025 KC50251 P30 'JC325V IC328 US7351G05025~ i US735 G05025l 72c::-i—5 T0930 SV 23 TD930 SV230 Kceso i T2sM ` K0850 T25M HC844 JC5015 H0844 .2 SV 23 5 SV235 TP4oo 3 lC635 GX30 |C635 É2_2IË-I T9035 i Z mw%m: .. 0Y30M CY30M N52
CD ».. -. , 8 . 5 i ., i ézzflgb lts II//lg-4laV fits"/If ųflfiwų Z4 zahggqgV S'4¡¡Dl/k ~52 s 44 .6.0/ii.. Teoos i sv4os "l'P1000 AC700G` iTPfD0O Acrooei T9005 SV405 JC1 1 UV GM10 J0110V KC9i0 UE8005 GC4015; il"l'1300 lC428 |\) 7? so 0 0910 UE6005 604015; TT1 C')4; co ____ any CMPv A01000' A01000 Toeos i 3V305 svsos yi Qi -4:2 J05003 H05000
uoouuoi i`l'P1000 GM8015 K 09010 i UE6005 onsets 'kceoio uesoos ireiooo roeoi 5 i SV510 TD9015 SV51 0 JC100V GM lC90i 5 Va.»l-;'¢'4,¡¡4ME f-4927m. 2._ _M/rsl405312 . GM20 i K0990 `UE6010 UE6010 604015lTP100'A07006 G04015 TPiU0]A0700GŠ 20 l0fl048 lC8048' 1 ; KC935 iUEG02l] iA02000 GMB020 iGM8020 K0935 UE6020 GC1525
601525 TP15 §A02000 J05003 lC570 J05003l I0570 cP2oo KC5010šUCE010 6M10 iK05010 UC60i0 cP2o0'i\ GMl0 I'I'I I _I. Z isacsg z..:y_ii¡„ 'C10 K10 teaser" ,__R 43aa3-~ yrs »'41__¡ i :.>:~:'~:E *š ;¡t;;.~... as %%fi%5 au%%§ sauna N55 I ífioafie" ;'-L ii; i. 5.;5: .4' ST30E $25M S25M ii S35M I K2S ` "-:~'-"tram: 1- A30 Å30 sea 883 K21 , íífiý |028 I028
370 I/5,8 'Kuhn /.g-4.48 flłųflł/ _Zfl¢@;-c it JC215V P10 JC2I5V: UX25 i TX30 l - II/ 0/ _= U13C3 U'! VC7 V07 TX25 5 A30N Asoiv yi 525M S25M SMA onE.'JP 0023 S25M s2sM 360M S60M KMF "VI M P20 . i 42 li J0100Vi TX20 (D _L I U) —II\3 Z IT1 PD1 yP01 l ` K21 K2i 1 hfl10 M10 l CV16 CY16 PVA P40 P40 1 F1F 1m ; A 04/9 egg} I NS530 V08
OAwNo NS5301 §0T320 ie__e_ei ..22_,___J l VC7 510M TX10S l7(1 US V07 S10M S1P ; U")ST1 OP'U Pi SIP —I_& 1 P100 VC1 65 TX1 OD V0165 350 TX10D '< N72 STQCT STi20T K45 KMF KMF STi1 OT STRUT UTQOT UTi20T K29 lC70 I070 P K45 K125M ICSUM i050M Pzo P20 . K2885~ K2885 N80 2 mO Application ñppiioaiion Material: ' Materials
61" 0 6'0071' 1¡¡Ë_Ĺ_ : 3560 baa 'El coA'|'E|] GOÅTED gRA|]Es GRÅDES -5 l PII1 PĐ1 TUNGSTEN TUNGSTEN |;A|;B||;E GÅRBIDE GR!-\DES COMPARISON GOMPÅRISON TABLE GRADES TABLE i 0 1., i 4023 Åfllľgyümlfl /IËWg0MÉ'; i_ílíj22,4. '.- _ $I7_ Y 0 ~. 4/1157, -._ e f ! si /;,/V4544 i, ¡¡ Ista" Z I 1 "W tSO lSfJ Classification Classilication , _ fll i 1.
"C I'l'I ._-.»;. .- -_.»: ilľ il il li li li li l urm zq z-unmz ą 7 l' iĐ '.nz-- Uvvvlui Jesmo Y 250 CCY250 STEEL STEEL T250M VP15TF i 602030 l 03 2 8 'KC721M i 5'KC9i0 M13515 i>.. 2 Komo ' §§*}§haiJC35t1§ Jcasii Hcsso iceto &K0705M H0830 |0910 Kcvosivi i _ 2:" .._jit . ;a=-,1 i {(1 .IC6tD 1 0Y100H Kcsezivii ;K0992M a L; iz" .iceio cvioon i t~"H:eas
:~:rf;~tij>v. ' JC35i5 0Y10H CY1 OH A I ,.. s .. ,.. i ri*1'":11.1..l'1 Uf ; i F5010 rrrihn TUUCU F502ü Ei AÅ021I 0211 T200M i T2DOMi inrwnnnn.' UUOUQU. 1'-lI"f\II A CUCCTTBO1 TT60100 |0908 lC908 eivleois G) MBM5 I0250 lC250 K0730 601020 CP500 i i0228 lC228 Ji c": -4 -L c:: |0220 |c22o :GH330 GH330 i vcess V0935 Anaao i lAH330 i T325
T325 VN8 5 603020 !G03020 i onsso' GH330 ` VN5 TT6030 so; „...-,...i EHŽUZ 1 iauivi i 1 l GC304ü nuwwg V0928 iACZ310 ` AH330 Aiisso ` vcezs 7 iACZ31O i i i CPSU£3 0P5 TT701 AH740 T`l70100 ,AH74O >- C225 tteo 10 i T3t3V T3i SV AC225 TT5010 TT9030 TT903U VC 905 VC905 ng 929 VC929 "za ~ 1-Ĺ' lim Um TUNGSTEN CÅRBIDE ennmzs
GRADES COMPARISON COMPÅRISON TABLE TÅBLE Am GERMET GRÅDES .F5E.' .\'.'§T 5'.' -- Š$ 1 .»..z ...a %§§& - .3' -.01'-\ - - \'A.'v ~>..\ _ . ' 1 I01 P01 Hp CX50 0X50 ;iC520N l0520N 1 CX50 CXSO -4- ",0,1/'1"?¢_*'~/_ , P10 fii.' .1 ' P10 0; '$0-*-~_g:._&__$5; __1 E1 00011 _ . . 0-'_; ~- 1 P20 P20 §§00 f~:'§" \. \- .2;-=.1.. _:'G5; .1 \\ _ 3§;;_: ___; HT2
I052 HT2 l0520N gg 2: Tu-L ca~4U1(J1 . 5 KT175 0x15 1 . EXËL cxso 1 lC20N CX50 NAT 'lC520N NAT |C520N or 5 Ë-0. "-JU'! 1 1 CX75 1 lC53UN 1 1!C530N CX90 __ __ :00'. - , ~>-=1':-$0; 1,:-'__ ..¢-K1-1 _;»-::-:-. -"- fi€¢§ FV3" PV30C KZ205 lC30 lC30N NIT NH 7.-' * -'. HIA HTX »u __\-1 @së_:§~§'?r?"'»: "'7; 0%"; 0000 M10 y 0110 LN10Z l_ 21 PS5
1 TN90 . 5 CT5015 1 1 ;|C520N ics2oN LN10 1 ._1_ _ F) —|U1 1_ .. 1 1. -up /@Q0 05%" mn SN60 SN80 Siifiü Ë _. -1-~ 5-8 .0Q 00620 C7C1 cnhaca 3§> i CX3co Síiüü 1K111111-1400 Kyon4400 1 -L I 1 CDU _. 111,0,-T10 AL,0,-Ti0 sazor S Iruo-ri ' K090 K090 1 A65 Å65 SLN,-0VD Sl,N,-CVO SL250C I880 lS80 K110134001 Kyon3400 1 sL25001 J 1;. ~;
31:1 .1 ,~.-~'5e"-'-_- :1'-0 -; 1- . 'aY "- 1-. 1*: " 0 1'-.'-'~01. ;-= 1 e 'r " K0105 xmosi ->~-31> 1 Š W80 55cnca J> JP W20 :5noca n„,_„"4 0 l)(A ' MilTIlMIlTIiBlI lMiBlM '—i' 1 SP2 1XC1510l G01930 NS2600; S010 l TF110 i . 1 *"i/-1'1-r-._-53'1"1. -,"'~ ;-'-'-—1;, --*1 ;_- . P 11%. "Io A'5,W 04 sz] rS',4¡¡0V,k M/Ts ' 41/wam 41/700,0 .r. -4ł.--,'5. ~0¡_łZ_ .2/. __A-
_-0.t2._ 0__)5___*~_M._ ' F ' I Syndite 'Syndite Compax I ID4 ; ; 1 |i 1 . KD050 1KPD002i M0230 | DX1201 O 'DG .KD050.KPD002 MD230Ëj CD10 DA2200 KP100 KP100iDXi20 002 11` 1600 IDS '= 11 11 1 11 1I iso . Syndhe 1 Compax Syndite 0e 3 -cz Q 1 2O 1 010 1 _-5 Coarse 1300 1 1000 A 025 A .. 1i Compax ._;` 011150 0x140 oA15o Ž ox14o
1KPOoo fiaoo ; 001001 10x10o o/ooo , y oxieo ' . . . T 1 ~ 1 s130., Si,„N„ -- *Silicon Silicon 01111110 Nitride *0 AL203 TiCN - Aluminium Oxide - Titanium Carbonitride . MD220 010220 Ti MD205 i 11102051 . 1 %KPoo25; .;=._ PD025i 1500 1 I . KD100 KPD010 1o5ur yKD1005KPD0101 ~ 1 1 115 _i 0 Syndite _ |-\Iulfil- 1i 0020 Aezo , 1x11 mi 1 1 —-—— 1
1 =; 1 ' y 44,5' 44,57 _ Fine FIIIE I"/UUU czen - 1 11/ /1/ ' Medium 1 0x010 exsi 0 T iexsao 1 exsao 1 1011000 exseo I 1 i BX380 Bxseo 1 | |BXC50 iexcso CD O') U"l @ . 1 0121 Lx2i -.1-_ 1sP2[x0151o1e0193o 0020001 5010 111110 ' 'ir;\i..;r:.«-.;='=^i 1 2..-'1 11* 7 ;1 : . ef);_f"4 NS520 1 1102|x0202100e5o Hc2 ×o2o2i cceso 00000 Nesos ` AB30 Aeso
1-.» 1- -'- -1 ->1" 1- -'1 2 1 0555698 .é€&é_"__£Z£c Qfgzafis ^°lecË¡%_ /52.4" KS500 K8500 AZ5000 K060 IRcacnc: -1' HOIU 1. U) _.C> NS130 Z cn -_L cu ca n\!n|-tn C) Ifi l Grade r1u1o NS260 100000 Ĺ BX950 1 00000 1 BN600 KB90 =0K45o BX450 K090 1 00250 BN250 BX480 1 0x400 41 r7„š„;,; s:. 1; _ ;"' 100% lf\Jl'\ Ć) cn OJ\IG GNU C A|_2o,.Ti0||
SH1 \ l\L,0,-TiCN . s01 04"7.'74;0 8 06090 C6090 CDU! X\-€ -A *š;å},},',;"U Tlnnnnn 1 ROOUUU Z 1 ii AL,0, ALU. "7? J!/)3. 4I/l6'y¡¡s"/ l N_.aocncz cnnacnr-r"i-' Qc:ca pg-0.ZCH@ _.1. @ CD O') Cf) l'_F"|"" CDZ 1 1 ,__ ._ __._ . - 1 uig AT520 >Z *520 ua- To 1 P00 POD 1Potv0mrsT0Lu0E (POLYGRYSTÅLLINE 01001000 DIÅMOND 0o|v||=A0Ts1
BUMPÅCTS) 1 'MZQ : 1 ' D-L 1i T ' Keeo 0xe_5o exeso 1 1 11039001011900 Keeori . exeao ! 1 KB65 Kees 1011050 Ž exsso 'L 1 r A 71/@Avg 7§U3 CDZ . i "0 %""f::e ; 11110010 00x Meaio , 1i 1KD050 1 i 08002:Š cao . Kooso 1*less EKDUB1 0100201 0050 0 tnmw2:Ššno a_.oocac: Teeso Meezs ceso -4 1 Koosi 00100; (ŠBN100 i 01000251 1 00250 1
isao i Meaozs 0020 ce2o _?;_;; Keeo BN250 1 K000 i > 1 1= ` i 0200200 eznezoo Sm' 1 NS520 .1 Kyenzooo KS6000 Kssooo 5x1 XE515 Kyon20001 Kyon3000 K-y-eescee 1 xsaoce sx2 š>_S1 š ŠŠnoca N O01 é 65 inoO5 CD 2 O3 Q 1 pm 4'94!' r l I ' ___..._ 1 1 _1 L 1 Si,i1i, Siji, f?7ČŽ. #4-,¡«"h4l lzamnflr T U1 U"l 1 MB730;' MB730 BZN6000 1000
|B90 'KD120 KD120 0200000 2 1 MB80 MB80 = A Super figgfiz Alloys" 0 . 1 11 -51- 05880 H Hm-""9"; Hašdened |-| 00000 \Bel 1 ZCD NS540 U1 -L';$ /fl '"144 ' fiomposition Composition Composition . 1 0 1 «e„„,. 4!/radio 1 Z _L Z $ 1 N308 11 ËËÑÑA U := 019*. . T 1 NS530 1 0s500 151 L-"1 TCZUN l I NS520 T2000Z 120002 T1200Å. 1 F 112000 ?'05,:??€'L-
4%.,?I4. "@§' -521."A .55/4-5.4" Q .73}; _4447/rs 3% SQ. .-%. í°7»„Ĺ; ,„ 95,755256-gl/Ž __ TN60 i AP25N I CT530 0T530 NX2595 1 001525 GCl525 PV60 0.02525 /¡¡ . 0 1 .1,_ 1S fi:; 1 r 1 1 T110A TTTDA 06555," " za -1U\ O GT530 T25UA —|l'\J 500 1 ' I AP25N J=-'Uha 01 Z u 0200000 ' ezneooo i 1000 ieeo unŠ oo 1¡ 1 i 100002 Taoooz 1 1 NS530 nssao
T250A 12502 1 CT520 "520 "I NS540 nss4o < .s _ 00010001000000 GBN (GUBIG BORON 0110100) NITRIDE) V . NS530 T130A CX75 1 1 11 Nssso NS530 AT530 . AT530 T3000Z _ * .0' T2000Z 1 1 120002 i T1200A - 112 CT420 no111'1i 01420 GC1525 G01525 TN60 -4Z G') Z | KT175 KT1 75 1 = TN3O AP25N AP2sN crsis 1 TT10A T1 M 1Ei 01020
ciszo TN30 iczon PV30 . 110125251 nx2s2sl` cT5015` ` Pvaao 1 015015 PV320 il ;1002o0 TNEO * AP25N 1 IČŠŠÖN 1 KT315 Krste TNBO T2000Z LN10 APZSN 0T525 TZOODZ 0T320 ' 1 1 CT525 1 CT320 K1 0 I010 |c2oN 1 111x Htxi PV60 1 NX2525_ We ' 10200 NX2525Ä i _ g_;> T1200A T1200Å l052ON 105200 1 AP25N 2i NW NIT Am" c1s2o 13 5
C-T520 'I: K20 in0:» ICZON 1 Nxzszs 1 1 10200 0x2525 =i 1 1i GERÅMIC GRADES GRAIIES CERAMIC K01 '_;.:'_1..= _E._:'_:_=. .1-.._..._ _. TN60 TN60 . 1000 1 TC6ClM PV90'=2 1 PV90 NIT _1 HT2 ! NH 1112 d 0030 M30 T1200Å 01420 CT420 CT525 . 112000. _ 0X5DZ CX5 |y| 0120 M20 CT5015 Aezsn 5` 1 AP25N Nx252s i 0x2525 UP35N uPssN 1
0x035 Nxsss NS520 Nim E GGT530 53 0 T2000Z 01020 CT320 120002 AP25N P25N PV90 . 1 NX2525 525 TN60 HT7 1 PV60 'U—l . KT315 KT OD 1-0-L (J1 -L 0+0? ` 1 1 1 10000 |030N 1 CX99 ' F030 P30 -105000 l0530N 1 suz _1gi Lflisuz 1 n -i => 1 05520 1 01020 1 nsszo 3'3> 1 TT10A 10020] .ËIËËË. AT520 .. .-i.lY32°. TN60 HT5 CX90 as, 0 . 1
AP25N ' AP25N _ a£;_____ '|'[||\g5'|'|5|| g1R$| TI'I'ËUUMPHHIĐ ËËËI'-E'".\P'Š!*' gTABLE GI :I:I :I Iiö COMPARISON _2: Ël |-I Il'l GRADES Application 1 £5129 1 liG410)» GG lv KT3151 KT315 I020N E5 % v rs==„»;; a;.;f 2 "%„ -ig;__"_ 1 TN30 KT125 . (QT /ralifg l L 5 1 1 l I #03,'. 4!/76. 'il/I-S'(¡¡i.W" Uglfia |020N |C20N 1 Q 0 I/8,9 /304" 1 L010 LN10
~.' r 0- - -__ 4400;,' 441% 0 LN10 LN10 i?' _-'e _. '_\~ 13 r 1 1 1 iS0 iäü . Classificatlon Classification t.;:..;`r1;=." .ć~.-i.'z"»" 1 T 1 . . . 1.Ĺ . 0000 DA90 = _ . 1L,... . 1 1 1 KP5001ox10o1 KP500 DX180 1 i . T10 TiC -- Titanium Titanium 0011111111 Carbide CVD PVD - Chemical Vapour Deposition - Physical Vapour Deposition CERMET - A cutting tool
material that is a composite of Titanium Carbide and Titanium Nitride tor light roughingto roughing to high speed finishing. and designed forlight |'\tn|\|lll||'\ A M„o„| „„;,a„ ..„-.......„.:a.. ...nia Ma-.. „».„.....z[„' ...„|| _..:»„..i :__ 4:._:-t_ ....,...i.z..z..,. CEHANIIC edge ĐLIGIIQUI strength well ULIIHIIIIU -' A H rnetal lllGll1 oxide UÅIUU composite
l¡Ulll|JUblL\'J with lllllll UUUU WUII suited BUILCU for |Ul finish-machining ll||lhl|'ll|dl,lll|l|IIU materials with a hardness upto 65 R0. Rc. PCiN PCBN - Polycrystalline Cubic Boron Nitride (next hardest material to diamond) that is designed lorfinish/rough Rc. forfinish / rough machining of hardened materials upto 70 R0. Polycrystalline Diamond
nartinles partieles tinhtlv tightly sintererl sintered onto 2a WT} WC base and rlesinnerl designed fnr for 1 PCD - Polvorvstalline nfaehining machining highly abrasive non-ferrous and non-ferrous and non-metal materials at speeds upto 2000 m/min. - --J--J----------- ------------ |---------- --U----J --'~_-v'- _-_ - - --- -v-_ --.- ---.3.-...- ...-. L251 . ,lël (_.1 TUNGSTEN INSERT runesreu
CARBIDE cnneioe iusenr IDENTIFICATION ioeiiriricrmon TIINGSTEN CARBIDE 'rusznr Ill'!.'i$IF!'-EFJ"!F'DE NSERT 1 IDENTIFICATION iL'.'{;tif~"l _ IDENTIFICATIUN @smMfl@1% te ili i"i i'"~ i 1 TNMG 1604031'!-20: 160408R-ZG - Grade Grude ' A A I R7 Insert Shape 1 Symbol Š -Insert_Shapeinsert Shape .Symh_ol_1 1 W £1 Parallelogram 85° C,
1 _- 1 ' cC i _.-, . 1 .EE _. - - ' U - — Rhombic 75° `Rhombic75° 7 I _.If ' 1 .... _ . ____ . .12 . | EE E ILL 1 -1 i M m [1 '. L„Q0 H1 ."1 --1.@-005-1. _ 'l'I 1. :'I*.'1" : : . 1 Octagon »_ .PP 1 Pentagon .R" H _......v x>=-gazmr-r'|-l1f> ___. . 1 I F 777' i Czšl"-'3 T - ——— [ICE ._ I Triangle , .. if _ 77.-_-'M 1 Rhombic 35° l W 1Trigon iTrigon i `_e ca 'ua on 0.130 0.025 .
