PISTON RINGS AND PISTONS — SAE J929

SAE Standard

Report of Miscellaneous Division approved August 1916 and last revised by Engine Committee July 1965.

General—These specifications are in general use and have been adopted as an SAE Standard primarily for conventional automotive type engines. This category includes passenger car and light to medium duty truck, tractor, and industrial engines, as well as some compressors. For heavy duty gasoline and diesel engine it may be necessary to depart from these standards. When deviations from Table 1 are made they should be in the piston groove specifications and not in the ring specifications.

Groove root diameters (Tables 2, 3, and 4) were calculated from the following formulas which allow for normal piston land clearances, 0.010

TABLE 1—PISTON-RING AND GROOVE WIDTHS UP TO 8 DIA

Nominal Ring Width	Ring Widths[a]			Ring-Groove Widths							
				Compression-Ring Grooves				Oil-Ring Grooves[b]			
	All Dia	Under 5 Dia	5 to 8 Dia	Under 5 Dia		5 to 8 Dia, Inclusive		Under 5 Dia		5 to 8 Dia, Inclusive	
	Max	Min	Min	Max	Min	Max	Min	Max	Min	Max	Min
3/64	0.0470	0.0465	0.0460	0.0500	0.0490	—	—	—	—	—	—
1/16	0.0625	0.0620	0.0615	0.0655	0.0645	—	—	—	—	—	—
5/64	0.0780	0.0775	0.0770	0.0810	0.0800	—	—	—	—	—	—
3/32	0.0935	0.0930	0.0925	0.0965	0.0955	0.0970	0.0960	0.0960	0.0950	—	—
1/8	0.1240	0.1235	0.1230	0.1270	0.1260	0.1275	0.1265	0.1265	0.1255	—	—
5/32	0.1550	0.1545	0.1540	—	—	0.1585	0.1575	0.1575	0.1565	0.1580	0.1570
3/16	0.1865	0.1860	0.1855	—	—	0.1900	0.1890	0.1890	0.1880	0.1895	0.1885
1/4	0.2490	0.2485	0.2480	—	—	0.2525	0.2515	0.2515	0.2505	0.2520	0.2510

[a] On side-coated compression rings subtract 0.0005 from minimum ring width. On side-coated oil rings add 0.005 to maximum ring width.

[b] On slotted grooves add 0.005 to maximum groove width.

