SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J2004
(ISO 6627)

Issued 1990-09-10

INTERNAL COMBUSTION ENGINES - PISTON RINGS EXPANDER/SEGMENT OIL CONTROL RINGS

This document is equivalent to ISO Standard 6627 TR.

1. SCOPE AND FIELD OF APPLICATION:

This SAE Recommended Practice is equivalent to ISO Standard 6627 TR.

Differences, where they exist, are shown in the appendix with associated rationale.

This document specifies the dimensional features of commonly used oil control rings having two steel segments (rails) separated and expanded by one steel expander/spacer.

The segments vary in width from 0.4 to 0.6 mm. The assembly width ranges from 2.5 to 4.75 mm. The 4.75 mm width is equivalent to existing 3/16 in applications. Expander design will vary considerably with piston ring manufacturer.

The total circumferential deflection and the piston groove depth should be considered when designing these oil rings to optimize the fit of the ring assembly into the piston groove.

This document applies to oil control rings up through 125 mm for reciprocating internal combustion engines. It may also be used for piston rings of compressors working under similar conditions.

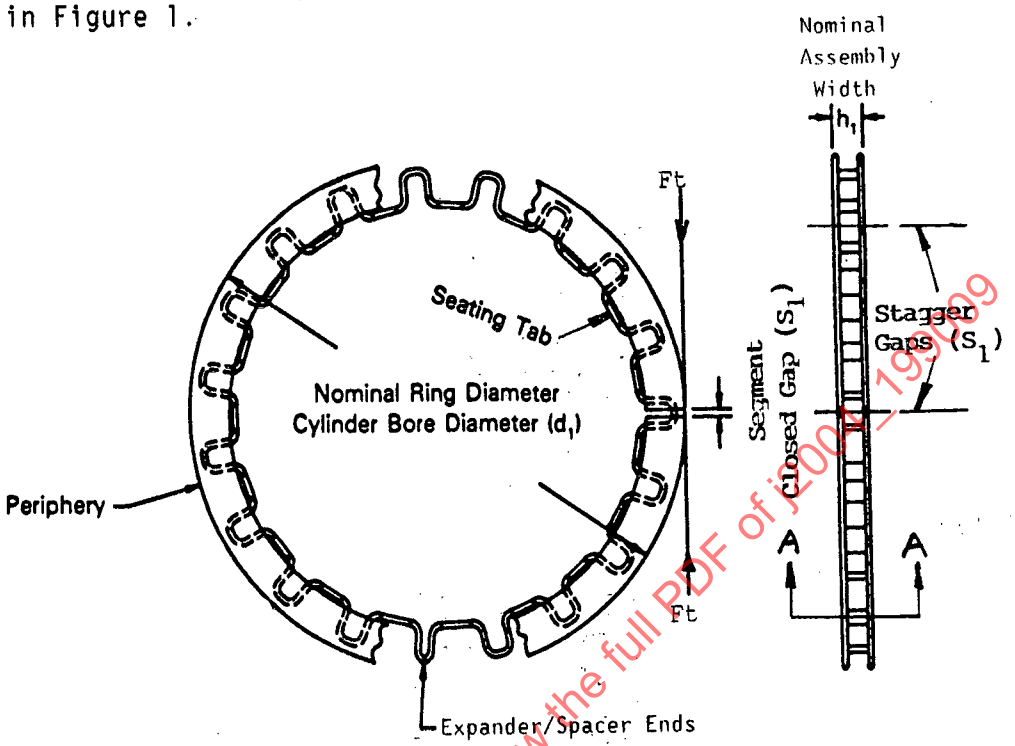
2. REFERENCES:

