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AEROSPACE RECOMMENDED PRACTICE

ARP 1233

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

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Revised

GLAND DESIGN, ELASTOMERIC O-RING SEALS, DYNAMIC RADIAL, 1500 PSI MAX

1. PURPOSE

- 1.1 The purpose of this document is to provide the aerospace industry with standardized dimensional criteria for dynamic radial elastomeric O-ring seal glands. It is intended for use in conjunction with ARP 1231, "Gland Design, Elastomeric O-Ring Seals, General Considerations".

2. SCOPE

- 2.1 This document establishes standard gland design criteria and dimensions for dynamic radial O-ring seal applications and provides recommendations for modifying these glands in special applications. There are no provisions in this document for anti-extrusion devices.
- 2.2 SI unit conversions for U.S. customary units have been provided for reference purposes.
- 2.3 The criteria set forth here are similar to but not identical with those in MIL-G-5514. This document is not intended to replace MIL-G-5514 for hydraulic applications.

3. GENERAL REQUIREMENTS

3.1 Applicable Documents

- 3.1.1 ANSI B46.1-1962 - Surface Texture
- 3.1.2 AS 568 - Aerospace Size Standard for O-Rings
- 3.1.3 ARP 1231 - Gland Design, Elastomeric O-Ring Seals, General Considerations
- 3.1.4 ARP 1232 - Gland Design, Elastomeric O-Ring Seals, Static Radial

3.2 Gland Configuration

- 3.2.1 General - In addition to the considerations in ARP 1231, gland designs for dynamic applications require consideration be given to the frictional forces imparted by O-ring seal compression and swell. Experience has shown that the O-ring seal squeezes employed in static applications result in friction forces which cannot be tolerated in most dynamic applications. In order to achieve an optimum dynamic gland, it is necessary to select gland dimensions which reduce squeeze below the levels used in ARP 1232 and, at the same time, maintain a satisfactory minimum squeeze under all tolerance conditions. It should be noted that with the reduction of squeeze below the ARP 1232 level, a small incidence of seal leakage may be experienced. The actual amount of leakage will depend upon such factors as translational speed, temperature, fluid and elastomeric material choice. However, such leakage is not expected to exceed a few drops per 1,000 cycles.
- 3.2.2 Standard Glands - Figure 1 depicts rod-mounted and bore-mounted radial O-ring seal glands. Standard dimensions for these glands are tabulated in Table 3. These dimensions are designed for use with seals conforming to AS 568 tolerances. They are computed in accordance with the criteria defined in paragraph 4 of this document and in ARP 1231.

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3.2.5.2 Applications involving surface speeds outside the limits of 3.2.5 introduce special conditions. At very slow speeds, the O-ring seal tends to adhere to the irregularities in the surface, resulting in seal deterioration, high friction and spiraling of the seal. Other types of seals are normally used in these slower applications. At speeds higher than 600 in. (15000 mm)/minute, the heat generated by seal friction becomes significant and must be considered in the gland design. Included in this consideration is the phenomenon known as the "Joule effect". Under this phenomenon, stretched elastomers will contract when heated. To account for this effect, the glands must be designed to avoid stretching the seal in its assembled position. A more detailed handling of higher speed applications is beyond the scope of this document.

3.2.5.3 Normally radial glands will be limited to use with translating applications, but they can be used in rotating and oscillating applications if the surface speeds are within the limits of 3.2.5.

3.3 Surface Texture

3.3.1 Figure 1 defines the preferred surface texture to be used with the glands described in this document. It will be noted that a minimum surface texture is specified on the sealing surfaces. This is necessary to provide for fluid to wet the sealing surface so that the O-ring seal is lubricated during dynamic operation.

4. DESIGN CRITERIA

4.1 O-Ring Seal Stretch

4.1.1 The maximum installed stretch should be held to the lowest value possible, consistent with manufacturing tolerances and with a minimum installed stretch of .2%. The stretch associated with the standard gland dimensions results in a .2% minimum stretch and a maximum stretch of under 5% in 90% of the cases.