TABLE 2—PISTON-RING RADIAL WALL THICKNESS[a] AND GROOVE-ROOT DIAMETERS FOR REGULAR WALL RINGS

D Cylinder Dia	T Max Ring Radial Wall Thickness	Max Ring Groove-Root Dia		D Cylinder Dia	T Max Ring Radial Wall Thickness	Max Ring Groove-Root Dia		D Cylinder Dia	T Max Ring Radial Wall Thickness	Max Ring Groove-Root Dia		D Cylinder Dia	T Max Ring Radial Wall Thickness	Max Ring Groove-Root Dia	
		A Compression Rings	A Oil Rings			A Compression Rings	A Oil Rings			A Compression Rings	A Oil Rings			A Compression Rings	A Oil Rings
1	0.046	0.876	0.842	2-3/4	0.127	2.452	2.419	4-1/2	0.189	4.065	4.035	6-1/4	0.247	5.687	5.658
1-1/16	0.049	0.932	0.898	2-13/16	0.130	2.507	2.475	4-9/16	0.191	4.123	4.093	6-5/16	0.249	5.746	5.716
1-1/8	0.052	0.988	0.954	2-7/8	0.133	2.564	2.532	4-5/8	0.193	4.182	4.151	6-3/8	0.251	5.803	5.776
1-3/16	0.055	1.044	1.010	2-15/16	0.136	2.619	2.587	4-11/16	0.195	4.239	4.209	6-7/16	0.253	5.861	5.832
1-1/4	0.058	1.100	1.066	3	0.139	2.676	2.644	4-3/4	0.197	4.298	4.267	6-1/2	0.255	5.919	5.891
1-5/16	0.061	1.156	1.122	3-1/16	0.141	2.734	2.702	4-13/16	0.199	4.355	4.325	6-9/16	0.257	5.978	5.949
1-3/8	0.064	1.212	1.179	3-1/8	0.143	2.793	2.760	4-7/8	0.201	4.414	4.383	6-5/8	0.259	6.036	6.007
1-7/16	0.067	1.268	1.234	3-3/16	0.145	2.850	2.818	4-15/16	0.203	4.471	4.441	6-11/16	0.261	6.094	6.065
1-1/2	0.069	1.326	1.293	3-1/4	0.147	2.908	2.876	5	0.205	4.530	4.500	6-3/4	0.263	6.152	6.123
1-9/16	0.072	1.382	1.349	3-5/16	0.149	2.966	2.934	5-1/16	0.207	4.588	4.558	6-13/16	0.265	6.210	6.181
1-5/8	0.075	1.439	1.405	3-3/8	0.151	3.024	2.992	5-1/8	0.209	4.646	4.616	6-7/8	0.267	6.268	6.239
1-11/16	0.078	1.494	1.461	3-7/16	0.153	3.082	3.050	5-3/16	0.211	4.704	4.674	6-15/16	0.269	6.326	6.297
1-3/4	0.081	1.551	1.517	3-1/2	0.155	3.140	3.109	5-1/4	0.214	4.761	4.730	7	0.271	6.384	6.356
1-13/16	0.084	1.606	1.573	3-9/16	0.157	3.198	3.167	5-5/16	0.216	4.818	4.788	7-1/16	0.273	6.443	6.414
1-7/8	0.087	1.663	1.630	3-5/8	0.159	3.257	3.225	5-3/8	0.218	4.877	4.846	7-1/8	0.275	6.500	6.472
1-15/16	0.090	1.718	1.685	3-11/16	0.162	3.312	3.281	5-7/16	0.220	4.934	4.904	7-3/16	0.277	6.559	6.530
2	0.093	1.775	1.742	3-3/4	0.164	3.371	3.339	5-1/2	0.222	4.992	4.962	7-1/4	0.280	6.614	6.586
2-1/16	0.096	1.831	1.798	3-13/16	0.166	3.428	3.397	5-9/16	0.224	5.051	5.021	7-5/16	0.282	6.673	6.644
2-1/8	0.098	1.889	1.856	3-7/8	0.168	3.487	3.456	5-5/8	0.226	5.109	5.079	7-3/8	0.284	6.730	6.702
2-3/16	0.101	1.945	1.912	3-15/16	0.170	3.544	3.515	5-11/16	0.228	5.167	5.137	7-7/16	0.286	6.789	6.760
2-1/4	0.104	2.001	1.968	4	0.172	3.603	3.572	5-3/4	0.230	5.225	5.195	7-1/2	0.288	6.846	6.819
2-5/16	0.107	2.057	2.024	4-1/16	0.174	3.661	3.630	5-13/16	0.232	5.283	5.253	7-9/16	0.290	6.905	6.877
2-3/8	0.110	2.113	2.080	4-1/8	0.176	3.719	3.688	5-7/8	0.234	5.341	5.311	7-5/8	0.292	6.963	6.935
2-7/16	0.113	2.169	2.136	4-3/16	0.178	3.777	3.746	5-15/16	0.236	5.399	5.369	7-11/16	0.294	7.021	6.993
2-1/2	0.116	2.225	2.193	4-1/4	0.180	3.835	3.804	6	0.238	5.457	5.428	7-3/4	0.296	7.079	7.051
2-9/16	0.119	2.281	2.249	4-5/16	0.182	3.873	3.862	6-1/16	0.240	5.516	5.486	7-13/16	0.299	7.135	7.107
2-5/8	0.122	2.338	2.305	4-3/8	0.184	3.951	3.920	6-1/8	0.243	5.571	5.542	7-7/8	0.301	7.193	7.165
2-11/16	0.125	2.393	2.361	4-7/16	0.186	4.009	3.978	6-3/16	0.245	5.630	5.600	7-15/16	0.303	7.251	7.223
												8	0.305	7.309	7.282

[a] Allowable tolerance on ring thickness is 0.010 up to 5-1/2 dia, and 0.015 over 5-1/2 dia.