SAE DESIGNATION	ISO[1] EQUIVALENT	
		INTERNAL COMBUSTION ENGINES - PISTON RINGS
J1588	6621/1	Vocabulary
J1589	6621/2	Measuring principles
J1590	6621/3	Material specifications
J1591	6621/4	General specifications
J1996	6621/5	Quality requirements
		INTERNAL COMBUSTION ENGINES - PISTON RINGS
J1997	6622/1	Rectangular rings
J1998	6622/2 TR	Rectangular rings with narrow ring width
J1999	6623	INTERNAL COMBUSTION ENGINES - PISTON RINGS - SCRAPER RINGS
		INTERNAL COMBUSTION ENGINES - PISTON RINGS
J2000	6624/1	Keystone rings
J2001	6624/2 TR	Half keystone rings
J2002	6625	INTERNAL COMBUSTION ENGINES - PISTON RINGS - OIL CONTROL RINGS
J2003	6626	INTERNAL COMBUSTION ENGINES - COIL SPRING LOADED OIL CONTROL RINGS
J2004	6627 TR	INTERNAL COMBUSTION ENGINES - EXPANDER/SEGMENT OIL CONTROL RINGS
	1101	TECHNICAL DRAWINGS - Tolerancing of form, orientation, location and run-out - Generalities, definitions, symbols indications on drawings

[1]TR refers to Technical Report

3. EXPANDER/SEGMENT ASSEMBLY:

When assembled in the engine the segments and expander shall be positioned as shown in Figure 1.



a_1 Segment Radial Wall Thickness	h_1 Nominal Assembly Width	d_1 Nominal Assembly Diameter
a_8 Spacer Radial Height	h_7 Spacer Width	θ Seating Tab Angle
a_{10} Seating Tab Height	h_9 Expander Width	F_t Tangential Force
a_6 Assembly Radial Thickness	h_6 Segment Width	
a_9 Expander Radial Height	s_1 Segment Closed Gap	

NOTE: For measuring purposes only, segment gaps shall be in line and expander/spacer ends shall be at the back of the segments (see SAE J1589 3.2.5b).

FIGURE 1

3.1 Ring Types:

There are any number of possible oil ring expander designs. The more common designs in use today are designated in Figures 2 through 6.

3.1 Cross Section Configuration:

3.1.1 ES-1 Type:

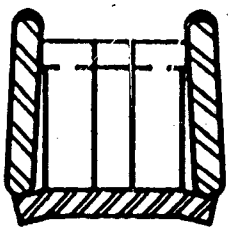


FIGURE 2

3.1.2 ES-2 Type:

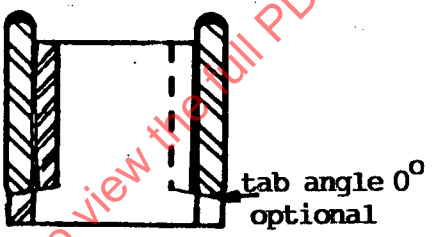


FIGURE 3

3.1.3 ES-3 Type:

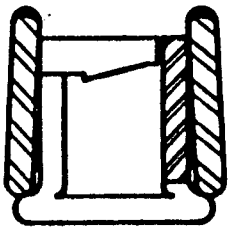


FIGURE 4

3.1.4 ES-4 Type:

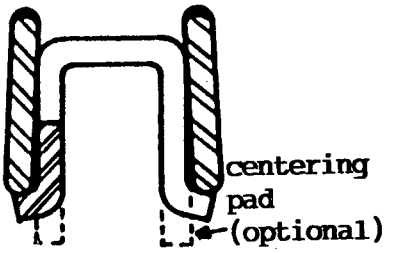


FIGURE 5

3.1.5 ES-5 Type:

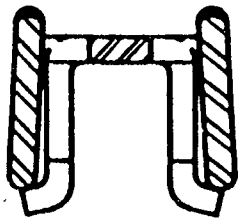
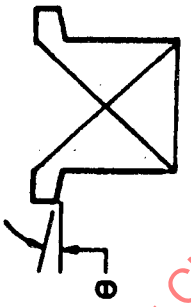


FIGURE 6

4. COMMON FEATURES:

4.1 Expander Seating Tab Angle: (See Figure 7.)

The expander may be designed with the seating tabs at a slight angle resulting in side sealing between the segment and the side of the piston groove.