4.2 O-Ring Seal Squeeze

4.2.1 To avoid assembly problems, to achieve low friction levels and to minimize leakage, dynamic O-ring seal glands should be designed to achieve nominal squeeze as listed in Table 1. Resulting minimum squeezes should not be less than those given in Table 1. These values have been used in computing the gland dimensions of Table 3. Minimum squeeze should be calculated by considering the following factors: a) diametral tolerances, b) eccentricities, c) offset, and d) seal cross section reduction due to stretch. Offset refers to the condition when the rod has shifted in the bore to the extent that the rod and bore are in contact.

TABLE 1
O-Ring Seal Squeeze

Nominal Cross Section Diameter per AS 568 (W)	Nominal Squeeze % of W Nominal	Minimum Squeeze
.070 in. (1.78 mm)	19.0	.003 in. (0.076 mm)
.103 in. (2.62 mm)	15.0	.003 in. (0.076 mm)
.139 in. (3.53 mm)	13.0	.003 in. (0.076 mm)
.210 in. (5.33 mm)	11.5	.004 in. (0.102 mm)
.275 in. (6.98 mm)	10.5	.006 in. (0.152 mm)

ARP1233

- 4 -

4.3 O-Ring Seal Swell

- 4.3.1 To accommodate O-ring seal swell, gland widths should be designed to achieve a volume slightly greater than the maximum swollen seal volume. However, the gland width must be limited to reduce O-ring shuttling and spiralling motions which occur during dynamic application. These motions damage the seal and lead to early failures. A suitable gland volume for general usage is 125% of the O-ring seal unsoaked volume. This value has been used to compute the gland widths in Table 3. This value is less than the 130% recommended for static seal applications to reduce O-ring shuttling and spiralling motions.

4.4 Diametral Clearances

- 4.4.1 The rod to bore diametral clearances must be controlled to prevent O-ring seal extrusion during operation. The diametral clearances listed in Table 2 are suitable for use at operating pressures up to 1500 psi (10340 kPa) and with elastomers of 70 shore hardness or greater. The glands in Table 3 incorporate these diametral clearances. ARP 1231 should be consulted when using these glands with higher pressures or with elastomers with less than 70 shore hardness at operating temperatures.

TABLE 2
DIAMETRAL CLEARANCES
INCHES

<u>Seal Cross Section (W)</u>	<u>Bore to Rod Clearances</u>
.070 (I.D. $\leq$.500)	.001 - .004
.070 (I.D. $>$.500)	.001 - .005
.103	.001 - .006
.139	.002 - .006
.210	.003 - .007
.275	.004 - .009

TABLE 2 (SI)
DIAMETRAL CLEARANCES
mm

<u>Seal Cross Section (W)</u>	<u>Bore to Rod Clearances</u>
1.78 (I.D. $\leq$ 12.7)	0.025 - 0.102
1.78 (I.D. $>$ 12.7)	0.025 - 0.127
2.62	0.025 - 0.152
3.53	0.051 - 0.152
5.33	0.076 - 0.178
6.98	0.102 - 0.229

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Committee E21 Design and General Standards for
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Committee G4 Elastic Seals