TABLE 3—PISTON-RING RADIAL WALL THICKNESS[a] AND GROOVE-ROOT DIAMETERS FOR INTERMEDIATE WALL COMPRESSION RINGS

D Cylinder Dia	T Max Ring Radial Wall Thickness +0.000/−0.010	A Max Ring Groove-Root Dia (Compression Rings Only)	D Cylinder Dia	T Max Ring Radial Wall Thickness +0.000/−0.010	A Max Ring Groove-Root Dia (Compression Rings Only)
3	0.141	2.672	4-1/4	0.198	3.799
3-1/16	0.144	2.729	4-5/16	0.201	3.856
3-1/8	0.147	2.784	4-3/8	0.204	3.911
3-3/16	0.150	2.841	4-7/16	0.207	3.968
3-1/4	0.153	2.896	4-1/2	0.209	4.025
3-5/16	0.156	2.953	4-9/16	0.212	4.082
3-3/8	0.158	3.010	4-5/8	0.215	4.137
3-7/16	0.161	3.067	4-11/16	0.218	4.194
3-1/2	0.164	3.122	4-3/4	0.221	4.249
3-9/16	0.167	3.179	4-13/16	0.224	4.306
3-5/8	0.170	3.235	4-7/8	0.227	4.362
3-11/16	0.173	3.291	4-15/16	0.229	4.420
3-3/4	0.175	3.349	5	0.232	4.476
3-13/16	0.178	3.405	5-1/16	0.235	4.533
3-7/8	0.181	3.461	5-1/8	0.238	4.588
3-15/16	0.184	3.517	5-3/16	0.241	4.645
4	0.187	3.573	5-1/4	0.244	4.700
4-1/16	0.190	3.630	5-5/16	0.246	4.759
4-1/8	0.192	3.687	5-3/8	0.249	4.814
4-3/16	0.195	3.744	5-7/16	0.252	4.871
			5-1/2	0.255	4.926

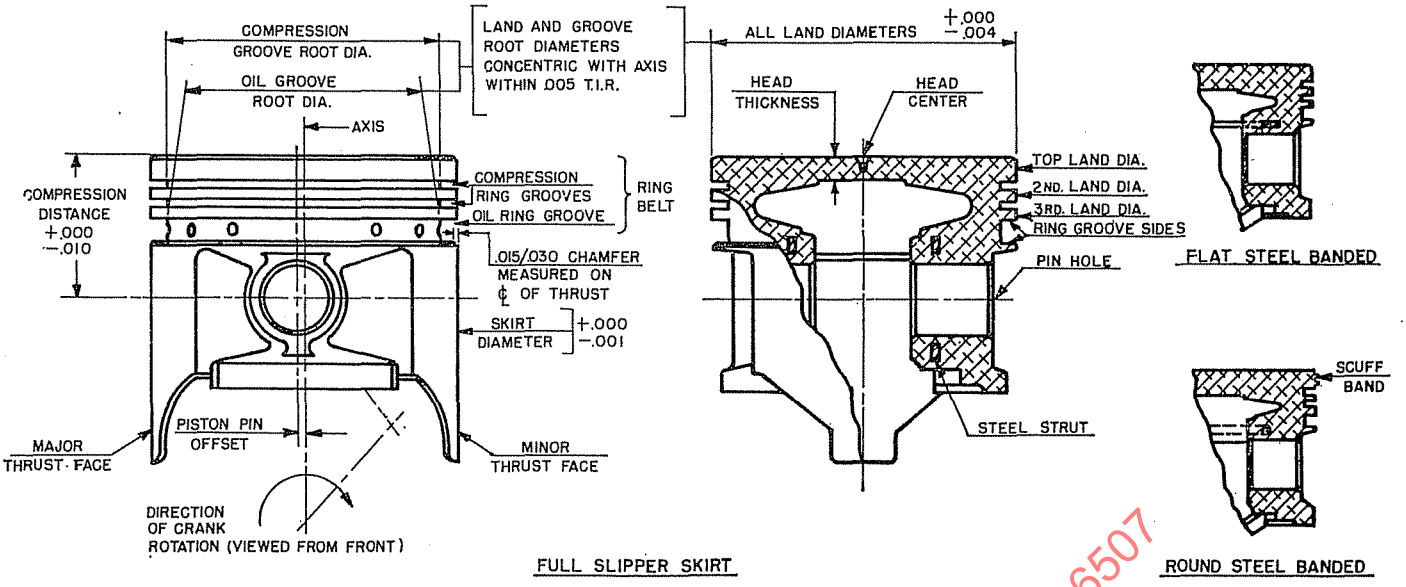
[a] Maximum thickness is dia/22 +0.005.