_..._.1 '7 ___')_ '_,.'__ I - Q0 -hþmsoomfi ——-R - —- —| I > i> L_______.J1`Ž @IG-F _ | I _. _..l___ 1 7.94 794 9.52 A. 51> ĔDE L |Feed# 1rt:r:u" " :Č|Ñci-Ñ:|\rI~Q:-|A'-A-å1»å-rI:_Id|\:Icànë-rfl=h:i|xmlbr~fl:l šc:_ E:2: 5 Round Insert W F I "H _. in L ten. . 1 i- 1 ran 1 3 T 1 Sharp - .=y ri i Chamfer + _Honey ;. iHone i 1i C N I 1' N Neutral Neutral; 1 Chamfer
unamfer 1 ____ Žflfl 33 :1?)_-. 1 . 1 1 1 4-—-> ii _ 1-| *Most manutacturers I # Most manufacturers 1 ~kMostmanufacturers generally omit 1 omit this symbol omlt this syrnbol when CuttingEdgeSymbol. Cutting Edge Symbol. 1 theinsertisfleutral. the insert is Neutral. 1|Chip Chip Breaker|Th Breaker1Thisis Symbol is reserved for tor Mtr.'s Mtr.'s Chip
Breaker Design. I i Recommended Max. Depth of oi Cut 'd' 'd' 1 0 "0 for tor Standard Inserts lnserts U g _ 1 1 1 1 'U I _>1d1'_411% 1 =;. . . .2 5 1-EEG - . - .dfiil Special D K Ž _,1d14__,Hg 7 H —+11;11- "-2 (1d Id! i\:4>mon I\3-1>'U'-10 » \Insert lnserl Size - *11 ni I _I 1—fi1 06 Oca 09121619 Ona N O: ES -W [E11 .. y..,. Ñ.. >< ax . 3-9?. -_- §i'$@$
{GDHID"~l'@CIl'UJ'Il Ëëęå SE _ r:_:-I = tišrl 1 1 'J10 LLIU ___---i 2535 6-Sä.....i ić-__í 2. os 1.2 2 7 1.6 1.6 2.67' 2.0 2.4 2.4 2.8 2.8 3.2 ¢ ~.13 ¡_._. O'I€»-703 .08~ Z@ C . 74! Y t_š< 5'Ĺ < :É _e CA) ii,,ã. ....- ___ V i=l.i: m O0-I>"'~."| 9.13 3.97 2 4.767 77 4.76 sec 5.56 1 Z'O-IE5 --Đ l>OOC[J_I\'; _ 0 o.4 2:171-4 1 0.8 1 Q1? 2.78 ta A lClŽ]Ĺlyvtl „1:1
i1II1w;I:1 3"/!" 131 B 1 E :< cal:0101 .O130 Ž..- v i Rhombic 35° 1 v C:-läCål\II\I -----1 '. .» OD is 1?. 1g|;ugt: iEdge* n '§ 2.38 2.38 Symhol1 'Fe'aiureT Symboli Feature ;gSymbol1.g*Feature Symbul, Feature SS 1 Å Square ....__1i____ . 'c:01 2:» OD 1 Round 1 .1 n nnr 1 . 3 z I ZNJ [1 it "605625025 I T ES 0.025 I A-°fi~.-Ž _'" -13 -.13 _i os ."-15.1 9-13°.
..~1 i.oa~.1s Ž :75: o.o25 C) is .13-.30 1 10.1230 ~.25T C> 1 Fixing / Chip Breaker 1 __._. . .. 1 ~' I IURadius no E':1': c1 : O'! O') 11.98 00 11 T1 "Ž"1 U.ULU r_. 0 0. ' noge i„o.o2_5Ñ i 0.0251 0.025 --1_2-021-0.013 0.025 1i o.o1a "oñzs 0.995 1 0.025 0.130 ivooš; 1 0.025 o.o2e_„_' 5130 0.013 i oíšwi| 0.013 0.013 o.o1_a_ 0.0252 ~ .10 137 oĹo2"$" 11$.
i.osŽ._g 0.025 o.oso .o5~.101 61025 __g5~,_1g_ or 5.013 0.013 1g 0.025 1 U.U¢fiD T gSymbo_l'1Nose Symbol1 Symbol Nose Rad.1 Rad. -S'ymbol1 Symbol Figure Symbol Figure , 1 T 4? ' '= W1 - 0.025 0.025 1i_o.o2s_ 1 0.025 " ja]„ 1 Z Š" Z 1&4 11 i íšs „I —-id U.U1L$ /7 L L-ĂL T r- *i` ' iThiekness -|E21 :3 {II C5 7? .U. ołios -0 19'??? ' `o.o2s Q -mi
Č o._0_2_5 ""öŽo2s E I-U homic 86° Rhombic Q 1 Tolerance \ i«L»l E: ËUr;U ed a1= ~ @ze Ž.v. Fm ="L 1% Šþ* Š {U=L aiSea {O mm; Tol.:: .5 1 1To'l. Tol.:i isdsun Ì Tol.: ffi Glass ' ."Tol. m, (mm) -'S'. (mml i 'flImml ^m'(mm) A 'S'(fl1ml ml 1 1" Rectangle Special \Special I F 'L Cl E3 1 -7.- ' -.1 1.. *T ' E TT] I 2 'Z _ 1Parallelogram Parallelogram 55° U
5 1 K — -00 i20°1: _. -_ . _.—i,_ —l is +1.- 111°C 1.. 3> H " Hexagon 1 H 0 CD II i . i0 _iz-. ll. . ._|_ _ - Cutting Edge Length L (mm) U>fteL Fr 125°g;\ 5°C I. t .P. P 11° li *2 Rhombic Rhombic 50° 50° ^ so°i*_C ž Gc 1 30° N iofií -~i :1" Ql L C1- T .'FF . v___~ ..r- o 1 /7 K .U 1* F1 I /' 01 Rhombic 55° i *i'ËuT%~ii l.+— ii Q i Rhombic Rhombic 80° 80°
IA 13° ia 15° Parallelogram 82° 82°1Ej . I i bol, Relief Reliel EH91?' Angle inhol 1-;Relie.l Angle Sy Symholi Reliel Angle 1 SymholË __1 B nener M919 Angie Relief 1I . 1161 i°.4i "Bi i"°i* i""i# 1291 CD Li; 1. 1% wi on 1tlIilM1|l 1l IOl 1Hl I1l i1lI . I1 in >" T/_\ ->1g1 -+1q1 \l 1. — 071115 _t G\I U1 ,1 | I ,,1|l 5.. =š Id,' |Ne\:.r:-msoa: iinsen size 'lnsertSize
Ĺ -o—~->:oa§o1-4:1:111.1ĹmŠ- Y/ í _ oo 12 15 19 09121519 11 16 22 27 33 1116 -pi01 _L CD . ___ 3 Z in 1-f-| in ix +ili`1 ii ii Oon O _|. tN (3 OJ Q IQ 8 _n. CT! 3 . J.(33 I'\3 I «É (.0 tvO iI Om E C') < í Ii ->ldl ~ rlzl . 111622 é 4 Š ii i',"'7 7 @dv |I 00 06 08 Y \ E1 W ruucsreu cnneioe INSERT iusent ruuosreu CARBIDE IDENTIFICATION ioennricnrion
(MILLING) iniiuinei 1 @L31E LTK1 LU \1_.1/ SEKN12ll0l_FTN G rade SEKN 1203AFTN - Grade 1 1I '| I I I 31 I I 4 1 Parallelogram 85° II ,__- »A B s° ' cC 7., I S 1 Parallelogram 82° G 1 U i Rhombic 80° 1Rh0mbic H ~~e 1"_1"'—'5 L L S S' Hexagon R-7" ' ' Rectangle -~ n0 U 15° I5°-.C '.1 E 20° É 20° @UO . .-.-%_i. .. 3. .. Round 1 S S Square TT
1111311918 Triangle >DUO OU O i> 44 1I feature Feature ' 1131 1 1 111N 0.013 J 1 0.050 ' ii .`_f_-\A 1-\J——-—_--1 .. .1 »: 1 BU .-._1-_ 0.025 0025 I1 0.025 o.o25 1 FD_CD__1i. O.) OJ C) C3 l'\) CFI C11 CD I'\J FD_CD 0.025 0.013 0.025 - Q; 1.|u .vu: u- vv ——-—' R . _-"1 1T 1 I X". 1 1 @° 150 Syml:ol.Thielrness §!!F' 1?911T.111F1'"°$$ (S) 151 .2-
331...1 03 3.13 1 - _ 60° 00° 75, åD= %i111*>=v T fþ I--I 7.-i-,- V-L .1: ""1"7r;71-F :as sa Oe.=.»=»>i×= I QQ$ -IU1C31 (IO-5 90° 90° 05° 65° i11 1iMI1il1Mfl1iMI1iM1I1 0.8 ÑII"l"Ĉl$CI3 ____._1_ 1.2 -. 4. I\J "'l'II1 162 ' 1-62 A Rognd lnsert Rvufldlflsflft 2 ___ KK NN 1203AFTN 12 03 T N Metrlc Metric series Series 0 O E E K K T T 06 -— 15';13 1;: il 7..\ ii
=1 1.-.'I1'.' II a Iifvl 13".') É,:-J 1117 ili I.1 .. 1: I Hone S 1 Chamter Chamfer '_ M;..Jt.I'|_°Ee_. +Hone _1 Y: - rtu-zmłm uiiuiiiivi I"I'I'n'\'Fr\r \JI IQI I IIUI S i I I 1' Qf___.'_ ..__I 11° 10° Q).-.-.;4':0 .Q 1:"'T' ž 14°5 CbT 'U -' W. ZCD . . _2?.Ž _ I 23° ~»~~~~«1 ~ FIË-IUJËTZË Nl.= Special OO U N nirnniimnn ni Direction u||uu|.|u|| olCutting ul P||l"I'ir|r| uuu.|||g L
L N' N &ghtRotation B_igh_tRotation ^^ ,~./.- @ Rotation @Rotation ^^ ,~.,.. T' '_ rfi _ "" . ._ -- _ _ I 30° 239 08" I ąz : : ` I Sharp 1 *_ _i ez ;_________ mi O I\'J U"l 25°. R R ' ' I W' "Ti" T 06 20° I EE |=F I o.8 .. .L _Iã°_- I SS W 7° ._ Std. series Series E Q 13 i1 ali 0-3S II 4 li li Z1 M _4_L ND RD Za ' I I M0 1 1RelielL |neiier2 QŠ Qno -0.G1 7 r--*--v—7*--'1
Special " 0-4-1>- 53 1 1 1:] 1_1:1.1 I 16 I1 Special I COCD-LTI\lfiii *GO 1Symhot1Relie_tA(B) SymbolIReliefć(Ii) 0.2 .9z.2.._ 1 § Ni „Ji 3 $h@tt0..P@Pl 3 A1 3°3" Shflfefidol... 01 0.1 MM Ie I._5°s° "'1 0 01 @Šåfi 1:: -:- 1 1 1 ' Nose Radius Q -A _...1_ 2-7.577 _. 85° 35° |:['Il'*|l:| ti-- 1lI or-ugu Edge 1 I 1. §-Symbol_§ -231:'2 ___. 3.9? ýllýni 4.76 1 _-.1__+
5.56 1 __ Nose Radius Cutting Angle Angle.(i1) (41) 45° 215°. 1 l L Symbol Figure 1 SymbolË ......_S____.. í W ills fiišs I U 31,1 Example:1 E×flfl1P|_°=I'=1 1|II . 1 i C3 I Z |`l I 9 111 _ ii 1Thickness |Thickness 1. 3 in ik 1 1 1 1 Feature I i_ 8 RR ' 'I'Il'l'| >< W_ . M 1+11 Å- n ri . -P 'U 'U 131 .05 ~ ..13 |.u i . "l'l "f'I 0.025 0025 ~ .13 05~13 oois . o.o2s .
