

Axial shaft seals | Metal face seals

C.2

Metal face seals



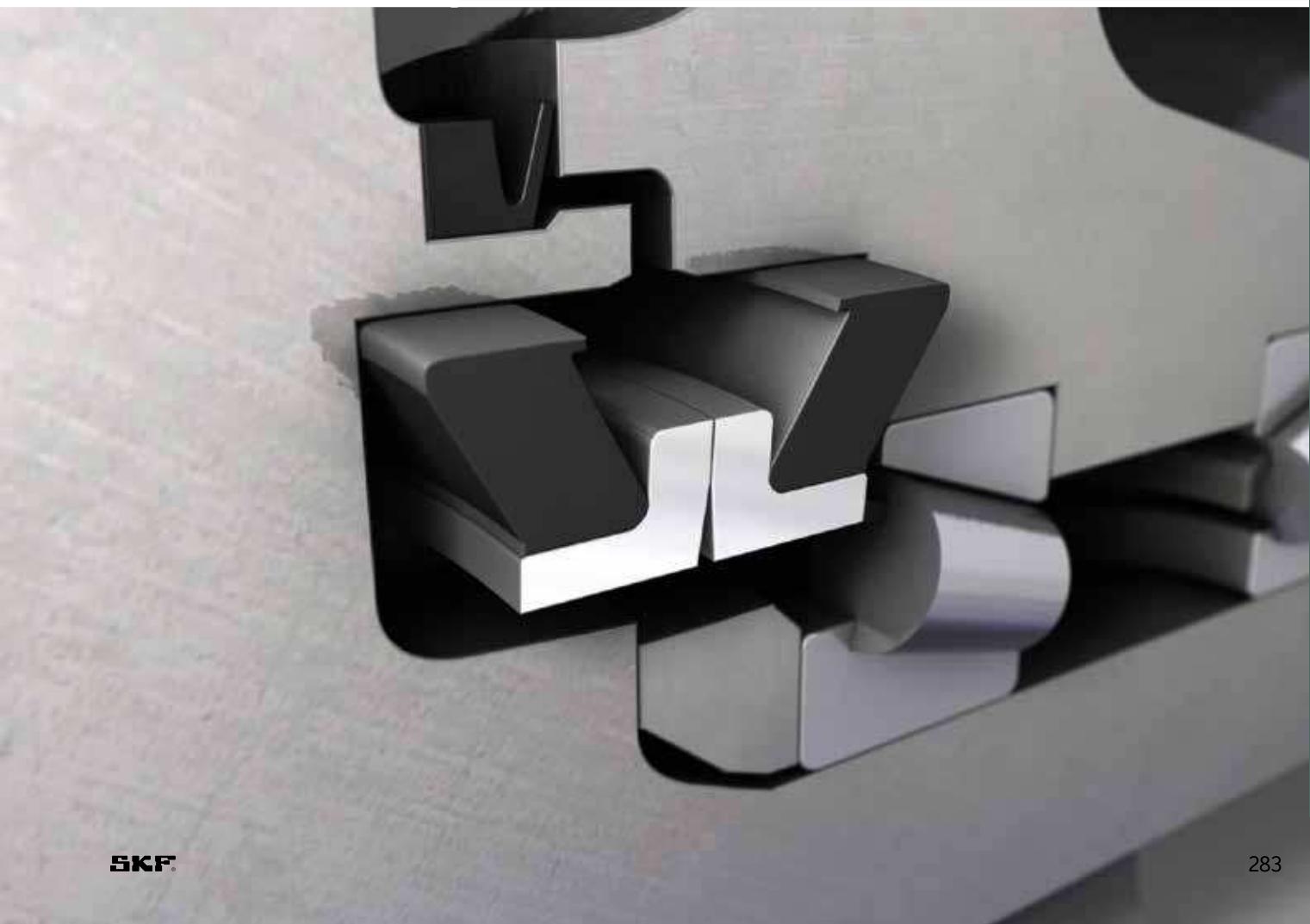
PROOFED SOLUTION
FOR OFF-ROAD AND
TRACKED VEHICLES



