

The diametral tension of the ring causes its initial bearing against the cylinder wall. Fluid pressure is transmitted to the ring through the clearance between the piston and the cylinder, forcing the ring outward and away from the pressure.

Primary sealing occurs on surface "A", while secondary sealing is achieved on surfaces "B" and "C" after fluid pressure or system pressure occurs. Once the ring is seated the pressure differential becomes constant and maintains contact between the mating surfaces (See Figure 1).

The end clearance, necessary for thermal expansion and cylinder tolerance, in the Permaseal® ring is so incorporated into the joint as to eliminate a direct path for leakage (See Figure 2 & 3). This design removes the need for ring fitting and compensates for ring and cylinder wear.

Originally developed by Grover Piston Ring, the Permaseal® joint design has become the industry standard for hydraulic cylinder service. Because the Permaseal® joint design is bi-directional, fewer rings are required in double-acting applications, and costly assembly errors are eliminated in all hydraulic cylinder applications.

End Clearance in the Permaseal® ring not only compensates for cylinder diameter tolerance and thermal expansion, it also eliminates the need for ring fitting during assembly, and allows for ring and cylinder wear during operation.

Permaseal® outperforms all other piston rings when passing open ports. Its unique overlapping, interlocking joint design prevents the ends of the ring from moving radially outward when passing open ports, and eliminates the danger of port-clipping. Port diameters up to four times the ring width have been accommodated.

The diametral tension of the Permaseal® ring pressing against the cylinder wall establishes an initial circumferential seal. Fluid pressure transmitted to the ring through the radial clearance between the piston and cylinder wall causes the side face of the piston ring to seal against the side face of the piston ring groove. These surfaces, in conjunction with the sealing effectiveness of the Permaseal® joint design, ensure that oil bypass rates are maintained at or below acceptable levels in the majority of industrial hydraulic applications.

The efficiency of the Permaseal® ring as a dynamic seal depends upon the sealing surfaces provided by the piston groove and the cylinder wall. Please refer to sections covering "Ring and Groove Design."

FIGURE 1

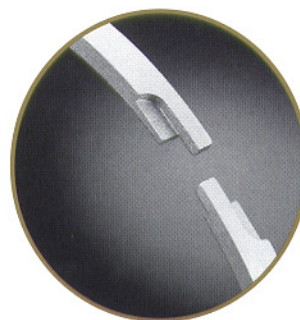
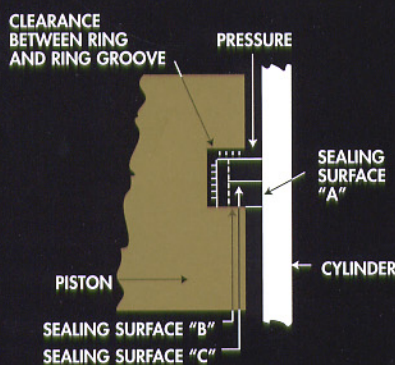


FIGURE 2

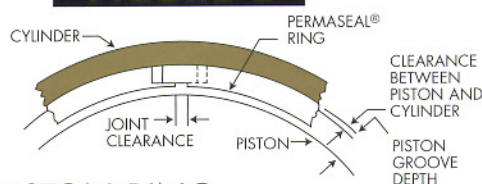
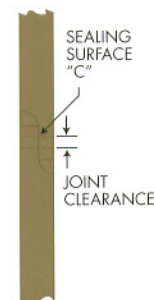


FIGURE 3



GROVER PISTON RING
I N C .

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NOTES

WALL FINISH:

Surface finish is not critical with the use of metallic piston rings. Satisfactory results can be obtained in bores ranging from 4 to 80 RMS. It has been found, however, that excellent ring seating takes place in cylinders with wall finishes from 16 to 40 RMS.

OUT OF ROUNDNESS:

This should not exceed .0005" per inch of cylinder diameter to a maximum of .005".

TAPER:

This should not exceed .0001" per inch of cylinder length to a maximum of .005".

