Bulletin K-3.3

FORM ROL

KNURLING TOOLS

FOR CIRCULAR AND DIAMETRAL PITCH KNURLING

Form Rol Knurls are made to extremely high standards from the finest material available.

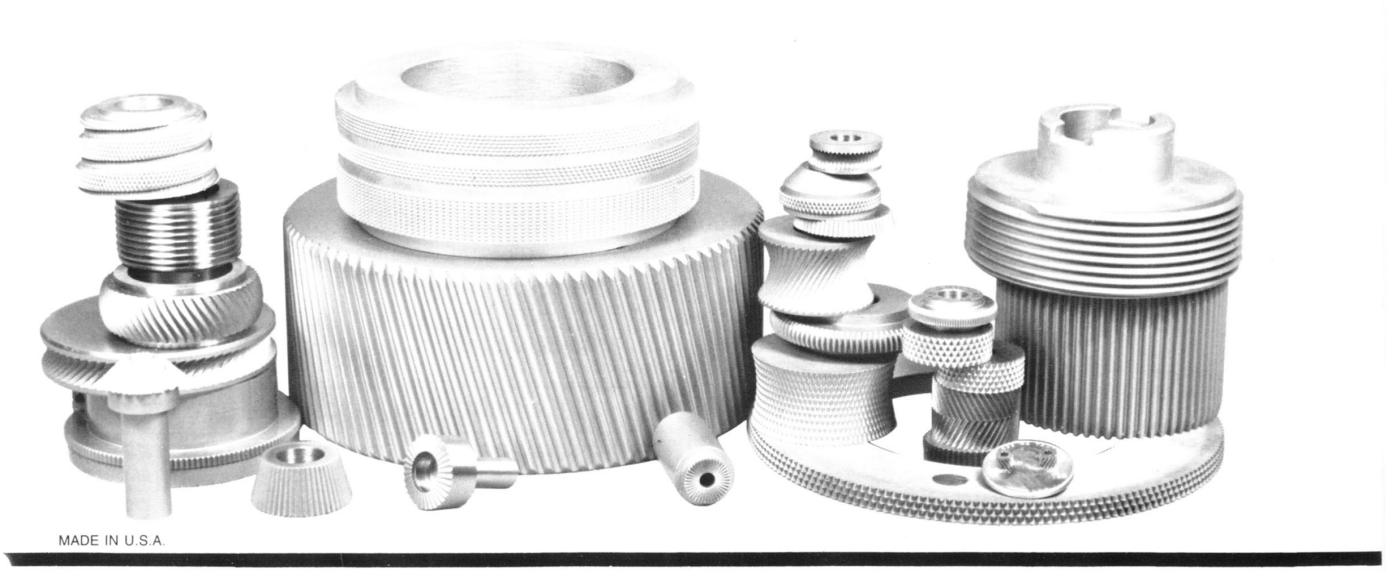
The care and precision used in their manufacture assure the user of a premium quality tool.

The High Speed Steel Knurl, lapped to a smooth hard finish will give longer life and impart a smooth clean surface to the knurled part.

Special knurls for a multitude of speciality applications made to your specifications and needs, including attachment head knurls.

250 different sizes and styles for circular and diametral systems are carried in stock to assure prompt delivery.

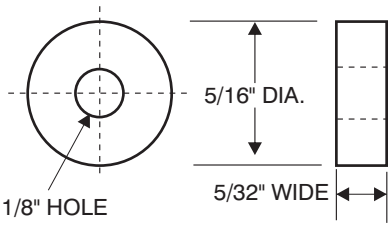
Also call us for thread rolling applications.



MADE IN U.S.A.

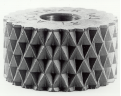
FORM ROLL DIE CORP.
217 Stafford Street
Worcester, MA 01603-1198
Telephone 508-755-2010
FAX: 508-755-5835
E-Mail: formroll@tiac.net
Website: www.formrolldie.com

BP SERIES



Will Fit Following Holders
Form Roll
OR-CSBP05
OR-CSBP06
OR-CSBP08
OR IH-BP
OR-BH-BP
OR-BH-BPS
And For Swiss Automatics

BP SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**BPS-225** 25 TPI/25T				
90°	**BPS-230** 30 TPI/29T	**BPR-230** 30 TPI/26T	**BPL-230** 30 TPI/26T	**BPM-230** 30 TPI/26T	**BPF-230** 30 TPI/26T
90°	**BPS-235** 35 TPI/34T	**BPR-235** 35 TPI/29T	**BPL-235** 35 TPI/29T		
90°	**BPS-240** 40 TPI/39T	**BPR-240** 40 TPI/34T	**BPL-240** 40 TPI/34T		
70°	**BPS-450** 50 TPI/49T	**BPR-450** 50 TPI/43T	**BPL-450** 50 TPI/43T	**BPM-450** 50 TPI/43T	**BPF-450** 50 TPI/43T
70°	**BPS-460** 60 TPI/59T				
70°	**BPS-470** 70 TPI/69T				
70°	**BPS-480** 80 TPI/79T	**BPR-480** 80 TPI/68T	**BPL-480** 80 TPI/68T	**BPM-480** 80 TPI/68T	**BPF-480** 80 TPI/68T
70°	**BPS-490** 90 TPI/89T				
70°	**BPS-500** 100 TPI/99T				

BP SERIES DIAMETRAL PITCH

80°	**BPS-096** 96 DP/30T	**BPR-096** 96 DP/30T	**BPL-096** 96 DP/30T	**BPM-096** 96 DP/30T	**BPF-096** 96 DP/30T
80°	**BPS-128** 128 DP/40T	**BPR-128** 128 DP/40T	**BPL-128** 128 DP/40T	**BPM-128** 128 DP/40T	**BPF-128** 128 DP/40T
80°	**BPS-160** 160 DP/50T	**BPR-160** 160 DP/50T	**BPL-160** 160 DP/50T	**BPM-160** 160 DP/50T	**BPF-160** 160 DP/50T

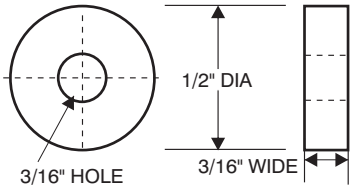
Equivalent Normal TPI of Diametral Pitch Knurls

All Diametral Pitch Knurls made to American Standards **(ASA B94.6 1984).** Diamertral Pitch Knurls produce the D.P. number of teeth per inch of diameter. Rolled Circular Pitch Knurls, produce the TPI number of teeth per inch of circumference measured normal to the teeth.

DP	Equivalent Normal Circular TPI	
	Straight Teeth	30° Diagonal
64	20.7	23.9
96	30.8	35.6
128	41.1	47.4
160	51.2	59.1

TABLE 1

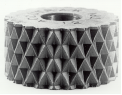
EP SERIES



Form Rol OR BH-EP

Will fit the following holders
Brown & Sharp No.
185-200 (00D) • 190-100 (00AA)
195-100 (00BA) • 200-100 (00CA)
210-100 (00RA)
Boyar-Schultz 00K
Deterbeck-00
Somma KT00

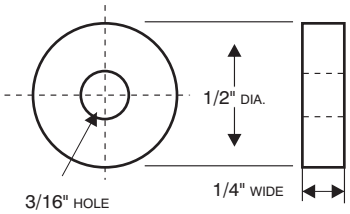
EP SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
		EPR-212 12 TPI/16T	**EPL-212** 12 TPI/16T		
90°	**EPS-216** 16 TPI/25T	**EPR-216** 16 TPI/22T	**EPL-216** 16 TPI/22T		
90°	**EPS-219** 19 TPI/30T				
90°	**EPS-220** 20 TPI/31T	**EPR-220** 20 TPI/27T	**EPL-220** 20 TPI/27T	**EPM-220** 20 TPI/27T	**EPF-220** 20 TPI/27T
90°	**EPS-224** 24 TPI/37T				
90°	**EPS-225** 25 TPI/38T	**EPR-225** 25 TPI/34T	**EPL-225** 25 TPI/34T	**EPM-225** 25 TPI/34T	**EPF-225** 25 TPI/34T
90°	**EPS-230** 30 TPI/47T	**EPR-230** 30 TPI/40T	**EPL-230** 30 TPI/40T	**EPM-230** 30 TPI/40T	**EPF-230** 30 TPI/40T
90°	**EPS-232** 32 TPI/49T	**EPR-232** 32 TPI/43T	**EPL-232** 32 TPI/43T		
90°	**EPS-235** 35 TPI/55T	**EPR-235** 35 TPI/47T	**EPL-235** 35 TPI/47T		
90°	**EPS-240** 40 TPI/63T	**EPR-240** 40 TPI/55T	**EPL-240** 40 TPI/55T	**EPM-240** 40 TPI/55T	**EPF-240** 40 TPI/55T
90°	**EPS-241** 41 TPI/65T				
90°	**EPS-247** 47 TPI/73T				
70°	**EPS-435** 35 TPI/55T				
70°	**EPS-440** 40 TPI/63TT				
70°	**EPS-450** 50 TPI/79T	**EPR-450** 50 TPI/68T	**EPL-450** 50 TPI/68T	**EPM-450** 50 TPI/68T	**EPF-450** 50 TPI/68T
70°	**EPS-453** 53 TPI/83T				
70°	**EPS-460** 60 TPI/94T				
70°	**EPS-470** 70 TPI/109T				
70°	**EPS-480** 80 TPI/125T	**EPR-480** 80 TPI/107T	**EPL-480** 80 TPI/107T		**EPF-480** 80 TPI/107T
70°	**EPS-490** 90 TPI/140T				
70°	**EPS-500** 100 TPI/155T				