ARP 1233

TABLE 3 - STANDARD GLAND DIMENSIONS IN INCHES

GLAND & AS 568 DASH NO.	* PISTON DIA. C	* ROD MOUNTED BORE DIA. A	* GLAND DIA. F	* ROD DIA. B	* BORE MOUNTED BORE DIA. H	* GLAND DIA. E	* GLAND WIDTH G
-006	.228-	.230-	.120-	.120-	.123-	.230-	.100-.111
-007	.260-	.262-	.151-	.151-	.154-	.262-	
-008	.292-	.294-	.182-	.182-	.185-	.294-	
-009	.324-	.326-	.214-	.214-	.218-	.326-	
-010	.356-	.358-	.245-	.245-	.248-	.358-	
-011	.419-	.421-	.307-	.307-	.310-	.421-	
-012	.482-	.484-	.370-	.370-	.373-	.484-	
-013	.544-	.546-	.432-	.432-	.435-	.546-	
-014	.607-	.609-	.495-	.495-	.498-	.609-	
-015	.670-	.672-	.559-	.559-	.562-	.672-	
-016	.734-	.736-	.624-	.624-	.627-	.736-	
-017	.796-	.798-	.686-	.686-	.689-	.798-	
-018	.860-	.862-	.749-	.749-	.752-	.862-	
-019	.923-	.925-	.812-	.812-	.815-	.925-	
-020	.986-	.988-	.875-	.875-	.878-	.988-	
-106	.348-	.351-	.180-	.180-	.184-	.351-	.135-.145
-107	.381-	.384-	.212-	.212-	.216-	.384-	
-108	.412-	.415-	.243-	.243-	.247-	.415-	
-109	.476-	.479-	.305-	.305-	.309-	.479-	
-110	.539-	.542-	.368-	.368-	.372-	.542-	
-111	.602-	.605-	.430-	.430-	.434-	.605-	
-112	.665-	.668-	.493-	.493-	.497-	.668-	
-113	.729-	.732-	.557-	.557-	.561-	.732-	
-114	.793-	.796-	.622-	.622-	.626-	.796-	
-115	.856-	.859-	.684-	.684-	.688-	.859-	
-116	.919-	.922-	.747-	.747-	.751-	.922-	
-117	.983-	.986-	.811-	.811-	.815-	.986-	
-118	1.046-	1.049-	.874-	.874-	.878-	1.049-	
-119	1.107-	1.110-	.936-	.936-	.940-	1.110-	
-120	1.171-	1.174-	.999-	.999-	1.003-	1.174-	
-121	1.233-	1.236-	1.061-	1.061-	1.065-	1.236-	
-122	1.296-	1.299-	1.124-	1.124-	1.128-	1.299-	
-123	1.360-	1.363-	1.188-	1.188-	1.192-	1.363-	
-124	1.423-	1.426-	1.251-	1.251-	1.255-	1.426-	
-125	1.486-	1.489-	1.314-	1.314-	1.318-	1.489-	
-202	.474-	.478-	.240-	.240-	.244-	.478-	.175-.185
-203	.537-	.541-	.302-	.302-	.306-	.541-	
-204	.601-	.605-	.365-	.365-	.369-	.605-	
-205	.664-	.668-	.427-	.427-	.431-	.668-	

ARP 1233

TABLE 3 - STANDARD GLAND DIMENSIONS IN INCHES (CONTINUED)

