G-T® RINGS

10,000 & 12,000 Series

DOUBLE ACTING SEAL

The unique G-T® Ring provides a compact double acting seal for use in a new design for heavy duty applications where a more bulky type of seal had previously been required, as well as for retrofit in standard grooves designed for O-rings with two, one, or no backups. This proven seal combines a tough, resilient, T-shaped sealing ring with precisely-dimensioned, pressure-actuated non-extrusion rings – for use with pressures ranging from zero to 10,000 psi (690 bar) and higher.

Performance, reliability, and economy as a piston seal are unequaled – with no piston drift with minimum piston length. This seal eliminates two major sealing problems: 1) the G-T Ring sealing element is protected from extrusion so that it seals satisfactorily when clearances must be abnormally large or where pressures are high, 2) the unique G-T Ring configuration presents seal roll and spiral failure. (See Fig. 1)

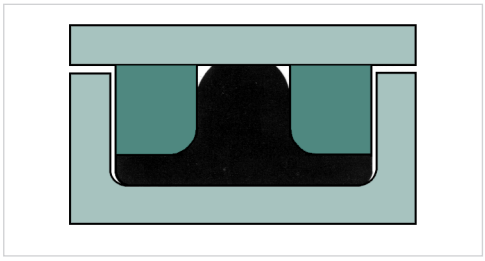
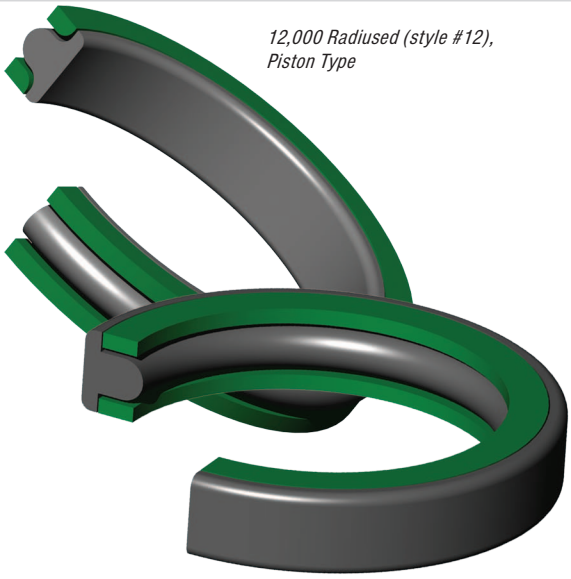


Figure 1

The G-T Ring is a piston, rod or static seal for use in cylinders, intensifiers, accumulators, spool valves, and other demanding fluid power applications. It is currently specified for critical applications on all major jet aircraft (both military and commercial), sealing accumulators, reservoirs, actuators, valves, and the most rugged landing gear shock strut applications.

For more than 25 years the G-T Ring has been used by the Ordnance Department as the primary seal in recoil systems and by designers to solve their most severe sealing problems encountered in a wide variety of industrial and mobile equipment - including rough terrain lift trucks, front end loaders, tractors, back hoes, excavators, graders, cranes, jacks, oil field valves and well heads, and machine tools.



12,000 Radiused (style #12), Piston Type

10,000 Non-Radiused (style #10), Rod Type

Extrusion Resistance

The G-T design resists extrusion by preventing the elastomeric sealing element from wedging into the diametral clearances, or pinching off under motion or pressure. Under pressure, the resilient T-shaped elastometric-sealing element deforms transmitting hydraulic pressure “down stream”. This causes radial swelling or expansion of the flange under the non-extrusion backup ring on the low-pressure side of the assembly (See Fig. 2). The skive cut in the non-extrusion ring permits instantaneous radial movement into positive contact with the cylinder bore or rod being sealed, closing the clearance gap before any extension of the sealing element can occur.

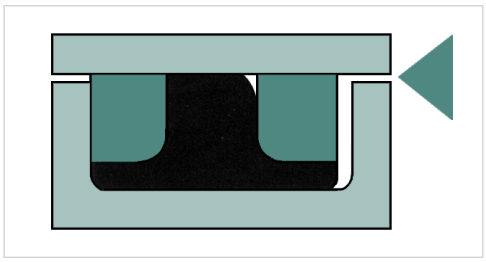


Figure 2

Since the non-extrusion rings do not rely on axial compression to radially expand, but are moved radially by hydro-mechanical action, they need not be made of easily deformed material. Rather they can be made of durable, low friction material with high shear strength and high resistance to cold flow, which results in superior resistance to extrusion. These pressure activated, non-extrusion rings successfully bridge the large clearance incident to the use of wear rings – and protect the seal both from extrusion and contamination. As radial loading of the non-extrusion rings varies directly with fluid pressure, seal friction is kept to a minimum during the low pressure portion of the pressure cycle.