TABLE 4—PISTON-RING RADIAL WALL THICKNESS[a] AND GROOVE-ROOT DIAMETERS FOR THICKWALL COMPRESSION RINGS

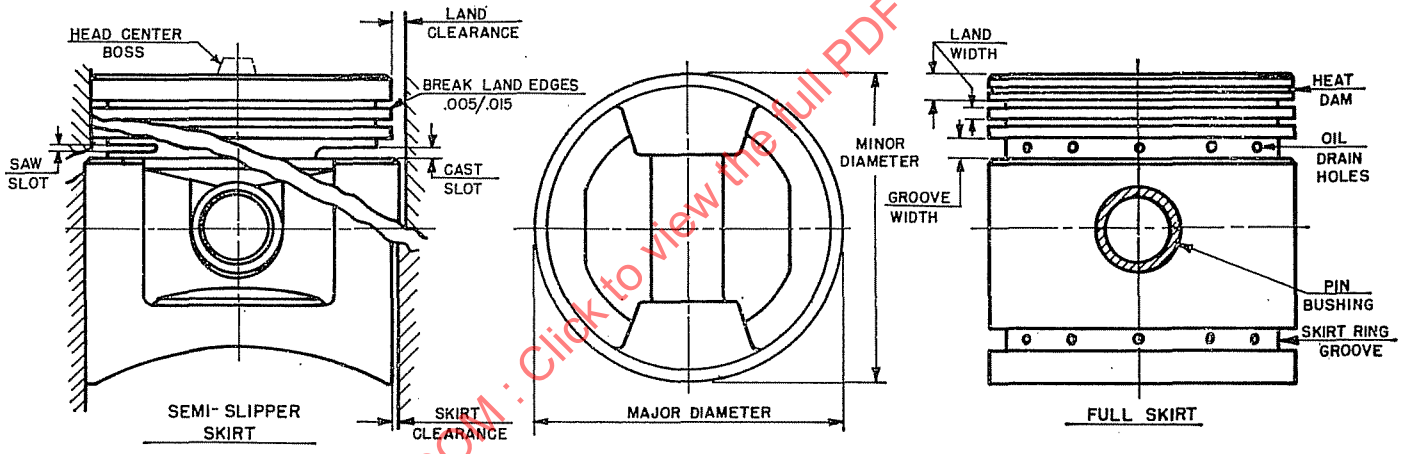
D Cylinder Dia	T Max Ring Radial Wall Thickness +0.000/−0.010	A Max Ring Groove-Root Dia (Compression Rings Only)	D Cylinder Dia	T Max Ring Radial Wall Thickness +0.000/−0.010	A Max Ring Groove-Root Dia (Compression Rings Only)
2	0.100	1.761	3	0.150	2.654
2-1/16	0.103	1.818	3-1/16	0.153	2.711
2-1/8	0.106	1.873	3-1/8	0.156	2.766
2-3/16	0.109	1.929	3-3/16	0.159	2.823
2-1/4	0.112	1.985	3-1/4	0.162	2.878
2-5/16	0.116	2.040	3-5/16	0.166	2.932
2-3/8	0.119	2.095	3-3/8	0.169	2.988
2-7/16	0.122	2.152	3-7/16	0.172	3.045
2-1/2	0.125	2.207	3-1/2	0.175	3.100
2-9/16	0.128	2.264	3-9/16	0.178	3.157
2-5/8	0.131	2.320	3-5/8	0.181	3.213
2-11/16	0.134	2.376	3-11/16	0.184	3.269
2-3/4	0.137	2.432	3-3/4	0.187	3.325
2-13/16	0.141	2.486	3-13/16	0.191	3.379
2-7/8	0.144	2.542	3-7/8	0.194	3.435
2-15/16	0.147	2.598	3-15/16	0.197	3.491
			4	0.200	3.547

NOTE: Thickwall specification is maximum permissible radial thickness applicable to compression ring types only.

[a] Maximum thickness is dia/20.