Typical tool radius is .010"

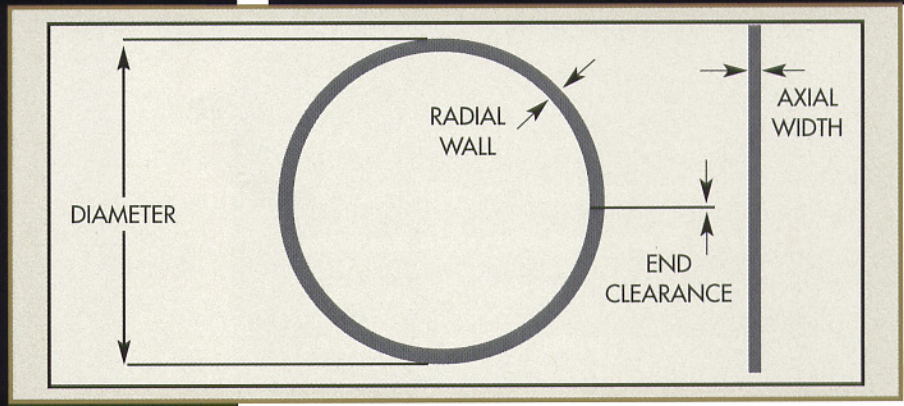
The dimensions listed are only common sizes and tolerances in reference to Grover's standard price sheet. Grover Piston Ring Inc. is capable of manufacturing a wide range of diameters, cross sections and joint configurations. Please contact our engineering department for custom designs and tolerances to meet your unique needs.

PERMASEAL® PISTON RING

MATERIAL – GREY CAST IRON

Size Range 1 1/2" OD – 30 1/2" OD

LEGEND



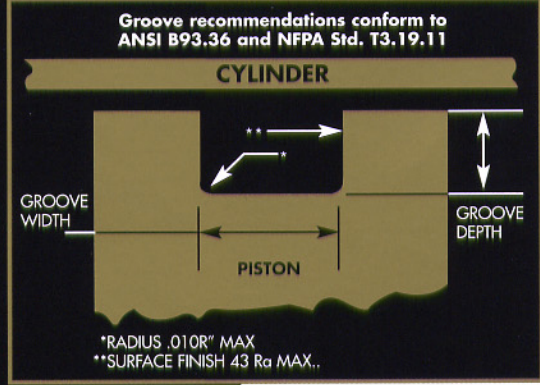
RING AND GROOVE DESIGN AREA

Diameter Range	Axial Ring Width			Radial Wall
	Optional	Standard	Optional	
1.5000" - 1.7500"	.0925/.0935	.1230/.1240	.1855/.1865	Diameter/26
1.7510" - 2.5000"	.0925/.0935	.1230/.1240	.1855/.1865	Diameter/28
2.5010" - 5.7500"	.1230/.1240	.1855/.1865	.2480/.2490	Diameter/30
5.7510" - 7.7500"	.2475/.2490	.3095/.3110	.3715/.3730	Diameter/30
7.7510" - 9.5000"	.3095/.3110	.3715/.3730	.4965/.4980	Diameter/30
9.5010" - 12.000"	.3090/.3110	.3710/.3730	.4960/.4980	Diameter/30
12.001" - 16.000"	.3710/.3730	.4960/.4980	.6210/.6230	Diameter/30
16.001" - 19.500"	.4960/.4980	.6210/.6230	.7450/.7470	Diameter/30
19.501" - 30.500"	.6205/.6230	.7445/.7470	.9945/.9970	Diameter/35

Diameter	Permaseal End Clearance
1.5000"- 4.5610"	.005/.015
4.5620"- 19.970"	.010/.020
19.971"- 30.500"	.015/.030

Diameter	Radial Wall Tolerance
1.5000" - 12.000"	+.000 - .015
12.001" - 30.000"	+.000 - .030

GROOVE DESIGN DATA



- Ring Diameter =**
Minimum Bore Diameter
- Minimum Groove Width =**
Maximum Ring Width + .002
- Maximum Groove Width =**
Minimum Groove Width + .002
- Minimum Groove Depth =**
Maximum Radial Wall + Maximum Tool Radius + .005
- Maximum Groove Depth**
is dependent upon specific assembly alignment.