0.013_ 0.025"..05 iMvi .o8~.1e .os~.1s .03~.1e 0,130 0130 .05-.13 "um .1s~.37šWo.ioo I.os~.2s AI 1WSy°1nhol Symbol I 555° 1 H A> 1 W511 Fnmg/cmpemamr Fixing / Chip Breaker Symbol Symbol} en -< 3 =-E. _fw I D @UOC z z 7~ 1 FF U _CD CD I\J 7\) Uf! n 1 Angle 'MetricSeries11uose1nauius]1 I1 Cutting CuttingAngle IMetric Series (nm
Radius) . 45: .1312 em-~ - 1 W W $Trig0n T'I9°" . A U F ij-uu L u L Q Tol. Tol.:: § Tol. Tol.:§ '10.:: Tol. : Class .M, (mm) 'S' (mm) id' clasp - __'M' (mm) ' _. 'S' 'ti' 11mm] (mm) A . _1"1.25 0.025 A 0.005 0.005 0.025 00.025 0.025 1 Q0 łO= füw* 1 1-J-» Special od E 1 1 3 " 1 EU 1 _ TD BIHIIGB ad 1" _*1od 1Pentagon Pentagon R 1: É I«i_4 i=11°I* 11° O
Cutting Edge Edge Length LengthL(mm) Cutting L (mm) n > 1 1 1 _1__ .... 0.025 0110013: 0.013 . P I1 '111 „@i@"0 Octagon 0 1 DD 3 1 .._ Rhombic 86° M -Rhombic . K 7 I _ 40:17 1|. '.: C ą C e 130° iso" Ñ: n .o° . _1 1'. B 1 I Ł:*?IZMEETE "PI iii If ili @ I'iI 41 I Relief Angle 22|1 mmmmn =1 Symbol Relief Angle Angle Syfmhoii Angle1 Symbol 1 Reliet
[Symbol Relief Reliet Angle 11 AATI: 3° 11_ FF 125° .25 „ ÑLI mwwmm Insert Shape Symbol Insert Shape A 12 1 I 'fli 11$ TUNGSTEN CARBIDE INSERT ruuosrrau CARBIDE INSERT _ Il|ËlllTlF¡0ÅT¡0Ñ IDENTIFICATION iTIlIIit..i_iii.iiíäI """" _„_ . ._.,.-....,:. ,1 . - =11 1'2»:- /2. gwge I i I Neutral Riê Right Left grit 8& Leti Rotation I .. A J _lfi - |Y| .\.
runesfen runesreu CARBIDE crrnnrne INSERT rnsenr IDENTIFICATION IDENTIFICATIUN (THREADING) (THËËAUIÑËI š 2' š :I l E] n 1.0ume iso A1 @QV l1s| i1.fii„"EUBH1 llll3ll'Il|5ll5l' I N l 1 ~ 1 16ER1.0 ISO-A1 ISO-A1 -Grade - Grada I 1|iÅ|i-*|]4|]°|l°l 1 1een1.o I Insert Version 1 [Edge Length ' 2 iApplication__ |Applicaiion 3 |I lnsertversion i" T ^»
A er + © L fÉ , _Standard U-Type dlmm)-ic _I iysymboli" SymI:oIŠ -Application. Application L L(mm) Llmmi 2 Tdimml-in 05 Woe . 397 3.97 EE I External External _>_____I18_ 4,76 __N__. Internal T: Tlii4.7s I...___N—_i——_I.IIIernIaI 1,1,_,_ H 5'35--6,35 __ U___________,L|-TVPB . ._-_.-.1]__i .--.AA-9_-%U-IYPB 9-525 r NOTE ___o9,,-525 nor: ;z 12.70
15.87?7 XIV-5 .\NI-U.IiN|GHuIc—:n * Www" '15_37?_' ifrorremrilzrmm) Q Full_?Proli*lei(mm) U1 'L > _L 'L _.,_au --L PI".-^ U13(1133 3*!" 9"S¡"!\'7-.'"-^' $0'@U'l \|J F-S-""PF-'_-°^ U13U`I@U`I 53°F CJZ@SN @PH ~_L ,1:-coasC.-T'l ¡l>©U'I O-;_L gesmm a.o10.o 8.0 10.0 12.o14.o 12.0 14.0 l2.5 _sl 5 I -Ää -ISODCAJ U3I.O"-\|JI\'3J = 5.5-8.0mm =5.5-
8.0mm 4.5-5tpi 4.5-3tpi 7XZCr §ZGD3>')3> IW]ĴLU'HËtUCË2Ë T Z Q 48-16'[pi 48—16tpi 48-8tpi 48Bipi 18-8fpi 18-Bipi 7-5'tpi 7-5tpi . . -' -._-~ li' '1' BPEX BPEX E _ ii CCMT ccmr CNMA CNMA @ If/"BE üäö ® _l DCMT CNNIG CNMG CNMA DNMÅ KNUX KNITX DNIVIG DNMG .1 4» C) @Q@ " WA I =0.5-1.5mm =0.5—1.5mm =0.5-3.0mm 0.5 -3.0
mm G) {D = =1,75-3.0mm =1.75-3.0mm =3.5-5.0mm ÅPMT APMT ÅPKT APKT CNGN L Part Profile Profile -Part Full Profile (tpi)"y @ @ I- .@ H r. ('fie 'er?' S/1'~F'~ U APCT APCT L as Thread Pitch Prren Irurrvrorrrelrpi) 5 _ r\: ::J 0.5 0.7 0.8 0.51 0.75 0}? 48 4o 32 24 2o 1.0; 1,25 1.5 1.75 18 re 14 13 _ĹJ1 R Common - Turning / fvfiiiing Milling
inserts Inserts 7" . A mfInternal Threading Some manufacturers use "| "to " to denote Internal. 4 I l L 3 Refer pages 1128 28 to 131 for detailed information regarding regardlng Insert identification. identifioatlon. NUTE : Chipbreaker shapes and designs vary considerably between manufacturers. QLQE: Threading External Threadino /\ I The following
is a list of some of the common basic shapes of Tungsten Carbide inserts Inserts that may be found in most engineering workshops. womshops. H in kn nn mnnnn zu »nwtnr-»ham-íru-t li.-O mm-J I.- m-mrtfi.-\A nfi zu I-»h\v+¡»~„ nnínłdnvlnz-An ¡.l^„6ił;^»-«bina itis means alll¡UIll[JIUll5IIĐIVE comprehensive list starting identificationI. ILID by Il] no
IIUIIIUCIIIĐ llül and GIIU is ID provided FIUVIUUU as GG a Klüldl Llly point HUIIH. for IUI insert Illüül LIUUIILIIIUGIIUI w 1_n. I133 I119. {II IIIIICK VISUAL IDENTIFICATION CFIFICATION OF TUNGSTEN CARBIDE -rr::°::E Es! Š! sa :r INSERT ::- zrË _| SHAPES = 9'II'Hnl ar ca ZiË g:rE UI ÉŠ: \l_V OEKT LECN @ '1' \ Thread Form 4/ SCMT '.-a-. 7 .-.-1' "1-\ —~
I Ö [ii SNMÅ SNMA I ® 7' [I1 [ ] \\ ffl SPKR SNMG A TCMT TC MT \[1/ SEÅN SEAN ll I\ /I \;::/ | _L______.-I U/,, wíw SNEX SNKN [Žig lld E % SPMN/SPUN /\ /\\ TPKN TPMR TNMG fume TNMA RNGN II. If E _4 SPMR semn T % T "ii HCMT U Q D UËLC Q iii gl E1 SGEW SCEW _,/ g/ RNMG FINMG Profile Profile y ' W W Profile I| Symbol 7 _ Profile
Iijyymhol Symbol I Symbol RND = Round DIN 405 60 = V profile 60° BUT2.5 = Buttress Fig.2.5 STACME = Stub Acme 55 = V profile 55° T BUT2.6 = Buttress Fig.2.6 DIN 103 TR = Trapezoidal DIN ABUT = American Buttress BSPT = Whitworth Taper Unifierl ' Unrfi "ed UN = American ACME = Am.Acme-G i EL = Extreme Line Casing ot Root UNJ
= UN-Controlled Ro lnst. API = American Pet. inst. _lI-I9V0 -l€J_O = Hughes VAM = Vam Vallourec ISO, = lS0, ISO, Metric Metrlc API RD = API Rd. Casing l_S_Q*i= W = Whitworth (BSW) I A BUT= API Buttress A NPT = National Pipe Taper tor Basic 'hread Thread Profile details. ' Refer pages 15-19 for g RGMM RCMM OFHN UFHN SPMT sewn [>
TPUN/TPGN AR O rs» ®@ gs d% r=:.\ fii-":-_-_-1'--\j IND. of Teeth / Chip Breaker I Optionalfi:WTo Optional :To Manufacturers Manufacturer's Discretion? Discretion 56 |No. VBMT WNMA WNMG WPGX ACME V THU. (Threading Inserts) Common - UCl'aII1IC/ üeramic / lIBI'I'IIBIg_[Cermet / PgIIBN/ PCËN / PUD PCĐ IIISBTIS Inserts UIJIIIIIIOII 4-
Full Profile | Profile Partial Profile WIW S g gi -0 Workpiece maybe slightly 'Tops' the thread. oversize as insert 'Tops' ~I No subsequent thread deburring I is necessary. E S l__í 10 Workpiece needs to be A accurately pre-machined. wi de ' -1 One insert covers a wide | range of pitches. bitches. _ - ._ _ - .-. ___. ____ Z '1-P'-'-'7.'»"'I'.'§-"" » 2; .5-'5' 1,: Single
Tooth Insert I SinuleToothlnsert .. E: ::EF. Tooth E"E.:r insert ŠŠ iiiiiiii Il hlil lflil tl il i --:2:-'--;-i."-?:-~;11;'-mmQ:-'~ §_.,>. . . _ .. _. :-.-'.¢-c\-..:->.-=."">"3\5-4"é4~'Tf-'\'.\'I~:r-be; .-'-. .:-'52;.-.' .11-.1,'-; .-_'-»- DNMÅ IJIIIVIA _a '-;.':-31 ' ' "e-a.-.-. , 4'/¢ .1. :14*II_.1, -.,\-'-:.;,;:'a-.';¢\','33#"-'-'Biz'-.f*3?--a"-I-'i\:.1'. 51!-!it-'1"-' "4-p>-'~_;:=5¢.t-r-'
,.==;¢=-' =;:rr. ;.__~-'; e,. -_ ~ _ -.;. -. '_e_-.' f'_'"1.5-(PI-_'.¢,>__-;_; -» DNGN SNGN HNGN N __§ TNGN \INGÅ IINGA ., CNGN 11$ flä 'le -_-.. 'Nllll re . r.'5'%'?b;"»'v-. .- 1:.'/.-\-:-t-(-Z-/-1 ~.'¢-.'- ' ."1-.--. ' . RNGN Ĺ .,„.. &vi xi TPGN SPGN -" '~ ¢- 5-'=.\ . :«;-_fw -e fefiëtrjęšgif-»eg 'sin ~'-3-..o"i@' :51 i~;- rj-.-,trg < -';s',.r' ' -1;-_ '\1'."'*r ~s,r?-.;-.--.;';.- - a -
> iv '5 _- iii '= 9 -1' rt.» CNMÅ 3. -_-vi CNGN 7 \ II T CARBIDE (EXTERNAL) fiëfl TUNGSTEN runesre __ TCCLHOLDER HDLDER IDENTIFICATION „lGZ>äc Š Ei= DZ! =°:I5 :I GI"":=- :la5 5'ć Cl 51"'Š É o —l —LO7 D NÅ enif ll e-|_u eec:: ll -Uaa ll :U5 uŽ,n,IICI1 llŽi -š i llT;e uY;eąęlåi 4|š.II_Ž TUNGSTENCARBIDE TCCLHCLDER Pi ruuesren
cnnrsrnrs (INTERNAL) rrnrennnų roourotoen Hi, IDENTIFICATION j*_* E. IDENTIFICATIÖN I_ CI I'l'l ill ..ielrlelr.5W 2.5 ill l- 1 ;,; 3'-.Ji -li .5" LÄI1 External Turning Turnin Toolholder "I l Clampingi Clamping Clamp Lock Clamp + Pin Lock Pin Pirl Lock Screw Lock S' S°"""I"L°°" Vii s=„»1= - Wedge Lock s 3 Ii 7 Z llnsert Shape g 90° I 175" CD $ i4s°`
0, ° .-~i O/.v (Tl (J1 A_., ;:l.____ AA -Parallelogram -Pzraiielogram 85° 85° I:I5 III rv magi FT I 1' "i I \T eo" eo"':3.1 ,___: l U I' Z= 0-'. _B -Parallelogram 82° U 951'-F1 ° 82°E QSĹÉII 535 @sam rw? U 'L 2 N I n Pi L Cc -Rhombic -Rhombic 80° ao" U III-."'I { 4`s"°I>Iso°ñI U'! Er fig; n - U'\ . O s . ri P . 5% _I W„, In:I_:_". '.: . 'K - 55°Z K -Parallelogram
555 L -Rectangle |:| -Rhombic 85° 86° M -Rhornbic U C0 -Octagon -5°, ._ (;- 7" B'. I 1. 5° AI. D-15° r=-25°C 25° FIR -Round o _ 30° S -Square N - 0° 0" g: II ._'l >UOOOUU DDOOO ,TT]-Triangle _-Triangle V -Rhombic 35° 5 5 V-Fihombic35° ' E-20°C 20° P -Pentagon I G) 'CZ? __ H Shank ,__I Shanltm Width w - (mmfl (mm) i Tnnl Tool lnnnih Length
(mm) (mm) IBYI l\IIIu'II ' I I I I II, I @Mill :Lame e L-——-~~>1 'I ri- 1f°'§__ 11° C gfi8 .. | \I"'G-ILIUDZ3 TICĐ (DC)@|\'-I n,,.„„, -1,, 1,, uurning Edge |:uge Length Len @I .- =- L¡.. im E „r Cutting .-_ E 5. 55 „L £3 CD Zggl QE /IJ7 hm Eg Eš CDN =5:I I: —*-_Nfit} EICD -uE: -1HD IQ C: -'1 OD ...__ U9 EI -'m H -Hexagon - 100 Z - 125 3': gx::-H |:-i-i 150 _. _.