Resistance to Roll

The seal is installed in the groove on a flat, stable, static base. The non-extrusion rings complete the rectangular shape of the seal assembly and "lock" the T-shaped sealing element in position so that it is restrained from rolling around its circumferential axis. The G-T® ring cannot roll, twist or spiral (See Fig. 3) and therefore, it is not subject to this mode of failure.

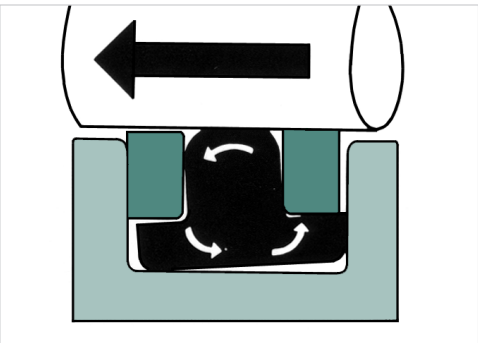


Figure 3

Wear and Compression Set

Since the G-T non-extrusion ring prevents extrusion and spiraling of the elastomeric sealing element, it is not necessary to sacrifice desirable wear resistance or low compression set characteristics by selecting a harder compound for its resistance to extrusion, even at high pressures. Wear resistant compounds with low compression set are available for virtually any operating environment for which G-T Rings are recommended. G-T Ring design features which prevent roll of the seal (See Fig. 3), also lock the dynamic sealing surface in place so the seal cannot twist or move axially when it is pressurized. The plane of sealing contact is maintained as pressure builds and the piston and rod move. It is this constant sealing surface contact throughout the entire stroke that prevents a leakage even when the elastomer may have taken some compression set or some wear has occurred.

Low Pressure Sealing

The G-T Ring is dimensioned so that the sealing element is installed with seal "squeeze" balanced between static and dynamic surfaces, thus providing a positive seal even at zero and low-pressure differential across the seal.

Effective Service Life

Style #12 (Fig. 4) offers the ultimate in G-T Ring performance. The mating radii at the intersection of the dynamic sealing element and the non-extrusion ring actuating flanges reduce tensile stresses, which can occur at this location (See Fig. 2) when the seal is pressurized. These radii also permit even and quick flow of material into the flange when pressure is applied which results in extremely fast response of the non-extrusion ring to close the extrusion gap.

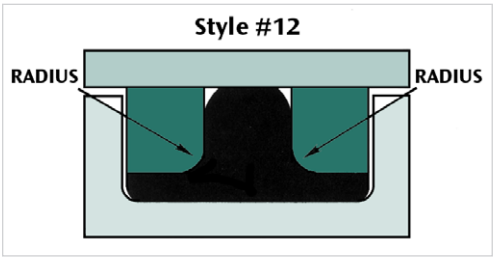


Figure 4

APPLICATION RECOMMENDATIONS

Clearances

Even though clearances should be reduced to a practical minimum in applications where pressures are 3,000 psi (207 bar) or higher, the outstanding capability of the G-T Ring to bridge the extrusion gap permits its use with clearances commonly encountered where bearing elements are included in the cylinder design or where there is side loading or piston and rod "lay down" (See Table 2).

Temperature and Fluid

Suitable materials are available for use with all currently used hydraulic fluids in temperature ranges from -65°F to 450°F (-54°C to 232°C). The G-T Ring correctly applied, provides long useful life in the proper hydraulic fluid.

Motion

The G-T Ring is used against either constant or impulsed pressure, as a dynamic seal where there is reciprocating motion or as a static seal. It is also used successfully against intermittent oscillating motion, as in swivel joints.

Surface Finishes

Rod or cylinder surfaces should have a standard finish of 12 to 16 micro inches (rms). At pressures above 5,000 psi (345 bar) service life can be prolonged by reducing surface roughness to 10 to 12 micro inches. For rod or piston grooves, a good machined finish of 32 micro inches is recommended.

Installation

The G-T® Ring assembly installs quickly and easily (without tools) into the same single groove recommended for an O-ring or an O-ring with backups. The usual installation consists of one seal assembly per piston or rod. In special situations where two or more seals are used (such as an accumulator piston) it is recommended that the space between the rings be vented.