PERMASEAL® PISTON RING

MATERIAL – GREY CAST IRON

PERMASEAL® PISTON RING STANDARD PART NUMBERS

Part Number	Diameter	Minimum Width	Maximum Width	Minimum Wall	Maximum Wall	Minimum Gap	Maximum Gap	Minimum Groove Width	Maximum Groove Width	Minimum Groove Depth	Groove Root Radius	Maximum Extrusion Gap
P-1001	1.500	0.1230	0.1240	0.052	0.067	0.005	0.015	0.126	0.128	0.082	0.010	0.018
P-1001-03	1.500	0.0925	0.0935	0.052	0.067	0.005	0.015	0.096	0.098	0.082	0.010	0.018
P-1001-06	1.500	0.1855	0.1865	0.052	0.067	0.005	0.015	0.189	0.191	0.082	0.010	0.018
P-1002	1.625	0.1230	0.1240	0.056	0.071	0.005	0.015	0.126	0.128	0.086	0.010	0.019
P-1002-03	1.625	0.0925	0.0935	0.056	0.071	0.005	0.015	0.096	0.098	0.086	0.010	0.019
P-1002-06	1.625	0.1855	0.1865	0.056	0.071	0.005	0.015	0.189	0.191	0.086	0.010	0.019
P-1003	1.750	0.1230	0.1240	0.060	0.075	0.005	0.015	0.126	0.128	0.090	0.010	0.020
P-1003-03	1.750	0.0925	0.0935	0.060	0.075	0.005	0.015	0.096	0.098	0.090	0.010	0.020
P-1003-06	1.750	0.1855	0.1865	0.060	0.075	0.005	0.015	0.189	0.191	0.090	0.010	0.020
P-1004	1.875	0.1230	0.1240	0.060	0.075	0.005	0.015	0.126	0.128	0.090	0.010	0.020
P-1004-03	1.875	0.0925	0.0935	0.060	0.075	0.005	0.015	0.096	0.098	0.090	0.010	0.020
P-1004-06	1.875	0.1855	0.1865	0.060	0.075	0.005	0.015	0.189	0.191	0.090	0.010	0.020
P-1005	2.000	0.1230	0.1240	0.060	0.075	0.005	0.015	0.126	0.128	0.090	0.010	0.020
P-1005-03	2.000	0.0925	0.0935	0.060	0.075	0.005	0.015	0.096	0.098	0.090	0.010	0.020
P-1005-06	2.000	0.1855	0.1865	0.060	0.075	0.005	0.015	0.189	0.191	0.090	0.010	0.020
P-1005-08	2.000	0.2480	0.2490	0.060	0.075	0.005	0.015	0.251	0.253	0.090	0.010	0.020
P-1006	2.125	0.1855	0.1865	0.065	0.080	0.005	0.015	0.189	0.191	0.095	0.010	0.022
P-1006-03	2.125	0.0925	0.0935	0.065	0.080	0.005	0.015	0.096	0.098	0.095	0.010	0.022
P-1006-04	2.125	0.1230	0.1240	0.065	0.080	0.005	0.015	0.126	0.128	0.095	0.010	0.022
P-1007	2.250	0.1855	0.1865	0.070	0.085	0.005	0.015	0.189	0.191	0.100	0.010	0.023
P-1007-03	2.250	0.0925	0.0935	0.070	0.085	0.005	0.015	0.096	0.098	0.100	0.010	0.023
P-1007-04	2.250	0.1230	0.1240	0.070	0.085	0.005	0.015	0.126	0.128	0.100	0.010	0.023
P-1007-05	2.250	0.1540	0.1550	0.070	0.085	0.005	0.015	0.157	0.159	0.100	0.010	0.023