EP SERIES DIAMETRAL PITCH

80°	**EPS-064** 64 DP/32T	**EPR-064** 64 DP/32T	**EPL-064** 64 DP/32T	**EPM-064** 64 DP/32T	**EPF-064** 64 DP/32T
80°	**EPS-096** 96 DP/48T	**EPR-096** 96 DP/48T	**EPL-096** 96 DP/48T	**EPM-096** 96 DP/48T	**EPF-096** 96 DP/48T
80°	**EPS-128** 128 DP/64T	**EPR-128** 128 DP/64T	**EPL-128** 128 DP/64T	**EPM-128** 128 DP/64T	**EPF-128** 128 DP/64T
80°	**EPS-160** 160 DP/80T	**EPR-160** 160 DP/80T	**EPL-160** 160 DP/80T	**EPM-160** 160 DP/80T	**EPF-160** 160 DP/80T

EQ SERIES

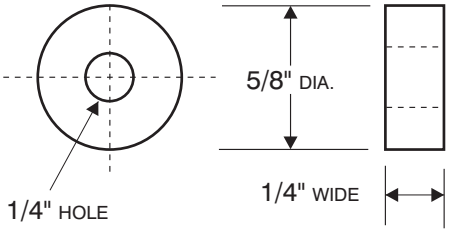


Armstrong & Special Holders

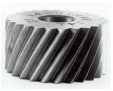
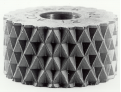
GK SERIES

Will fit the following holders

Form Rol OR BH-GK
Brown & Sharp No.
185-220 (20D)
185-322 (22DA)
190-120 (20AA)
195-120 (20BA)
200-120 (20C)
210-120 (20KA)
Boyar-Schultz OK
Detterbeck 0
Somma KT1, KT2, KT2EC, KT3, KT3EC



EQ SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**EQS-214** 14TPI/22T	**EQR-214** *14TPI/22T	**EQL-214** *14TPI/22T		
90°	**EQS-216** 16TPI/25T	**EQR-216** 16TPI/22T	**EQL-216** 16TPI/22T		
90°	**EQS-220** 20TPI/31T	**EQR-220** 20TPI/27T	**EQL-220** 20TPI/27T		
90°	**EQS-221** 21TPI/32T	**EQR-221** *21TPI/32T	**EQL-221** *21TPI/32T		
90°	**EQS-225** 25TPI/38T	**EQR-225** 25TPI/34T	**EQL-225** 25TPI/34T		
90°	**EQS-230** 30TPI/47T	**EQR-230** 30TPI/40T	**EQL-230** 30TPI/40T		
90°	**EQS-233** 33TPI/52T	**EQR-233** *33TPI/52T	**EQL-233** *33TPI/52T		
90°	**EQS-235** 35TPI/55T				
90°	**EQS-240** 40TPI/63T				
90°	**EQS-241** 41TPI/65T				
70°	**EQS-450** 50TPI/79T	**EQR-450** 50TPI/68T	**EQL-450** 50TPI/68T		
70°	**EQS-460** 60TPI/94T				

EQ SERIES DIAMETRAL PITCH

80°	**EQS-096** 96DP/48T	**EQR-096** 96DP/48T	**EQL-096** 96DP/48T		
80°	**EQS-128** 128DP/64T	**EQR-128** 128DP/64T	**EQL-128** 128DP/64T		
80°	**EQS-160** 160DP/80T				

NOTE:

Right Hand Knurling produced by L.H. Knurls.

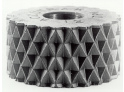
Left Hand Knurling produced by R.H. Knurls.

Male Diamond Knurling produced by R.H. & L.H Knurls used in pairs

Male Diamond Knurls produce Female Diamond Patterns.

Female Diamond Knurls produce Male Diamond Patterns

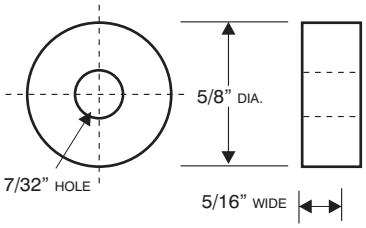
GK SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**GKS-212** 12 TPI/23T	**GKR-212** 12 TPI/19T	**GKL-212** 12 TPI/19T		
90°	**GKS-214** 14 TPI/27T	**GKR-214** 14 TPI/24T	**GKL-214** 14 TPI/24T		
90°	**GKS-216** 16 TPI/31T	**GKR-216** 16 TPI/27T	**GKL-216** 16 TPI/27T	**GKM-216** 16 TPI/27T	
90°	**GKS-217** 17 TPI/33T				
90°	**GKS-219** 19 TPI/37T				
90°	**GKS-220** 20 TPI/39T	**GKR-220** 20 TPI/34T	**GKL-220** 20 TPI/34T	**GKM-220** 20 TPI/34T	**GKF-220** 20 TPI/34T
90°	**GKS-221** 21 TPI/41T				
90°	**GKS-224** 24 TPI/47T				
90°	**GKS-225** 25 TPI/49T	**GKR-225** 25 TPI/42T	**GKL-225** 25 TPI/42T	**GKM-225** 25 TPI/42T	**GKF-225** 25 TPI/42T
90°	**GKS-229** 29 TPI/56T				
90°	**GKS-230** 30 TPI/59T	**GKR-230** 30 TPI/52T	**GKL-230** 30 TPI/52T	**GKM-230** 30 TPI/52T	**GKF-230** 30 TPI/52T
90°	**GKS-232** 32 TPI/63T				
90°	**GKS-235** 35 TPI/68T	**GKR-235** 35 TPI/58T	**GKL-235** 35 TPI/58T		**GKF-235** 35 TPI/58T
90°	**GKS-238** 38 TPI/73T				
90°	**GKS-240** 40 TPI/78T	**GKR-240** 40 TPI/68T	**GKL-240** 40 TPI/68T	**GKM-240** 40 TPI/68T	**GKF-240** 40 TPI/68T
90°	**GKS-241** 41 TPI/81T				
90°	**GKS-247** 47 TPI/92T				
70°	**GKS-435** 35 TPI/68T				
70°	**GKS-440** 40 TPI/78T				
70°	**GKS-450** 50 TPI/98T	**GKR-450** 50 TPI/86T	**GKL-450** 50 TPI/86T	**GKM-450** 50 TPI/86T	**GKF-450** 50 TPI/86T
70°	**GKS-453** 53TPI/103T				
70°	**GKS-460** 60TPI/116T				
70°	**GKS-480** 80 TPI/155T	**GKR-480** 80 TPI/135T	**GKL-480** 80 TPI/135T		

GK SERIES DIAMETRAL PITCH

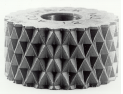
80°	**GKS-064** 64 DP/40T	**GKR-064** 64 DP/40T	**GKL-064** 64 DP/40T	**GKM-064** 64 DP/40T	**GKF-064** 64 DP/40T
80°	**GKS-096** 96 DP/60T	**GKR-096** 96 DP/60T	**GKL-096** 96 DP/60T	**GKM-096** 96 DP/60T	**GKF-096** 96 DP/60T
80°	**GKS-128** 128 DP/80T	**GKR-128** 128 DP/80T	**GKL-128** 128 DP/80T	**GKM-128** 128 DP/80T	**GKF-128** 128 DP/80T
80°	**GKS-160** 160 DP/100T	**GKR-160** 160 DP/100T	**GKL-160** 160 DP/100T	**GKM-160** 160 DP/100T	**GKF-160** 160 DP/100T

GR SERIES



ARMSTRONG & SPECIAL HOLDERS

GR SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**GRS-214** 14TPI/27T	**GRR-214** *14TPI/28T	**GRL-214** *14TPI/28T		
90°	**GRS-216** 16TPI/31T	**GRR-216** 16TPI/27T	**GRL-216** 16TPI/27T		
90°		**GRR-220** 20TPI/34T	**GRL-220** 20TPI/34T		
90°	**GRS-221** 21TPI/41T	**GRR-221** *21TPI/41T	**GRL-221** *21TPI/41T		
90°		**GRR-225** 25TPI/42T	**GRL-225** 25TPI/42T		
90°	**GRS-233** 33TPI/65T	**GRR-233** *33TPI/65T	**GRL-233** *33TPI/65T		
90°	**GRS-240** 40TPI/78T				