.U°„'1|\J©@@DTS as as n5 C: —T E3. CI :I É: CID I-TD SE. I-CiGI =5:I fillli 2: 22.GI OQDQQ com S -Square Il 'IH IHl IlMIHl IMIH1 ...... I 'ii I ru| i|u_'.....II . Reliefć li=iaiiei4 5 _ B- se 3° V .._'! 7° II 7° L: _łr ur e :.4lI|-U Ž 7 S o _ 15° EE _ 2o°yI__IË_ .\"'i 25° .|._ ,.- 30° JC A 8pg Version Version L N _ o° E _L Rj- Right Hand L - Left Hand I raga} L-Left
.._ '- 11° 'E Ix' aip -Ž-lD j H I rm9A >UmO303O0DUmU§ _ A Q I 5"5° . ; V -Fihombic -Rhombic 35° /_7' 5 W - Trigon W-Trigon I U0 R -Round T i-Triangle T-rnangle 'I co . Screw Lock E 5:/>-U - Wedge Lock '45=o a '45 0U -Octagon I "=2 - Pin Lock g_ M -Rhombic 86° P -Pentagon 7 Clamp clamp ++ Pin Lock Lock - 250 CA3 Z Z 300 |`r 350 DJ U1 ca r I L
-Rectangle I c; comp Lock Lock M _ Clamp Šfl7@" _, ___._ ___. ___ K -Parallelogram 55 \° \ --170 170 200 - 250 "I-IU, UJIT --- 300 'U Insert °'"'"P"'i' Elamging System "'°°" $l"°'°"! _I P _ Clamping r E -Rhombic 75° F -Rhombic 50° f f+IŠI„„„/_-KIIA, U B -Parallelogram 82° E ..._.. 47 Approach Angle Z roneâí ., IO .. 47 EE is {E {H em Läis {E ŠDŠE {E
@ĐL ÉY,{Š ŠIĐ«Q5 M-|_-A ga lI -Rhombic 55° D -Flhombic 1 {H ii :un-uz ZIIDTZ U _- I Shank ht l lmmľi I _flifllll-I lffl' 'lG€¢-1fl>1'-'I M- 15° 150 170 180 200 C -Rhombic 80° 8 Ĺ) T ' 0 '- Special Q 5I""Z š I Insert Shane '_.1! _ , II W-Trigon Z -125 FXG- -140 Shank l 'r7 !Shank| Shank 56 |Shank| I rA_A'__L¡_ H - 1 so TV |I 'd' (mm) Diameter 'd'°(mm)° mi
-.' if, °_;_'_ Š liftfl I _ . 5 I:I A -Parallelogram 85° I:l l"qn.-an O OT H -Hexagon I , .* |I Tool Length (mm) " -» - 110 Shankfiń i Shank * 4 RBIIBIL Reliefz 5 I Version E --Rhombic Rhombic Rhombic 75° U Anal: „_30 I; inf-nigiiii in-Right; LL-ten Left NN-Neutral Neirali F -Rhombic 50° L7 —"' l '"T°' Z' H °° N ® §§ V Ñ/ U1. ll SZ5TCTFPR1I:i S25T CTFPR 16 2zi |
shank Shank I".-I\-I ll, ll A ll V _. _v , r '* . _T. I113.-I _:—_"_ "r.5_' E * U * o__. E4.£6_____ n -Rhombic 55° 55° D-Rhombic U' I f —L C7 Cl I Boring Bar - Hole Steel with Coolant I A -Steel Hol e . i CU - Carbide Shank Shank' E - Coolant through Carbide Shank p S~~_steel|Sha„k i—§_St ee |Sh ank I107 ,flesh Ii]V°I°]F°IT IĹËĹ {T —v. | Type Type Borin Ber
Bar Shark Shank ': _L__B"'i" ni ti t ti ni ei ,I „ I "U ll; ll * ll A ll ' _II " Approach Angle Approaoh r" 4h l\D O1 pl crevo zszs uns p HÑ e' n llTi°iTllFll ri CITIFI 'U iI I IT %l U II C/J C/I -!'"Q"1? i insert Insert Clamping Glamging System l [)_P- PEIEA j A__. I Special Cutting Edge Length L (mm) = ll E reųrufulfiflfluf pp ii. 'F Em e -H l+L+i i|+L+I fI¢L+I HN
L+i ..il+L+l ___. ._,_E__._m_!\l+L+l .._. FE ä]E> @ {E F/_'I....:Đ5Š i _-= If T anIi F hiianuiacturefs ívianuíacturelš Designation Đesignation I M;L 59 __N/___n ' '„ ` ' Ë' lfid - r . , lf_,...,--32';-'>:. „A-I-,I 2' .»'-''CE'7 -r __ -' -LA'-_.W I-"„>,/'Å "'ez 151--351--. t_.v- -- §--- 1.:-.== TUNGSTEN runesrrsn cnneinerooinotnsn cnrnsrue rootuotnen IDENTIFICATION
ioirrriricrrriorr (THREADINGI irrrrrerininei 0(Ö- f l2o2oI Ix] I15] fol IITŠ |In| I I3 II 4 I I5 II fir I7 I I I'l'l I-I R I K i [I I ;_ :-.+;_t, at-_ ., ' -.. mgnrnarrgoulhnluer Flight Hand Toolholder IRI \ I Neurrzrltåirinoluer Neutral Toolholder (N) I ł- ND / U /' -H3 /7' r—_~'"."" GER 202O 2020 K1 K15O CER .. I I I ' I -s IE I?I E'I IŠ'PI IBI E I'G:'I I'§"_I I°°F°I H - _ r- .
. . _. I ' -'.'l :U É i Internal Threading Bar internal a? @ _ I , ' I I ' BNR D020 0020 P16 CNFI __ 2IApplication_(2 |App|¡car¡onI 3 I 11II Clamping Glamping / Internal External ¡| nternal F Clamging Insert Clamping System ' E - External Threading N - Internal Threading I S - SCTBW Screw System I NOTE : Some manuracturers manutacturers ; I use "I"
"l" to denote Internal. I f I External Toolholder Externafiooihoider A II A -i 1 it H IJ—>I iz-»I I+ F Shank - h x b Example : 2020 = 20 x 20 mm Internal Toolholder C —i 125 'I25 '_- 140 -—- 150 it 'ITO 170 ---r rr i Shank - Diameter d Example : 0020 = 20 mm diameter. I I Til 80 00 1 O0 -_ 300 350 is I . I Ii;-I-5-2:'-:-.;:g1-_.1-'5.-I 5;; -. ~1-,-. Lveml%
¢tood;n_I__,I -; :- -I A1 I I:.'rJ;f-l'.-t]'."'.°. L I as I oe :=; I I 1~ I I 5.9? 4.75 ._l1aL_E§_. -I-'Š4:3 I"-',. '5-. '.1:;e-;-'-; ".'#_-;.'II; . I _A UI 16 _I,I, I 22 27 21 Ž š'>:.,` . 5312.70 12.70 ;I i15.875W 15.875 I I l||,........:,...,a.........r.._ r\:._._..-x;:...... l \. X?-f=es~;~,-*,»@šåitr_} I tit-1" \-In .» =12: = .-;r_ -I--\ I s, .1~- ,7-_e -1 - .r.».,. -. :1-"522; 1.2.'/~.=»; Ir r-ii °-- ° °
insert lnsert - SPMR, SPMH SPLIN SPUN I CTBPR/LN? GTBP R/L Ili MI I IMI I I _ 79 ílí' _ir——' I 7%* I ITISSTI TPMR TPUN, TPUN TPUX I Insert-_TPiv1R, Hg 'Fe * I CTCPN PTCPN i (L 0 -x_ ~ Insert - SPMR, SPMR SPUN 455° °° fi (_(crcéea/L CTCP R/L i cT|=P R/L crre 9[]° _` EI i i Y' I 6%' T ' | |IlS€l'I TPMR TPUN I Insert-TPMR, y crrP B/L R/Lj
CTTP I I _ Insert insert lil |_i 90° BO _ 4- I Insert TPMR TPUN TPUX (Insert-TPMFi,TPUN,TPiJX __| _ |I1SBI'I TPMR TPUN , insert-TPMR, cToP B/L R/L clot? EL elf insert-TPMR,TPUN_TFUX Insert-TPMR,TPLIN,TPUX csse RfL "I5°I Insert - SPMR SPMR, SPUN _i aft" . y I J (I -IFIIZHËËÄ 4- y R/L BTDP CTDPR/L mi __i I Insertnsert RNGN CSKP 5/L 4-
45° .-._ "!- ~. ;\ I I 457°. Insert - SPMR, SPUN 9.525 ,__.______ ....__i.________...., r 400 4OO |'\l.-I-. I!-...,.l..... I n....4.:.......__| FF @ . I - DIUGRUI I - . IU IVIdIILlldbILIIUI „.- .. I 7'II I|Nü. of Teeth Chip Breakenüptronal tvtanutacturers„ b urscrenon =5 Fl C E-ICI =l' / \.|lll|.I |U[Jl.lUIId.I :To UIDLIUIIUII -0: _._..v"_'i I: . I\Insert Insert - KNOX KNUX
CSDPN nvaš0 1z 15° csrr R/L _(_g_y csre "|\"|°"|'|" _. -. ;. I I IHSGTI - SPMH, SPMFI. SPUN insert :-J '-'-T3: - "I"fI.° I Š I Insert ~ KNUX I an -I35 at... * 7 N I; 200 250 __Il;\ ' ei I -t| csee n/L R/L I ___ ç_ssr= ' I in Away from from Chuck Chuck Away Toolholder: with lL§!flfl1BIF1_9 C Clamprngjystem @Ip WEB! Clamp) I TQ2!.Il9|_l!B!§_WIII' 3¥§I§"LIT2P
cctnryzszs M12 I WIICNJNB/L cknr PJL crorn Ft/LI Fit 7 ila/L '((((((cctnii252(5in12 (L CKNN cnsn°n)L es" I o5°I 95°° ` 53° 90° 6 IlnsertSize Ilnsert Size I Syniiioi Symbol Length (mm) D 60 -> —> ldentification - refer page 134 NOTE : For Toolholder Identification ;-_1'.1j':}°"};-'I.; A. A 5 I ToolLength Tool Length I 4——> Drrectron of Tool Travel
(Feed) Direction Insert - QNGN CNGN lnseit- 4 I ShankSize I /— Version L Ln Hind Hãnfl R FI' ht I-End HŠIII1 j 1;G - giamp Clamp System Leo Hznrhroolnoruer Left Hand Toolholder (L) I I O External Threading Toolholder ÅCÅÅ . ft TUNGSTEN CARBI E TDDLHOLDER 'IL TUNGSTEN GARBIDE T00l.HOLOER ___ _______ _D___ ____ SELECTION
sum-IIUN // APPLICATION APPLII-ATIUN _ -1-_r-. -,;.- -.v; UN TPUX UN. refi 4 ITISBTI TPMR TPUX Insert —I"0 E .33TPUN feuulfeux ~~ E-*J runes CARBIDE TOOLHOLDER TIINGSTEN SELECTION / APPLICATION SEI. ru-Ir.-:E ' Ein ::>/Å 1:'Il 2,..-cfio' III- =:QČcgE == Toolholder;with [Ill (Ninth) Clamprng Toolholders withyyllllyytlllultiyi Clamping
System (Top Clamp + Pin Leek Lock) _ TMCLN NIDJN MSSN R/L Mctn n/L R/L * Mom Pr/L mt I _ MHGNB/L_ Mnorr R/L rrrssu — A T ~ Ill -3 E eel m eeIt eII e{efiIgHef I I axB is at 4 IIII 0 mieele tel la erefi MI @Š II LJmetee;g gtägwgsm WEI 95°' Pte Š ~Ë I let; 9Bat re W 93° IllS8l'I - CNMA Insert CNMA, CNMM CNMM, CNMG CNMG IOSBTI Insert
- DNGN DNGN MTENN MTGN Mrsrrrrž rrnon R/L R/L 7' I i 90°- Il'lSBl"E FINGA RNM× RNMX Insert - RNGA, MTJN nrrn R/L R/L ; T _Im 90° IllS8l'[- SNMG Insert SNMG NITNNN ynrnnn Irlåert - TNMG, 2 ca TNMX —l2 §>-< I ITISGTI - TNMG, TNMX MX Insert - TNMG, TNMX r—O- R/LF': E: -I:n- E: QC! ` MVON R/L Er— _*_ £5 ca2:_4222 " nsert -
CCGT, CCMT, CCMW Insert "Jl'\J (ii) Z Insert - VNMG ' PCFN R/L 75° 75 90° so 3 TI /UN I I-I ` > T RCSN R/L ___PCSN ž___ „Ñ _h-—s 45 50° 2 rnscj/L__y_ PRSC B/L šueåeäogi Eb' §B /_"\ _ :i\, '—. all -- CD ___ yrsnnny PSDNN E B Insert - RNMG __Ž_r{gurR/L Qty Ft/L ° - I I Insert - SNMG Insert - SNMG _Ž „É Mg PSSNB/L ___` ĐEEIË 45° 3 Q ,I 15° an
Prorlyrt/ty row/I W 45° E] §LJ svi ga fi Đ I I Insert Insert- SNMG I Insert - SNMG 45° 45° 45° > \ I I Insert |l'iSfllI' - TNMG TNMG, TNMX SBSC R/L I snsc_R_/L 4 1- — ___ 90° eo° Itwfl I J --Q R _ W Insert - RCMT _(___..m____. .- InsertInsert - SCGT, SCMT, SCMW NSTAC arr _smenu _(L___srnca/L m _„s_roce/L ° > :E} 45° _ 3 InS€rI Insert ~- TCGT,
TCMT, TCMW srec sro:: B/L PVLWH N;I srac R/L _gro 9o°1 93° so°I " —¡ 95° |n5g|"[~- T[)(§T| TQMW ITISSII ICGT, TCMT TCMT, TCMW | 45° 90° s _'— : svvo R/L P./L svve 7:1 II IIIIIII sser: B/L P yssacnrt _Ir—h 75° 15° I T srrc rrc R/L B/L oo° _"— so° TQMT TCMW ITISGTI -- T[]°[;'('[|°' TCGT, TCMT, TCMW (Insert |n5g|"[-- TQQTI TCGT, TQM]:
TCMT, TQMW TCMW SVHC I gsv.ieIn__ SVJC___R/ SVLCB/L sviri: B/L R/L ysv.rrry_i1/yL__yyy ysyrc R/LL _ svr.c R/L _ % Efliorsdl kg-H 9a°% % 93° :t 3-H 1o1°aoi lt_< Insert lflfierl -- VCGT VCGT VCMT VCMT Ž 45° . 99°° I insert T(]MT_ TQMW IIISGIT -- TCGT TCGT, TCMT. TCMW _W ___"_ RGMT Insert - RCMT Insert IrIS€rI - CCGT, CCMT, CCMW
IIBSBTT I |rlS8rI - DCGT, DCMT, DCMW ___E}*_L___ sssc(((nIL___I sssc R/ty H I,I ' .,.@iP' Insert-*1I-0- - IURCMT C) 93° » I srrc Ft/L R/L Insert - UNIVIG DNMG, DIIIIVIA DNMX "H _ Ë> I lfiafilt 90° 15° I I- SCGT, SCMT, SCMW I Insert - SCGT, InS9rI SCGT. SCMT, SCMW I Insert - TCGT, TCMT, TCMT. TCMW Insert Pnsn n/t_ R/L _I N __Vr=snN
PBSN PSBN R/L 90° SRDCN Z ___ 9 snocn _m,,H 99°, ° 45°I jg} Ä 'l\m\/iii II|nSert_WNMG msen V WNMG I € ýV_P0NN R/L___Ž _ PONN R/I." Insert - CNMA, CNMM, CNMA, uiuiviivi CNMM, UIVJVIG CNMG ii'iSci InsertDNMG, Diiiivi DNMX E:2.. cuCNMG 2E0': I Insert 6 6| l - L!I\ll\ll|"'\ I. UIVIVIG W PRDCN Pnocrl I _Iw ____ __ as I Ly> 99° 95° °I°
IIT sooscn ssncn g l`/I PDJNJ3/L _ POJN_R/L -I___//1—i\ . 95°" E Insert - DCGT, DCMT, DCMW I Insert - RCMT Insert-CNMA,CNMM,CNMG Insert-CNMA,CNMM,CNMG Insert-CNMA,CNMM,GNMG MM CNMGI IIlSBl'[CNMAKL] CNMM CNMG |nSBl'II CNMALI'-=:I CNIVIM CNMG |lS8F A CNMM CNMG L _ ga ||-
;SBrt_"|'NMG|TNMX Insert - TNMG. TNMX Insert ITISGI1 - CCGT, CCMT, CCMW -W Penn R/L WY PCNlNN_ _ orfirfifi PCMNNIWJ 75° 60° (1 ,°;tl,4uW I Insert - WNMG I E] 'r_/I-IVme2°so' s2°3o' Toolholders with P C_la_mprrigSysterp_(Pin Clamping System (Pin Leek) Lock) Toolholiters wrth Pceir R/L ' ° oooofferrwl SDNCN suncu l } Insert - VNMG
99° PI 0 Insert - VNMG -=1'z . 5 {D > I|n3e|-FTNMGITNMX Insert - TNMG. TNMX B MWLN__Rý/L rrrwtnjj ; 00° Toolholders (Screw!.LOEISI Lock) I9.9IIi 9!§.§.!§.Mlwith!.§.§lS ?Clamping__S_ystem H!.Pl9.9§1.§!9.lil..I§E.LEi SCAC in/L H y y___'_SCLCR,/l . scac 9.II_ s9.Iea,r. sonce/L sctc P./L__ sone R/L f L¡ smc R/L Il'lS6r`I - TNMG TNMG, Trilrvlk
TNMX insert -2MVIINN :5;-=5:¢E_i 2:2=5 E |n3e|-t_TNMG_'|'NMX Insert - TNMG. TNMX y-u_v _I/_\I_l) T ....__ ILA TUNGSTEN TOOLHOLDER runesren CARBIDE crnroroe roourotoen IE, SELECTION / APPLICATION ŠELËCTIUÑ ÅPPLICATION Tgqymaidgi-3% Toolholders with P clampiii;gfi§yst(eyrn__(Pin Clamping_System (Pin LoolQ...contd.