P-1007-08	2.250	0.2480	0.2490	0.070	0.085	0.005	0.015	0.251	0.253	0.100	0.010	0.023
P-1008	2.375	0.1855	0.1865	0.076	0.091	0.005	0.015	0.189	0.191	0.106	0.010	0.025
P-1008-04	2.375	0.1230	0.1240	0.076	0.091	0.005	0.015	0.126	0.128	0.106	0.010	0.025
P-1008-08	2.375	0.2480	0.2490	0.076	0.091	0.005	0.015	0.251	0.253	0.106	0.010	0.025
P-1009	2.500	0.1855	0.1865	0.082	0.097	0.005	0.015	0.189	0.191	0.112	0.010	0.027
P-1009-03	2.500	0.0925	0.0935	0.082	0.097	0.005	0.015	0.096	0.098	0.112	0.010	0.027
P-1009-04	2.500	0.1230	0.1240	0.082	0.097	0.005	0.015	0.126	0.128	0.112	0.010	0.027
P-1009-05	2.500	0.1540	0.1550	0.082	0.097	0.005	0.015	0.157	0.159	0.112	0.010	0.027
P-1009-08	2.500	0.2480	0.2490	0.082	0.097	0.005	0.015	0.251	0.253	0.112	0.010	0.027
P-1010	2.625	0.1855	0.1865	0.087	0.102	0.005	0.015	0.189	0.191	0.117	0.010	0.028
P-1010-03	2.625	0.0925	0.0935	0.087	0.102	0.005	0.015	0.096	0.098	0.117	0.010	0.028
P-1010-04	2.625	0.1230	0.1240	0.087	0.102	0.005	0.015	0.126	0.128	0.117	0.010	0.028
P-1011	2.750	0.1855	0.1865	0.091	0.106	0.005	0.015	0.189	0.191	0.121	0.010	0.030
P-1011-03	2.750	0.0925	0.0935	0.091	0.106	0.005	0.015	0.096	0.098	0.121	0.010	0.030
P-1011-04	2.750	0.1230	0.1240	0.091	0.106	0.005	0.015	0.126	0.128	0.121	0.010	0.030
P-1011-08	2.750	0.2480	0.2490	0.091	0.106	0.005	0.015	0.251	0.253	0.121	0.010	0.030
P-1012	2.875	0.1855	0.1865	0.093	0.108	0.005	0.015	0.189	0.191	0.123	0.010	0.030
P-1012-04	2.875	0.1230	0.1240	0.093	0.108	0.005	0.015	0.126	0.128	0.123	0.010	0.030
P-1013	3.000	0.1855	0.1865	0.095	0.110	0.005	0.015	0.189	0.191	0.125	0.010	0.031
P-1013-04	3.000	0.1230	0.1240	0.095	0.110	0.005	0.015	0.126	0.128	0.125	0.010	0.031
P-1013-08	3.000	0.2480	0.2490	0.095	0.110	0.005	0.015	0.251	0.253	0.125	0.010	0.031
P-1013-10	3.000	0.3100	0.3110	0.095	0.110	0.005	0.015	0.313	0.315	0.125	0.010	0.031
P-1014	3.125	0.1855	0.1865	0.100	0.115	0.005	0.015	0.189	0.191	0.130	0.010	0.032
P-1014-04	3.125	0.1230	0.1240	0.100	0.115	0.005	0.015	0.126	0.128	0.130	0.010	0.032
P-1014-08	3.125	0.2480	0.2490	0.100	0.115	0.005	0.015	0.251	0.253	0.130	0.010	0.032
P-1014-10	3.125	0.3100	0.3110	0.100	0.115	0.005	0.015	0.313	0.315	0.130	0.010	0.032
P-1015	3.250	0.1855	0.1865	0.103	0.118	0.005	0.015	0.189	0.191	0.133	0.010	0.033