HOW TO SELECT THE PROPER SEAL

(Refer to Aerospace GT-Ring Catalog for aircraft applications)

Style

Two basic G-T Ring styles are available, the #12 and #10 Styles. For ultimate performance and/or service life, Style #12 radiused G-T Rings should be selected. This seal is especially recommended for use in high-pressure hydraulic systems, for systems that develop high-pressure spikes, or where rapid, accelerated motion or rapid pressure reversals occur. Style #12 radiused G-T Ring is an advanced concept originally developed to meet the rigorous sealing requirements of jet aircraft hydraulic and landing gear systems. Since their introduction, the seals have demonstrated their superiority in thousands of aerospace and industrial applications.

For less demanding applications Style #10 non-radiused G-T Rings (See Fig. 5) are suitable. This G-T Ring incorporates the basic G-T Ring geometry that has been used with great success in a variety of fluid power components for more than 30 years. In all static applications, Style #10 G-T Rings are recommended.

Seal Width

Three seal widths are available – wide, intermediate, and narrow. In rugged hydraulic applications, the heavy-duty wide base G-T Ring is designed to function in a groove that can accommodate an O-ring with two backup rings. The wide base G-T Ring has maximum stability in the groove, the largest sealing surface, and heavy non-extrusion backup rings which make them suitable for relatively high pressure, high clearance conditions, even when considerable side loading occurs.

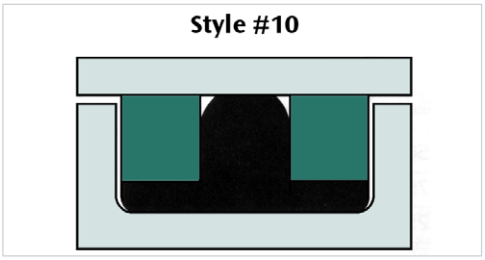


Figure 5

In all piston accumulator applications, the heavy-duty wide base G-T Ring is recommended. When minimal axial length is of particular importance, the compact narrow base G-T Ring should be selected. This seal assembly is designed to function in a groove that can accommodate an O-ring without backups. The intermediate base G-T Ring may be selected for use in a groove that accommodates an O-ring with one backup.

Selecting The Appropriate Size

Refer to Table 4. Select appropriate size designation based on groove and rod or bore dimensions, which are applicable.

Seal Material Selection

Select the proper compound from Table 1, compatible with the fluid to be sealed and the temperature range anticipated. This table covers the most frequently encountered fluids and temperatures. It is recommended that realistic rather than arbitrary temperature ranges be used. These recommendations are based on normal operating conditions within the temperature ranges.

Non-Extrusion (Backup) Rings

Select the specific materials from Table 2 based on pressure range, temperature range, maximum diametral clearance anticipated, and seal width selected. With extrusion of the seal through a clearance gap as the most predominant cause of seal failure, it is essential that you use realistic estimates of pressure spikes and maximum clearances under side loading and lay down conditions.

GTL™ RING for Unidirectional Sealing

GTL Rings provide unidirectional sealing when used in “Compact, Narrow Base” glands (Table 4). Their backup rings are generally thicker than backups used with G-T Rings and therefore should withstand slightly higher pressures and diametral clearances. Axial length of the elastomeric sealing element is increased and thus provides more sealing surface.

Part numbering system for the GTL™ Ring follows the same pattern as for the G-T® Ring except for the third digit (seal configuration); the digit "7" should be used for rod-type or the digit "8" for piston-type (See Part Numbering System); G-T Rings can be designed for other gland lengths and cross-sections as well as non-standard diameters. Greene, Tweed Engineering should be consulted for such designs.