Metal face seals

- › High resistance to wear, corrosion and chemicals

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General

SKF metal face seals type HDDF (**→ fig. 1**) are designed for use under severe service conditions at relatively low circumferential speeds. They offer reliable protection against solid and liquid contaminants as well as leak-proof retention of lubricants. The seals were originally developed for off-road and tracked vehicles, but have been found to be equally suitable for a range of other applications where effective protection is required against sand, soil, mud, water etc. (**→ fig. 2**). These applications include:

- All types of mixers
- Sand treatment equipment
- Conveyors and other construction equipment
- Agricultural machinery
- Washing equipment
- Grinding mills and other pulverizing equipment
- Ore dressing equipment
- Mining equipment

Design features

HDDF seals consist of two identical metal sealing rings and two similar Belleville washers (cup springs) made of nitrile or fluoro rubber compounds, specifically developed for these seals (**→ fig. 3 on page 287**). The sealing rings are made of wear- and corrosion-resistant cast alloy and have finely finished sliding and sealing surfaces.

The Belleville washers of nitrile or fluoro rubber provide the necessary uniform face loading and effective sealing at the bore and outside diameters. The outside diameter of the washers adapts to the form of the bore in which they are installed. It is crucial that the bore diameter and bore depth are in accordance with the dimensions listed in the product table on **pages 288 to 291**. Adequate tolerances between the seal assembly and its mating component are crucial to ensure a proper sealing performance.

Lubricant requirements

A lubricant should be applied on the dynamic sealing surfaces of a metal face seal to prevent scoring and cover at least 30% of the sealing surface to properly lubricate and cool the sealing rings. The lubricant can be either a detergent like SAE 10W-40 or a mineral based oil ranging from 10 WT to 90 WT, depending on the ambient temperature. It should be noted that some oils contain additives that make them incompatible with elastomers, which can cause degradation of the Belleville washers, especially when exposed to elevated temperatures.

Although mineral oils are always the recommended lubricant, a grease lubricant can also be used in some slowly rotating or oscillating applications, where the seal face surface speed does not exceed 0,5 m/s (100 ft/min). At higher speeds, an oil lubricant is required, not only to provide lubrication to the sealing faces, but also to cool the sealing rings.

Fig. 1

HDDF seal

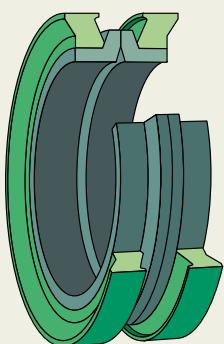


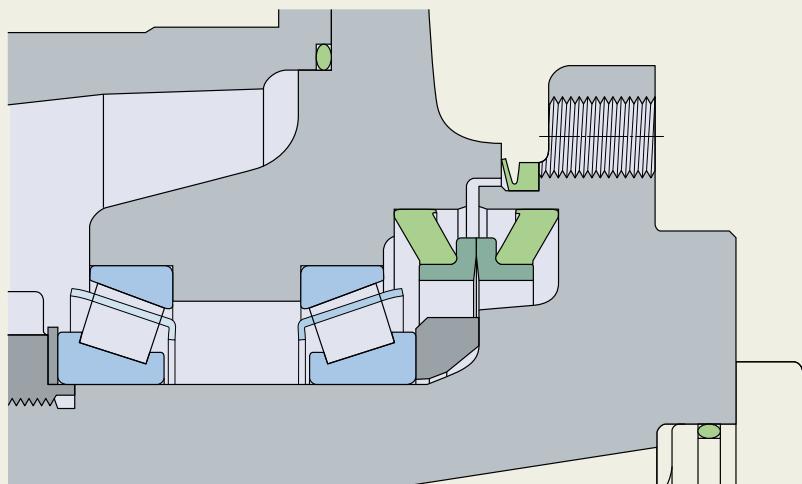
Fig. 1

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Metal face seals

Fig. 2

HDDF application



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Permissible operating conditions

Depending on their design, metal face seals can withstand different amounts of internal pressure. It should, however, generally be maintained below 0,25 MPa (35 psi). Other recommendations regarding operating conditions for the metal face seals, like temperature and speed, are provided in **table 1**. The chemical resistance of the nitrile and fluoro rubber in general is dealt with in the section *Chemical resistance* on **page 37**.

Contaminants

Metal face seals are often used in heavily contaminated environments, where mud packing in the cavity between the housing, sealing rings and Belleville washers can occur. Eventually, the mud packing can cause the Belleville washers to be pushed out of position, resulting in improper face loads or mud being pumped past the Belleville washers.