GLAND & AS 568 DASH NO.	* PISTON DIA. C	* ROD MOUNTED BORE DIA. A	* GLAND DIA. F	* ROD DIA. B	* BORE MOUNTED BORE DIA. H	* GLAND DIA. E	* GLAND WIDTH G
-206	.728-.730	.732-.734	.490-.492	.490-.492	.494-.496	.732-.734	.175-.185
-207	.791-.793	.795-.797	.554-.556	.554-.556	.558-.560	.795-.797	
-208	.855-.857	.861-.863	.619-.621	.619-.621	.623-.625	.859-.861	
-209	.918-.920	.922-.924	.681-.683	.681-.683	.685-.687	.922-.924	
-210	.982-.984	.986-.988	.745-.747	.745-.747	.749-.751	.986-.988	
-211	1.045-1.047	1.049-1.051	.808-.810	.808-.810	.812-.814	1.049-1.051	
-212	1.108-1.110	1.112-1.114	.871-.873	.871-.873	.875-.877	1.112-1.114	
-213	1.171-1.173	1.175-1.177	.933-.935	.933-.935	.937-.939	1.175-1.177	
-214	1.234-1.236	1.238-1.240	.996-.998	.996-.998	1.000-1.002	1.238-1.240	
-215	1.295-1.297	1.299-1.301	1.058-1.060	1.058-1.060	1.062-1.064	1.299-1.301	
-216	1.361-1.363	1.365-1.367	1.123-1.125	1.123-1.125	1.127-1.129	1.365-1.367	
-217	1.423-1.425	1.427-1.429	1.185-1.187	1.185-1.187	1.189-1.191	1.427-1.429	
-218	1.485-1.487	1.489-1.491	1.248-1.250	1.248-1.250	1.252-1.254	1.489-1.491	
-219	1.548-1.550	1.552-1.554	1.311-1.313	1.311-1.313	1.315-1.317	1.552-1.554	
-220	1.612-1.614	1.616-1.618	1.374-1.376	1.374-1.376	1.378-1.380	1.616-1.618	
-221	1.674-1.676	1.678-1.680	1.436-1.438	1.436-1.438	1.440-1.442	1.678-1.680	
-222	1.740-1.742	1.744-1.746	1.502-1.504	1.502-1.504	1.506-1.508	1.744-1.746	
-223	1.804-1.806	1.808-1.810	1.567-1.569	1.567-1.569	1.571-1.573	1.808-1.810	
-224	1.868-1.870	1.872-1.874	1.631-1.633	1.631-1.633	1.635-1.637	1.872-1.874	
-225	1.932-1.934	1.936-1.938	1.695-1.697	1.695-1.697	1.699-1.701	1.936-1.938	
-309	.784-.786	.789-.791	.418-.420	.418-.420	.423-.425	.789-.791	
-310	.848-.850	.853-.855	.481-.483	.481-.483	.486-.488	.853-.855	
-311	.911-.913	.916-.918	.545-.547	.545-.547	.550-.552	.916-.918	
-312	.976-.978	.981-.983	.610-.612	.610-.612	.615-.617	.981-.983	
-313	1.039-1.041	1.044-1.046	.672-.674	.672-.674	.677-.679	1.044-1.046	
-314	1.103-1.105	1.108-1.110	.736-.738	.736-.738	.741-.743	1.108-1.110	
-315	1.165-1.167	1.170-1.172	.799-.801	.799-.801	.804-.806	1.170-1.172	
-316	1.229-1.231	1.234-1.236	.862-.864	.862-.864	.867-.869	1.234-1.236	
-317	1.290-1.292	1.295-1.297	.924-.926	.924-.926	.929-.931	1.295-1.297	
-318	1.354-1.356	1.359-1.361	.987-.989	.987-.989	.992-.994	1.359-1.361	
-319	1.415-1.417	1.420-1.422	1.049-1.051	1.049-1.051	1.054-1.056	1.420-1.422	
-320	1.480-1.482	1.485-1.487	1.114-1.116	1.114-1.116	1.119-1.121	1.485-1.487	
-321	1.543-1.545	1.548-1.550	1.176-1.178	1.176-1.178	1.181-1.183	1.548-1.550	
-322	1.605-1.607	1.610-1.612	1.239-1.241	1.239-1.241	1.244-1.246	1.610-1.612	
-323	1.668-1.670	1.673-1.675	1.302-1.304	1.302-1.304	1.307-1.309	1.673-1.675	
-324	1.732-1.734	1.737-1.739	1.365-1.367	1.365-1.367	1.370-1.372	1.737-1.739	
-325	1.860-1.862	1.865-1.867	1.493-1.495	1.493-1.495	1.498-1.500	1.865-1.867	

TABLE 3 - STANDARD GLAND DIMENSIONS IN INCHES (CONTINUED)