FULL SLIPPER SKIRT



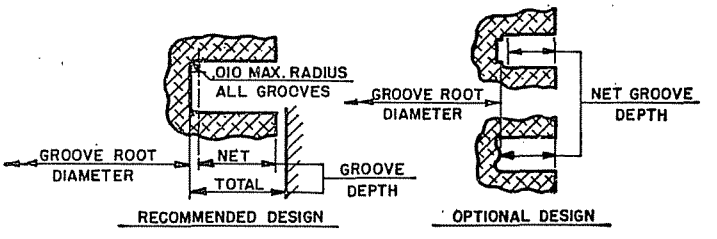
SEMI-SLIPPER SKIRT

FULL SKIRT

TOP GROOVE INSERTS

NOMINAL GROOVE WIDTH	DRAIN HOLE	SLOT WIDTH
1/8	3/32	1/16
5/32	1/8	3/32
3/16	5/32	3/32
1/4	3/16	1/8

OIL GROOVES



TYPES OF GROOVES

FIG. 1

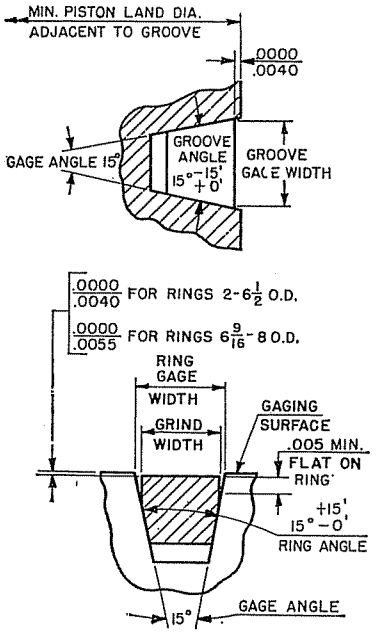


FIG. 2—FULL KEYSTONE

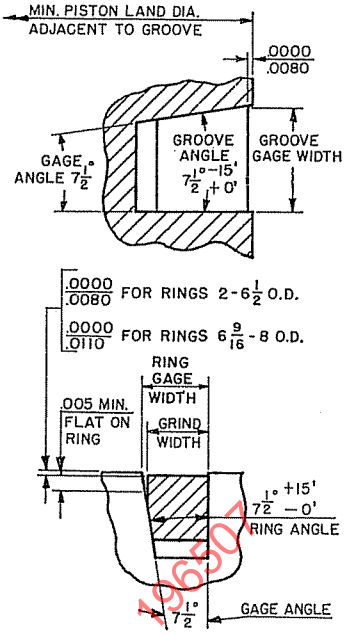


FIG. 3—HALF KEYSTONE

maximum radii at the root of the grooves and 0.005 TIR eccentricity of the groove root. Interpolate for sizes not tabulated.

Compression ring grooves: $A = D - (2T + 0.007D + 0.025)$[1]

Oil ring grooves: $A = D - (2T + 0.006D + 0.060)$

For all ring grooves: $B = A - 0.010$

where

A = High limit for groove root diameter
B = Low limit for groove root diameter
D = Nominal cylinder diameter
T = Maximum ring radial wall thickness

Groove root diameters are shown in Fig. 1.

It is recommended that cylinder diameter tolerance be specified as plus above the nominal diameter. Piston ring end clearance must be determined from the minimum cylinder diameter. It is recommended that end clearance for rings in automotive engines be as given in Table 5.

Finished piston ring and piston oversizes recommended for service installation are 0.020, 0.030, 0.040, and 0.060.

Material—Gray cast iron piston ring material is used for general automotive applications. Gray cast iron piston rings are made with a high carbon equivalent iron and with casting techniques that promote, in the small section castings, the most desirable graphite and matrix microstructural conditions for wear resistance and adequate mechanical and physical properties. The chemical element ranges shown represent typical chemical compositions for gray cast iron piston rings.

Element—

Total Carbon: 3.50 — 3.95
Silicon: 2.20 — 3.10
Manganese: 0.40 — .80
Phosphorus: 0.30 — .80
Sulfur: 0.13 max

Alloying elements such as chromium, copper, molybdenum, vanadium, tin, etc., may be added to enhance the material properties or improve the material for special applications.

Hardness—Rockwell B 95 — 107.

Microstructure—Gray cast iron piston rings are made to present an abrasion resistant matrix combined with the best graphite attainable in gray iron for mechanical and physical properties.

The matrix is esssentially completely pearlitic or sorbitic with a minimum of free ferrite and massive cementite. The phosphorus constituent, steadite, is uniformly distributed in nonmassive particles.

The graphite will consist principally of randomly oriented flakes that are described as AFS-ASTM type A or A-B combination. The graphite particles will normally be of AFS-ASTM sizes 4-8.

Keystone Specifications—For keystone specifications see Figs. 2 and 3 and Table 6.

Piston Ring Nomenclature—Common types of rings in general use are shown in Fig. 4.

[1]Dimensions in this standard are expressed in inches.

TABLE 5—RING END CLEARANCES[a], IN.

Cylinder Diameter	End Clearance	Cylinder Diameter	End Clearance
1 to 1-31/32 inclusive	0.005 to 0.013	4 to 4-31/32 inclusive	0.013 to 0.025
2 to 2-31/32 inclusive	0.007 to 0.017	5 to 6-31/32 inclusive	0.017 to 0.032
3 to 3-31/32 inclusive	0.010 to 0.020	7 to 8 inclusive	0.023 to 0.040

[a] Compressor and sealing rings, depending upon the particular application, require special end clearances and tolerances.

TABLE 6—DIMENSIONS OF KEYSTONE RINGS[a] (FIG. 3)

Nominal Ring Width	Piston and Ring Gage Width	Grind Width, max	
		Full Keystone	Half Keystone
3/32	0.0935	0.0890	0.0910
1/8	0.1240	0.1195	0.1215
5/32	0.1550	0.1505	0.1525
3/16	0.1865	0.1820	0.1840
1/4	0.2490	0.2445	0.2465
5/16	0.3115	0.3070	0.3090
3/8	0.3740	0.3696	0.3716

[a] The keystone type of ring is used only in engines where ring sticking is a problem.

(Fig. 4 appears on next page)