NOMINAL SEATING ANGLE (Θ)
DEPENDING ON DESIGN

TOLERANCE = ±5°

FIGURE 7

4.2 Segment Chromium Thickness: (See Figure 8.)

(Common feature of segment is chrome plated periphery.)

FIGURE 8

TABLE 1 - Layer Thickness

Dimensions in millimeters	
CHROMIUM	THICKNESS MIN
CR1	0.05
CR2	0.10
CR3	0.15

4.3 Segment Width (h_6): (See Figure 9.)

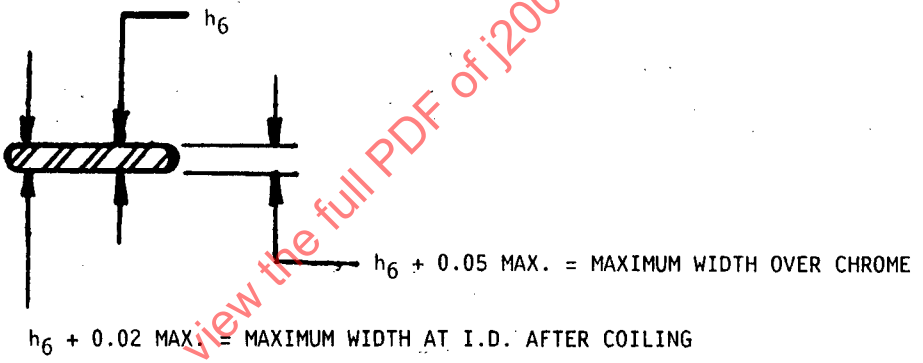


FIGURE 9

5. MATERIALS:

5.1 Expander:

Austenitic Stainless Steel (SAE J1590)
Carbon Steel (as agreed upon between client and manufacturer)

5.2 Segment:

Carbon Steel

6. FORCE AND NOMINAL CONTACT PRESSURE:

6.1 Tangential Force (F_t):

The force of expander/segment oil control rings is determined by the force of the expander and can be calculated with the following equation:

$$F_t = 1/2\ P_o \cdot d_1 \cdot 2h_6 \qquad \text{(Eq.1)}$$

P_o = Required Nominal Contact Pressure

6.1 (Continued):

The force exerted by the segments is negligible.

In Table 3 of Section 7, Dimensions, the F_t has been tabulated at a unit pressure of P_o = 1 N/mm^2.

6.2 Nominal Contact Pressure P_o:

F_t for selected unit pressures is calculated by use of the multiplying factors in Table 2:

TABLE 2

MULTIPLYING FACTOR x F_t (FROM TABLE 3)	UNIT PRESSURE P_o
1.60[1]	1.60 N/mm^2
1.25	1.25 N/mm^2
1.00	1.00 N/mm^2
0.80	0.80 N/mm^2
0.60[2]	0.60 N/mm^2