LookI,..contd.. _y Priiiir-i°rLi_(y T" PTCN R/L Prriin/L I i=w@=r)_L M I Prrn R/L I Pron RJL IO r=rrN__Rí /_L »www _| i l\ -i Insert Insert -- VBMAI VBMM I 12°50' 1z°3o' n I .-.-' Ilnsert-VCGT, Insert - VCGT, VCMT J l\ flit II insert Insert -- VCGT, VCGT. VCMT VGMT swe R/L sinie B/L pyg I 72°39' 1z°3o' Insert-VBMM Insert - VBMM tihi' ijlzg. 1;' . '_-I R
\ "4-—I -in Insert Insert -- VCMT VCMT svxcryt rr/L_ svxc R/I-W y__;I 0 g svzc R/L w1? I ee ie 15 113° I 11?? insert-VGMT Insert - VCMT I Insert-VCGT, Insert - VCGT, VCMT 100° 100" I ,, Y'\ El ,B91 rurrosrrzrr rutiosnati or-morn: cnnninti oonmeerrn nonirio nttn SELECTION ŠËĹËËTIËÑ // APPLICATION ÄFP¡.¡ËÄTiü¡Il TUNGSTEN Tunnsmt CARBIDE
ottnnntnta BORING nontno BAR nttn SELECTION ŠËĹËCTWIÑ / APPLICATION ÃFPi.¡Ĉ¡\TiüN Boring Bar Feed Direction - Hand oi of Tool I ;` in à, noting Bars witn P ciamping_systeni (Pin Look) B_§riooeBe_arseewithtPBlflfltpiflflfirsiflmT(Pi!!L09Kl Ii @ Right Hand Boring Bar —P_CKN ; —PCLN R/L FI/L _ _ _I -PCLN R/L - PCKN R/l__ 75 /i _-__ _ 15°0
___ I //ñ"' (lb ___-_____ I L.' I - .,'_ ' | ///„,. Direction oi (Feedl llirectinn ot Tool Tnol Travel IFeedI - _ - ___-____ - -. .4, i._. 1'... . ' . Q (L) ILI _95° 95° J ` Insert -- CNGN, CNGN, CNGX CNGX IHSBFI -CSKP R/L -csttv PJL ' *1.._? -'__ fi..JI L.L 4._1_..1..._z.'1__¢...r 93° /////4 o= -[:"!E=' L Insert nitex Insert -- niteti, DNGN, DNGX ._.__ ,__ „ |lIiSEIl',3"'MH' ~ SPMR,
SPUN SPUN SPUN II!§_e_II I 1% A /////Å 1.. 4 ' 'Ti. '1 @ llllll /0111,. T ; 711774/Q' A ZZ/Z/[Q 7+ *I ` |I1S€l'I IHSETI - CNMA, CNMG, CNMM Ållllfi B _ on" I 9o° /I/[Iii Q " 77777742 I imvvrr R/L , "Mim, B/L 7"T ,1/5);, % ' W -mwm -MW'-N R/L R/L ns" 95° ///'I þ_` Insert-D§§5_T.Q0_M_T. DCMWI Insert-ECMT % I////1 -ssttc it/L _____ - Aee,;$rTFce/L _ -srrc R/L
—e$$KBR/Le U 75° 4 IA 7/it A /II W ~ I _-A , /////J GMT„amf //'///// ,„Se„_DCGI mm_ ECMT ' ___ ._ . _ ' . _ ' _, . _ insert; DNMA,DNMi3,DNiMX. Insert - DNMA, DNMG, DNMX —PWLN "°WL" M?i 90° I /////1 BU 95° lllll 95' ' I fr, \ hm {$1 i '7" Insert-WNMG in _ .„. insert semi, sciviw Insert -- sest, SCGT, SCI/'|'|', SCMW , __ -SVQC R/L N;$V!10B/L L I//I/í O
os" ~ f '*I i Insert IHSBFI - DCGT, DCMT, DGMW DCMW -sELc"_e/I -seto R/L _ _ _ _ 95° 95° pi Q ; ,I////. A: W I%;soitr>_R/_L ;sQ _ --0' 5 ii ii /////1 f/II/J _ n _ 1o1°ao' Insert IHSBFI - CCGT, CCMT, CCMW Insert |i'iSBi"[- SNMA, SNMG, SNMX Cf ?_ 93° _ . r~» Mg' '.'> Å _ Boring Bars withthee$eP|@o!oi S Ciampingjystem (Screw Lock)_Bvri
oeo_eB§r§eewi I11§r§t@to($@re,rtLvs=kl _M~sr:|.To R/L _; _}__ -sees rrr|_m__*_H 7* it I -soucR1t*????*?? ;e_ci,n__ii/_L ______ -snnc ti/L _ _ -sougig/_L _ -B-» 75° 7; *I __ ' |n§ert-SNMA,SNMG,SN|triXWW Insert-TNMA,Tit_M§,TNMX I siti/io, stiivi; in Titmefiiiiviš- 1 4 1/2" 1 95° . _I _J -Mstrile/L -Msroie/Li 93° Insert - DNMA, DNMG, DNMX IHSBTI —MTFN R/L i
W" ,,Ž;MI|ĹtíBL,,,,_Iý, ' |lIS8lI ~ TPMR, TPUN, TPUX , , Inr°€F3IIeTleIIIW'Ie-lIIUN~,IITIU,X -Mnuii R/L —MDUNR/L '='*"'° "II/f I 95° ` __,M ////1, Boring Bars ~!i with M (Multi) (Igy Clamp Look) B~rinoBars !eheMe;i M!e!tiGlampingjystem tBIaortase$r$t¢em_,(I0r_efll amerw:+ ,EiPinneLoe¢ti -mcttt R/L -Mctrrrrit IHI HHII 93° L B ______ |ltSBl't -
TPMR, TPUX Ins?" IPMR TPUN, IIIQI\':eIEIJ,I(,,, , 93° -BTUP -crur R/L _R/L I __l I-IOO QUO _._ _ _____ _ _ C —CTFP -crrv R/L ii/L 75° _§ 93° insert -- Kiiux Insert KNUX . Insert-CNMA,CNMG,CNMM Insert - CNMA, CNMG, CNMM O do "."""' ___,-__ ,____ ' we 93 os"0 "fill ' 75° ///"¡ ID t /4/7714 377777771 93" _ ///0) ,___ /III/í/I >. R/L' ' —PTFN R/L _'—
PSKN PSKN R/L" a"'TF'"*i ~ l Boring System (Tog Boríng Bars Bars with mm GU Glamging clampmgåystem (EP Blamgi clammS40T—CCLNFlt2 I -courregt -BKUNR/L S4DT~BCLNR12 _I ~CDUN H/I. A I -GKUN R/L ///i/J ____ _. ' —PDi.IN R/L R/ft _-@N I. f *_ NOTE : For Boring ldentification - refer page 135 Bo ring Bar Identification . „ j j Insert-
CNMA,CNMG,CNI\itM Insert - CNMA, CNMG, CNMM ' 4-> lþ __~ Uri' Ci 95 95°o N /l//I i Left Hand"Boring itanri noting Bar nor Left '151 I_ IHSBFI - DGGT. DCGT, DCMT, DCMW I Insert /L _ T"I _ _ _ _ —SELP -SELPRR/L 97°30' 97030' 91°30' 97030: I z~~ ` _ W F r Insert-EPMT,EPMW,EPM; __ -STWP R/L 9" -sTwPH/L 6" 90° 60° M þfl in /E A F *i /
ZZQZZJ Insert TGMT, TCMW rciviw _ IHSBTI Insert -- mer, TCGT, TCMT, Insert - TPGX, TPMT -SVUB R/L :_8vueR/L _ _+7 -SVUC WL -svuce/L _ _ Fi' Eli in +1 .1 Qkiflfiiflfii ______„,_„_____. „a*in____*a*i z;;;;;;;;;; _t_t_...__.____ Insert -TNMG, TNMX Insert-TNMG,TNMX zjíjxj _ I _'_ rI ,_.____._._. Insert -VNMA, VNMG Insert-vNMA,vNMG rjjjjjjjl 'Ž _r _r . ?_
_._._._____ Insert » WNMG insert-WNMG Z . i IMI IIIIII 7 7.Z7777z 7.2277772 1"7°3°'* 107039" 4.. I InsertVCGT, \/GMT VCMT Insert-VGGT, I '7-227772 'm77771 Insert - VBMM insert-\/BMM 93° 93° 93° 7zz77771 '7-Q7777; r Insert-VCGT, Insert - VCGT, \/CMT VCMT I V \S . . ëfl -'> ~- .=',',Q-I 4. .;.- 11. .{ i:- -.- ;-. -- :_=,.-=.;=..-1;' =-.:;\
ABBREVIATIONS ABBnev|Arions useo ustao IN ENGINEERING onriwincs in Erioiiissnitio nnnvtiitios El -I U Common international Engineering Standards lntl. Organisation for Standardisation Australian Standards Association Frangaise Française de Normalisation Deutsches lnstitut Institut ftir für Normung (Werkstoff No.) German Material Number
(Werkstofi Ente Nazionale Nazicnale ltalianc Ulnificazione Italiano di Ulnificazione Japanese Industrial Standards Korean Standards Swedish Standards British Standards American iron institute Iron and Steel Institute American National Standards Institute American Society for Testing and Materials Society of Automotive Engineers Aerospace
Material Specifications ISO AS AFNOR DIN WR UNI JIS KS SS BS AISI ANSI ASTM SAE Ai"v'iS AMS INTERNATIONAL AUSTRALIA FRANCE GERMANY GERMAN Y ITALY JAPAN KOREA SWEDEN UK USA ` /5_@1°_SeEatS_ _ _ A II' I A/_E _ Assv /535*' SQ/T _ l II. n-nan l'In-Ln Hbl UIJD Fldlb Assembly Assejmbly _ _g i CM _ Centimetres CL orL
CLorL Centre line CHAM QIEM _ Chamfered čir Ho on no csk CSK head Cheese bead Countersunk CSK Q QSK BIZ C'BORE C'BOFiE C'r'i_ i CYL DATUM DATOM _ head I Countersunk otŠinłéršínI _ _ _ I Counterbore II Cyiínder oi Cyiindiical fl..l2....|.... ..._ fl..l.:..._l..:.g_..l t;yl|llUUliUl L;ylllIUllbdl syfl__e_n1 Datum system (ot angle) L 'Degree
3eQT§@(°I_E1"QI@I @šef @_Q _L ,____Q¡_a_UI9_Ie_f__DI,flFD@,I€L L _ lllécql DIM oi_ivi_ Dimension D¡_"l_9"$IËI _ _ Abbreviation Abhrevlation Term ll\I'l' TI r...I..........| I INT ll\ll llInternal llb'l I ldl 1/Di "internal diameter IZD Jnt_efi1ë|_ as Me@re'_ L VIIN ___? ' g g g Minimum ~ (ol angle) Minute igfangle) N_QI_I9_SC_flI9___e_ A _
tNtQtt9§@elc,7 _NTS \JT$ 7 No. _ Number _ _ _ _ i\lO. DRG Drawing W g_ if ij Outside diameter Io/*ni I To/o EOUISP _ _ Equally Spaced _ _ _ _ @__ Pon POD Pitch circle diameter @Si __ E)(l' f EXT External LB 7 Pound L, _ FIG FT or ĔTEĹ' GAL E/GALV _-_LV HRA HRA __ ___ HRB HFIB HRC HFIC V HFID c___t EL? HRE HRE_ HB I HS Figure Foot
Gallon Gailon Galvanized or R RAD orR _ _ Hardness Hardngs Rockwell A scale Hardness Rockwell B scale Hardness_Rockwell Hardness Rockwell C scale Hardness Rockwell D sca scalee or ININ PL 1 INSUL insüí I T' _J Hexagon head Hydraulic inch Insulated lnsulated or insulation _ _I Radius f Revolutions get per minute Right hand e g BM Round
head ___ I so STD SHL_ sviie swe THD ren TP1 TPI vot.. vol WT _, Spherical HTB Square S_c_Iu g St_agdaro_ 5ifl"EI_€1_tQ.._ II I _Z _ Term Term c P ' © I Ii U Ñ Difference Different; I Therefore Tim iI7o < l E __@He S I Pi _I Parallel To IInerpenoiĉoiarro Pg_rngi1djgiiI3_r'TQ I IsIS To Iiąatio) (Ratio) T' I _I" Ž l'l_ — Anoularitv ADQUIHTIW 1 H"? Arc`
MIDI" tengr Il ' . .. * max. material condition At max._material C0l'ldl'[lOllW _J At l_east least material condition I Basic dimensions CU paE3. ca E3: E3 ct: -:iIDIUI ID Q. I Circular runout II Circularity Circulaiity COHICHI taner lalifif |` Conical r' L Contricity/Coaxiality Counterbore/Spotface COUTIIGYUOYG/SPOTIGCG 1 Countersink Cylindricity
CYIIDUFICICIIY |_ Al ll ET 7 T l'\Irr\ _ _ Datum ISHIUTB feature -I DEIIUITT Target DflIumlflfgfli Ž @ I Datum DIHITICIBT ñ_ IDiameter I Dimension not to scale E_-jicsa li ga 47;; __,Ĺ ii', IDimension origin rvimensin origin ti-'I-t'§"*I,-"'5-P"-".=.' I . H'II synioot Symbol :Term Irernt ' T __ T kr I A7..- 'f _ Engineering Drawing Symbols ,9 I A" "Fund " /9
IĹÅII FOUHU - DFOTIIB Df0ffl9_ t _ or L VT SUITI Of —Sum I Product Of _l_ I $lll11I10I Svmiwi ITBTID Iferm 4 _ Proportional To 'I Depth/Deco 'd _ I_ DŠPIII/DËBP __ I Infinity".Infinity oc OC \ H ll— QI A 'Standard Standard (imperial) (Imperial) wire gaugi gauge f Thread 5 Thread per inch Volume = Square Root Ot Of W ', _ -\II \/Y ,1__i I 11 I MI
We I ill IQ I W 00 (I) Equal To 7EqualýTo Ž 2 M at H Not Equal To III L'? Approximately Equal To fi z iz I> A ~ Of the Order Of/ Similar To Greater Than >ý 'GreaterThan W I I 1; > Less Than 7|| *Ž< *Less Ii Greater Than } >A TNot 'N0tGrealerThan I J_I I Not Less Than ¡; \\ I IMM S I: I143 lbW 2 I GreaterThan GreaterThan or Equal Equal To 2 < If
I Less Than or Equal To 3 nivioeti By Divided [Q __ |y|a||¡ęm¡t¡¡;¡| Symbols 3!m|¡0|s Mathematical Term IIH $ymIJr;i! syrnnni *rerni I` Minus MIUUS or 01' Negative Nflilative or Pos,/Neg; Plls/Minus Pos./Neg_" i t _ I Plus/Minus _ I Multiply By ______X By_ X __lVlultIply I A _,_. .. ,. .-_-. _,-r x;. It -1 =1 -1 '.;.;= 1; I Plus or Positive "If \Bee l \ __ i _'L'\.@.|_me_
—' _' __ Weight E swear , SYDTIJOI Symbol +t I co Igg __ SCR Screwed _ _SCR____ H I Second (of (oi angle) anale) SK Sketc Sketch SPEC _ ____ Sp_ecili_c Specification SPEEL @wi _Z sen SPH Hardness Rockwell E scale Hardness Brinell "rrv _ __I Hardness HHTCIIIĐSS Vickers VIQLËS H;HEXv_ g_ risx _ I Hexagon HEX HD HYD RPM EFI/L RH ni-I nn
HD HD _RD i.f_: 15;} , 3. mm", '11 1:::N ENGINEERING STANDARDS |" :z E::111 If' EE:: rn DRAWINGS I:'Đ5: :E :: onon " -----------: trn FOR II Common Engineering Drawing Abbreviations Abbreviation Abhl'evial ionII Term Term 1-"'"':e :1; ri _ A V" . :"" -""1-,' -'-"' ' c -. e ii s- " >.'-i'§" - ' >#''S :1 E-1.': I á>L®AB C_I Feature control frame ==@@5®ABIC'
I A Le Z @mess E Flatness I I_ /X /X __y Number of times/places 'I _ * — y //-r 7 I"Parallelism Parallelism i- I1 Perpendicularity I Position I"U5|I.IUI| Q9 Profile of a line wmemame I Profile of a surface Drninn+ IProtected IU]UL'l co C2. tolerance i i iiCID no:5 cuci: r~.zone i §> E @ Ž II l Radius I I Ž I (40) IAI 'Reference Reference dimensions dimensioí
u IX Qt ' Slope Lope ii SQI ISpherical Ž Spherical diameterý A SO diameter sa =I Spherical radius SR U _ (Shape) Square (shape) — I IN ~ square ? Z I Straightness Stralghtness i Symmgtfy ii Igymmem, ' T >< iI Target poim ý>< point iz I ~ *____ .. 74-___ . I M l"'_.!;!._- __M M — J D>ee D I1l'\ -1 Žszo _ _yt " /y ft a 'T5 -*1 -.'" _ Irotairnngnt
Totalrunout _'< .'-' :.' .-=_II-~." ,i=:. .-"-.-~. "r=."§@_ _ 144I M _____________/________"77 Auuu PHYSICAL Pi-ivsir:AL niiviizusimis noun DIMENSIONS "_'"` ' " "wu _'m-"nn" . in . Adult Male Dimensions E [Of Small ogeralor ma percentile) 0 era percentile)___ (5th 19_A ' ž $15; Lerrreooer.ator @mmm je E I . I1 leee-NAAAI if A It _ Ë E - 5 °/0%
'Sew %ipI 50% 4 7 95 % * 7 7 'I 100% II]II% PI" ¡ B G D _, ' H lit iIIii I i I III" ._1\7i --:_ A A. - A will Iireaowiotir F H. A_ I , ' eyetoozot IIEyeloba'ck .. A. . .-_, ' I Chest depth .Ci1estdepth . ' K. Infiminaiíårtn 'AbtlDmin3IdB|]Ih »AA ' _ . . . . ____.. I v L-4i——M u — I ti >< ___ 'U "š%V _l ""-' Ir'I —$— r - | Q Y R :0 I T—l E5T ' IESTTIQ ëC I—c wm EE Z I""--I ;