GLAND & AS 506 DASH NO.	* PISTON DIA. C	* BORE DIA. A	* GLAND DIA. F	* ROD DIA. B	* BORE DIA. H	* GLAND DIA. I	* GLAND WIDTH G
-326	1.985- 1.987	1.990- 1.992	1.618- 1.620	1.618- 1.620	1.623- 1.625	1.990- 1.992	.850-.266
-327	2.109- 2.111	2.114- 2.116	1.743- 1.745	1.743- 1.745	1.743- 1.745	2.114- 2.116	
-328	2.235- 2.237	2.240- 2.242	1.869- 1.871	1.869- 1.871	1.874- 1.876	2.240- 2.242	
-329	2.364- 2.366	2.369- 2.371	1.997- 1.999	1.997- 1.999	2.002- 2.004	2.369- 2.371	
-330	2.488- 2.490	2.493- 2.495	2.122- 2.124	2.122- 2.124	2.127- 2.129	2.493- 2.495	
-331	2.613- 2.615	2.618- 2.620	2.247- 2.249	2.247- 2.249	2.252- 2.254	2.618- 2.620	
-332	2.740- 2.742	2.745- 2.747	2.373- 2.375	2.373- 2.375	2.378- 2.380	2.745- 2.747	
-333	2.866- 2.868	2.871- 2.873	2.500- 2.502	2.500- 2.502	2.505- 2.507	2.871- 2.873	
-334	2.992- 2.994	2.997- 2.999	2.625- 2.627	2.625- 2.627	2.630- 2.632	2.997- 2.999	
-335	3.116- 3.118	3.121- 3.123	2.750- 2.752	2.750- 2.752	2.755- 2.757	3.121- 3.123	
-336	3.242- 3.244	3.247- 3.249	2.876- 2.878	2.876- 2.878	2.881- 2.883	3.247- 3.249	
-337	3.371- 3.373	3.376- 3.378	3.005- 3.007	3.005- 3.007	3.010- 3.012	3.376- 3.378	
-338	3.497- 3.499	3.502- 3.504	3.130- 3.132	3.130- 3.132	3.135- 3.137	3.502- 3.504	
-339	3.621- 3.623	3.626- 3.628	3.255- 3.257	3.255- 3.257	3.260- 3.262	3.626- 3.628	
-340	3.747- 3.749	3.752- 3.754	3.381- 3.383	3.381- 3.383	3.386- 3.388	3.752- 3.754	
-341	3.872- 3.874	3.877- 3.879	3.506- 3.508	3.506- 3.508	3.511- 3.513	3.877- 3.879	
-342	4.002- 4.004	4.007- 4.009	3.635- 3.637	3.635- 3.637	3.640- 3.642	4.007- 4.009	
-343	4.128- 4.130	4.133- 4.135	3.761- 3.763	3.761- 3.763	3.766- 3.768	4.133- 4.135	
-344	4.252- 4.254	4.257- 4.259	3.886- 3.888	3.886- 3.888	3.891- 3.893	4.257- 4.259	
-345	4.377- 4.379	4.382- 4.384	4.011- 4.013	4.011- 4.013	4.016- 4.018	4.382- 4.384	
-346	4.502- 4.504	4.507- 4.509	4.136- 4.138	4.136- 4.138	4.141- 4.143	4.507- 4.509	
-347	4.630- 4.632	4.635- 4.637	4.264- 4.266	4.264- 4.266	4.269- 4.271	4.635- 4.637	
-348	4.755- 4.757	4.760- 4.762	4.389- 4.391	4.389- 4.391	4.394- 4.396	4.760- 4.762	
-349	4.880- 4.882	4.885- 4.887	4.514- 4.516	4.514- 4.516	4.519- 4.521	4.885- 4.887	
-425	5.002- 5.005	5.009- 5.012	4.517- 4.520	4.517- 4.520	4.523- 4.526	5.008- 5.012	.320-.330
-426	5.127- 5.130	5.134- 5.137	4.642- 4.645	4.642- 4.645	4.648- 4.651	5.133- 5.137	
-427	5.253- 5.256	5.260- 5.263	4.768- 4.771	4.768- 4.771	4.774- 4.777	5.259- 5.263	
-428	5.378- 5.381	5.385- 5.388	4.893- 4.896	4.893- 4.896	4.899- 4.902	5.384- 5.388	
-429	5.507- 5.510	5.514- 5.517	5.022- 5.025	5.022- 5.025	5.028- 5.031	5.513- 5.517	
-430	5.632- 5.635	5.639- 5.642	5.147- 5.150	5.147- 5.150	5.153- 5.156	5.638- 5.642	
-431	5.758- 5.761	5.765- 5.768	5.273- 5.276	5.273- 5.276	5.279- 5.282	5.764- 5.768	
-432	5.883- 5.886	5.890- 5.893	5.398- 5.401	5.398- 5.401	5.404- 5.407	5.889- 5.893	
-433	6.008- 6.011	6.015- 6.018	5.523- 5.526	5.523- 5.526	5.529- 5.532	6.014- 6.018	
-434	6.133- 6.136	6.140- 6.143	5.648- 5.651	5.648- 5.651	5.654- 5.657	6.139- 6.143	
-435	6.259- 6.262	6.266- 6.269	5.774- 5.777	5.774- 5.777	5.780- 5.783	6.265- 6.269	
-436	6.384- 6.387	6.391- 6.394	5.899- 5.902	5.899- 5.902	5.905- 5.908	6.390- 6.394	
-437	6.509- 6.512	6.516- 6.519	6.024- 6.027	6.024- 6.027	6.030- 6.033	6.515- 6.519	
-438	6.634- 6.637	6.638- 6.641	6.149- 6.152	6.149- 6.152	6.155- 6.158	6.640- 6.643	
-439	6.759- 6.762	6.763- 6.766	6.274- 6.277	6.274- 6.277	6.280- 6.283	6.765- 6.768	
-440	6.884- 6.887	6.888- 6.891	6.399- 6.402	6.399- 6.402	6.405- 6.408	6.890- 6.893	