Contaminants can also cause abrasion to the Belleville washers, which in turn causes deterioration of the elastomer. To minimize the risk of seal failure due to this deterioration, it is critical to select a proper Belleville washer material for the application in question.

Installing HDDF seals

General

Careful handling and installation of a metal face seal is crucial to avoid cutting or tearing of the elastomeric Belleville washers or breaking the metal sealing rings, both of which can cause premature seal failure and immediate leakage. It is also vital to keep the sealing faces free of contaminants like dirt or lint. Always carefully observe installation instructions provided on **page 287**.

Housing and seal preparation

All housing components contacting the Belleville washers must be free of contaminants (oil, grease, dust, lint particles etc.) when installing the seal. SKF recommends using a non-petroleum based solvent and a clean, lint-free wipe to clean these components prior to installation.

All seal parts must be handled with care to avoid damage or scoring.

Table 1

Permissible operating conditions		
Operating condition	Recommended value	
Temperature, max.		
Continuous operation		
Nitrile rubber (NBR)	-25 to +100 °C	(-15 to +210 °F)
Fluoro rubber (FKM)	-10 to +190 °C	(15 to 375 °F)
Circumferential speed, max.		
Continuous operation	1,8 m/s	(350 ft/min)
Brief periods	3,8 m/s	(750 ft/min)
Pressure, max.		
Continuous operation	0,25 MPa	(35 psi)
Brief periods	0,35 MPa	(50 psi)

Installation procedure

- 1 Install the Belleville washers seated against the inside shoulder of the metal sealing rings (**→ fig. 4a**).
- 2 Carefully push each seal half (Belleville washer and metal sealing ring) into the housing until it is fully seated. Check that the seal is not cocked and that the washers are seated evenly at the bottom of the housing bore. Improper seal installation can result in uneven face loads around the circumference of the seal faces, causing scoring or the sealing rings to separate and allow oil to leak.
- 3 Clean both metal sealing ring faces with a lint-free wipe and apply a thin film of oil. Ensure that no oil is applied to any surface but the sealing ring faces (**→ fig. 4b**).
- 4 Check that both housings are concentric and in correct alignment. The Belleville washers must not unseat from the bottom of the housing.
- 5 Carefully bring the two housings together, avoiding high impact that can scratch or break the seal components.
- 6 Finally, hold one half of the assembly stationary while rotating the other half at least ten complete revolutions.

NOTE

This procedure enables the installer to check that the housing and the Belleville washers are aligned. If the seal assembly wobbles, it is necessary to disassemble it and make sure that the Belleville washers are properly seated in the housing.

Fig. 3

Design features

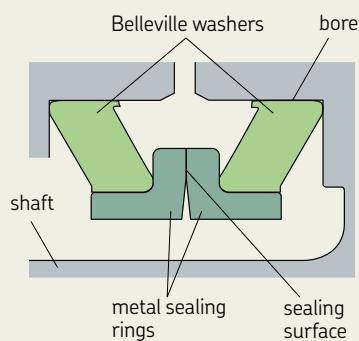
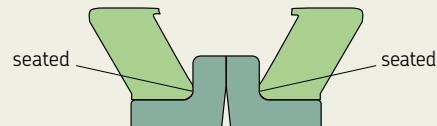