__-_L _-L 3.74" __ -- 3.74" I70 170 I 6.69" 6.69" I70 I70 I 210 210 210 A I 5.98" LID =-=2 A 36.50" 36.50" U'! PO ____ _ _ _-L 4.13" I15 I 4.53" 4.13" 11541*. 4.53" _r__ sass" 72300 82.68" _I 2300 'I ooss" 90.55" A 7.40" 205 5 3.07 7.40" 205 T 5.07? 'I05 A 105 " I88 188 I 5.59" I88 6.69" 188 _ 7.40" 7.40" 8.27" 8.27" 245 9.65" 9.65" A 8.27" l10.04" 8.27"
li I 255 255 . 4" _ _ A, CD U1 165 . Q') 6.50" Cl'! =2 1016 40.00" ioiš II I4o.oo" $.71 _' 21oo 2100 .. . _29.53" 29.53" . .I I __ .I __ .I __ 31.50" 31.56" ___? _ _ 9.84" _4 _&.| __ _ . . - 205 205 I 8.07" 8,07" I 280 A 11.02" 280 11.02" IA 300 11.81" 300 11.81" Int ' 2e5 285 .. ; ._7 I 1 11f22" 12.so" 11.22" 1' 320 320 IA 12.5? _ __ L 825 825 I32.48" I s2.4a" ._ _ .. I 880
734.55" . 34.65" Vaso 1. . ___ A __,,.....I.._I._ _i _. .. _ ,..._ ,. .. _. ,______ 15.75" I1 15.75" . " . I 900 35.43" 900 A 35.43" A __ _. _ 960 II 37.80" 960 37.80" 840 1 33.07" 3407; 39.97" A ....__ ._ __,__490 490 ' 19.29" 19.29" _L___ ..|:s.C5': C3 . 120 120 II . . . . .1 3 _.1. U': U1 |-\3 _|. CD A_-I. 4.72" 4.72" I45 7145 17o II 6.69" 6.59" IA 1tee 170 se eso 440 380 I
14.96" 14.96" 440 A 385 385 I 15.16" 15.16" 450 450 I 320 920 072.607* 355 I 12.eo" A ass _- _. _ _ L__|. 4. 19.69" » _stši 500 AI 19.69" 560 722.05", A 22.05" 620 II 24.41" 24. -isQ25250 I __ I 16.54" 16.54" _ .A......___ I 17.52" 17.52" 445 470 470 20.47" I 18.50" _såi Ëo.47"7 I __ A 41o 1e.14" 460 I 18.11" 410 I 16.14" O0 _ci 1,1o _1. É: I no5:: 2o.oa"
ca 420 =; s= Thighthickness 71' ==.=== IHandlength _ãhoulderwidlh I?' A ;?.ShoulderwidAth .- , IN I 95 400 I Back to call _EBaclrItocalf .....,__IL A tL'trA Were-.~:„:e;~;f" "fi tiiiiiii ` »--. I'll 'I1 -u=I'Q A 27.17"Ž 27.17" 765 AI 30.12" 765 50.12" *. 2o.e7" 20.87" . 590 590 t 23.23" I sso o5o7I. 25.59" 25.591 I 200 zoo IIII7.s1"-"WI 2351 9.257 I z7o 270
SI 1o.es" .' 7 . 87 Ĺzas 10.63" ,. _I -12.°=_š!"? 1. -I:Forearmtohand IForearm to hand FL CJ1 U1 95 ; 750 800 U 1.F'==.¢=A Aeteeeeeetgat MWIlišf ' ez v-4 . I 5.51" 7152 927 927 Eyeheighl 690 IzI;;r;r„n"7 on AShoIlderheight 7" si 530 fiiaimtrarira ¢_-..._ IKnee height height(with (Knee (with shoes) i= E- --1 I' 25o 250 M. IAnterior
IAn_Ierio_rarmreach arm reach I Chest height AIChesIheigI1t K .~ fl'h. 'I1 CD '--v 1ooo AII 74.80" 1900 74.80" ___ _. I Headlength IHeadlength I.». X L r-i—i °I°""°' 837 e37 II 32.95" 32.95" IHorizontal sitting height II-IItJIrIZOntaISiI_Iing heiIgIII_ El I'—"i. Ifl M If I ai AD " A 1... 140 Shoewidth Isnoewiutir __... . E _- —-—""¢'i-__— _ Medium 770*-
„Ĺ,:I'; I l I,Hee [I width _____. .. . Iii._H/-if _______ tíšl ~._.v c. ___(Overhead 'üverhead reach reach r ___ A 71-: :_ 4-I-I CH no=3' E. jHIip pointtofloorAI lninpointtntinnr J> >- E || °"°'"I°'. Ii . _ _________i,___ ... .i_ _. _. . ______i.._ G ' ,___________i Large perator Operator Percent I (Seth tit Pareentiie) Percenti * .-E GI! 21:F Fercenitie) " Eerceniiie) -A a-_ :II .z:r
Percentiie) M A WEIM 'Ž I - "Weight A I I Wei hl AI I-.55-lrgs121.25llh's-J6.-5 216,05-ihsi .. - A-_. A -. . itosA . ¢..._5- llts 15.5 kgs _:168.6__5lbs 1 68.65 lbs . '98 _l_lB_llags. r_gs `_ij6_.0_5 llrs __ (inch (inch) (rnctt) _lg eš oh)I :i,ti=`-I (ITTCII) A IA T' 1550 '17-.--.. l 1/15 ._1I ti/.52" --_-.. l 1880 Il 74.02" I or.uz" _r. U1 U'I O G? 1 02" 67.52" ieso I 74.02"
_.1715 1585 I 62.4 A 1585 62.40" 1750 68.90" 1921] 75.59" 0" 1 75o ' 68.90" 192o 75.59" - 1-in A S Small::,„, 09"*-;' I Designation Designation I I AE I _ . D. ' G7 iw/___l 'fie. Errirm éli_oriws rarer' ' eso 33.465",, A oso s7.£iIo'" '1o5FI Ann span, =pan,einow=toitieo s5o I 33.45" 950 I 37.40" 1o5o 41.111175 41.34" _J .- Symbo|.I Symbol.. _ . /\ Č'- I _ * A
Heighl 'J: ' E -F" =I" (with '- " CIU E. =I' shoes) U'=1'I: .__ 'IE _____ I_Arrnenzn B._ IArm span — I r li II *r _ I L. fShoe IShoelength length it lg" noun PHYSIUÅIPHYSICAL DIMENSIONS ÅWI-T AAAAAAAA Page DIMENSIUNS AAAAAA (RBIET P3gB144) Ft >1 ___ ________*i________ I ' \-TC' $(-)cU 1 A I95th percentile) percentilel (95111 Mediuni lTeratot
operator ivieuium A AA _ A _ _ _ ,_ - _ ~ ~ ' 'I ' " (50th percentile) , M» _ / (50thpercentilei_____.~~-\""" I' ' F___---"(AAA E; L.--.š _Uf "A N 3 S -A . A i . _. _ . _ — 170 I 6.59" mi 67.51.-ifI 205 205 T a.o7" eo? A soo 119.59" 1 19.69" " I5oo 5.71" 5.71" " I 7.40" 7.40" I I 17.32" 17.32" II17.72" 17.72" _ 7.1 I 14.37" 1 43 I __ I... _ ' _ .. _ ..._ I _ . 515_ 1I 20.2
20.28" 515 _ B" __ 410 16.14" 410 I 16.14" ., __ Q Source: Data compiled from ISO 3411:1999 Human Physical Dimensions of Operators. A NOTE: The above information is intended as a general guide only and varies significantly throughout the basic design of workstations and equipment. the world. ltit is provided to help ininthe 0« The 50th
percentile adult mate in the United States between 2S-65 mm (69.1 adultmaie 20-65 years old, is 1755 tnm (691 ") tall & weighs 78.4 kgs (172 (1 72 lbs). This equates to approx. 2-3% > than the figures figures in the above table. heightisis 1 650 mm (64.96") and for iorwomen I60.5"). ¢» The worldwide average male height women is 11537 537 mm
(6D.5"). ¢» Awheelchairuser's A wheelchairuser's eye level is approx. 370 mm (14.6") belowthatofthe standing person. e.^ Wtteeichair Wheelchair users need a minirnurn rnlnirnurri aisle aisie ciearance of oi approx. SOO 800 mm (31.5") (31.5") and aaturning turning circleI' circle ofofoetween15oornrn(59"Iano17oornrn(o7""). between 1500 mm (5o")
and 1700 mm (cm. A Il thGI =E ADULT I: I: 5-1 I1_4l I Ifli c-coo: ADDRESSES-I' I" CONTROL 'rfi' en:: -t:ioc: ,.azUeaÑII5 tr:::I "H I'l'IË si NUMERICAL ::QC:Uil USED IN Cl U! I'I'1 :I 2 EË In:: EL' ID :zrw: 'U :E - A-(Mical Typical Furniture Measurements based on 50th Percentile Male Dimensions in mm [_ A II \ __.-_ uí \ II „„_Ž.I Denotes point to point
rapid traverse operations. G01 E near interpolation. Linear G79 G70 lnch programming. 602 Circular interpolation -- clockwise movement. G71 Metric programming. Metrlc G72 Circular interpolation - Clockwise (3 dimensional). G73 Circular interpolation - CounterCounter~ clockwise (3 dimensional). G74 Cancels clrcular circular interpolation.

G75- G79 G75-G79 Unassigned. G03 Circular interpolation -- counterclockwise movement. G04 Dwell -- a programmed time delay. G05 Unassigned. GD6 Parabolic interpolation. G07 Used for programming with cylindrical diameter values. *_-Inna III . .1 O (D A -I?»W Ln ii "1—U'l—I [ZED Ii —" "ML _ I _L -I "TI A A 1 I 4:I>5 ;,'L__~ -5-rii '11ov 'J coca Z
III? 8I53$° EQ Il\:1 I ~_ G64-G69 G64- G69 I Unassigned. I I l G81 GB1 GB2 C')inre G09 Programmed deceleration. G83 G10-G12 Unassigned. (504 G84 G13-G15 Axis selection. X-Y plane selection. 618 X-Z plane selection. G19 Y-Z plane selection. G20-G32 Unassigned. 633 Thread cutting, constant lead. G34 lead. Thread cutting, increasing lead G35
cutting. decreasing lead. Thread cutting, G36-G39 ` Unassigned. L-v——560———1 G40 fi*-ÅT ~=-tr liši 95' 1095 O /_\'//IE\—I A I I , \7< IÅW fie? I 765 7Is I ÅŽIzë>~å)Is\åsII . - . ' -:,~.'- I;-'- 9% . "-—-. .- -,-.-_ - r ,1-;. 1' :.J. =1." =-.< r .- .-. >..\.-_' .~ 1 .',.. _. -.3 '._- r' _--, -¢._- -3'-~ -. -,:Is_, ,. '. ."* MII Il IIIi lI lI ill 7 Cancels fixed cycle. oycle. GBO G80
Programmed acceleration. acceleraiion. I ' '.e.':». : ':-I ,» - G63 G08 G11 .--"' '" _ 1." ne __ I I -G63 I TappingPmode. G00 sq 1905 I- Description I G-Code I Descrl tion Description G-Code Descriptiori Drill cycle. l I l l 1n 21. -; SE cycle. Drill &§?° 1:dwell -: l i ED :2. CU UIUI Peck drill cycle. Tapping cycle. I G85 spindie Boring cycle - rotating spindle
retraction. G86 Boring cycle - rapid traverse. G87 GB7 Boring cycle - manual retraction. G88 Boring cycle - dwell & manual retraction. GB9 true Boring cycle - dwell and feed retraction. G90 Absolute input programming. G91 GD {ID _.L incrementai input programming. incremental Preload of registers. G92 Cancel compensation/offset. '-. G93 lnverse
Inverse time feed rate. I G41 comperisation left. Cutter compensation G42 Cutter compensation right. G43 Cutter offset, inside corner. C')4:-I; G? ili .|:-. CT co É:1:: £1co ::i:co -'T-I G45-G49 Unassigned. G96 G95 Constant surface retraction speed speed. G50-G59 Reserved for adaptive control. G97 Spindle speed programmed in rpm rpm. G60-G62
Unassigned. G98-99 G98 -99 Unassigned. et, outside CD 331CO Feed rate in inches or millimetres per minute. G94 G95 corner corner. l i i Feed rate given directly in inches nr Ar'Ar'gIIIAIrl"|DI'l'DQ nor revolution. I'D\.'t'1I|l'IIQ['] _or millimetres per \]l it r lLLJLl\J\-I IJUI l\Il\Il\J '7 V V wY ' nil mi — . JIIII "LETTER LETTE ADDRESSES DDHE USED
CONTROL E :INUMERICAL C U G IN Cl Š ãi E! Cl ,ElË siili:I: -IlICD „. _ l'I 'M7 Letter Laue' Address I Š M00 MIJIJ Angular dimension about the X-axis, measured in decimal parts of a degree Axis nomenclature B Angular dimension about the Y-axis, measured in decimal parts of a degree Axis nomenclature C Angular dimension about the Z-axis,
measured in decimal parts of a degree Axis nomenclature D . Angular dimension about a special axis, or third feed j function, or tool function for selection of tool compensation Axis nomenclature E 1 Angular dimension about a special axis or second feed function Axis nomenclature F l Feed word (code) G i Preparatory word (code) H M01 M02 l M05
M06 E5c:an M07 M08 M09 M10 M11 M12 J or thread lead parallel to the Y-axis interpolation parameter orthread Circular interpoia» interpolalion and threading tion itK 5 interpolation interpoiation parameter or thread lead ieao parallel to the Z-axis Circular interpolation and threading Unassigned 5 Miscellaneous or auxiliary function Miscellaneous
tunctions functions N Sequence number Sequence number 0O Sequence number tor secondary head only Sequence number Third rapid-traverse dimension or tertiary-motion dimension Axis nomenclature , parallel to xX l QU l Second rapid-traverse dimension or tertiary-motion dimension parallel to Y Axis nomenclature R y First rapid-traverse
dimension or tertiary-motion dimension 1 parallel to Z or radius for constant surface-speed calculation Axis nomenclature S Spindle-speed function i Spindlespeed T Tool function Spindle-speed Tool function U lr Secondary-motion dimension parallel to X Axis nomenc ature nomenclature itV l Secondary-motion dimension parallel to Y Axis
nomenclature nomenc ature W U3 econdary-motion dimension parallel to Z t Secondary-motion Axis nomenclature nomenc ature X \ Primary X-motion dimension Axis nomenclature nomenc ature Y Primary Y-motion dimension Axis nomenclature nomenc ature Z1 él Primary Z-motion dimension Axis nomenc ature nomenclature til ti tli tl il il ti @ "%
DBSOflpfi0n Description Automatically stops the machine. The operator must push a button to continue of the program. with the remainder remainderof An optional stop acted upon only when the operator has previously slgnaled signaled for this command by pushing a button. On sensing the Mot M01 code, the machine stops automatically. At the
completion of the machining operation, this end-of-program code stops the machine when all commands in the block are executed. May include rewindingthetape. Starts spindle rotation in a clockwise direction — - when viewed from the spindle face. — when viewed from the Starts spindle rotation in a counterclockwise direction spindleface.