TABLE 1 ELASTOMERIC COMPOUND SELECTOR

Service Conditions					
Fluid	**Temperature Range**	**Base Polymer**	**Durometer Hardness (Shore A)**	**Compound Designator**	**Compatible Non-Extrusion Ring Material***
Hydraulic Fluids					
General purpose hydraulic oils - petroleum base lubricating oils, air, water, water-glycols, soluble oils	-30°F to 300°F (-34°C to 149°C)	NBR (Nitrile)	75	173	TFE, NWR
MIL-H-5606, MIL-H-6083	-65°F to 275°F (-54°C to 135°C)	NBR	70	160	TFE, NWR
MIL-L-23699, MIL-L-7808	-20°F to 450°F (-29°C to 232°C)	FKM (Fluoroelastomer)	75	731	TFE, NWR
	-40°F to 450°F (-40°C to 232°C)		75	772	
Silicone Oils	-30°F to 300°F (-34°C to 149°C)	NBR	75	173	TFE, NWR
	-65°F to 300°F (-54°C to 149°C)	EPR (Ethylene propylene)	80	952	TFE, NWR
Pydraul 30E, 50E, 90E, 115E	-20°F to 450°F(-29°C to 232°C)	FKM	75	731	TFE, NWR
Fuels					
Gasoline, Kerosene, Aircraft Fuels, ASTM Fuels A, B, C	-80°F to 350°F (-62°C to 177°C)	FVMQ (Fluorosilicone)	75	409	TFE, NWR
	-20°F to 450°F (-29°C to 232°C)	FKM	75	731	
Automotive Fluids					
Brake Fluid (SAE-J-1703)	-65°F to 300°F (-54°C to 149°C)	EPR	80	952	TFE, NWR
Gases					
Nitrogen and most inert gases	-65°F to 275°F (-54°C to 135°C)	NBR	70	160	TFE, NWR
	-30°F to 300°F (-34°C to 149°C)	NBR	75	173	
	-20°F to 450°F (-29°C to 232°C)	FKM	75	731	
Miscellaneous					
Chemicals, lubricating oils, solvents	-20°F to 450°F (-29°C to 232°C)	FKM	75	731	TFE, NWR
Hot water amines, H_2S (Very low permeability material)	25°F to 450°F (-4°C to 232°C)	Fluoraz (Tetrafluoro-ethylene-propylene Elastomer)	75	797	TFE, NWR, P9
			90	799	

**TFE: Virgin or filled to GT specifications*

TABLE 2 ANTI-EXTRUSION RING MATERIAL SELECTOR

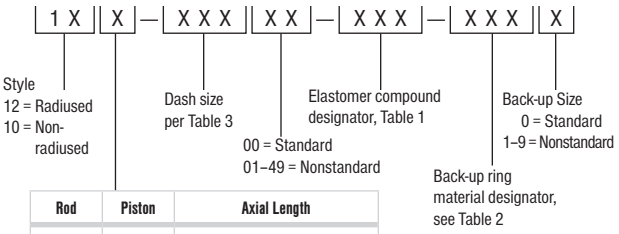
Pressure (psi)	Clearance	Recommended Anti-Extrusion		Comments
		Material*	Designator	
0 to 3000	See Table 3	Virgin TFE	005	
		NWR	006	Includes balanced designed clearances to 0.025 in. (0.635 mm) diametral (i.e., with wear rings)
		P5	021	
		P4	016	Thin wall cylinder breathing to 0.012 in. (0.305 mm), diametral clearance
3000 to 4500	To 0.025 in. (6.35 mm) diametral	NWR	006	1. Relatively balanced actuator system, even stroke with intermittent side loading and lay down 2. Static applications
	From Table 3 to .030 diametral	†Staged Virgin TFE & NWR	050 (12,000 Series)	1. Heavy duty wide base seal only 2. Heavy shock load system with clearance due to cylinder distortion
			060 (10,000 Series)	
	See Table 3	P5	021	
Extreme Pressures	See Table 3	P9	045	Recommended for service extremes (temperatures to 450°F/232°C)

**Material: TFE: Virgin TFE, NWR: Wear Resistant Nylon to GTS-002E, P4: Graphite filled TFE to GT specification, P5: Glass and MoS_2 filled TFE to GT specification, P9: Polyetheretherketone to GT specification*
†Assembly includes 4 backups. . . 1 TFE backup each side adjacent to rubber sealing element; 1 NWR backup each side adjacent to groove wall
(Unless otherwise indicated, for temperatures above 275°F/135°C, contact GT for backup material selection.)

PART NUMBERING SYSTEM

The part numbering system requires the use of tables 1-3.

For nonstandard designs contact GT engineering.



Rod	Piston	Axial Length
1	2	Narrow Base (0b/u)
3	4	Intermediate Base (1b/u)
5	6	Wide Base (2b/u)
7	8	Narrow Base GTL