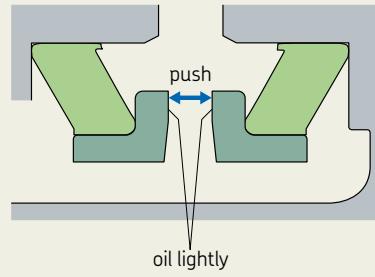
Fig. 4

Installation procedure

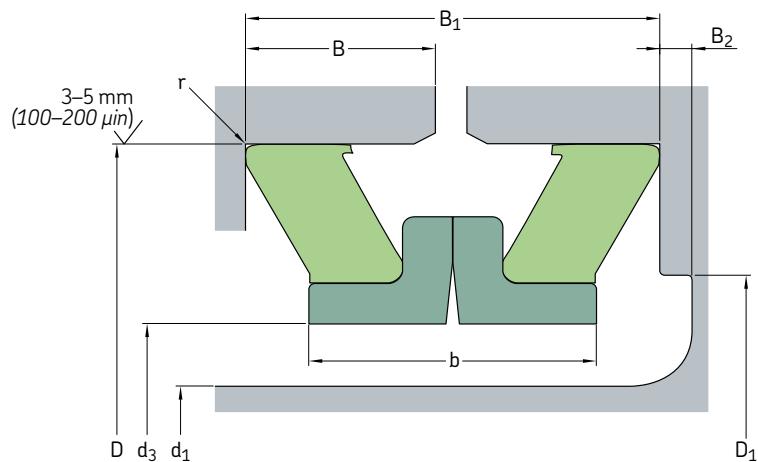
a



b



Axial shaft seals | Metal face seals | HDDF – inch and metric dimensions

 d_1 1.688–8.688 in

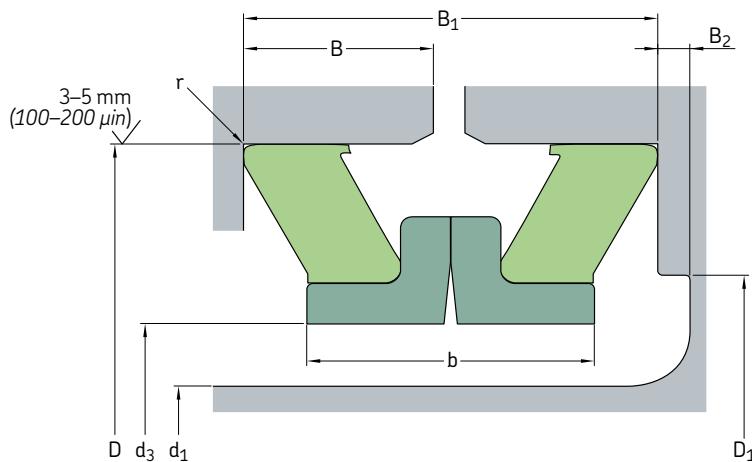
Designation d_1 max.	Lip mat- erial	Inch dimensions	Shaft diameter d_1	Bore diameter D	Operating width B_1	Seal inside diameter d_3 min.	Bore depth B	Recommended shoulder diameter D_1 max.	Under- cut B_2 min.	Sealing ring width b max.	Radius r max.
-	-	in									
16904	R	1.688	2.760 ±0.002	0.974 ±0.038	1.760	0.453	2.282	-	-	0.846	0.037
18259	R	1.812	3.003 ±0.002	0.892 ±0.031	1.910	0.416	2.475	-	-	0.790	0.042
21215	R	2.125	3.250 ±0.002	0.900 ±0.033	2.215	0.418	2.759	-	-	0.812	0.045
25096	R	2.500	3.762 ±0.002	0.907 ±0.033	2.580	0.422	3.188	-	-	0.840	0.042
27536	R	2.750	4.030 ±0.002	0.918 ±0.035	2.830	0.426	3.480	-	-	0.810	0.042
30651	R	3.063	4.500 ±0.002	1.016 ±0.035	3.170	0.475	3.833	-	-	0.912	0.042
35076	R	3.500	4.953 ±0.002	1.096 ±0.043	3.620	0.511	4.296	-	-	0.962	0.035
38740	R	3.875	5.312 ±0.003	1.102 ±0.024	4.040	0.524	4.750	-	-	1.002	0.042
38751	R	3.875	5.562 ±0.003	1.267 ±0.050	4.040	0.594	4.791	-	-	1.110	0.051
43135	R	4.312	5.823 ±0.003	1.102 ±0.024	4.420	0.524	5.125	-	-	1.002	0.042
43150	R	4.312	6.000 ±0.003	1.320 ±0.040	4.420	0.625	5.173	-	-	1.090	0.051
46975	R	4.688	6.400 ±0.003	1.525 ±0.050	4.795	0.722	5.583	-	-	1.254	0.047
50655	R	5.062	6.750 ±0.003	1.280 ±0.040	5.170	0.605	5.975	-	-	1.150	0.057
54000	R	5.400	6.990 ±0.003	1.310 ±0.030	5.625	0.625	6.625	-	-	1.182	0.057
56170	R	5.625	7.250 ±0.003	1.366 ±0.031	5.825	0.650	6.486	6.174	0.032	1.300	0.057
58775	R	5.875	7.641 ±0.003	1.510 ±0.031	6.000	0.724	6.868	6.548	0.056	1.490	0.073
63796	R	6.375	8.120 ±0.003	1.265 ±0.040	6.570	0.598	7.555	7.505	0.125	1.350	0.042
67560	R	6.750	8.620 ±0.004	1.375 ±0.030	6.920	0.656	7.750	-	-	1.260	0.042
74310	R	7.438	9.400 ±0.004	1.656 ±0.040	7.540	0.793	8.431	-	-	1.344	0.073
78020	R	7.800	10.000 ±0.004	1.750 ±0.050	7.940	0.835	8.910	-	-	1.500	0.058
82540	R	8.250	10.062 ±0.004	1.560 ±0.040	8.358	0.745	9.280	9.220	0.071	1.562	0.058
86850	R	8.688	10.911 ±0.005	1.924 ±0.030	8.790	0.932	9.754	-	-	1.642	0.058