spindlefaoe. Stopsthe Stops the spindle. spindle, Pn GS m r~l-pnnn nf tnnl hilt rinnc: pint r~n_rnrfl1_l=\vuuv cnirlgijgp UU §3 cs automatic :3at;If'UUIM HUU \]\.| but nu does uuuu not \J coverthe vv u CD :3 c: E51. or Commands manual change of tool selection -1 cr Z ifwithiththei-words. st E1 H::r'ool,'aas 5.is possible ossiEB oftool, the T-words. O')
Unassigned Circular interpolation and threading P M04 Preparatory words A Interpolation interpolation parameter or thread lead parallel to the X-axis L M03 Feed words I M MISCELLANEOUS FUNCTION MISGELLÅNEOU NCTIU worms RDS usen IN NUMERICAL cournot Š n-Efr:= UŠËË iii Ñii ' I- rici ' z: -|::ici ,. . Code Refers to ._ . A l '
Description 7 — 'U Turns flood coolant on. Turnsflood coolanton. Turnsmistcoolanton. Turns mistcoolanton. Turns coolantoff. coolant oil. Applies to auto-clamping of the machine slides, Workpiece, Appliesto ofthe workpiece, fixture spindle, etc. Unclamping code. An inhibiting code used to synchronize multiple sets of axes, such as a four-axis lathe
iathe having two independently operated heads (turrets). Simultaneously activates Clockwise spindle motion and coolant flow in the same M13 command. Simultaneously activates Counterclockwise spindle motion and coolant flow in M14 the seme same command. feed motion in eitherthe either the + (Mi 5) or-(Mi 6) direction. Rapid traverse of
oifeed (M15) or-(M16) M15l0 M15 M15to M16 Unassigned. M17lo M18 M17to Causes the spindleto spindle to stop at ataa predetermined angular position. M19 Permanently unassigned. M2l]to M29 ivi2tlio An end-of-tape code similarto M02, but M30 will also rewind the tape; also may M3U M30 automatically to a second tape reader switch
automaticallyto reader. M31 known as interlock bypass fortemporarily iortemporarily circumventing a normally i A command provided interlock. Unassigned. M32 to M39 Used to signal gearchanges gear changes if required atthe machine; otherwise, unassigned. M40 to M4fi M46 Continues program execution from the start of the program unless
inhibited by M47 inieriock signal. an lrlleriock Cancels M49. M43 M48 teed override and returns the parametar parameter to the M49 Deactivates a manual spindle or feed programmed value. liilbll Mb I Unassigned. IVIÐU I0 ID Mb! Cancels M59. M53 Nl5B use when M59 is initiated. Holdsthe rpm constant atthe value in usewhen M59 Unassigned.
M6010 M60 to M89 for use by the machine operator operator. Reserved foruse M90 to M99 V \ El Pi' SURFACE SURFÅCE ROUGHNESS 8: & CONVERSION GUNVERSIDN TABLES SURFACE FINISH SURFÅCE FINISH EXPECTED EXPEGTED FROM FRUM VARIOUS MANUFACTURING PROCESSES VÃRIDËS ¡il¡¡\N¡¡FÃČTi¡RiNË PROËËŠŠËŠ _1fl
Rgug|'||1e$3N¡|_ Roughness No. N12 N11 N10 N9 iiiiciom ' " eters Ll Rarfi) Fiailiii'i) ~ . _ 50 25 12.5 6.3 R/llcrrumeters su zs sa Ra - Average roughness oi of centerline Fl ato : . /A i /"rw l -1-—P -_- %V nofagn'f'c not =ememagn`f`caton r"\ \-J D'D`*recctt'o prof _.'A lifit-\ nnnn innn 1-*.|~u'\ irirblutiibiluh l1d(_Luil}zi.ruu ruuu auu Ifviiül'üiñüiiñã
Hã(_uiii)2üüfi ifiüü äüíi Recorded direction diregtion y..'f!?!!!" . \ I I J?Q _I. D'"_onreectct'o prof profe i L lI (Measuring length) Rz - Average roughness at 10 points - A -P 'Wm_ y - E a H ' magn`fcaton f'cmagn at'on '4.-i Ñ H? 2 Ln WY .: =cfonof -of Ë*~ i~ fon c D'"re prof 7:1 m R3 r- '__? Ñ /M . g' . convefsion Tables Tables Conversion Average iM`
aximum Average Maximum Roughness height ._h 5 ofcente_rlineg_______g____ _______ Z 0f fiflflflflíflš__ Ra (um) _ Ra (pin) Ry. (um) W|1fl(l.1i'I'l) R\l'(_Lll11) N iu* 0-012 0.012 i........Q-.59 „150 . 9-95 0,05 . N1 oozs 9% 0.1 to 0.025 1 0.1 _l|..1. N? NaN3 —— 1 _ —— 2 _ -._______ . N4 N4 N5 _§ N5 N_fi ill? N? N? 5 NB H5. N9 i ._J_9 N1_0 N1_U__ N11 " PR
N11 25 N12 77 fiN12 Mi W *so 501* 1000 1.000 zooo .2000 - 1. 00 199 200 A T Wzoo 1. 00 1.9.9. 200 200 i. ; . 5 _ g_ _. . ` V Å W .-. 1.1.';-: . _:.;_. 'r.'-'11'!-.' Il i lit iltil i til il — l i U U ` :2'-I2-T-L1: '.5:-§\I-I'T_I K il __, _.,_ . l ' ' | y ii X- at-I 3131'; l i. _i W 1 -______i_a_ai-_ -I-lęfl mzPr—4aa=nm; 'F|l' ' i \ I SiT i i it r ' -1 ' i I ' 4 " ii' 0 _(1 I I A A . .__ti _L E ll
m::.1=-—=-|n:I>=-šE; l A » . I A .. ';:5;=;::_;;.¢j:.'-,-;_,_-. l `) C _»T A ((i_errtcl,„ fjf .I _Ž; ~ A _ -;-;~. '-}.'-'-!-:-'-.'7:'-'-.-T1-2I1':i-";'!; 1;: U H __l" Extruding |__i_.---._.. Drawing/Cold Rolling/Cold Rolling Rolling" g Die Casting W -t W A b Z l as l | t investment Casting ('"vs$toet1..9eeiitL VW _ _ _ l l l _ Žiri FTTiirfliiiiiirliriiicićiaiifi. grm-Mwflflišfý y{__l VV __ _ Forging
VVV 1 V L .$.*'.'1l .°?lâ'_iF!.@1__ I . 03 C ` _ _„ _ WH ' .- :-;'.-.¢.-:- ` A 5051* i »Ž V; l l _-i_-¢l_'-».1 I Sand Casting "' ' T" """"""—"" Hot Blliiiflg Rolling M Hill | (\ l l I Fir" """"l""""" _'l"i 7 F* ' *\ I .. Super Finishing Y Z A -- Polishing f_0|;S|1;_I19 |_app¡„g I-aiiiiino VVVV _ fD`\-Illkl \ l R0||e|B|_||'||i$|1i|1g Tr'l range Triangle Symbol U u.oU l) l Honing
Average Average roughness 3 at 10 points atiopnints Rz (pm) Rz().im) .0.0fis_ . 9-.°.53_ - 31"' 211;-E1 . ;;:-_A :.; -r.'-:-_' Z~-.'?'I- iiser Cuttiiig I19 H g 1I g r_7___ Barrel Finishing Finishing Finishing . - 5 we. V LC \ ._.1= _v" i=.r.i _-fl_=i eri=.f g 0.125 0.125 0.05 0.2 0.250 0.250 005 A _ 0-2 nin 4 _g__g_ 0.4.1>. 0.50 o.1.o_l o.2c on.h o.e 0.20 i 0.8 1.00 0.40
__________„_ _L 1.6 zoo 16 0.40 1-5__-_... __2-.000.eo egg _ W/i.0 0.80 ` .- . 32 3.2 4.0 1.5 1.6 Ñ -'i 7.1 63 ; as 7.1. 3.2 § 12.5 125 12.5 12.5 .125--. . 12.5 6.3 250 25 25 S250 9 25 25 as 12.5% 12.5 500 50 __ _M50 50 500 so _50 —-'——fi I __ , _suriazeoririåing ghz . A -.$.tr*ats.w.--. R7 g 'I ËI 'I§1 zzľ W LEI Recorded % ÉL l .- - r. -. . „.v v. 1;" v-v .
direction L l (Reference length) 4 li E Reaming R°?"'¡_"9 G U u A .___ _ F Turning/Boring -..ttriii.s!B"iwi Average N0 i til" \ P ęèuý ` Broaehing eriiriei iiirrr R5 6 Rh oug ess Roughness Number `` 9"°""°a[Ëlilľflltlifl. Ebm .-._.," Millinn ýmiuirlo .... "5 "ZZ 7 I0 in N1 0.05 0.025 0.012 o.1Wo.os"o.ozs o.o1z 0.1 .. ' ' " i . T -—) N3 N2 00551155" N4 _ . .
-._- _rlPlaning/Siiaiiiig affii/.Sr=-vifli . direction idhecuon 32 u sawills Sawi ng Filing .fflwj Recorded §; ;:% D na3 - Drilling žé E rimfifl? "F of onf magn`f'caton _ =emagnt l\ ICU 125 N5 . IS :-' |-il- Average I IIF NE Hand Grinding pi-landifirinding i Disc GGrinding rinding 7 ._ a E5st (Ry) - iviaxiniiim Maximum hei" height 2! fit>12 Rmax _ N1 N7 1.6
""o.ŠWo.4 0.8 0.4 0.2 te o.z 2.". an ltriugiier Finer' ltuugher 4—> 4--> Fine; Flame Cutting Snagging l.§'Fi99?'?9..-.... E t flPl\ {DU Zãü Mfg. Mig. Process Average L I (Measuring length) 'I ~on cat 3 |%RTii:.,....:;'.:_;_i..tA_ 5 NB 3.2 '151¡ A Ĺ . I l l A 4 ' lil *_ g _ 1A (.._-.. . . pw)t _ r . '_ r->—ln'i§ 11I->-Im: _ y . _ : (l l .. __ __ G'-I2- ESQ-I1 \ NOTE NDTE :
The ranges shown above are typical forthe for the processes listed. Higher or lower values l may be obtained under special conditions. underspecial < r It -___. -_ -I - -_ ",' .l - ' _, l _-.-.- .3--. 3. , ;. "'_;;. .'-' ".- - \L-7| i_- :._-_- - ., _.) 1 '.-.; .'- _ 1 . El ..-_ 'fw ____'COMMON Ë9_'I'lV'TREATIVIENT PI'_TERMS IËEFL'Ë_ OF __ _____ _ USED IN THE HEAT
TREATMENT Uf STEELS I I HEAT TREATMENT: A process which involves a combination of heating and cooling of STEEL HARDENING/TEMPERI-NC STE" "^'*°¡'""°/TEW!ËE!*!Ë"Ë__ TEMPERATURES COLOUR TEMPERÅTURES JUOGEIJ JUDGED BY GDLUUB Deg. C Deg. F F _I . Colour "rile" I steel in a prescribed manner with respect to time,
temperature and rate of heating and 1400 cooling so as to induce desired properties inthe in the steel inthe in the solid state. HARDENING: A process which increases the hardness of steel by changing its chemical and structural makeup. This usually involves heating the steel to above its critical point and then quenching it in a prescribed medium.
Steel with less than 0.3 % carbon cannot be hardened in this manner but its surface can be changed to high carbon steel (by case hardening) which then can be hardened in the normal way. White welding heat ` 255-2 2552 1300 1300 A 2372 Yellow-White 1200 5 2192 Orange-Yellow 1100 'I100 2 2012 201-2 Orange-Red 1000 1000 900 000 ; E 1832
1832 Bright Cherry-Red BrightCherry-Red CASE BASE HARDENING: Hardening the surface layer of steel by changing its composition, composition. followed by heat treatment in the normal manner. The process of case hardening involves heating the low carbon steel in a rich carbon source (powder or gas) at a specific temperature for a set period of
time, whereby carbon is absorbed into the surface of the steelto steel to form a high carbon steel casing. The steel is then hardened and tempered in the normal manner. P Cherry-Red P Cherry-Red 1472 Dull Cherry-Red 700 700 1292 A 1202 501 1077 ca "-J'-.| _-L CZ El E5' :3' Red ITheat, IJIJcica. 2. SI CID in5»sunlight lia- visible 975 Red heat, vlslpleni visible in
daylight 1 C '__L__s. 1652 1652 525 . l 800 CI1 OD -1. l: Dark Red f\ flfl \l'lf'\I I3 Ifl CI r-'0' U„=_=„=„ „ -in GUENCHING: An accelerated cooling process by immersion of the heated steel in DUENCHING: A liquids orgases. Oils are often preferred to water as a quenching medium as they are less drastic and more uniform in their cooling effect.
Quenching in water produces very hard steel whilst softersteel likelyto quenching in oil produces a slightly softer steel that is less likely to crack or distort. TEMPERING: Re-heating the quenched steel to a temperature below the transformation range and, if, necessary, holding at that temperature, followed by cooling at a suitable rate to achieve
desired mechanical properties. ZIIILIIIULI I l R-|I\]\]\]lJ\J \]| IIILI LI\]LI\]|| IS \J§II lJ\J|I ||||.\J 608 Grey 590 LightBlue Light Blue 570 Dark Blue , 560 560 I l Full Blue 277 l I NITRIDING: A process of surface hardening by introducing Nitrogen into the surface in a suitable steel by heating and holding itft at an appropriate temperature in contact with
cracked ammonia or othersuitable other suitable nitrogenous medium. steei withoutfurther without further need tor This process produces a hard case in the steel for heattreatment. NORMALISING: NDRMALISING: A process of heat treatment for improving mechanical properties Brown Purple Spotted-Brown 260 l 500 Brown Yellow 490 Yellow
Brown 480 Dark Yellow 243 232 1 t I If 232 li lil il ilil li LightPurple Light Purple 520 510ill 51 l . ` 470 238 230 | 530 I 249 ' Full Purple 266 255 254 I -I Hari: Purple Piimlo Dark ......,. ... ,... 550 271 appropriate temperature and quenching in a suitable medium. STRESS RELIEVING (STABILIZING): Heating to and if necessary, holding at a below
sufficiently high temperature be ow the transformation range, followed by slow cooling to remove internal iniernai stresses only. 626 m2a2 282 1 54o 540 INDUCTION HARDENING: A process of heating by electrical induction to the INDUCIIQN heating and holding for a specified time at a suitable temperature above the 320 310 288 FLAME
HARDENING: Rapid heating of the surface layer of the steel by means of a flame to a temperature above the transformation range, followed by immediate quenching. transformation range, followed by cooling freely in air. CD I\J Ci') 293 293 \||\J brought about by grain refinement and uniformity in structure. The process involves 330 299 nrnnnce of
nf IfTITl'\fllIf"I|"'if'f infn the 'rhi:i CARBURIZING (C Greyish Green li"\-nail-.L\ i"\-nan UIIUYIDII UIIUUII OJ OJ CI 460 450 450 l 227 440 221 430 Deep Straw Yellow i 5 Straw Yellow II 'DZ 1: -: |rn'ušrl1-I (Pale Straw Yellow PaleStraw l LightYellow Very Pale Yellow PaleYellow _- I! il GI :Ð Iii-0-ll! ni ::l P+ :5 ::_ca. -i:3"cia noca' ca ea.2?-2,g re=1 1' , . . .