GR SERIES DIAMETRAL PITCH

80°		**GRR-064** 64 DP/40T	**GRL-064** 64 DP/40T	
80°	**GRS-096** 96 DP/60T	**GRR-096** 96 DP/60T	**GRL-096** 96 DP/60T	

* The TPI on these knurls are measured TRANSVERSE
To be comparable to Armstrong Williams Knurls

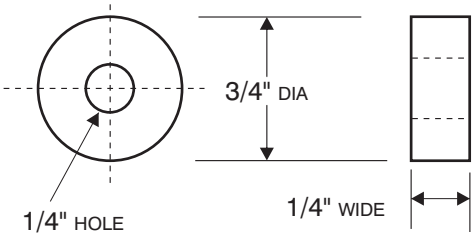
APPROXIMATE INCREASE IN KNURLED DIAMETERS

TABLE II

Using Form Rol Circular or Diametral Pitch Knurls

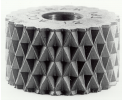
TPI	TOOTH ANGLE	STRAIGHT	DIAGONAL	DIAMOND MALE	DIAMOND FEMALE
12	90°	.034	.034	.038	.023
16		.025	.025	.029	.017
20		.020	.020	.023	.014
25		.016	.016	.018	.011
30		.013	.013	.015	.009
35		.011	.011	.013	.007
40		.009	.009	.010	.006
35	70°	.014	.014	.016	.007
40		.012	.012	.013	.008
50		.009	.009	.010	.006
60		.007	.007	.008	.005
70		.006	.006	.007	.004
80		.005	.005	.006	.004
Diametral Pitch	Tooth Angle	Straight	Diagonal		
64	80°	.024	.021	.024	.015
96		.016	.014	.016	.010
128		.012	.010	.012	.007

KN SERIES



Form Rol OR BH-GK
Will fit the folowing holders
Brown & Sharp No.
185-224 (24A)
190-122 (22AA)
195-122 (22BA)
200-122 (22C)
210-122 (22KB)
Boyar-Schultz 2K
Deterbeck 2
Somma CSKT-DAV

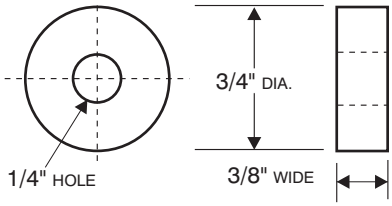
KN SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**KNS-210** 10 TPI/23T	**KNR-210** 10 TPI/20T	**KNL-210** 10 TPI/20T		
90°	**KNS-212** 12 TPI/28T	**KNR-212** 12 TPI/25T	**KNL-212** 12 TPI/25T		
90°	**KNS-214** 14 TPI/34T	**KNR-214** *14 TPI/34T	**KNL-214** *14 TPI/34T		
90°	**KNS-216** 16 TPI/38T	**KNR-216** 16 TPI/33T	**KNL-216** 16 TPI/33T	**KNM-216** 16 TPI/33T	**KNF-216** 16 TPI/33T
90°	**KNS-219** 19 TPI/45T				
90°	**KNS-220** 20 TPI/47T	**KNR-220** 20 TPI/41T	**KNL-220** 20 TPI/41T	**KNM-220** 20 TPI/41T	**KNF-220** 20 TPI/41T
90°	**KNS-221** 21TPI/50T				
90°	**KNS-224** 24 TPI/57T				
90°	**KNS-225** 25 TPI/59T	**KNR-225** 25 TPI/51T	**KNL-225** 25 TPI/51T	**KNM-225** 25 TPI/51T	**KNF-225** 25 TPI/51T
90°	**KNS-229** 29 TPI/68T				
90°	**KNS-230** 30 TPI/71T	**KNR-230** 30 TPI/61T	**KNL-230** 30 TPI/61T	**KNM-230** 30 TPI/61T	**KNF-230** 30 TPI/61T
90°	**KNS-232** 32TPI/75T				
90°	**KNS-235** 35 TPI/82T	**KNR-235** 35 TPI/71T	**KNL-235** 35 TPI/71T		
90°	**KNS-240** 40TPI/94T	**KNR-240** 40TPI/81T	**KNL-240** 40TPI/81T	**KNM-240** 40TPI/81T	**KNF-240** 40TPI/81T
90°	**KNS-241** 41TPI/97T				
70°	**KNS-450** 50 TPI/117T	**KNR-450** 50TPI/102T	**KNL-450** 50TPI/102T	**KNM-450** 50TPI/102T	**KNF-450** 50TPI/102T
70°	**KNS-480** 80TPI/189T	**KNR-480** 80TPI/163T	**KNL-480** 80TPI/163T		

KN SERIES DIAMETRAL PITCH

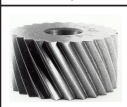
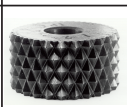
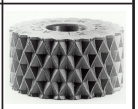
80°	**KNS-064** 64DP/48T	**KNR-064** 64DP/48T	**KNL-064** 64DP/48T		**KNF-064** 64DP/48T
80°	**KNS-096** 96DP/72T	**KNR-096** 96DP/72T	**KNL-096** 96DP/72T		**KNF-096** 96DP/72T
80°	**KNS-128** 128DP/96T	**KNR-128** 128DP/96T	**KNL-128** 128DP/96T		**KNF-128** 128DP/96T
80°	**KNS-160** 160DP/120T	**KNR-160** 160DP/120T	**KNL-160** 160DP/120T		**KNF-160** 160DP/120T

KP SERIES



Will fit the following holders
Form Rol OR BH-KP
Brown & Sharp No.
185-224 (24A) • 190-122 (22AA)
195-122 (22BA) • 200-122 (22C)
210-122 (22KB)
Armstrong No. 1k, 2k
3k-1, 3k-2, 673, 674
All Prat & Whitney
J. H. Williams No.
1K, 2K, 3K1, 3K2
Graham No.2, 3
Slitters 50-1, 50-2, 50-3
Raimike 139-1, 139-2
All Wettstein (Eagle Rock)

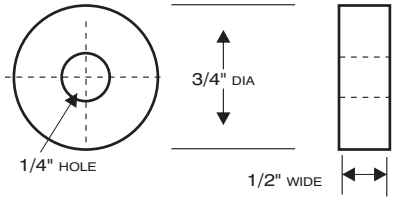
KP SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**KPS-208** 8TPI/19T	**KPR-208** 8TPI/16T	**KPL-208** 8TPI/16T		
90°	**KPS-210** 10TPI/23T	**KPR-210** 10TPI/20T	**KPL-210** 10TPI/20T		
90°	**KPS-212** 12TPI/28T	**KPR-212** 12TPI/25T	**KPL-212** 12TPI/25T	**KPM-212** 12TPI/25T	
90°	**KPS-214** 14TPI/34T	**KPR-214** *14TPI/34T	**KPL-214** *14TPI/34T	**KPM-214** *14TPI/34T	**KPF-214** *14TPI/34T
90°	**KPS-216** 16TPI/38T	**KPR-216** 16TPI/33T	**KPL-216** 16TPI/33T	**KPM-216** 16TPI/33T	**KPF-216** 16TPI/33T
90°	**KPS-218** 18TPI/42T				
90°	**KPS-219** 19TPI/45T				
90°	**KPS-220** 20TPI/47T	**KPR-220** 20TPI/41T	**KPL-220** 20TPI/41T	**KPM-220** 20TPI/41T	**KPF-220** 20TPI/41T
90°	**KPS-221** 21TPI/50T	**KPR-221** *21TPI/50T	**KPL-221** *21TPI/50T	**KPM-221** *21TPI/50T	**KPF-221** *21TPI/50T
90°	**KPS-224** 24TPI/57T				
90°	**KPS-225** 25TPI/59T	**KPR-225** 25TPI/51T	**KPL-225** 25TPI/51T	**KPM-225** 25TPI/51T	**KPF-225** 25TPI/51T
90°	**KPS-229** 29TPI/68T				
90°	**KPS-230** 30TPI/71T	**KPR-230** 30TPI/61T	**KPL-230** 30TPI/61T	**KPM-230** 30TPI/61T	**KPF-230** 30TPI/61T
90°	**KPS-232** 32TPI/75T				
90°	**KPS-233** 33TPI/77T	**KPR-233** *33TPI/77T	**KPL-233** *33TPI/77T	**KPM-233** *33TPI/77T	
90°	**KPS-235** 35TPI/82T	**KPR-235** 35TPI/71T	**KPL-235** 35TPI/71T		
90°	**KPS-240** 40TPI/94T	**KPR-240** 40TPI/81T	**KPL-240** 40TPI/81T	**KPM-240** 40TPI/81T	**KPF-240** 40TPI/81T
90°	**KPS-241** 41TPI/97T				
70°	**KPS-435** 35TPI/82T				
70°	**KPS-450** 50TPI/117T	**KPR-450** 50TPI/102T	**KPL-450** 50TPI/102T	**KPM-450** 50TPI/102T	**KPF-450** 50TPI/102T
70°	**KPS-470** 70TPI/165T				
70°	**KPS-480** 80TPI/189T	**KPR-480** 80TPI/163T	**KPL-480** 80TPI/163T	**KPM-480** 80TPI/163T	