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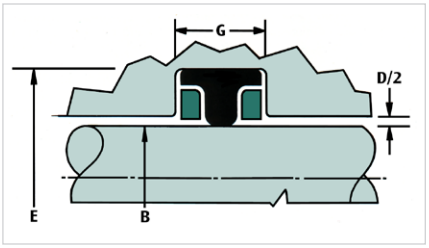
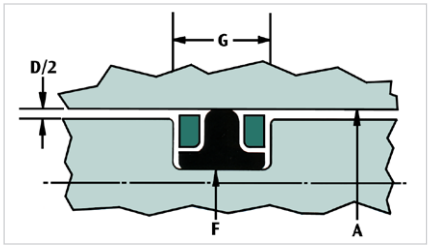
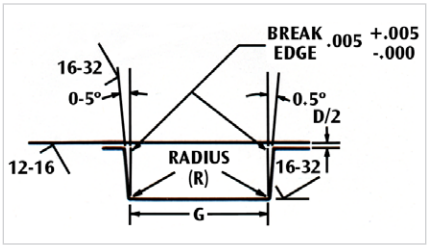


Rod Seal



Piston Seal

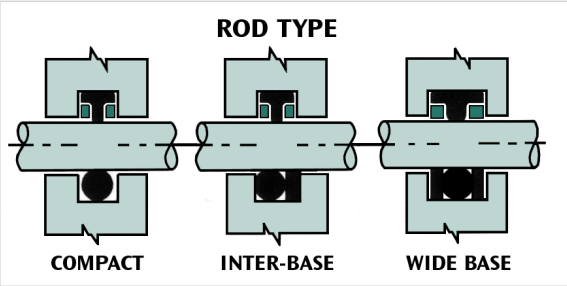


Gland Detail

TABLE 3 DIMENSIONAL INFORMATION

G-T Ring Dash Size (Per A5568)	Nominal Cross-Section	Piston Type				Rod Type				D Diametral Clearance (Max)	R Radius	G Gland Width* (+0.010/-0.000)		
		A Bore Diameter		F Gland Diameter		B Rod Diameter		E Gland Diameter				0b/u	1b/u	2b/u
		Inch	Tol.	Inch	Tol.	Inch	Tol.	Inch	Tol.			Compact Narrow Base	Intermediate Base	Heavy Duty Wide Base
006		0.250		0.138		0.124		0.236						
007		0.281		0.169		0.155		0.267						
008	1/16 in.	0.312		0.200		0.186		0.298						
009	(0.070	0.344	+0.001	0.232	+0.000	0.218	+0.000	0.330	+0.001	0.004		0.094	0.149	0.207
010	±0.003)	0.375	-0.000	0.263	-0.001	0.249	-0.001	0.361	-0.000					
011		0.437		0.325		0.311		0.423						
012		0.500		0.388		0.374		0.486			0.005			
110		0.562		0.384		0.374		0.552			to			
111		0.625		0.447		0.436		0.614			0.015			
112	3/32 in.	0.687		0.509		0.499		0.677						
113	(0.103	0.750		0.572		0.561		0.739				0.141	0.183	0.245
114	±0.003)	0.812		0.634		0.624		0.802						
115		0.875		0.697		0.686		0.864						
116		0.937		0.759		0.749		0.927						
210		1.000		0.757		0.748		0.991						
211		1.063		0.820		0.810		1.053						
212		1.125		0.882		0.873		1.116		0.005				
213		1.188		0.945		0.935		1.178						
214		1.250		1.007		0.998		1.241						
215	1/8 in.	1.313		1.070		1.060		1.303			0.010			
216	(0.139	1.375	+0.002	1.132	+0.000	1.123	+0.000	1.366	+0.002		to	0.188	0.235	0.304
217	±0.004)	1.438	-0.000	1.195	-0.002	1.185	-0.002	1.428	-0.000		0.025			
218		1.500		1.257		1.248		1.491						
219		1.563		1.320		1.310		1.553						
220		1.625		1.382		1.373		1.616						
221		1.688		1.445		1.435		1.678						
222		1.750		1.507		1.498		1.741						

**Gland details conform to MIL-G-5514F. For old standard gland lengths to MIL-P-5514B, GT Style #11 is available where required.*
For metric-sized G-T rings, see Greene, Tweed's Metric G-T Ring catalog.