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PERMASEAL® PISTON RING

MATERIAL – GREY CAST IRON

PERMASEAL® PISTON RING STANDARD PART NUMBERS

Part Number	Diameter	Minimum Width	Maximum Width	Minimum Wall	Maximum Wall	Minimum Gap	Maximum Gap	Minimum Groove Width	Maximum Groove Width	Minimum Groove Depth	Groove Root Radius	Maximum Extrusion Gap
P-1015-04	3.250	0.1230	0.1240	0.103	0.118	0.005	0.015	0.126	0.128	0.133	0.010	0.033
P-1015-05	3.250	0.1540	0.1550	0.103	0.118	0.005	0.015	0.157	0.159	0.133	0.010	0.033
P-1015-08	3.250	0.2480	0.2490	0.103	0.118	0.005	0.015	0.251	0.253	0.133	0.010	0.033
P-1015-12	3.250	0.3720	0.3730	0.103	0.118	0.005	0.015	0.375	0.377	0.133	0.010	0.033
P-1016	3.375	0.1855	0.1865	0.106	0.121	0.005	0.015	0.189	0.191	0.136	0.010	0.034
P-1016-04	3.375	0.1230	0.1240	0.106	0.121	0.005	0.015	0.126	0.128	0.136	0.010	0.034
P-1016-08	3.375	0.2480	0.2490	0.106	0.121	0.005	0.015	0.251	0.253	0.136	0.010	0.034
P-1017	3.500	0.1855	0.1865	0.109	0.124	0.005	0.015	0.189	0.191	0.139	0.010	0.035
P-1017-04	3.500	0.1230	0.1240	0.109	0.124	0.005	0.015	0.126	0.128	0.139	0.010	0.035
P-1017-08	3.500	0.2480	0.2490	0.109	0.124	0.005	0.015	0.251	0.253	0.139	0.010	0.035
P-1017-10	3.500	0.3100	0.3110	0.109	0.124	0.005	0.015	0.313	0.315	0.139	0.010	0.035
P-1017-12	3.500	0.3720	0.3730	0.109	0.124	0.005	0.015	0.375	0.377	0.139	0.010	0.035
P-1018	3.625	0.1855	0.1865	0.112	0.127	0.005	0.015	0.189	0.191	0.142	0.010	0.036
P-1018-08	3.625	0.2480	0.2490	0.112	0.127	0.005	0.015	0.251	0.253	0.142	0.010	0.036
P-1019	3.750	0.2480	0.2490	0.115	0.130	0.005	0.015	0.251	0.253	0.145	0.010	0.037
P-1019-04	3.750	0.1230	0.1240	0.115	0.130	0.005	0.015	0.126	0.128	0.145	0.010	0.037
P-1019-05	3.750	0.1540	0.1550	0.115	0.130	0.005	0.015	0.157	0.159	0.145	0.010	0.037
P-1019-06	3.750	0.1855	0.1865	0.115	0.130	0.005	0.015	0.189	0.191	0.145	0.010	0.037
P-1020	3.875	0.2480	0.2490	0.123	0.138	0.005	0.015	0.251	0.253	0.153	0.010	0.039
P-1020-04	3.875	0.1230	0.1240	0.123	0.138	0.005	0.015	0.126	0.128	0.153	0.010	0.039
P-1020-06	3.875	0.1855	0.1865	0.123	0.138	0.005	0.015	0.189	0.191	0.153	0.010	0.039
P-1021	4.000	0.2480	0.2490	0.127	0.142	0.005	0.015	0.251	0.253	0.157	0.010	0.040
P-1021-04	4.000	0.1230	0.1240	0.127	0.142	0.005	0.015	0.126	0.128	0.157	0.010	0.040
P-1021-05	4.000	0.1540	0.1550	0.124	0.142	0.005	0.015	0.157	0.159	0.157	0.010	0.040
P-1021-06	4.000	0.1855	0.1865	0.127	0.142	0.005	0.015	0.189	0.191	0.157	0.010	0.040
P-1021-10	4.000	0.3100	0.3110	0.127	0.142	0.005	0.015	0.313	0.315	0.157	0.010	0.040
P-1021-12	4.000	0.3720	0.3730	0.127	0.142	0.005	0.015	0.375	0.377	0.157	0.010	0.040
P-1022	4.250	0.2480	0.2490	0.135	0.150	0.005	0.015	0.251	0.253	0.165	0.010	0.043
P-1022-04	4.250	0.1230	0.1240	0.135	0.150	0.005	0.015	0.126	0.128	0.165	0.010	0.043
P-1022-06	4.250	0.1855	0.1865	0.135	0.150	0.005	0.015	0.189	0.191	0.165	0.010	0.043
P-1023	4.500	0.2480	0.2490	0.145	0.160	0.005	0.015	0.251	0.253	0.175	0.010	0.046
P-1023-04	4.500	0.1230	0.1240	0.145	0.160	0.005	0.015	0.126	0.128	0.175	0.010	0.046
P-1023-06	4.500	0.1855	0.1865	0.145	0.160	0.005	0.015	0.189	0.191	0.175	0.010	0.046
P-1023-10	4.500	0.3100	0.3110	0.145	0.160	0.005	0.015	0.313	0.315	0.175	0.010	0.046
P-1023-12	4.500	0.3720	0.3730	0.145	0.160	0.005	0.015	0.375	0.377	0.175	0.010	0.046
P-1024	4.750	0.2480	0.2490	0.152	0.167	0.010	0.020	0.251	0.253	0.182	0.010	0.048
P-1024-04	4.750	0.1230	0.1240	0.152	0.167	0.010	0.020	0.126	0.128	0.182	0.010	0.048
P-1024-06	4.750	0.1855	0.1865	0.152	0.167	0.010	0.020	0.189	0.191	0.182	0.010	0.048
P-1024-12	4.750	0.3720	0.3730	0.152	0.167	0.010	0.020	0.375	0.377	0.182	0.010	0.048
P-1024-16	4.750	0.4970	0.4980	0.152	0.167	0.010	0.020	0.500	0.502	0.182	0.010	0.048
P-1025	5.000	0.2480	0.2490	0.160	0.175	0.010	0.020	0.251	0.253	0.190	0.010	0.050
P-1025-04	5.000	0.1230	0.1240	0.160	0.175	0.010	0.020	0.126	0.128	0.190	0.010	0.050
P-1025-06	5.000	0.1855	0.1865	0.160	0.175	0.010	0.020	0.189	0.191	0.190	0.010	0.050
P-1025-10	5.000	0.3100	0.3110	0.160	0.175	0.010	0.020	0.313	0.315	0.190	0.010	0.050
P-1025-12	5.000	0.3720	0.3730	0.160	0.175	0.010	0.020	0.375	0.377	0.190	0.010	0.050
P-1025-16	5.000	0.4970	0.4980	0.160	0.175	0.010	0.020	0.500	0.502	0.190	0.010	0.050
P-1026	5.250	0.2480	0.2490	0.166	0.181	0.010	0.020	0.251	0.253	0.196	0.010	0.052
P-1026-04	5.250	0.1230	0.1240	0.166	0.181	0.010	0.020	0.126	0.128	0.196	0.010	0.052
P-1026-06	5.250	0.1855	0.1865	0.166	0.181	0.010	0.020	0.189	0.191	0.196	0.010	0.052

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