KP SERIES DIAMETRAL PITCH

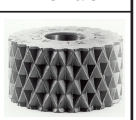
80°	**KPS-064** 64DP/48T	**KPR-064** 64DP/48T	**KPL-064** 64DP/48T	**KPM-064** 64DP/48T	**KPF-064** 64DP/48T
80°	**KPS-096** 96DP/72T	**KPR-096** 96DP/72T	**KPL-096** 96DP/72T	**KPM-096** 96DP/72T	**KPF-096** 96DP/72T
80°	**KPS-128** 128DP/96T	**KPR-128** 128DP/96T	**KPL-128** 128DP/96T		**KPF-128** 128DP/96T
80°	**KPS-160** 160DP/120T	**KPR-160** 160DP/120T	**KPL-160** 160DP/120T		

KR SERIES



Will fit the
following holders
Form Rol
OR BH-KR
and Special Holders

KR SERIES CIRCULAR PITCH KNURLS

INCLUDED TOOTH ANGLE	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°		**KRR-208** 8TPI/16T	**KRL-208** 8TPI/16T		
90°	**KRS-212** 12TPI/28T	**KRR-212** 12TPI/25T	**KRL-212** 12TPI/25T	**KRM-212** 12TPI/25T	
90°	**KRS-214** 14TPI/34T				
90°	**KRS-216** 16TPI/38T	**KRR-216** 16TPI/33T	**KRL-216** 16TPI/33T	**KRM-216** 16TPI/33T	**KRF-216** 16TPI/33T
90°	**KRS-220** 20TPI/47T	**KRR-220** 20TPI/41T	**KRL-220** 20TPI/41T	**KRM-220** 20TPI/41T	**KRF-220** 20TPI/41T
90°		**KRR-221** *21TPI/50T	**KRL-221** *21TPI/50T		
90°	**KRS-225** 25TPI/59T	**KRR-225** 25TPI/51T	**KRL-225** 25TPI/51T	**KRM-225** 25TPI/51T	**KRF-225** 25TPI/51T
90°	**KRS-230** 30TPI/71T	**KRR-230** 30TPI/61T	**KRL-230** 30TPI/61T	**KRM-230** 30TPI/61T	**KRF-230** 30TPI/61T
90°	**KRS-232** 32TPI/75T				
90°	**KRS-233** 33TPI/77T				
90°	**KRS-235** 35TPI/71T				
90°	**KRS-240** 40TPI/94T	**KRR-240** 40TPI/81T	**KRL-240** 40TPI/81T		**KRF-240** 40TPI/81T
70°	**KRS-450** 50TPI/117T			**KRM-450** 50TPI/102T	
70°	**KRS-480** 80TPI/189T	**KRR-480** 80TPI/163T	**KRL-480** 80TPI/163T		**KRF-480** 80TPI/163T

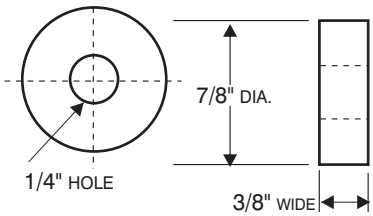
KR SERIES DIAMETRAL PITCH KNURLS

80°	**KRS-064** 64DP/48T	**KRR-064** 64DP/48T	**KRL-064** 64DP/48T		**KRF-064** 64DP/48T
80°	**KRS-096** 96DP/72T	**KRR-096** 96DP/72T	**KRL-096** 96DP/72T	**KRM-096** 96DP/72T	**KRF-096** 96DP/72T
80°	**KRS-128** 128DP/96T				
80°	**KRS-160** 160DP/120T	**KRR-160** 160DP/120T	**KRL-160** 160DP/120T	**KRM-160** 160DP/120T	**KRF-160** 160DP/120T

** The TPI on these knurls are measured TRANSVERSE To be comparable to Armstrong Williams Knurls

MT SERIES

ARMSTRONG
AND SPECIAL
HOLDERS



INCLUDED TOOTH ANGLE	MT SERIES CIRCULAR PITCH KNURLS				
	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
90°	**MTS-216** 16TPI/44T	**MTR-216** 16TPI/38T	**MTL-216** 16TPI/38T		
90°	**MTS-220** 20TPI/55T	**MTR-220** 20TPI/47T	**MTL-220** 20TPI/47T	**MTM-220** 20TPI/47T	**MTF-220** 20TPI/47T
90°	**MTS-225** 25TPI/69T	**MTR-225** 25TPI/59T	**MTL-225** 25TPI/59T		**MTF-225** 25TPI/59T
90°	**MTS-230** 30TPI/82T	**MTR-230** 30TPI/71T	**MTL-230** 30TPI/71T		**MTF-230** 30TPI/71T
90°	**MTS-240** 40TPI/110T				
70°	**MTS-480** 80TPI/219T				

	MT SERIES DIAMETRAL PITCH				
80°	**MTS-064** 64DP/56T	**MTR-064** 64DP/56T	**MTL-064** 64DP/56T		
80°	**MTS-096** 96DP/84T	**MTR-096** 96DP/84T	**MTL-096** 96DP/84T		
80°	**MTS-128** 128DP/112T	**MTR-128** 128DP/112T	**MTL-128** 128DP/112T		
80°	**MTS-160** 160DP/140T	**MTR-160** 160DP/140T	**MTL-160** 160DP/140T		

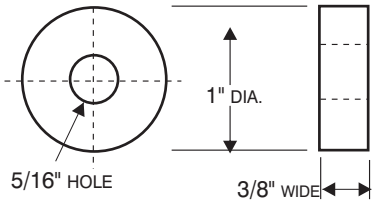
KNURL HOLDERS

Knurling can be done with many types of holders made for knurling or with any holder (or machine) made for thread rolling. Bump knurling from the cross-slide with a single knurl is often the easiest method. However, if a wide knurl must be applied, or the stock size is very small, this method might not be suitable as problems with excessive knurling pressures, or bending of the stock may result. In this case a straddle type holder should be used.

When knurling from the cross-slide with straight knurls in a straddle type holder without a connecting gear train, a certain percentage of parts may be expected to double track as the two knurls are tracking independent of each other. With knurls 30 TPI and finer the problem is minimal.

OU SERIES

Form Rol
OR BH-OU
ARMSTRONG



INCLUDED TOOTH ANGLE	OU SERIES CIRCULAR PITCH KNURLS				
	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
90°	**OUS-210** 10TPI/31T	**OUR-210** 10TPI/26T	**OUL-210** 10TPI/26T		
90°	**OUS-212** 12TPI/37T	**OUR-212** 12TPI/33T	**OUL-212** 12TPI/33T		
90°	**OUS-214** 14TPI/44T	**OUR-214** *14TPI/46T	**OUL-214** *14TPI/46T		
90°	**OUS-216** 16TPI/50T	**OUR-216** 16TPI/45T	**OUL-216** 16TPI/45T		
90°	**OUS-220** 20TPI/61T	**OUR-220** 20TPI/54T	**OUL-220** 20TPI/54T	**OUM-220** 20TPI/54T	**OUF-220** 20TPI/54T
90°	**OUS-221** 21TPI/67T	**OUR-221** *21TPI/67T	**OUL-221** *21TPI/67T		
90°	**OUS-225** 25TPI/78T	**OUR-225** 25TPI/68T	**OUL-225** 25TPI/68T	**OUM-225** 25TPI/68T	**OUF-225** 25TPI/68T
90°	**OUS-230** 30TPI/95T	**OUR-230** 30TPI/81T	**OUL-230** 30TPI/81T	**OUM-230** 30TPI/81T	**OUF-230** 30TPI/81T
90°	**OUS-233** 33TPI/103T	**OUR-233** *33TPI/103T	**OUL-233** *33TPI/103T		
90°	**OUS-235** 35TPI/110T				
90°	**OUS-240** 40TPI/124T				
70°	**OUS-450** 50TPI/158T				
70°	**OUS-480** 80TPI/249T				

	OU SERIES DIAMETRAL PITCH				
80°	**OUS-064** 64DP/64T				
80°	**OUS-096** 96DP/96T	**OUR-096** 96DP/96T*	**OUL-096** 96DP/96T*	**OUM-096** 96DP/96T*	**OUF-096** 96DP/96T*
80°	**OUS-128** 128DP/128T				

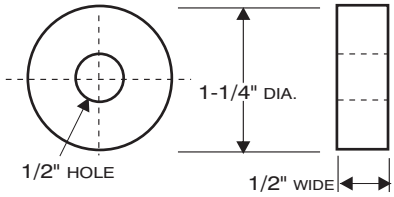
SPEEDS AND FEEDS

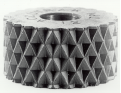
Knurling is normally done at the same speed as cutting operations. Bump knurling from the cross-slide should be done in about 10 to 20 revolutions. (Over rolling will cause flaking and poor knurl life). Knurls from the turret should be fed onto the work at about .005 to .020 per rev. (slower for harder materials, faster for soft materials) and off the work about twice as fast.