[1]Recommended for repair sizes only
[2]Not recommended $<d_1$ = 65 mm

7. DIMENSIONS:

TABLE 3

NOMINAL DIAMETER d_1	SEGMENT WIDTH h6 COLUMN 1	2	3	4	TOLERANCE	SEGMENT CLOSED GAP S1	TOLERANCE	F_t (P_n = 1 N/mm²) TANGENTIAL FORCE COLUMN 1	2	3	4	TOLERANCE	NOMINAL ASSEMBLY WIDTH h_1 USING AVAILABLE h_2 COLUMN 1-3	1-3	1-4	1-4	4
40								16	18	20							
41								16.4	18.4	20.5							
42								16.8	18.9	21							
43								17.2	19.3	21.5							
44								17.6	19.8	22							
45								18	20.2	22.5							
46								18.4	20.7	23							
47								18.8	21.1	23.5							
48								19.2	21.6	24							
49						0,15	+0.50 0	19.6	22	24.5							
50								20	22.5	25							
51								20.4	22.9	25.5							
52								20.8	23.4	26							
53								21.2	23.8	26.5							
54								21.6	24.3	27							
55								22	24.7	27.5							
56								22.4	25.2	28							
57								22.8	25.6	28.5		±30% $F_t \leq 30$ N					
58								23.2	26.1	29							
59								23.6	26.5	29.5							
60								24	27	30	36						
61								24.4	27.4	30.5	36.6						
62								24.8	27.9	31	37.2	±20% $F_t \leq 30$ N	2.5				
63								25.2	28.3	31.5	37.8						
64								25.6	28.8	32	38.4						
65								26	29.2	32.5	39						
66								26.4	29.7	33	39.6						
67						0,20		26.8	30.1	33.5	40.2						
68								27.2	30.6	34	40.8						
69								27.6	31	34.5	41.4						
70								28	31.5	35	42						
71								28.4	31.9	35.5	42.6						
72								28.8	32.4	36	43.2						
73								29.2	32.8	36.5	43.8						
74								29.6	33.3	37	44						
75	0.4	0.45	0.5		+0.025 0			30	33.7	37.5	45						
76								30.4	34.2	38	45.6						
77								30.8	34.6	38.5	46.2						
78								31.2	35.1	39	46.8						
79								31.6	35.5	39.5	47.4						
80								32	36	40	48						
81				0.6				32.4	36.4	40.5	48.6						
82								32.8	36.9	41	49.2						
83						0,25	+0.75 0	33.2	37.3	41.5	49.8			3.0	3.5	4.0	4.75
84								33.6	37.8	42	50.4						
85								34	38.2	42.5	51						
86								34.4	38.7	43	51.6						
87								34.8	39.1	43.5	52.2						
88								35.2	39.6	44	52.8						
89								35.6	40	44.5	53.4						
90								36	40.5	45	54						
91								36.4	40.9	45.5	54.6						
92								36.8	41.4	46	55.2						
93								37.2	41.8	46.5	55.8						
94								37.6	42.3	47	56.4						
95								38	42.7	47.5	57						
96								38.4	43.2	48	57.6						
97								38.8	43.6	48.5	58.2						
98						0,30		39.2	44.1	49	58.8						
99								39.6	44.5	49.5	59.4						
100								40	45	50	60						
101								40.4	45.4	50.5	60.6						
102								40.8	45.9	51	61.2						
103								41.2	46.3	51.5	61.8						
104								41.6	46.8	52	62.4						
105								42	47.2	52.5	63						
106								42.4	47.7	53	63.6						
107								42	48.1	53.5	64.2						
108								43.2	48.6	54	64.8						
109								43.6	49	54.5	65.4						
110								44	49.5	55	66						
111								44.4	49.9	55.5	66.6						
112								44.8	50.4	56	67.2						
113								45.2	50.8	56.5	67.8						
114								45.6	51.3	57	68.4						
115								46	51.7	57.5	69						
116								46.4	52.5	58	69.6						
117						0,35		46.8	52.6	58.5	70.2						
118								47.2	53.1	59	70.8						
119								47.6	53.5	59.5	71.4						
120								48	54	60	72						
121								48.4	54.4	60.5	72.6						
122								48.8	54.9	61	73.2						
123								49.2	55.3	61.5	73.8						
124								49.6	55.8	62	74.4						
125								50	56.2	62.5	75						

The radial wall thickness of the segment will vary with the design of the expander. Common ratios d_1/a_1 are approximately between 40 and 20.

The maximum radial thickness are of the selected assembly depends on its design (expander and segments) and has to be defined by the manufacturer.

APPENDIX A

A.1 This new SAE Standard has been established to harmonize the ISO and SAE piston ring standards. The U.S. Technical Advisory Group, with the support of the National Engine Parts Manufacturers Association, has worked with other organizations on this worldwide document. Some of the wording and phrasing may differ slightly for translation purposes.

In preparing this document, the Introduction, Scope, Field of Application, and Reference sections of the ISO 6627 TR have been editorially revised and reorganized.

The tolerances specified in this document represent a six sigma quality level.