-. . | 1- 4 3 =- .\: :~" 3: s 1' ._-H' ._-'\. '~_ .,,(,,..2-.r._4 5 (7.-.' ,1 a . rt-. F. /._ J_.5-. = ;.~l-2'...\1, if'-"_~-'»c§i L>:-?-,>-'\.I.-:1.;-"'~I ., rt i A 9"» 1 . -~r -\ '?.-.- 2 ea E2:fitcÉ?oO=2'3:3:Š1:coclCl « 5,3. . 2- 1: It Ć) ca" C2.r+ ee=>Pco 7 \Ñ Y .-. L .4 ;.-¢. .~.._, 2.-,5 -- .../ ______|i____________.'ī—~efi~ -L 61 I154) " fifiñe 11 III I: IE -I HARONESS C? G: E: -:i:: E! on
GD Il CHART :E :a :UII I:nnonon COMPARISON 7 ' 85.6 85.0 1 767 757 84.7 E 757 [U1 on A 0'I.'l84.4 ` 745 745 84.1 733 83.8 ?722 722 712 83.4 7l 710 _710 1 ' 696 698 670 77 570 9 656 555 7 ---_ -- ' 67.5 76.5 67.0 77571 76.1 900 95 7 66.4 53.4 75.7 1 330 880 93 64.7 74.3 7743 73.8 7 64.0 717736 820 7620 64.0 800 QII H Ud.U 1 65.9 1 65.3 --7
61.8 (81.3 80.5 601 1_ 501 É W. 79.8 i. 81.1 80.6 79.1 56.0 66647764 one 78.4 7|-A -I Q"I.! I-l-I- 54.7 2 77.8 634 77.6 534 77 7ílz776.9 514 76.9 495 7 4 | 53.5 can9°r_n 52.1 17 -_ 780 750 7670 7740 740 1 67.7 7 691 569 1 66.6 ` 669 65.8 il_ 7 547 647 0': F" '-~l 61.0 59.7 455 7 466 ~-72.0 7),---_ 72.0 -71.4 71.4 1 44.6 (445 1431 143.1 u-i 9° co 58.8
41_6 41.8 40.4 56.8 7'2 /1 73.4 I u.—r 74.2 74.2 72.8 11 7 70.6 63.8 51.0 . 49.6 62.7 48.5 51.7 61.7 440 1 425 57.8 1 410 (54.6 77 64.6 7 1 383 0-1an$7' 27-"11"\I 55.7 -- 1 86 7 1 66 -84 64 1 ---- l 1 75.I"1.~'7 "»:.'7':.;' 0'-1 11~. .1. ii =1 ' 4. .3 0 1: 5 .»-.- 1 81' 81 80 71 350 3507 gr .'--:. _.1 . rl -- 1 _ 75 \¡\l u1\| 70 I\J I'-J _i. CD 71 202 66 ' 65 T_ 1 : _,
mmm _kmmoi 61 154 01Lo 59 143 149 Utm 58 142 56 1427 136 136 129 129 Ž 754 124 *W 52 uwu-iu-i Nam 51 Q1 _.Å __l. _ 177 170 152 162 /—-. _L /—\ 1 7120 120 50 1 175 115 -l>u1ooo 48 112 tlfliü iül tilitl flli l 319 319 309 309 43 ->-àwu-i CPI '--r 47.6 301 OUI i l l l , _| 1 ,7 ' 1020) (102.0) 60.6 60.8 --77 --- l ---7 __-_ 7 l -- 1 247 247 97.3 077.3 241
É4 234 96.4 (17.5) (17.5) 228 05.5 (16.0) 222 (16.2) 1'15. 2) 93.6 93.8 1 (136) (13.8) 926 (12.7) 92.8 (12.7) ' 94.6 167 ---~ 86.0 -- 80.8 606 l1 70"? 77:17 -'Uri' ru.: 111 111 l »L _1 i ---A 1 69.6 69.8 -_ _ 67.6 67.6 _ 7 171 23 22 22 C111.'-1/' =.._ -.,. -.:-r. we K ->1-'-/.-=' '-1.-5.-' .-.'. -~ .1-. 3., _-. -.-, '.'-:4 '1 , _-.1. 7" .~.'-.;.6 _-„,, 4 -: .\. T->:a 1- - 2-.- 7 55
53 S 51 Utca 50 7' 760 47 21Ž7 4 46 20 127 127 19 122 122 713 16 715 15 .—..._ ..-s_ ./._. 7 507 58 _ 1 117 61 U1in 1 V \. 63 mmmwww cn _s 26 25 -ii-n 150 IQU 143 -I @- \l = . mmm\ 57tooo 156 1 na 66.7 65.7 III 65 753 163 1t eno. „ima o¡„..„ 7 ,i me ..... „... -..„.,„..,„„y ....„.|.. use". ...-.. 'II In ...., nhnun ...., r-ha ., |„ .,....... ...:u. ......1 „... :5 are
not commonly used. scale 0C5 and aree scaled with diamond brale. 2) Rockwell seal=1: E1 A, 1: ::: E; hiI'D G9 2- D U =2 :3'm I, 1 1 26 25 ._ 71 ---7. --- l _ 162 137 71 137 132 ` 7132 74.0 72.0 72 72 70 182 1 175 tí 1 76.4 - 1 28 27 7 7277 --- T 77 7 125 12671 192 102 -- \ 31 1 ?775707 69 30 77'577 ao 67 Q JI 202 2027 77729 29 196 Š 178 173 76` 78
1 32 188 l Qfl 760 uu \ 33 -- (44) (4.4) mnomàmw 134 82 (32 _33-A 117 747 747 -- " 7 357 mwAm 34 I -- _ 89 Q1: uu l (3.0) ' (210) 16.4) (5.4) 7 (64) (5.4) (0.0) (0.9) --- 7 7 (9.0) (3.3) __ - Ž-7' 85.0 143 1 - 82.9 62.9 149 'I/IQ I_Y\-I 7 7207 207 -I 1 (11.6) 1 11.5) (10.0) (10.0) --- 77 218 216 7 212 212) 7 \ 1 1 —i i 99 38 l 170 -_ 1 41.4 170 1 269 269 20.6
20.5 i 40.5 40.5 (166) 113.0) 7 -- I 103 (CCD 36 caGa 21.7 21.7 . 30 39 ` 737 mw \ICQ F" -- 44.2 44.2 l 253 263 90.0 90.0 1 89.0 1 _ 1_ 67.6 87.8 ` 66.6 86.8 H3 179 276 276 1 l 103 _AOon 1057 106 ' 07 com\lw _1-_i94 . _ 41 417 1 40 $7 -.i=. 9171 Ë31 261 91.9 91.9 'Ñ7 90.7 7` 284 1 45.0 7 7 _-- 292 1 95.5 I 45 find 46.7 1 46.7 1 45.9 469 1 26.4 25.4
98.2 3. - J—sn 121 .11-In "-H.D /-\ _L G 63.0 mm „WE"oo: 192 192 116 116 | 46 ->01 43.2 432 —-L CD$.71 nn n7 £21.21 $4 W 131 7 323 328 42.0 /--. __| 167 1377 x„í_w '~_r Z \-4 47 -B\A 50.0 1 60.0 49.3 1 49.3 46.3 43.73 1 24.2 24.2 U\J.\J 156 1 1|- Z 339 22.6 22.8 £12 '3 153 163 ' -*4 f 174 1747 170 1}. ' i7 51 51.0.0 7. 51.3 17 100.0 61.6 1000 7 61.4_
51.4 '7 99.0 I7 186 ii 177 A) 1| (it \._,r 7' O:N 52.5uw . (101.0) 101.0) 777193 5 Y \|`1\i 9.30: 70 moc 68 1 1 '--. 167 .137 133 163 77 J ,—~ 241 77 235 236 |. \Jco 79 l 266 277 277 269 250 262 ' 232 255 }is 7243 77246 229 7777223 223 217 212 | 212 207 207 201 201 '1 197 107 1))1 57.5 67.6 17 (106.0) 108.0 1| 34 . 3 34.3 1_676_9 (107.6)1 66.9 07.5
) 33.1 66.3 I 66.3 (107.0) 070 I` 32.1 321. 65.7 66.7 -_ 1 (106.0) 30.9 F" 30.0 l_ 66.3 (106.6) 772799 64.6 (1016) 26.6 64.6 :0-8 ' 28.8 (1040) 27.6 0777 64.1 54.1 (104.0 27.6 1030)- 26.6 7 53.5 7 (103.0) 26.6 229 83 350 360 U"l _L 5 CD1 ' 2ų_ -- 372 @ I 87 67 ' 396 6467 70.0 353 1 -9° oo 1 0-163.6 . 3)1 (110.0) 352 69.3 (110.0) (37.0 37.9 352 750 0'1
I" 341 777667 (109.o)` 36.6 341 537 , (109.0) 355 1 52.8 51.9 331 7 7753.1 66.1 (1066) (103.5) i1 36.6 35.5 39.1 R 88 1 I LUU %T1; 7 90 -L Rockwell Hardness ' "RD HRB _HRl _3 'HRC HRD 1 111111! shme Transverse "mm HRC Vleliers . 0 rs . -Sitore Scaie ` Scaie Scale Scale Scale l Scale Hardness "" 1 Rupture " " 50318 HaI't1l1ESS 1 Hardness
1001191 50 kg Strength 60 kg 1 100110 100. kg 1 150 150110 kg) 100 kg A 50kg)""""'°ss 84'6""? 1 (ko/mm") (K0/mm) Brale l '/1.,|n Ball Brale 1 Brale 1 /1,, in Ball' I 4 3.1: ODE -- 90 1 293 2937 . -- 91 UI 7 1 [ti HRA 311 31 1 302 302 _ 1 92 1 _Efl-I JUI 60.8 AUG /100 -n_u (321 321 1 615 up -_i T4 1 cc -r 05.7 UUJ 1 45.7.7 45.7 -- 363 7 840 47.1 --
74.9 375 -- - 76_6 75.6 415 T 401 7 4071 366 ' 333 96 528 523 508 503 77 491 491 W 472 76.3 7 477 461 451 444 4447 -me 92071 920 l l l l 627 72.1 72.1 - Qfifl uuu 860 7 73.3 73.3 72.5 72.6 1 \ 97 737 72.0 1 7377 72.0 l . 61.7 720 71.6 61.0 ' 71.5) 51.0 7oT 700 70.3 60.1 -_ 60.1 7 70.6 697 -_ 71 50.0 60.0 1' 70.7 70.6 690 70.5 690 59.7 680 70.1
77660) 59.2 70.1 670 69.6 1 670) 53.3 7 50.3 77536 667 667 69.7 58.7 -_ 66.7 640 640 66.7 1 68.7 0157.3 T4on 81.8 80.8 74.8 940 61.7 82.2 638 533 630 630 T- 75.3 1 -- 71 753.3 63.3 52.5 l7 62.6 82.2 1 —l -- 82.6 81.2 . 1 83.0 653 553 647 547 1 76.9 r 664 684 662 682 68.0 -- l1 67-3 67.0 85.3 -H"? (HB) (H5) 7r 1 l I Brinell Hardness 3,000 kg I -.-.
EE l Rockwell ockwell Hardness , A '_ 0 — T 6? z. Transverse Z Brinell 7 Vickers HRD)_UlCI(&l'S HRA HRB HRC Show Shore A Rupture Rupture Hardness Hatdness i-iardness Scaie 'Hardness (HB) Scale ,(Scale =) Scale Scale ;Hardnessi Hardness Strength (H3) 50 kg 1kg¡mm,1 100 kg k 1 100kg 150k 100l1g 50kg y (kg/mm.) ' 60 kg 100 kg 150 kg
00 0 , 0 3,000 kg /1,, in Ball* Brale Brate \ Brale Brale 1'/1,lnBall' Moo kg 512111" Ll -=1-. er. 07.;-P .,'._ = II I: :I I: II rn on Ch Cä S: I: E! onC: il CHART GI :II ::IU -I HARONESS COMPARISON \ ll -2. ,(¢--._ ll 44 447 42 7427 i1 2 41 39 77 . I 1 1. .4 1-1.3 1¢_1'.-.- .'. .1, #91 . 11 E. '41-7.».- '51.; 11 1134 11-,. 5 '_' äur31fiwwä ~ 15 .1-1-~ _.-_.»-_--51-1-;.-
-.-4 .- - -- 31 L»z-. ->25 'ff"1tflæ '\ . ...1- 1-':._.\ 1-. -1 .\' 1157 -1:= EE 111 OF TABLE 1: -11 NATURAL :Il Ih -11:: IIID ,.. SINES 1!!:i: 111135 TABLE IABLE OF UE NATURAL NATLIBAL SINES SMES 'L SINE 1059, 0331 SINE 9105 g1 fwfi De2_T__11 111 111 111 % 59__ 50 75991 1°0'1ff 2577777777?701r7f ii "Ž _Š¡f"Ë"_A9 00 11 10 13
7"ñwéžñééfiéñiâ44Ë444¡07717`7š0"" 717777f?51.11¥ 3" 1 40 1 507 P 7 W7 Ul30 `; R0 nnnnn I _gggQ1 110000 00582 00873 1 .01164 n **** _302917 ""_ Ĺ00532_1 _00373 .01134 11 .0145 .0145 .I> _'_.01745 "74""'¡¡" 01.,5 1 7__:_ :_;_;;;1;1_1_ -'* ______l'ŽŽ_J ' I 45 j71 .1 02055 1 1 .01711 01745 _02033 __„ _ ,O3490 _03731 __"_m1 .03490 .03781
flalhã _05234 0525 4 _05524 05524 _03973 05075 ___ 0725 072 66CD .08716 _03713 .09005 _09005___+_ 10455 _____f ___10453 _____1 _12137 12157 _02327 0232 '"--J 404071 .04071 .05814 05814 07555 _07556 _09295 09295 .11o31 .11031 ____02313 „_02618 __ .02908 _ 0 290 3 _ 031;7 _9 .03199 .2 .._ 1 ca. _03490 .03490 33 717557 _.13629_
13917 13329 1 .13917 I GDQHGIGJI-B -___ "J. 1 -¢h§ 1 1 *4 11 lb g. T1 1 32 I B2 10' _§311 _š3___,._ 54 54 1 1_g1»~41 _35337 35837 522 1 57451 _2Z____ãZ461 23 ~ _39073 39073 131 24 11 _40374 4 05 74 f";:0 £3 1 42252 42232 _43337 45557 45399 __.45399 DJ CD *4 - r__ 'Jhé UÑËQ 1 *4 -5 A 'NI _36379 36379 .57750 _37730____37999 37999
_39341 1 _39303 .39341 39608 740050 . _40939 _41204 41204 .42525 _42525_17Ĺ42733 .42788 _44093 _44359 .44005 44359 .45658 .45353 _ _45917 45917 Ub |\'ŀNWN MI fl'I in-Inr J nA_An CDJi C7OD 1 4. §_ltflGQ I I 1 1 ;A7flO .JQIUD 1 ;An;4 .JqUJ| | ;;4nn __ [C2141 .JJqQ CD .JdlU% rcnwn UUU/O . — Gfi G0G GBlb 1 \J\]\]l_ fld :¢fl | Rfl/11 /1
n\I\I_T|_|' RHI-ME |\J\J\J'-|'\J I .UUUIU I .UI IUI 9 I'I'f\-lf\ 1 2 | C'1'J'J7 1 11 |\J|L'\]l . Q1 CDC -ULJUU 'EB IIŠ 00 00SINE 1' ë\1š3 29'1 7 1 fw 1 9 51: 1 005 - .4 |- 1.__.____.I... . ._. fi'1-'11')/I CH U'\J"I' fl'7fifi") U1' JUL 1 7"lOfiCfl .UUUvJU flO-lfi')' UU IUI 1 00910 \I\J'1I_l U' —L -J1 .. OOQCR |\JLJ.LlJ\-I G!"4 -I@ CD CD __ 13si OBO0O5 flfl Si C0 Ithi Q 01'
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COSINE /I/ 4 777 1 3 ~.;._.:.'. ».,,.'-' ~; 158 TAM __________ ___________11 ___TÅN -TA". 77777" 35215-306771 40 50 175366 60 = uzgľ 0 6 15??' 1 10 20 3_u__1A___40 1__50__ n0501'Y"1jí _00552 nn392 1__00373 00873 17 .01164_'_.01164 _01455 _ 1 .01746 1759"__ 77 7 .01455573f01745 00000 11 ....-. lj; 06330 00291 03201 71 .03492 ;___66_ 02033 _
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1.,-_-. -3.-'-. ll\ .5 - 4-_ .--., €';~:'» 33:'-.-:'r'¢f "č%`~`*r~"E"Ë».;Ĺ ;-'-I'-'5 -".1 3! '3 =1' '-=-=--7 ~-_.-' '".=".>-fr."-. '- '/7; 2: T/' V/ .i to :UI E- Cl ii mi alôiThis -1EI M Book UIOO ,_ Belongs F 1% ~ DRILL GAUGE ::I E! ,_,.- POINT EE :: -I SHARPENING aa ŠE nazac: :Ð I'l|'l 3 nn EEaza :E42) A n5 P:I: 'iu-O41 a 'lu(Refer fa Refer Pages 40, 3 I ' 7 7 _-'Ta ų ~~. _
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from your looal local industrial Equipment & Engineering Supplies Company. If you have difficultywin difficulty in obtaining additional copies, Publisher/Distributor listed on the front please e-mail the PublisherlDistributor inside cover of this book. In view of the fact that this book would be frequently used in a workshop environment, every page
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