HDDF – inch and metric dimensions

 d_1 42,88–220,68 mm

Designation d_1 max.	Lip mat- erial	Inch dimensions		Operating width B_1	Seal inside diameter d_3 min.	Bore depth B	Recommended shoulder diameter D_1 max.	Under- cut B_2 min.	Sealing ring width b max.	Radius r max.
mm										
16904	R	42,88	70,10 ±0,06	24,74 ±0,97	44,70	11,51	57,96	-	-	21,49
18259	R	46,03	76,28 ±0,06	22,66 ±0,79	48,51	10,57	62,87	-	-	20,07
21215	R	53,98	82,55 ±0,06	22,86 ±0,84	56,26	10,62	70,08	-	-	20,62
25096	R	63,50	95,56 ±0,06	23,04 ±0,84	65,53	10,72	80,98	-	-	21,34
27536	R	69,85	102,36 ±0,06	23,32 ±0,89	71,88	10,82	88,39	-	-	20,57
30651	R	77,80	114,30 ±0,06	25,81 ±0,89	80,52	12,07	97,36	-	-	23,16
35076	R	88,90	125,81 ±0,06	27,84 ±1,09	91,95	12,98	109,12	-	-	24,43
38740	R	98,43	134,92 ±0,08	27,99 ±0,61	102,62	13,31	120,65	-	-	25,45
38751	R	98,43	141,27 ±0,08	32,18 ±1,27	102,62	15,09	121,69	-	-	28,19
43135	R	109,52	147,90 ±0,08	27,99 ±0,61	112,27	13,31	130,18	-	-	25,45
43150	R	109,52	152,40 ±0,08	33,53 ±1,02	112,27	15,88	131,39	-	-	27,69
46975	R	119,08	162,56 ±0,08	38,74 ±1,27	121,79	18,34	141,81	-	-	31,85
50655	R	128,57	171,45 ±0,08	32,51 ±1,02	131,32	15,37	151,77	-	-	29,21
54000	R	137,16	177,55 ±0,08	33,27 ±0,76	142,88	15,88	168,28	-	-	30,02
56170	R	142,88	184,15 ±0,08	34,70 ±0,79	147,96	16,51	164,74	156,82	0,81	33,02
58775	R	149,23	194,08 ±0,08	38,35 ±0,79	152,40	18,39	174,45	166,32	1,42	37,85
63796	R	161,93	206,25 ±0,08	32,13 ±1,02	166,88	15,19	191,90	190,63	3,18	34,29
67560	R	171,45	218,95 ±0,10	34,93 ±0,76	175,77	16,66	196,85	-	-	32,00
74310	R	188,93	238,76 ±0,10	42,06 ±1,02	191,52	20,14	214,15	-	-	34,14
78020	R	198,12	254,00 ±0,10	44,45 ±1,27	201,68	21,21	226,31	-	-	38,10
82540	R	209,55	255,57 ±0,10	39,62 ±1,02	212,29	18,92	235,71	234,19	1,80	39,67
86850	R	220,68	277,14 ±0,13	48,87 ±0,76	223,27	23,67	247,75	-	-	41,71
1,47										

Axial shaft seals | Metal face seals | HDDF – inch and metric dimensions
 d_1 9.312–29.000 in