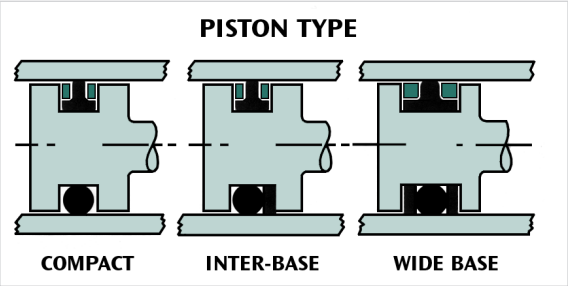


TABLE 3 DIMENSIONAL INFORMATION CONTINUED

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		A Bore Diameter Inch	Tol.	F Gland Diameter Inch	Tol.	B Rod Diameter Inch	Tol.	E Gland Diameter Inch	Tol.			0b/u Compact Narrow Base	1b/u Intermediate Base	2b/u Heavy Duty Wide Base
325		1.875		1.503		1.498		1.870						
326		2.000		1.628		1.623		1.995						
327		2.125		1.753		1.748		2.120						
328		2.250		1.878		1.873		2.245						
329		2.375		2.003		1.998		2.370						
330		2.500		2.128		2.123		2.495						
331		2.625		2.253		2.248		2.620						
332	3/16 in.	2.750		2.378		2.373		2.745						
333	(0.210	2.875		2.503		2.498		2.870						
334	±0.004)	3.000		2.628		2.623		2.995						
335		3.125		2.753		2.748		3.120						
336		3.250		2.878		2.873		3.245						
337		3.375		3.003		2.998		3.370			0.020			
338		3.500		3.128		3.123		3.495		0.007	to	0.281	0.334	0.424
339		3.625		3.253		3.248		3.620			0.035			
340		3.750		3.378		3.373		3.745						
341		3.875		3.503		3.498		3.870						
342		4.000		3.628		3.623		3.995						
343		4.125		3.753		3.748		4.120						
344		4.250		3.878		3.873		4.245						
345	3/16 in.	4.375		4.003		3.998		4.370						
346	(.210	4.500	+0.002	4.128	+0.000	4.123	+0.000	4.495	+0.002					
347	±0.005)	4.625	-0.000	4.253	-0.002	4.248	-0.002	4.620	-0.000					
348		4.750		4.378		4.373		4.745						
349		4.875		4.503		4.496		4.870						
425		5.001		4.524		4.498		4.975						
426		5.126		4.649		4.623		5.100		0.009		0.375	0.475	0.579
427		5.251		4.774		4.748		5.225						

**Gland details conform to MIL-G-5514F. For old standard gland lengths to MIL-P-5514B, GT Style #11 is available where required.*
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TABLE 3 DIMENSIONAL INFORMATION CONTINUED

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		A Bore Diameter		F Gland Diameter		B Rod Diameter		E Gland Diameter				0b/u	1b/u	2b/u
		Inch	Tol.	Inch	Tol.	Inch	Tol.	Inch	Tol.			Compact Narrow Base	Intermediate Base	Heavy Duty Wide Base
428		5.376		4.899		4.873		5.350						
429		5.501		5.024		4.998		5.475						
430		5.626		5.149		5.123		5.600						
431		5.751		5.274		5.248		5.725						
432		5.876		5.399		5.373		5.850						
433		6.001		5.524		5.498		5.975						
434		6.126		5.649		5.623		6.100						
435		6.251		5.774		5.748		6.225						
436		6.376	+0.003	5.899	+0.000	5.873	+0.000	6.350	+0.003	0.009				
437		6.501	-0.000	6.024	-0.003	5.998	-0.003	6.475	-0.000					
438		6.751		6.274		6.248		6.725						
439		7.001		6.524		6.498		6.975						
440		7.251		6.774		6.748		7.225						
441		7.501		7.024		6.998		7.475						
442		7.751		7.274		7.248		7.725						
443	1/4 in.	8.001		7.524		7.498		7.975			0.020			
444	(0.275	8.251		7.774		7.748		8.225			to	0.375	0.475	0.579
445	±0.006)	8.501		8.024		7.998		8.475			0.035			
446		9.001		8.524		8.498		8.975						
447		9.501		9.024		8.998		9.475						
448		10.001		9.524		9.498		9.975						
449		10.501		10.024		9.998		10.475						
450		11.001		10.524		10.498		10.975						
451		11.501		11.024		10.998		11.475						
452		12.001		11.524		11.498		11.975						
453		12.501	+0.004	12.024	+0.000	11.998	+0.000	12.475	+0.004	0.010				
454		13.001	-0.000	12.524	-0.003	12.498	-0.003	12.975	-0.000					
455		13.501		13.024		12.998		13.475						
456		14.001		13.524		13.498		13.975						
457		14.501		14.024		13.998		14.475						
458		15.001		14.524		14.498		14.975						
459		15.501		15.024		14.998		15.475						
460		16.001		15.524		15.498		15.975						

**Gland details conform to MIL-G-5514F. For old standard gland lengths to MIL-P-5514B, GT Style #11 is available where required.*
For metric-sized G-T rings, see Greene, Tweed's Metric G-T Ring catalog.

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