ARP 1233

TABLE 3 - STANDARD GLAND DIMENSIONS IN INCHES (CONTINUED)

GLAND & AS 568 DASH NO.	* PISTON DIA. C	* ROD DIA. B	* BORE DIA. A	* GLAND DIA. F	* BORE MOUNTED BORE DIA. H	* GLAND DIA. E	* GLAND WIDTH G
-441	7.514-7.517	7.029-7.032	7.029-7.032	7.029-7.032	7.035-7.038	7.520-7.524	.320-.330
-442	7.770-7.773	7.285-7.288	7.285-7.288	7.285-7.288	7.291-7.294	7.776-7.780	
-443	8.020-8.023	7.535-7.538	7.535-7.538	7.535-7.538	7.541-7.544	8.026-8.030	
-444	8.271-8.274	7.786-7.789	7.786-7.789	7.786-7.789	7.792-7.795	8.277-8.281	
-445	8.521-8.524	8.036-8.039	8.036-8.039	8.036-8.039	8.042-8.045	8.527-8.531	
-446	9.034-9.035	8.547-8.550	8.547-8.550	8.547-8.550	8.553-8.556	9.038-9.042	
-447	9.533-9.536	9.048-9.051	9.048-9.051	9.048-9.051	9.054-9.057	9.539-9.543	
-448	10.034-10.037	9.549-9.552	9.549-9.552	9.549-9.552	9.555-9.558	10.040-10.044	
-449	10.535-10.538	10.050-10.053	10.050-10.053	10.050-10.053	10.056-10.059	10.541-10.545	
-450	11.041-11.044	10.556-10.559	10.556-10.559	10.556-10.559	10.562-10.565	11.047-11.051	
-451	11.542-11.545	11.057-11.060	11.057-11.060	11.057-11.060	11.063-11.066	11.548-11.552	
-452	12.043-12.046	11.558-11.561	11.558-11.561	11.558-11.561	11.564-11.567	12.049-12.053	
-453	12.544-12.547	12.059-12.062	12.059-12.062	12.059-12.062	12.065-12.068	12.550-12.554	
-454	13.045-13.048	12.560-12.563	12.560-12.563	12.560-12.563	12.566-12.569	13.051-13.055	
-455	13.546-13.549	13.061-13.064	13.061-13.064	13.061-13.064	13.067-13.070	13.552-13.556	
-456	14.037-14.060	13.572-13.575	13.572-13.575	13.572-13.575	13.578-13.581	14.063-14.067	
-457	14.538-14.561	14.073-14.076	14.073-14.076	14.073-14.076	14.079-14.082	14.564-14.568	
-458	15.039-15.062	14.574-14.577	14.574-14.577	14.574-14.577	14.580-14.583	15.065-15.069	
-459	15.540-15.563	15.075-15.078	15.075-15.078	15.075-15.078	15.081-15.084	15.566-15.570	
-460	16.041-16.064	15.576-15.579	15.576-15.579	15.576-15.579	15.582-15.585	16.067-16.071	