For turret knurling, a faster, feed rate may correct a tracking problem, as this would make a larger impression on the first revolution, thus increasing the chance of the teeth falling in place on the second revolution even though the spacings were off slightly.

PH SERIES

will fit the Following Holders
Form Rol
OR SH-PH
OR SH-PHA



INCLUDED TOOTH ANGLE	PH SERIES CIRCULAR PITCH KNURLS				
	Straight Tooth Knurls	30° SPIRAL KNURLS		30° DIAMOND KNURL	
		RH Spiral	LH Spiral	Male	Female
					
90°	**PHS-210** 10TPI/39T				
90°	**PHS-212** 12TPI/47T	**PHR-212** 12TPI/41T	**PHL-212** 12TPI/41T	**PHM-212** 12TPI/41T	
90°	**PHS-214** 14TPI/55T	**PHR-214** *14TPI/55T	**PHL-214** *14TPI/55T		
90°	**PHS-216** 16TPI/63T	**PHR-216** 16TPI/53T	**PHL-216** 16TPI/53T	**PHM-216** 16TPI/53T	**PHF-216** 16TPI/53T
90°	**PHS-220** 20TPI/79T	**PHR-220** 20TPI/68T	**PHL-220** 20TPI/68T	**PHM-220** 20TPI/68T	**PHF-220** 20TPI/68T
90°		**PHR-221** *21TPI/82T	**PHL-221** *21TPI/82T		
90°	**PHS-224** 24TPI/95T				
90°	**PHS-225** 24TPI/97T	**PHR-225** 24TPI/85T	**PHL-225** 24TPI/85T	**PHM-225** 24TPI/85T	**PHF-225** 24TPI/85T
90°	**PHS-230** 30TPI/117T	**PHR-230** 30TPI/103T	**PHL-230** 30TPI/103T	**PHM-230** 30TPI/103T	**PHF-230** 30TPI/103T
90°	**PHS-240** 40TPI/158T				
70°	**PHS-450** 50TPI/196T				

	PH SERIES DIAMETRAL PITCH				
80°	**PHS-064** 64DP/81T	**PHR-064** 64DP/81T	**PHL-064** 64DP/81T		
80°	**PHS-096** 96DP/121T	**PHR-096** 96DP/121T	**PHL-096** 96DP/121T	**PHM-096** 96DP/121T	**PHF-096** 96DP/121T
80°	**PHS-128** 128DP/161T				

CIRCULAR PITCH KNURLS

The circular pitch knurl system is the older system and has been in use many years. The spacing of the teeth is measured by the number of teeth per inch (TPI) around the circumference. On diagonal and diamond knurls, the TPI is usually measured normal (or perpendicular) to the teeth. See figure (1). The Normal TPI = 1/Normal Circular Pitch

The transverse TPI = Normal TPI x cos (Helix angle)

"Form Rol" Diamond and diagonal knurls are specified by their normal TPI (except for KPR & L 214, 221, 233, 234, which are made to be equivalent to "P&W" and "Armstrong-Williams" Knurls).

Determining proper blank diameters for **circular pitch knurls** is more difficult and is usually accomplished by trial and error. The TPI of circular pitch knurls is only **approximate** and cannot be used to accurately pre-determine blank diameters.

DIAMETRAL PITCH KNURLS

American Standard ASA B94.6-1984 describes the diametral pitch knurl system. Diametral pitch knurls are designed to track uniformly on fractional size stock up to 1" in multiples of 1/32" or 1/64". They are held to closer tolerances for this purpose.

D.P.	Blank Diameters for uniform tracking
64	every 64th inch
96	every 32nd inch (also every 1/96th in. ..0104)
128	every 64th inch (also every 1/128th in. ..0078)
160	every 32nd inch (also every 1/160th in. ..00625)

The American Standard recommends that the use of 64 Diametral Pitch Knurls be avoided as much as possible, and that preference be given to the use of 96 D.P. Knurls for simplification of tooling.

The number of teeth that will be rolled can be easily determined by multiplying the blank diameter by the Diametral Pitch of the Knurl. **Example:** A 96 D.P. Knurl will roll 96 x ½ = 48 teeth on ½" Diameter stock.

See Table I for equivalent TPI of D.P. Knurls.

For bump knurling from the cross-slide, the random chance of proper tracking on a given blank is somewhat less, mainly because the size of impression made by the tool on the initial revolution is normally smaller than that made by the turret knurling. Sometimes stoning a small flat on the crest of the knurl tool, or increasing the infeed rate will eliminate a tracking problem, as both of these steps will give a larger impression on the first revolution.

If it is necessary to roll an exact number of teeth, or be sure in advance that a knurl tool will track well on a given blank, and one of the Diametral Pitch Knurls is not suitable, the formulas on page 11 can be used.

For **straddle knurling from the turret,** chances are 90% or more that a given pair of knurling tools can be made to track uniformly with proper set up and adjustment of the holder. With this method of knurling, the tools are already in their final position in relation to the root diameter of the part. When the knurls are fed onto the blank, a fairly large impression is made on the first revolution, which makes it easier for the tool to track properly on the second revolution even though the initial spacing wasn't perfect, If mistracking occurs on diamond knurling from the turret, it can be corrected by swiveling the knurl which is mistracking approximately 1 or 2°**.** This would not be noticeable on the finished part.

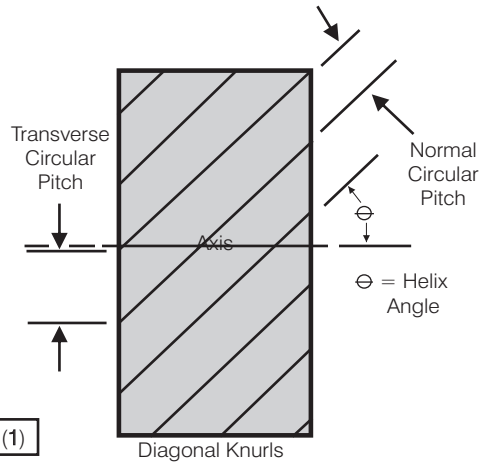


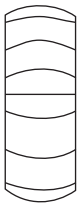
Figure (1)