Designation d_1 max.	Lip mat- erial	Inch dimensions		Operating width B_1	Seal inside diameter d_3 min.	Bore depth B	Recommended shoulder diameter D_1 max.	Under- cut B_2 min.	Sealing ring width b max.	Radius r max.	
–	–	in									
93115	R	9.312	11.000 ± 0.005	1.437 ± 0.032	9.410	0.687	10.360	10.260	0.090	1.510	0.050
93125	R	9.312	11.625 ± 0.005	1.754 ± 0.050	9.410	0.837	10.750	–	–	1.510	0.089
95620	R	9.562	11.859 ± 0.005	1.949 ± 0.069	9.660	0.925	10.703	–	–	1.700	0.074
108710	R	10.875	12.969 ± 0.005	1.540 ± 0.050	11.060	0.730	12.100	12.000	0.143	1.670	0.043
116500	R	11.625	13.250 ± 0.005	1.290 ± 0.030	11.780	0.615	12.780	–	–	1.210	0.045
124020	R	12.400	14.375 ± 0.005	1.656 ± 0.050	12.500	0.788	13.530	13.470	0.060	1.610	0.057
137570	R	13.750	15.817 ± 0.005	1.875 ± 0.032	13.910	0.906	14.985	–	–	1.670	0.089
806715	R	14.750	16.695 ± 0.005	1.875 ± 0.032	14.950	0.906	15.863	–	–	1.670	0.062
807115	V	14.750	16.695 ± 0.005	1.875 ± 0.032	14.950	0.906	15.863	–	–	1.670	0.062
171025	R	17.125	19.240 ± 0.006	1.531 ± 0.053	17.280	0.724	18.400	18.300	0.140	1.659	0.043
191022	R	19.125	21.500 ± 0.006	1.640 ± 0.042	19.250	0.784	20.950	20.850	0.175	1.832	0.057
238020	R	23.875	26.875 ± 0.006	2.125 ± 0.040	24.280	1.018	25.550	–	–	1.851	0.089
807199	V	23.875	26.875 ± 0.006	2.125 ± 0.040	24.280	1.018	25.550	–	–	1.851	0.089
807149	V	29.000	32.000 ± 0.006	2.125 ± 0.040	29.512	1.028	30.672	–	–	1.851	0.089

HDDF – inch and metric dimensions
 d_1 232,52–736,60 mm

Designation d_1 max.	Lip mat- erial	Inch dimensions		Operating width B_1	Seal inside diameter d_3 min.	Bore depth B	Recommended shoulder diameter D_1 max.	Under- cut B_2 min.	Sealing ring width b max.	Radius r max.
mm										
93115	R	232,52	279,40 ±0,13	36,50 ±0,81	239,01	17,45	263,14	260,60	2,29	38,35
93125	R	236,52	295,28 ±0,13	44,55 ±1,27	239,01	21,26	273,05	-	-	38,35
95620	R	242,87	301,22 ±0,13	49,50 ±1,75	245,36	23,50	271,86	-	-	43,18
108710	R	276,23	329,41 ±0,13	39,12 ±1,27	280,92	18,54	307,34	304,80	3,63	42,42
116500	R	295,28	336,55 ±0,13	32,77 ±0,76	299,21	15,62	324,61	-	-	30,73
124020	R	314,96	365,13 ±0,13	42,06 ±1,27	317,50	20,02	343,66	342,14	1,52	40,89
137570	R	349,25	401,75 ±0,13	47,63 ±0,81	353,31	23,01	380,62	-	-	42,42
806715	R	374,65	424,05 ±0,13	47,63 ±0,81	379,73	23,01	402,92	-	-	42,42
807115	V	374,65	424,05 ±0,13	47,63 ±0,81	379,73	23,01	402,92	-	-	42,42
171025	R	434,98	488,70 ±0,15	38,89 ±1,35	438,91	18,39	467,36	464,82	3,56	42,14
191022	R	485,78	546,10 ±0,15	41,66 ±1,07	488,95	19,91	532,13	529,59	4,45	46,53
238020	R	606,43	682,63 ±0,15	53,98 ±1,02	616,71	25,86	648,97	-	-	47,02
807199	V	606,43	682,63 ±0,15	53,98 ±1,02	616,71	25,86	648,97	-	-	47,02
807149	V	736,60	812,80 ±0,15	53,98 ±1,02	749,60	26,11	779,07	-	-	47,02