ARP1233

TABLE 3 - STANDARD GLAND DIMENSIONS IN MILLIMETRES

GLAND & AS 568 DASH NO.	* PISTON DIA. C	* ROD MOUNTED BORE DIA. A	* GLAND DIA. F	* ROD DIA. B	* BORE MOUNTED BORE DIA. H	* GLAND DIA. E	* GLAND WIDTH G
-006	5.791-	5.817	3.048-	3.073	3.124-	5.842-	2.54-2.79
-007	6.004-	6.029	3.835-	3.861	3.912-	6.652-	
-008	7.417-	7.442	4.623-	4.648	4.699-	7.468-	
-009	8.230-	8.255	5.436-	5.461	5.512-	8.280-	
-010	9.042-	9.068	6.223-	6.248	6.299-	9.093-	
-011	10.043-	10.068	7.798-	7.823	7.874-	10.693-	
-012	12.263-	12.288	9.398-	9.423	9.474-	12.294-	
-013	13.618-	13.643	10.973-	10.998	11.049-	13.868-	
-014	15.418-	15.443	12.573-	12.598	12.649-	15.469-	
-015	17.018-	17.043	14.199-	14.224	14.275-	17.069-	
-016	18.644-	18.669	15.850-	15.900	15.926-	18.694-	
-017	20.218-	20.244	17.424-	17.475	17.501-	20.269-	
-018	21.844-	21.869	19.025-	19.075	19.101-	21.895-	
-019	23.444-	23.470	20.625-	20.676	20.701-	23.495-	
-020	25.044-	25.070	22.225-	22.276	22.301-	25.095-	
-106	8.839-	8.890	4.572-	4.623	4.674-	8.915-	3.43-3.68
-107	9.677-	9.728	5.385-	5.436	5.486-	9.754-	
-108	10.465-	10.516	6.172-	6.223	6.274-	10.541-	
-109	12.090-	12.141	7.747-	7.798	7.849-	12.167-	
-110	13.631-	13.741	9.347-	9.398	9.449-	13.767-	
-111	15.291-	15.342	10.922-	10.973	11.024-	15.367-	
-112	16.891-	16.942	12.522-	12.573	12.624-	16.967-	
-113	18.517-	18.567	14.148-	14.199	14.249-	18.593-	
-114	20.142-	20.193	15.799-	15.850	15.900-	20.218-	
-115	21.742-	21.793	17.374-	17.424	17.475-	21.819-	
-116	23.343-	23.393	18.974-	19.025	19.075-	23.419-	
-117	24.968-	25.019	20.599-	20.650	20.701-	24.995-	
-118	26.568-	26.619	22.200-	22.250	22.301-	26.645-	
-119	28.118-	28.169	23.774-	23.825	23.876-	28.194-	
-120	29.743-	29.794	25.375-	25.425	25.476-	29.820-	
-121	31.318-	31.369	26.949-	27.000	27.051-	31.394-	
-122	32.916-	32.969	28.550-	28.600	28.651-	32.995-	
-123	34.544-	34.595	30.175-	30.226	30.277-	34.620-	
-124	36.144-	36.195	31.775-	31.826	31.877-	36.220-	
-125	37.744-	37.795	33.376-	33.426	33.477-	37.821-	
-202	12.040-	12.090	6.096-	6.147	6.198-	12.141-	4.44-4.70
-203	13.640-	13.691	7.671-	7.722	7.772-	13.741-	
-204	15.265-	15.316	9.271-	9.322	9.373-	15.367-	
-205	16.866-	16.916	10.846-	10.897	10.947-	16.967-	