NEW CONVEX KNURLS

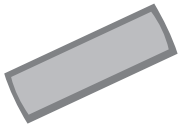
Hi-Cobalt Steel - Tin Coated

*** For Knurling long pattern feeding tools along the axis of part.**

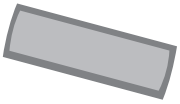


THESE ARE THE ULTIMATE TOOLS FOR AXIAL FEED KNURLING

TOOTH ANGLE	Pitch TPI/mm	EPV SERIES CIRCULAR PITCH KNURLS (1/2" Diam. X 3/16" Wide X 3/16" Hole)			GKV SERIES CIRCULAR PITCH KNURLS (5/8" Diam. X 1/4" Wide X 1/4" Hole)			KNV SERIES CIRCULAR PITCH KNURLS (3/4" Diam. X 1/4" Wide X 1/4" Hole)			KPV SERIES CIRCULAR PITCH KNURLS (3/4" Diam. X 3/8" Wide X 1/4" Hole)			PHV SERIES CIRCULAR PITCH KNURLS (1-1/4" Diam. X 1/2" Wide X 1/2" Hole)		
		Tool Numbers			Tool Numbers			Tool Numbers			Tool Numbers			Tool Numbers		
		Straight	30° RH Spiral	30° LH Spiral	Straight	30° RH Spiral	30° LH Spiral	Straight	30° RH Spiral	30° LH Spiral	Straight	30° RH Spiral	30° LH Spiral	Straight	30° RH Spiral	30° LH Spiral
90°	8/3.18	——	——	——	——	——	——	——	——	——	KPSV208	KPRV208	KPLV208	PHSV208	PHRV208	PHLV208
90°	10/2.54	——	——	——	——	——	——	——	——	——	KPSV210	KPRV210	KPLV210	PHSV210	PHRV210	PHLV210
90°	12/2.12	——	——	——	GKSV212	GKRV212	GKLV212	——	——	——	KPSV212	KPRV212	KPLV212	PHSV212	PHRV212	PHLV212
90°	14/1.81	——	——	——	——	——	——	——	——	——	KPSV214	KPRV214	KPLV214	PHSV214	PHRV214	PHLV214
90°	16/1.59	EPSV216	EPRV216	EPLV216	GKSV216	GKRV216	GKLV216	KNSV216	KNRV216	KNLV216	KPSV216	KPRV216	KPLV216	PHSV216	PHRV216	PHLV216
90°	20/1.27	EPSV220	EPRV220	EPLV220	GKSV220	GKRV220	GKLV220	KNSV220	KNRV220	KNLV220	KPSV220	KPRV220	KPLV220	PHSV220	PHRV220	PHLV220
90°	21/1.21	EPSV221	——	——	——	——	——	——	——	——	KPSV221	KPRV221	KPLV221			
90°	25/1.02	EPSV225	EPRV225	EPLV225	GKSV225	GKRV225	GKLV225	KNSV225	KNRV225	KNLV225	KPSV225	KPRV225	KPLV225	PHSV225	PHRV225	PHLV225
90°	30/.85	EPSV230	EPRV230	EPLV230	GKSV230	GKRV230	GKLV230	KNSV230	KNRV230	KNLV230	KPSV230	KPRV230	KPLV230	PHSV230	PHRV230	PHLV230
90°	32/.79	EPSV232	——	——	GKSV232	——	——	——	——	——	KPSV232	——	——		——	——
90°	33/.77	——	——	——	——	——	——	——	——	——	KPSV233	KPRV233	KPLV233			
90°	35/.73	EPSV235	EPRV235	EPLV235	GKSV235	——	——	KNSV235	KNRV235	KNLV235	KPSV235	KPRV235	KPLV235			
90°	40/.64	EPSV240	EPRV240	EPLV240	GKSV240	GKRV240	GKLV240	KNSV240	KNRV240	KNLV240	KPSV240	KPRV240	KPLV240	PHSV240		
70°	50/.51	EPSV450	EPRV450	EPLV450	GKSV450	GKRV450	GKLV450	KNSV450	KNRV450	KNLV450	KPSV450	KPRV450	KPLV450	PHSV450	PHRV450	PHLV450
70°	80/.32	EPSV480	EPRV480	EPLV480	GKSV480	GKRV480	GKLV480	——	——	——	KPSV480	KPRV480	KPLV480			
	DP/mm	EPV SERIES DIAMETRAL PITCH KNURLS			GKV SERIES DIAMETRAL PITCH KNURLS			KNV SERIES DIAMETRAL PITCH KNURLS			KPV SERIES DIAMETRAL PITCH KNURLS			PHV SERIES DIAMETRAL PITCH KNURLS		
80°	64/1.25	EPSV064	EPRV064	EPLV064	GKSV064	GKRV064	GKLV064	KNSV064	KNRV064	KNLV064	KPSV064	KPRV064	KPLV064	PHSV064	PHRV064	PHLV064
80°	96/.83	EPSV096	EPRV096	EPLV096	GKSV096	GKRV096	GKLV096	KNSV096	KNRV096	KNLV096	KPSV096	KPRV096	KPLV096	PHSV096	PHRV096	PHLV096
80°	128/.62	EPSV128	EPRV128	EPLV128	GKSV128	GKRV128	GKLV128	KNSV128	KNRV128	KNLV128	KPSV128	KPRV128	KPLV128	PHSV128	PHRV128	PHLV128
80°	160/.50	EPSV160	EPRV160	EPLV160	GKSV160	GKRV160	GKLV160	KNSV160	KNRV160	KNLV160	KPSV160	KPRV160	KPLV160	PHSV160	PHRV160	PHLV160



Form-Rol KNURL PINS



Size	Stock Number	
	Steel	Carbide
1/8 Dia. x 3/8 Long	S 062	C 062
1/8 Dia. x 1/2 Long	S 082	C 082
3/16 Dia. x 1/2 Long	S 083	C 083
3/16 Dia. x 5/8 Long	N/A	C 103
1/4 Dia. x 5/8 Long	S 104	C 104
3/16 Dia. x 11/16 Long	S 113	C 113
1/4 Dia. x 11/16 Long	S 114	C 114
3/16 Dia. x 3/4 Long	N/A	C 123
1/4 Dia. x 3/4 Long	S 124	C 124

Size	Stock Number	
	Steel	Carbide
1/4 Dia. x 7/8 Long	N/A	C 144
3/16 Dia. x 1 Long	S 163	C 163
1/4 Dia. x 1 Long	S 164	C 164
5/16 Dia. x 1 Long	S 165	C 165
1/2 Dia. x 1 Long	N/A	C 168
1/4 Dia. x 1-1/8 Long	S 204	C 204
1/2 Dia. x 1-1/4 Long	S 208	C 208
1/4 Dia. x 1-3/8 Long	N/A	C 224
1/2 Dia. x 1-1/2 Long	S 248	C 248

HOLDERS

STANDARD KNURLING TOOL HOLDERS

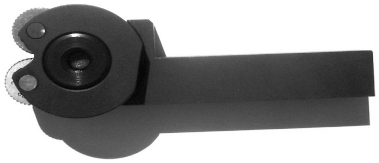
BUMP HOLDERS



Single Die Bump Holders are best suited to shorter work, or long work where knurling can be done close to the chuck or tailstock. Knurl not included

TOOL NUMBER	KNURL REQ'D	SQUARE SHANK	O.A.L.	KNURL PIN
OR BH-BPS	BP	5/16"	4-1/2"	C062
OR BH-BP	BP	3/8"	4"	C062
OR BH-EP	EP	1/2"	4"	C083
OR BH-GK	GK & KN	5/8"	4"	C104
OR BH-KP	KP	3/4"	4-1/2"	C124
OR BH-KPA	KP & MT	1"	5"	C164
OR BH-KPB	KP & MT	1"	6"	C164
OR BH-KR	KR	3/4"	4-1/2"	C164
OR BH-OU	OU	1"	5"	C165
OR BH-PH	PH	1"	5"	C168

SINGLE DIE BUMP HOLDER

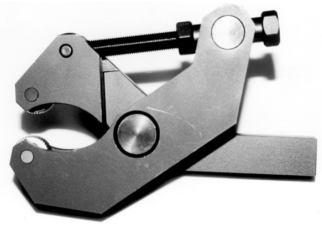


The Two Die Pivoting Head Bump Holders are designed for CNC lathe, for knurling both straight and diamond patterns. The pivoting head gives precise alignment to the working part. Knurls not included.

TOOL NUMBER	KNURL REQ'D	SQUARE SHANK	O.A.L.	KNURL PIN
OR 2KP12P	KP & MT	3/4"	5"	C124
OR 2KP16P	KP & MT	1"	5"	C124

TWO DIE BUMP HOLDER

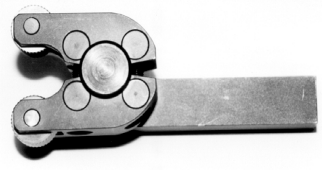
STRADDLE HOLDERS



LARGE CAPACITY, HEAVY DUTY

Designed to fit most medium to large size CNC machines, and to roll more difficult jobs. Supplied as right-hand style, but may be re-assembled as left hand style. Use one right-hand and one left-hand knurl to produce diamond pattern. May be traversed to produce long knurl pattern (beveled knurls recommended when traversing). Straddle knurling produces much less side pressure than bump knurling. Knurls not included.

TOOL NUMBER	KNURL REQ'D	SQUARE SHANK	MIN. DIA.	MAX. DIA.	KNURL PIN
OR SH-KP	KP & MT	3/4"	0"	2.1"	C164
OR SH-KPA	KP & MT	1"	0"	2.1"	C164
OR SH-PH	PH	1"	.75"	3.1"	C168



COMPACT, PRECISION TYPE

Designed to fit small CNC machines and "Swiss" type automatics. Supplied as right-hand style, but may be re-assembles as left hand style. Use one right-hand and one left-hand knurl to produce diamond pattern. May be traversed to produce long knurl pattern. (beveled knurls recommended when traversing). Straddle knurling produces much less side pressure than bump knurling. Knurls not included.

* Note: with MT series knurl Max/Min Capacity is .070--.870

TOOL NUMBER	KNURL REQ'D	SQUARE SHANK	MIN./MAX. DIA.	KNURL PIN
OR CSBP05	BP	5/16"	0/.437"	C082
OR CSBP06	BP	3/8"	0/.437"	C082
OR CSBP08	BP	1/2"	0/.437"	C082
OR CSEP06	EP	3/8"	.06/.750"	C103
OR CSEP08	EP	1/2"	.06/.750"	C103
OR CSEP10	EP	5/8"	.06/.750"	C103
OR CSKP08	KP & MT	1/2"	*.19/1.00"	C144
OR CSKP10	KP & MT	5/8"	*.19/1.00"	C144
OR CSKP12	KP & MT	3/4"	*.19/1.00"	C144
OR CSKP16	KP & MT	1"	*.19/1.00"	C168

STANDARD KNURLING TOOL HOLDERS

INTERNAL HOLDERS

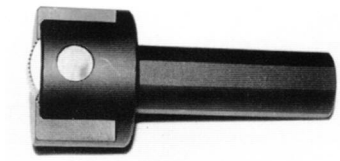


These are often used to repair parts with slightly oversize holes. Also, knurling new parts before press fittinig will make assembly easier and allow more machining tolerance. In addition, the finished assembly will normally be capable of transmitting more torque.

Knurl not included

TOOL NUMBER	KNURL REQ D	ROUND SHANK	MIN. DIA.	MAX. DEPTH	O.A.L.	KNURL PIN
OR IH-BP	BP	3/4"	.50"	1.25"	5"	C082
OR IH-EP	EP	1"	.75"	2"	6"	C083
OR IH-GK	GK & KN	1-1/4"	1.00"	3"	7"	C124
OR IH-KP	KP & MT	1-1/4"	1.25"	4"	8"	C164

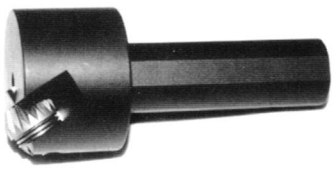
FACE KNURLING HOLDERS



To be mounted in-line with machine spindle. This type of holder is recommended for knurling relatively narrow bands on softer materials (especially tubing). It may be shifted off center to vary the diameter of the knurl band. They may not be suitable for these applications, especially at smaller diameters, or where appearance is critical.

TOOL NUMBER	KNURL REQ D	ROUND SHANK	MIN. DIA.	MAX. DIA.	O.A.L.	KNURL PIN
OR FH-KP	KP & MT	3/4"	1/4"	1"	4"	C164
OR FH-KPA	KP & MT	1"	1/4"	1"	4"	C164
OR FH-PH	PH	1"	1/2"	1-1/2"	4"	C208

Conical holders are recommended for more difficult applications.



They require a conical type knurl to provide geometrically correct tracking. The knurl pattern produced by a conical knurl has a better appearance than that produced by the face holder.

The knurl is not included and often must be special ordered.

TOOL NUMBER	KNURL REQ D	ROUND SHANK	MIN. DIA.	MAX. DIA.	O.A.L.	KNURL PIN
OR CH-30A	SPECIAL	3/4"	1/2"	1"	4"	C123
OR CH-30B	SPECIAL	1"	3/4"	1/2"	4-1/2"	C164
OR CH-45A	SPECIAL	3/4"	5/16"	1"	4"	C163
OR CH-45B	SPECIAL	1"	1/2"	1-3/8"	4-1/2"	C164

TURRET MOUNTED HOLDERS



This holder mis to be mounted in-line with the machine's spindle. You can use one right-hand and one left-hand knurl or two straight knurls (turned 30 degrees) to produce diamond pattern. Beveled knurls are recommended for this holder). Note: if used to roll a straight knurl pattern, mis-tracking may occur in a small percentage of parts unless a special synchronizing assembly is used

TOOL NUMBER	KNURL REQ D	ROUND SHANK	MIN. DIA.	MAX. DIA.	O.A.L.	KNURL PIN
OR TH-KPA	KP & MT	3/4"	0"	1.03"	5-1/2"	C144
OR TH-KPB	KP & MT	1"	0"	1.53"	6"	C144

Knurls not included.

Specials are Available for all types of holders. Simple modifications can be made in 2-3 days
Specials made from scratch, normally ship in 2-3 weeks.

THREAD ROLLS

THREAD ROLLS MADE PER ORDER.
PLEASE CALL US FOR PRICE AND DELIVERY.

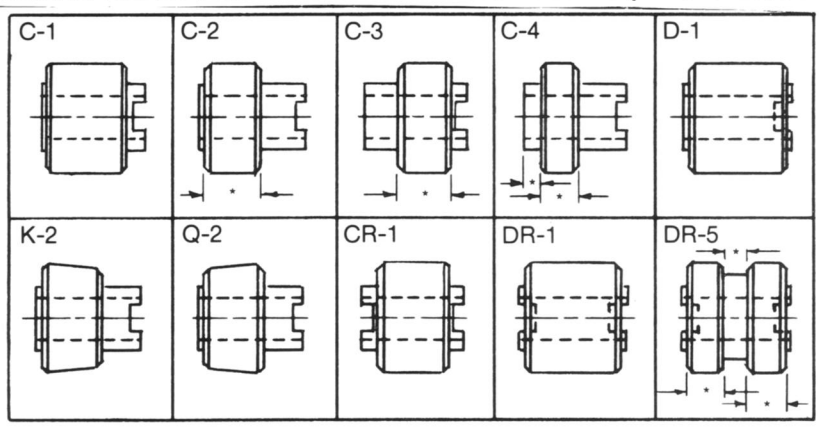


WHEN ORDERING OR REQUESTING QUOTATION ON THREAD ROLLS THE FOLLOWING INFORMATION SHOULD BE SUPPLIED.

1. TYPE OF ROLL.
   a. C-1, C-2, F1-44 etc.
   b. Working face or hub dimension when applicable.
   c. Die prints when possible.
2. ATTACHMENT OR MACHINE SIZE AND TYPE.
3. PART DETAILS.
   a. Thread size.
   b. Length of thread.
   c. Position and size of shoulder on part if applicable.

PRICES APPLY TO ALL STANDARD THREAD FORMS AND D-2 MATERIAL.
ALL THREAD ROLLS MADE TO ORDER.
DELIVERY: 2-4 WEEKS NORMALLY.

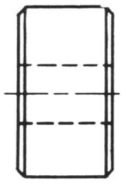
THREAD ROLLS FOR STANDARD ATTACHMENTS (TWO DIES/SET)



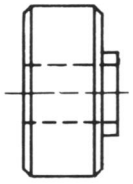
*DIMENSIONS MUST BE SUPPLIED BY CUSTOMER

BUMP TYPE THREAD ROLLS (SINGLE ROLL)

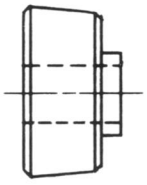
F1 STYLE
FULL WIDTH
WORK FACE



F2 STYLE
VARIABLE
WORK FACE



Y2 STYLE
PIPE ROLLS



PIPE ROLLS	
SIZE	WORKFACE
1/8-27	.357
1/4-18	.541
3/8-18	.547
1/2-14	.712
3/4-14	.724

OTHER WORK FACES MAY BE PROVIDED—AS REQUESTED.

Thread rolls also available for three die machines and can be made for a wide variety of specialty machines

BUMP KNURLING FROM THE CROSS-SLIDE:

(for Knurls and Blanks up to 1")

Condition I: Blank Diameter Known (if finished diameter is known, determine blank diameter from Table II on page 3)

$$\text{* KNURL DIAM.}_{\text{(ideal)}} = \frac{\text{Blank Diameter}}{\text{Teeth (on blank)}} \times \text{Teeth}_{\text{(on Knurl Tool)}} - \text{*C.F. (Correction Factor)}$$

* See Table III

Tolerance on Ideal Knurl Diameter should be approx. $\pm .7(\text{C.F.}) \times \frac{\text{Diam.}_{\text{(Knurl)}}}{\text{Diam.}_{\text{(Blank)}}}$

Example (1) What Knurl (approx. 5/8 diam.) would be required to roll 18 teeth on a 3/8" diam. blank (approx. 15 TPI) by bumping from the cross-slide?
(Closest stock knurl is GKS-216 - 31 Teeth)

$$\text{Knurl Diam.}_{\text{(ideal)}} = \frac{.375}{18} \times 31 - .010$$

$$= .646 - .010$$

$$= .636 \pm .7\,(.010) \times \frac{.625}{.375}$$

$$= .636 \pm .012$$

Therefore a GKS-216 Knurl (.625 Diam.) would be near the low limit of the tolerance of the ideal knurl diameter. It would most likely track properly, but to be more certain, either order a special knurl with the ideal knurl diameter ± 1/2 the above tolerance, or, if possible, change the blank diameter. (In this case a .369 blank diameter would give an ideal knurl diameter of .625.

TABLE III:

TPI	*Approx. Value of C.F.
12-19	.010
20-29	.007
30-39	.005
40-49	.003
50-80	.002

*This value is affected somewhat by machine speeds, material hardness, relative diameters of knurl and blank.

Condition II: Blank diameter or number of teeth not critical. (What should be the blank diameter to insure good tracking with a given knurl?)

$$\text{* Blank Diameter} = \frac{\text{Teeth}_{\text{(Blank)}}}{\text{Teeth}_{\text{(Knurl)}}} \times (\text{Knurl Diam.} + \text{C.F.})$$

The number of teeth on the blank is the nearest **whole number** to the $\frac{\text{Blank Diam.}_{\text{(approx.)}}}{\text{Knurl Diam.}} \times$ number of teeth on knurl.

Example (2) To what size should 1/2" stock be turned to insure good tracking with a KPS-220 knurl (3/4" diameter, 47 teeth, 20 TPI - Straight Knurl) bumping from the cross-slide.

$$\text{Teeth on Blank} = \frac{.500}{.750} \times 47 = 31.3 \text{ (round to 31)}$$

$$\text{Blank Diam.} = \frac{31}{47} \times (.750 + .007) = .499 \pm .001$$

Therefore a KPS-220 knurl will roll 31 teeth on 1/2" stock without turning it down.

The proper blank diameter for rolling 30 teeth would be $\frac{30}{47} \times (.750 + .007) = .483$

Somewhere in between .483 and .499 double tracking would probably occur.

*Note: These formulae apply accurately only to knurls bumped from the cross-slide.

KNURLING

...on Conical, Convex, Concave and End Surfaces

Often, parts require knurling on conical, concave, convex or radial surfaces, either for functional or decorative purposes.

With proper tools and application, a clean, well-formed knurl or serrations can be produced.

One of the most frequent mistakes made is illustrated in Figure 1. In this case, usually for convenience, the knurling tool and the part are set with parallel axes. This is similar to running a pair of bevel gears the wrong way. As the cone angle increases, the results become worse.

Figure 2, while technically not correct, is better than Figure 1, and has the advantage of being a substantially lower cost tool. This method often is satisfactory on relatively large diameters when the cone angle is small.

Figure 3 illustrates the proper method of rolling conical surfaces to produce a clean knurl with maximum tool life. With properly designed tools, and using this method, it is possible to roll tapered serrations with a controlled number of teeth.

For proper tracking at both ends of the piece, it is necessary to establish the geometrical relationship between the part and the tool with consideration given to the space available for tooling. It is sometimes advantageous to use a shank-type knurl, as shown in Figure 4, where clearance is not available for the conventional style knurl holder.

In certain cases, parts may be knurled with radial teeth on the end of parts, by using a conical knurl of the proper design. Here again, the results depend primarily on establishing the geometrical relationship between the part and the tool *(See Figure 5)*.

A tracking correction factor is usually applied to the calculated diameter because of the many variables involved, such as hardness of material, elasticity of machine tools and tool holders, etc. This factor is necessarily empirical.

It is geometrically impossible to knurl a perfect concave or convex part with conventional knurls. The problem is illustrated in figure 6. If the pitch on the tool or the part changes by more than 25% from the middle to the edges, poor results can be expected on the finished parts. A change of less than 10% in the pitch should produce a clean looking part.

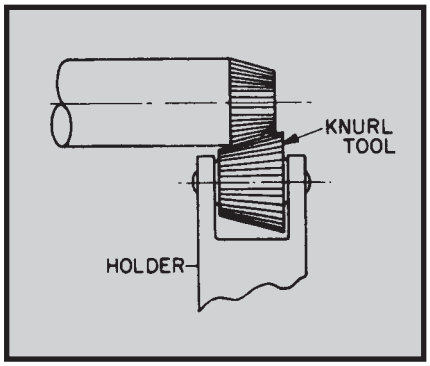


FIGURE 1 - POOR

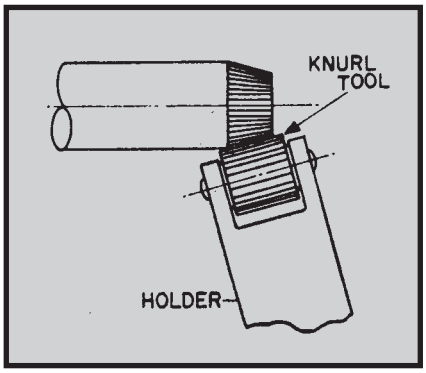


FIGURE 2 - BETTER

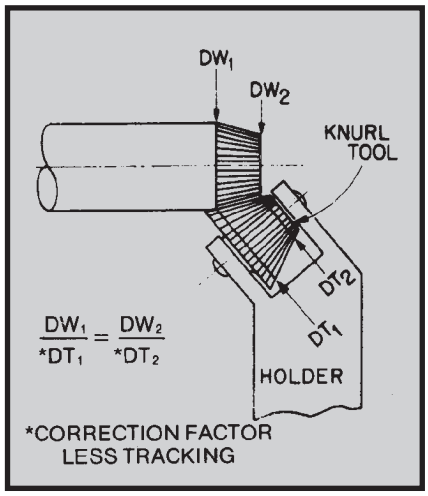


FIGURE 3 - BEST

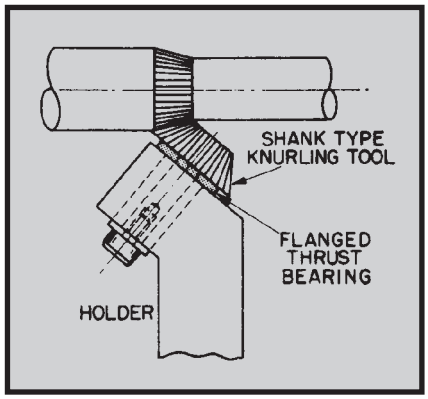
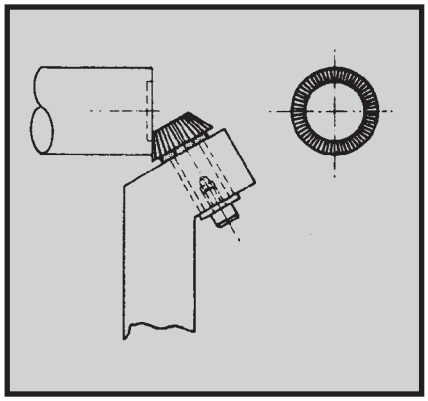


FIGURE 4 - Shank-Type Knurl



FUGURE 5 - End Knurling

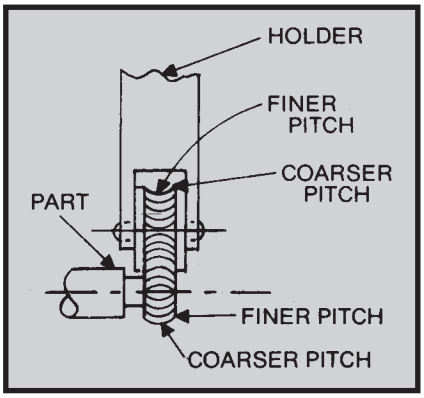


FIGURE 6

FOR YOUR SPECIAL KNURLS BY FORM-ROL
SPECIAL KNURL BLANKS CARRIED IN STOCK

A large variety of knurl blanks are regularly carried in stock insuring fast delivery on special knurls made to customer's specifications.

When ordering special knurls please furnish blueprint of knurl desired or specific information as outlined below.

1. Outside diameter of knurl.
2. Overall width of knurl.
3. Size of hole in knurl.
4. Dimension of any shoulders desired, giving width and diameter of each.
5. Knurl pattern, straight, diagonal, male or female Diamond. Diagonal or diamond teeth normally cut with 30^{o} helix angle.
6. Number of teeth on knurl. An odd number of teeth is usually preferred over an even number.
7. Tooth angle 70^{o} or 90^{o} for circular pitch and 80^{o} for diametral pitch. (See chart for approximate increase in diameter).
8. All tolerances unless otherwise specified will be those used on our stock knurls.

We will be glad to quote price and delivery on special knurls upon receipt of the necessary information as outlined above.

COMMON KNURLING PROBLEMS

Problem	Cause	Solution
Double Tracking	Circumference around blank is not an approximate multiple of the pitch of the Knurl.	1. Force knurl in harder on the first revolution. 2. Change blank diameter ± .005. 3. Try slightly different pitch knurl. 4. Grind or Stone approx. .003 off diam. of knurl tool. 5. Hone or grind hole .001/.004 oversize. 6. Order special knurl.
Flaking	1. Rolling on stock with scale. 2. Over-rolling work.	1. Turn off scale. 2. Roll up part in 10-20 revolutions **without** over-rolling.
Poor Tool Life	1. Above causes. 2. Knurling stainless (303). 3. Rolling semi-hardened steels. 4. Stock runs out excessive. 5. Knurls improperly hardened or of poor quality.	1. Solve above problems.
Diamond Knurling Specifications (Male or Female required?)	Many prints call for Diamond Knurling — without specifying Male or Female. If unspecified, usually **Male** Diamond Knurling is desired.	**From Cross-slide:** RH & LH Diagonal Knurls used as a pair produce Male Diamond Knurling. **Male** Diamond Knurls produce **Female** Knurling on part and visa-versa. **From turret** — Female Knurling cannot be done with straddle holder. Straight knurls can be swiveled to produce Male Diamond.

NOTES: