

Large Format Lenses from the Eastern Bloc Countries 1945-1991

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During the cold war, the main manufacturer of large format lenses in the Eastern Bloc countries was Carl Zeiss Jena in the German Democratic Republic (GDR). The Zeiss Jena lenses as well as their short-lived successors from Docter Optic have been described separately in three other articles [1-3]. However, Zeiss Jena was not the sole supplier. Other LF lens manufacturers were Hugo Meyer in Görlitz in the GDR, Meopta in what was then Czechoslovakia, PZO in Poland, and several plants in the USSR.

Examples of these Eastern Bloc lenses show up on the market occasionally. In terms of usability one has to keep in mind that – with some exceptions - these lenses come in barrel, and mounting into a shutter may rarely be justified. But optically they can offer some unusual choices, so if front mounting to a shutter is possible, they can be an alternative to Western-made lenses. This is of course even more true for the few lenses that do come in a shutter.

Hugo Meyer Görlitz – Meyer Optik, GDR

The company Hugo Meyer & Co. in the city of Görlitz (now at the German-Polish border) was a well-known German manufacturer of LF and other optics. Founded on January 5, 1896, by the Görlitz native and master optician Hugo Meyer [4], they started out making Aplanat-type lenses and later added anastigmatic lenses to their line. In 1911, Meyer acquired the company Schulze & Billerbeck, which was originally from Berlin, but had moved to Görlitz in 1910. They kept the lens lines separate for three more years, but finally merged Schulze & Billerbeck into Hugo Meyer in 1914. Before WW II, Hugo Meyer made a range of well-respected optics including the Aristostigmat (since 1903), the Trioplan (since 1913), the Euryplan, and since 1918 the famous series of “Plasmat” lenses designed by Paul Rudolph, the forerunners of most modern LF lenses. The end of WWII was devastating for Meyer - in 1945, all of their manufacturing equipment was brought into the Soviet Union as reparations. However, they started rebuilding in 1946. Production numbers are known for 1946, 566 photographic lenses altogether, but they list no LF lenses for that year [4,5]. Meyer installed their first coating facility, made by Carl Zeiss Jena, only several years later, in 1952. Like Carl Zeiss Jena, they were soon nationalized by the communist GDR government and in 1948 renamed “VEB Feinoptisches Werk Görlitz” (“VEB” is a GDR acronym for a nationalized company, standing for “Volkseigener Betrieb”). Their

Table 1: Approximate serial numbers for Hugo Meyer lenses.

1930:	500 000
1935:	700 000
1938:	900 000
1940:	998 000
1947:	1 051 000
1951:	1 200 000
1954:	1 400 000
1955:	1 600 000
1960:	2 600 000

postwar production of LF lenses ran from 1947 to 1960. In later years, they were better known for their Practica and Pentacon 35mm and medium format lenses, as a low-cost alternative to Zeiss Jena. In 1968, the company was absorbed into the “VEB Pentacon” combine, but up to 1969 the lenses were still sold under the name Meyer-Optik. In 1985, VEB Pentacon became part of VEB Carl Zeiss Jena. Apparently, there were plans to move the photographic optics production of Zeiss Jena from their Saalfeld plant to the former Hugo Meyer plant, but these were never realized. Meyer/Pentacon also had a subsidiary in Romania since 1968, but no LF lenses were ever manufactured there.



Fig. 1: Trioplan lenses from Meyer Optik in Görlitz. Front row from left to right: 210mm f/3.5, 260mm f/4.5. Back row from left to right: 300mm f/4.5, 360mm f/4.5. The red “V” designates the antireflective coating. Scale is in cm.

After the reunification of Germany in October 1990, Hugo Meyer tried to continue as independent optics manufacturer under its old name “Feinoptisches Werk Görlitz”; among other things, they offered the Mahogany stand camera “Globica II” (13x18cm and 18x24cm) with a 210mm/f4.5 Tessar (see below) in brass as standard lens at the 1990 photokina, with sales of 120 units [4]. However, they were closed by the German government trust agency “Treuhand” on June 30, 1991. Two

small companies, “optec Betriebsgesellschaft mbH” and “System-Optik GmbH” were formed after the closure and still exist. The former works in electronic controllers and the latter is apparently making lens adapters occasionally, but no other activities are known. In September 2014, the brand name “Meyer Optik Görlitz” was revived by the software and branding company “net SE” through their subsidiary “Globell”[45]. They announced and sold new OEM-produced lenses for 35mm digital under the old Meyer names (e. g. Lydith, Primoplan, Trioplan), through Kickstarter projects, but went bankrupt in 2018. As of 2019, the Meyer-Optik-Görlitz name is now owned by OPC Optics in Bad Kreuznach, Germany [46].



Fig. 2: Post-WWII “Weitwinkel Aristostigmat” wide angle lenses from Meyer-Optik. Bottom row from left to right: coated 100mm f/6.3 in Compur 0, coated 120mm f/6.3 in Compur-Rapid 0. Top row from left to right: coated 100mm f/6.3 in barrel, uncoated 160mm f/6.3 in barrel, coated 160mm f/6.3 in barrel. Note that the lens cells of the barrel versions are not compatible with those of the shutter versions. Scale is in cm.

Depending on the production year, their LF lenses might be labeled “Hugo Meyer & Co. Görlitz”, “Meyer Görlitz”, or “Meyer-Optik”. To my knowledge, the later “Pentacoon” label found on medium format and 35mm lenses has never been used for LF optics. As mentioned above, Meyer introduced antireflective coatings several years after the war. Most postwar lenses will be coated, but uncoated lenses exist for the production years 1947-1951, before the coating facilities were installed. Similar to Zeiss Jena’s red “T” designation, lens coatings were initially marked by a red “V” for “Vergütung”, meaning coating in German. This marking may, however, not be present in coated

early postwar production samples and it was dropped in later years, at least for MF and 35mm lenses. Hugo Meyer serial no. information is given in table 1. Up to 10,000,000 the numbers were consecutive and independent of lens type; afterwards, blocks of numbers were assigned to specific lens types, ranging from 4 to 7 digits, probably similar to the Zeiss Jena system after 1980 [6]. In general, younger lenses could thus duplicate older lens numbers, but no LF lenses were manufactured in that time frame.

Most or all of Meyer's LF lenses, listed in table 2, were based on the prewar models, although not all of those were continued. The most common series were the "Trioplan" lenses, a renowned triplet construction available in both f/3.5 and f/4.5 versions (fig. 1). The Trioplan lenses are still interesting today as portrait lenses, if an external shutter is available. A nice touch is that the Triopians (as well as the Telemegor, see below) all came with a dedicated lens hood. A soft focus version with adjustable center lens, similar to Voigtländer's Universal Heliar, existed before and during the war years (fig. 2); whether it was continued after the war is not sure.

The well-known "Aristostigmat" lenses made by Meyer were double Gauss types with 4 meniscus lens elements in 4 groups and go back to the beginning of the company. However, the f/6.3 "Weitwinkel-Aristostigmat" version is a wide angle redesign from the late 1930's by the optics designer Stephan Roeschlein, who also worked for Schneider-Kreuznach, and later opened his own optics shop in Bad Kreuznach. It is similar to the Kodak Wide Field Ektar. The coated version of the 100mm Weitwinkel-Aristostigmat in Compur 0, which is comparatively common on the used market, is interesting for the weight-conscious backpacker, since it is even smaller and lighter than the similar 100mm WF Ektar; the same is true for the 120mm one. Note that the cells of the barrel version of the same lens, although similar in size, are not compatible with a current shutter. Fig. 2 shows some of them, both in barrel and in shutter.

The Tele-Megor is a telephoto type, based on the classic construction using two cemented doublets [7,8]. It is unusual in that it uses a separate aperture in the large diameter front cell, not the one of the shutter. This allowed the use of a smaller Compur 2 (300mm) or Compound III (400mm) shutter instead of a IV or V Compound, without compromising the optical design. Like the Trioplan lenses, it was sold with a dedicated lens hood. A Tele-Megor with the same specifications (f/5.5, 400mm, 4 lenses in 2 groups, 82mm filter thread) was also sold extensively for the Pentacon Six medium format camera, the Exakta, and the Praktica 35mm cameras. It is actually not clear whether any 400mm Tele-Megors in shutter were made after WWII, most of the known specimens, as well as a rare 600mm version with Compound V, shutter seem to have been made in the war years or shortly thereafter (fig. 3).



Fig. 3: Front: Trioplan 260mm f/3.5 with adjustable soft focus setting; the adjustment (upper nickel plated ring with numbers from 0-3) moves the negative center lens. Back row from left to right: Telemegor 400mm f/5.5 in Compound III, Telemegor 600mm f/5.5 in Compound V. Note that in both Telemegors the aperture is set by the nickel-plated ring of the front barrel, not by the shutter. The lenses are uncoated and were probably made during WWII. Scale is in cm.

The Doppel-Anastigmat lenses in table 2 were lenses for close-up photography and are based on the Dagor type, 6 lenses in 2 groups; most or all of the existing specimens are uncoated (fig. 4). Why Meyer didn't continue the production of the well-known Plasmat after the war is a mystery, given the success of the similar postwar Schneider Symmar on Western markets. A possible reason is the fact that apparently not only all the machines were transported to the USSR after 1945, but also all the optical calculations. The lenses made initially in 1946/47 were based on data reconstructed from production notes of the engineers and foremen [4]. Furthermore, Meyer-Optik soon concentrated on medium format and 35mm optics.

Meyer also produced a series of "Helioplan" $f/4.5$ lenses (fig. 4), a 4/4 Dialyte construction, sold as enlarging lenses. Similar to the Doppel-Anastigmat lenses, they are usually uncoated, even lenses made in 1954, two years after the installation of their first coating facilities.



Fig. 4: Front row from left to right: Doppel-Anastigmat 210mm $f/6.8$, Helioplan 135mm $f/4.5$ from 1949, Helioplan 135mm $f/4.5$ from 1954. Note the different barrel styles of the two Helioplane. Back row: Helioplan 210mm $f/4.5$. The Helioplan lenses, a Dialyte construction, were sold as enlarging lenses. All lenses are uncoated, including the 1954 version. Scale is in cm.

Note that there are some rather new $f/4.5$ LF barrel lenses on the market with 180, 210, 250, and 300mm focal lengths. They are labeled “Meyer-Optik”, but without any lens name on the mount (fig. 5). These are actually Tessars made by the Carl Zeiss Jena plant in Saalfeld for the short-lived successor of Meyer-Optik after the reunification of Germany: this happened before Docter Optic took over the Saalfeld plant, sometime between late 1990 and early 1991. The mount design is exactly the same as the original Zeiss one, and some also use the Zeiss Jena serial numbers (others use a four-digit number series starting at 0001). As mentioned above, one version came in a shiny golden brass mount (fig. 5) sold with the Mahogany “Globica” studio stand cameras in 1990/91, but regular black anodized aluminum mounts also exist. Except for the labeling and the mount material in the case of the brass versions, they are identical to the Carl Zeiss Jena or Docter Optic Tessars in barrel. Their data can be found in table 2 of the article on Carl Zeiss Jena lenses [1].



Fig. 5: Modern (1990-1991) “Meyer-Optik” LF lenses on the left side and their Tessar counterparts from Carl Zeiss Jena on the right hand side. All lenses were made by the Carl Zeiss Jena plant in Saalfeld [1], the Meyer-Optik Tessar versions are the same as the Zeiss versions. Meyer Optik bought them from Zeiss to be sold with a mahogany version of their “Globica II” studio camera. The front row shows 210mm $f/4.5$ Tessars, the back row 300mm $f/4.5$ Tessars. The brass mount versions (front left) were a special run to go with the brass metal parts of the mahogany camera – the 210mm brass version shown is nearly twice as heavy as the aluminum version (625g vs. 335g). Scale is in cm.

Table 2: Hugo Meyer Görlitz large format lenses. * denotes calculated/estimated values.

lens name	max./min. aperture	focal length[mm]	lens elements/groups	coverage[°] open/f22 or format	image circle diameter [mm]	mount/ Shutter	filter size [mm]	weight[g]	remarks
Weitwinkel Aristostigmat	6.3/32	100	4/4	70/90	140/200	Compur 0	32 slip-on	101	Compur 1 version of the 160mm may exist
						barrel	37 slip-on	50	
		120	4/4	70/90*	168/240*	Compur 0	37 slip-on	107	
		160	4/4	70/90	224/320	barrel	47 slip-on	106	
Doppel-Anastigmat	6.8/	180	6/2	50	336	barrel			Macro lenses; other focal lengths between 180mm and 240mm may have been produced
		210					42 slip-on	212	
		240			448				
Tele-Megor	5.5/ 32	300	4/2	45*	249*	Compur 1 or 2			Image circle based on pre-WWII model information [4,5]
		400	4/2		330*	Compound III	85 slip-on	1204	
		600	4/2	45*	500*	Compound V	124 slip-on	3500	
Trioplan	3.5/32	210	3/3	48/57	187/228	barrel	72/75 screw-in/slip-on	510	comes with dedicated screw-in metal lens hood
		260	3/3	48*	232*			1544	Soft focus with moveable center lens
Trioplan	4.5/32	200	3/3	48/57	178/217				Other focal lengths may have been produced; comes with dedicated screw-in metal lens hood
		260	3/3	48/57	232/282		72/75 screw-in/slip-on	538	
		300	3/3	48/57	267/326		82/85 screw-in/slip-on	730	
		360	3/3	48/57	321/391		100 slip-on	1158	
Helioplan	4.5/32	135	4/4			barrel	42 slip-on	82	Symmetric dialyte; enlarging lens
		165		for 4x5					
		210		for 5x7			64 slip-on	288	

Meopta, Czechoslovakia

The company was founded in 1933 by the engineer Alois Benes as “Optikotechna”. It is located in Přerov, in the Moravia area of what is now the Czech Republic. Initially, they concentrated on dark-room equipment, including enlarger lenses (“Benar”). From 1939-1945, the company was seized by Nazi Germany, renamed “Hermann Göring Optische Werkzeuge”, and produced military optics. In 1946, with the beginning of the communist rule, they were renamed “Meopta National Enterprise”, or short Meopta. In the West, Meopta was mostly known for their enlargers (Opemus, Magnifax, etc.) and enlarging optics, but they also made camera equipment and a variety of other optical products [9,10]. This included at least one view camera and a few LF taking lenses (table 3). The 135mm Largor and the 210mm Belar (fig. 6) are 2 LF lenses that came in a Prontor-II/Prontor-S shutter and a Compound III-type shutter, respectively. For several years they were sold together with the “Magnola” 13x18cm technical camera, a simplified copy of the 13x18cm/5x7” Linhof Technika. The Magnola was produced from 1949 to about 1955. The 135mm Largor was a double Gauss wide-angle lens like the contemporary Kodak Wide Field Ektar or the Meyer Optik Weitwinkel-Aristostigmat described above. The Largor lens cells directly fit a modern no. 0 shutter. When stopped down to at least f/16 (which is necessary for all double Gauss wide angles for this format), the Largor is a capable lens, and it is significantly lighter than the 135mm WF Ektar.

Table 3: Meopta view camera and enlarging lenses. * denotes estimated values.

lens name	max./min. aperture	focal length [mm]	lens elements/groups	coverage [°] or format	image circle diameter [mm]	mount/ Shutter	filter size	weight [g]	remarks
Largor	6.8/32	135	4/4	85*	229*	Prontor-SVS Prontor-II Size 0	38mm slip-on	101	for “Magnola” 13x18cm/5x7” camera
Belar	4.5/32	210	4/3	56*	222*	Compound III	62mm slip-on	405	
Belar	4.5/?	180	4/3			barrel			Tessar-type enlarging lenses
	4.5/?	210	4/3						
	4.5/32	300	4/3				90mm slip-on	667	
	6.3/45	210	4/3						
Correctar	4.5/?	165	5/3	10x12cm					Enlarging lenses, Dynar/late Heliar type
Meopar	4.5/32	135	5/3	9x12cm*			42	129	
		180	5/3	10x15cm			52 slip-on	259	
		210	5/3	13x18cm			62 slip-on	392	
		300	5/3	18x24cm					
Apo-Belar	9/	600	4/3?	40*		barrel			Process lens, Apo-Tessar type; other focal lengths possible



Fig. 6: Shuttered LF lenses made by Meopta for the “Magnola” technical camera. Left: Largar 135mm $f/6.8$ in Prontor-SVS 0, a 4/4 double Gauss wide angle. Right: Belar 210mm $f/4.5$ in Compound III, a Tessar type lens. Scale is in cm.

The Belar is a $f/4.5$ Tessar type and very similar to the Zeiss Jena Tessar. Most of the other lenses listed in table 3 were enlarger or process lenses (fig. 7) and came in barrel. “Belar” enlarging lenses are again Tessar types, but the Meopar and the rare Correctar are a 5/3 Heliar-type construction and, according to Meopta, better corrected than the Belar. Despite being officially classified as enlarger lenses, these can be front mounted to shutters and used as taking lenses with good results – probably the cheapest way to get a Heliar-type lens for a view camera. The more recent “Anaret” and “Meogon” enlarging lenses were apparently not made in focal lengths suitable for large format. Meopta also had at least one line of process lenses, the Apo-Belar, a 4/3 construction similar to Zeiss Jena’s Apo-Tessar. Meopta is still in existence today [9], but does no longer produce LF equipment.



Fig. 7: Meopta enlarging and process lenses. Front row from left to right: Belar 75mm $f/4.5$, Meopar 135mm $f/4.5$, Meopar 180mm $f/4.5$, Meopar 210mm $f/4.5$. Back row from left to right: Belar 300mm $f/4.5$, Apo-Belar 600mm $f/9$. Scale is in cm.

PZO, Poland

A forerunner of the company can be traced back to 1899, when the engineer Henryk Kolberg founded an optical shop in Warsaw. After a bankruptcy following the 1st World War, the present company was founded in 1921/22 as “Company for Optical and Precision Products H. Kolberg”. After some changes in ownership during the depression years the name changed to PZO, standing for Polskie Zakłady Optyczne (PZO) - Polish Optical Works. During the occupation of Poland by Nazi Germany they were taken over by Carl Zeiss Jena. After WWII, PZO became a nationalized company. They were and still are located in Warsaw, and military optics were a large part of the company product range from the beginning.

Their best known civilian products were microscopes and the “Krokus” brand enlargers. However, a few LF and process lenses (table 4) are occasionally offered used. The only LF/process lens name I have encountered is “Poloxer”. The $f/4.5$ 210mm (fig. 8) and 250mm Poloxer, and maybe other focal lengths with an $f/4.5$ maximum opening, are Tessar type constructions, similar to the Zeiss Jena Tessar, Meopta Belar, or the Industar lenses from the Soviet Union (see below). Another 210mm Poloxer, but with a maximum opening of $f/9$ (fig. 8), shows steeply curved meniscus ele-

ments and is a symmetric wide angle process lens based on the Topogon type, similar to Schneiders G-Claron WA, or the Process Nikkors from Nikon. Beware that these latter lenses are sometimes offered as “Hypergon copies” on the used market; although they are wide angles with 70-90° coverage, they are nowhere close to the 130-140° of the real Goerz Hypergon. PZO also made enlarging lenses (Amar, Mikar, Janpol), but so far I’ve only seen 35mm and medium format versions. PZO is in existence today [11], but does not produce LF-related equipment.

*Table 4: PZO view camera and process lenses. * denotes estimated values.*

lens name	max./min. aperture	focal length [mm]	lens elements/groups	coverage [°]	image circle diameter [mm]	mount	filter size [mm]	weight [g]	Remarks
Poloxer	4.5/32	210	4/3	56*	223*	barrel	66 slip-on	611	Tessar type, other focal lengths may exist
Poloxer		250			265*				
Poloxer	9/22	210	4/4	85*	770* (at 1 :1)		104 slip-on	917	Wide-angle process lens, Topogon type



Fig. 8: Large format and process lenses from PZO. Left: Poloxer 210mm f/9 process lens, a wide angle Topogon type similar to a Process Nikkor or G-Claron WA lens. Right: Poloxer 210mm f/4.5, a Tessar-type lens. Scale is in cm.

MOM, Hungary

In Hungary, the company “Magyar Optikai Művek (MOM) - Hungarian Optical Works” made a variety of instruments for military use after WWII, but also lenses for 35mm cameras. There might be optics useable for LF applications, but not much is known about them. The company was founded by Nandor (Ferdinand) Süss as a precision tool workshop in 1876. In 1939 it was named Magyar Optikai Művek [12, 13] and after WW II was expanded to a large nationalized company under communist rule. In the last days of their existence they produced thermoanalytical instruments, but did not offer optics anymore. Sometime after the year 2000, the company closed its doors, and as of 2014 only one small spin-off making water flow meters still exists.

CCCP - USSR lenses¹

Soviet lenses useable for LF come in 3 categories: lenses for regular LF cameras and enlargers, process lenses, and aerial/military lenses. Princelle’s book [14] on Soviet cameras and optics is a good source for the general aspects of Soviet photographic equipment production, but it mentions LF equipment only on a few pages. A lot of information on the lenses made up to 1970 can be gleaned from the catalogs of the GOI designs from 1963 [15] and two catalogs on lenses from 1970 and 1971 available on the internet [16,17]; in addition, a rather new Russian web site shows many lenses from those catalogs, plus some other, newer ones [18] . Even with these sources, information is not complete, and it is likely that additional lenses not covered here will appear in the future. One should also be aware that not all sellers from the former Eastern Bloc countries are knowledgeable about LF-related optics. Therefore misrepresentations are possible. As an example, I have seen several LF and process lenses labeled as “projection lens”, whereas elsewhere a real slide projector lens was offered as a view camera lens. Therefore some knowledge about lens types and barrel designs (lenses without adjustable aperture are obviously not regular LF camera or process lenses!) together with common sense is helpful when shopping for these lenses.

In general, Soviet lenses can be interesting to use and investigate as Russian lens designers were very capable and came up with unusual and unique designs – the catadioptric lenses by D.D. Maksutov (1886-1964) [19] as well as the super wide angles by M.M. Rusinov (1909-2004) [20,21] and others [21,22] come to mind, but also a forerunner of the Zeiss Hologon [15,23]. This initial appeal is counterbalanced by the fact that the production quality in the Soviet system was rather variable compared to Western standards. This fact should be reflected in the prices, which is not always the case. A helpful feature for identification is that on most Soviet lenses the first two digits of the serial number indicate the production year, e.g. a lens with the serial no. 830617 was made in 1983 (prototypes or special production lenses start with “00”). The focal length may be engraved either in cm or in mm, with no apparent dependence on the production time.

¹ note: the transliteration of Cyrillic letters is based on the BGN/PCGN rules

Most Soviet optics were calculated by the “Государственный Оптический Институт” (Gosudarstvennyi Opticheskiy Institut) - State Optical Institute, founded in Leningrad/St. Petersburg in 1918, better known under its acronym “ГОИ (GOI)” [15,24,25]. If developed elsewhere, lens designs were at least verified by GOI.

The lenses were then manufactured at different plants in the Soviet Union. GOI manufactured only prototypes or specialized optics – these are marked by “GOI” in capital cyrillic letters on the mount. GOI still exists today as S.I. Vavilov State Optical Institute [26]. Fortunately, all the other different plants are usually characterized by a symbol on the mount (figs. 5 - 7). For LF and process lenses, the following companies are important (the symbols of some other Soviet companies can be found in [27,28]:

- a) ГОМЗ - ЛОМО (GOMZ – LOMO). This company, although nowadays often associated with the toy cameras of the same name, is the oldest Soviet Optics manufacturer, being founded before the revolution. It started in 1914 as the Российское Акционерное Общество Оптического и Механического Производства (Rossiyskoye Aktsionernoye Obshchestvo Opticheskogo i Mekhanicheskogo Proizvodstva) – РАООМП (RAOOMP) - “Russian Stock Company for Optical and Mechanical Production” in Petrograd (St. Petersburg), in Soviet times known as Leningrad. After the 1917 communist revolution it was nationalized (1921) and renamed ГОЗ (GOZ) for Государственный Оптический Завод (Gosudarstvennyy Opticheskiy Zavod) – State Optical Factory. It was renamed again in 1930 to ГОМЗ (GOMZ) - Государственный Оптико-механический Завод (Gosudarstvennyy Optiko-Mekhanicheskiy Zavod) - State Optical-Mechanical Factory, and became part of the larger conglomerate ВООМП (VOOMP) - Всесоюзного объединения оптико-механической промышленности (Vsesoyusnogo Ob”yedineniya Optiko-Mekhanicheskoy Promyshlennosti) - Federa-

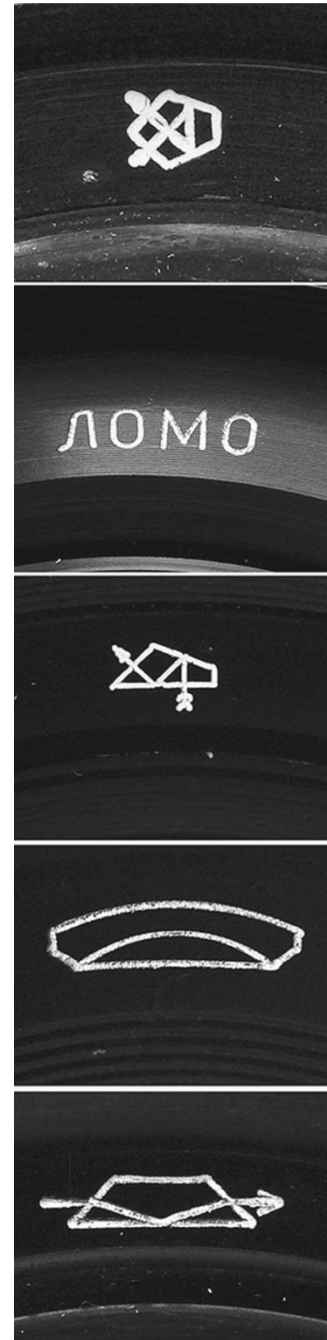


Fig. 9: Common Soviet lens engravings indicating the manufacturer. From top to bottom: GOMZ (Pentaprism symbol) – LOMO – KOMZ (Bauernfeind prism symbol) – MMZ (achromatic meniscus symbol) - KMZ (Dove prism symbol).

tion of Optical and Mechanical Industries. Both VOOMP and GOMZ used a Pentaprism with a light ray as symbol (fig. 9, top). In 1962 the name changes to ЛОМОП (LOOMP) - Ленинградское объединение оптико-механических производств (Leningradskoye Ob'yedinenie Optiko-Mekhanicheskikh Proizvodstv) – Leningrad Union of Optiko-Mechanical Production, and soon after (1965), to ЛОМО (LOMO) - Ленинградское оптико-механическое объединение (Leningradskoye Optiko-Mekha-nicheskoye Ob'yedinenie) - Leningrad Optical-Mechanical Union. This name is still in use today, despite the fact that the city is named Petrograd (St. Petersburg) again. They use the name Lomo in Cyrillic letters on lens mounts (fig. 9), otherwise (lens caps etc.) they use a stylized LOMO name with the cyrillic L centered above the “ОМО” (Fig. 10 top). Nowadays [29], the “Korablik”, a weather vane in the shape of a sailing vessel that is one of the symbols of St. Petersburg, sits on top of the “L” (Fig. 10 bottom); the original “Korablik” is located on the main spire of the Russian admiralty building in St. Petersburg.

- b) КОМЗ - КОМЗ. The Казанский Оптико-Механический Завод (Kazanskiy Optiko-Mekhanicheskiy Zavod) - Kazan Optical-Mechanical Factory was founded in 1940 in Kazan with the help of GOMZ engineers [30]. Kazan is the capital of the autonomous region of Tatarstan in Russia, about 500 miles east of Moscow. The КОМЗ symbol is a “Bauernfeind” type prism with a light ray (fig. 9, center). The most common Soviet LF lenses, the Industar-37 and -51, were usually made by КОМЗ.
- c) ММЗ - ММЗ. The Минский Механический Завод (Minskiy Mekhanicheskiy Zavod) - Minsk Mechanical Factory, was founded in 1957 in Minsk, Belorussia (now an independent country), again with the help of GOMZ. Their symbol was an achromatic meniscus (fig. 9). In 1971, ММЗ became part of the larger conglomerate “Беломо” - Белорусское Оптико-механическое Объединение (Belomo - Belorusskoye Optiko-Mekhanicheskoye Ob'yedinenie) - Belorussian Optical and Mechanical Union, which uses a stylized rendition of the company name as symbol [31]. They made several lenses for the “Rakurs” view camera (medium format), as well as photogrammetric, process, and enlarging lenses.



Fig. 10: Present day Lomo symbols, from ref. [29].



Fig. 11: Symbols of Arsenal Kiev (top), AOMZ – old version (center), LZOS (bottom), from ref. [27]

- d) КМЗ - KMZ. The Красногорский Механический Завод (Krasnogorskiy Mechanicheskiy Zavod) - Krasnogorsk Mechanical Factory was founded in 1941/42 as “state plant no. 393” in Krasnogorsk, in the Western suburbs of Moscow. The plant was relocated to Sverdlovsk/Ekaterinenburg during most of 1941, when the German Army was close to Moscow, but moved back to Krasnogorsk in 1942. It became a large military-industrial complex following the war years, employing 32,000 people in 1989 [32]. It is best known for having made the “Moskva” Super Ikonta copies, the “Zenit” SLR, and the “Horizon” panoramic cameras, but they were also responsible for a range of aerial lenses. Their symbol is a Dove prism with a light ray (fig. 9 bottom), nicknamed “the tombstone” by the KMZ workers.

All of the above companies are still in existence [29-32], but to my knowledge none of them produce view cameras or LF optics today. Other companies that occasionally made a few lenses useable for LF are: Завод и производственное объединение "Арсенал" (Zavod i proizvodstvennoye ob'yedinenie “Arsenal”) - Factory and production association “Arsenal”, located in Kiev (now Ukraine) [33], АОМЗ (AOMZ) - Азовский оптико-механический завод (Azovskiy Optiko-Mekhanicheskiy Zavod) – Azov optical-mechanical factory, in Azov in Russia [34], and ЛЗОС (LZOS) - Лыткаринский завод оптического стекла (Lytkarinskiy Zavod Opticheskogo Stekla) - Lytkarino Factory for Optical Glass, in Lytkarino near Moscow [35]. Their symbols are shown in Fig. 11.

Russian lens names give another clue, as after WWII a certain name usually indicated a specific design type or use, *across all film formats and manufacturers* (see also [36,37]). The specific model is then designated by a number following the name. Some common names of lenses useable for LF are:

- a) Индустар (Industar). The common “Industar” lenses are Tessar types. The name is usually not written out, but marked by the Cyrillic capitalized “Т” (“И”) followed by a dash and the model number engraved on the front (fig. 12). Interestingly, they also have a few long focus Tessars in the 1963 GOI catalog that were just named Tessar, and not Industar.
- b) Орион (Orion). These lenses are double Gauss wide angles related to the Topogon type; for some examples the outer positive menisci are cemented groups, not just single positive lenses.
- c) Руссар (Russar). The majority of the “Russar” lenses, starting with the Russar-21, are the super wide angle lenses covered by the Rusinov patent [20,36] described below, having a large negative meniscus lens at each end of the objective. However, other lenses designed by Rusinov are also named Russar, including some early Topogon-type constructions and a few others. Rusinovs novel construction was also used for some “RF” and “MR” aerial lenses.
- d) Уран (Uran). A fast double Gauss (Planar) derivative, usually 7 lens elements in 5 groups, with intermediate coverage around 50°; the lens diagram looks somewhat similar to the 3”/f1.5 Leitz “Elcan” aerial lens made bei Leitz Canada.

- e) Телемар (Telemar). These lenses are, as the name implies, a telephoto type, 4 lens elements in 4 groups.
- f) Таир (Tair). A telephoto lens, usually quite fast, a 4/3 or 3/3 construction. The original lens (f/4.5, 300mm) was designed by D. Maksutov, the inventor of catadioptric lenses, for the “Fotosniper” 35mm camera. Supposedly [14], he had the idea for the design when he looked at the quiet waters of Lake Tair, which is located in the Mari El Republic in Russia. The back lens or lens group (meniscus) is steeply curved, an unusual feature. Note that *the vast majority* of the used Tair lenses on the market are designed for 35mm. Only some of the aerial versions were intended for larger formats.
- g) T. This designates a triplet lens, although sometimes it may be written out as “Triplet”. Note that many triplets are projection lenses – it is worthwhile to check the original use with a seller.
- h) PΦ (RF). With a single model number, a process lens of 6/4 Planar design, but with a relatively narrow field of view (45°), essentially the Russian version of an Apo-Planar. The “RF-240” process lens, however, is a 6/4 Plasmal design. Other “RF” lenses are wide angle aerial lenses.
- i) O. Another process lens, a classic 4/4 Dialyte design similar to the standard Apo-Artars, -Ronars, and -Germinars. ПМ (PM). A long focus process lens of 6/4 construction, similar to some of the long Apo-Ronars or Apo-Germinars.

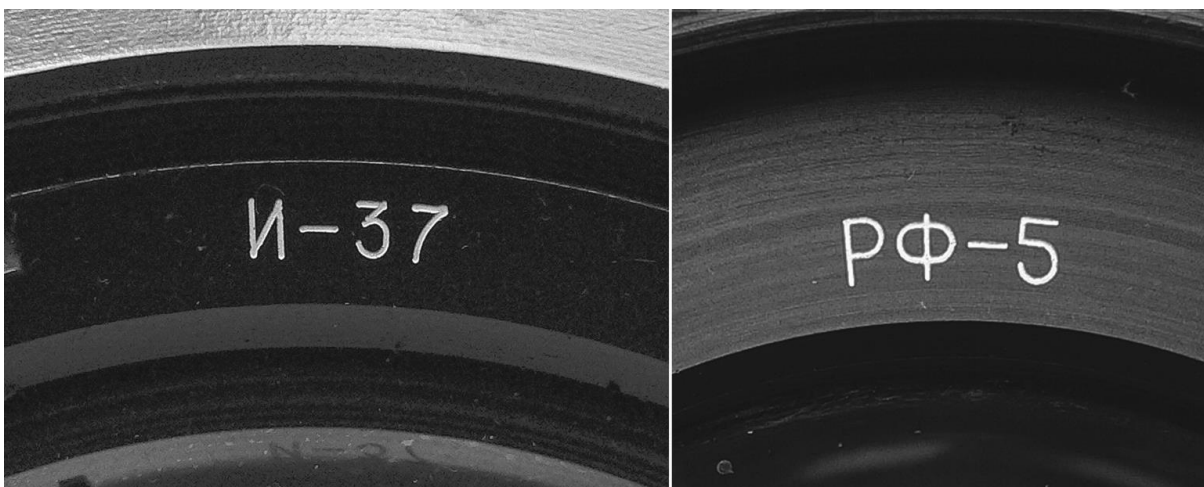


Fig. 12: Cyrillic lens mount inscriptions. Left: Industar-37 lens, “I-37”. Right: process lens “RF-5”.



Fig. 13: Regular LF lenses from the USSR. Front row from left to right: “Orion 18R” 100mm f/8 wide angle lens in barrel made by KMZ, “Industar-51” 210mm f/4.5 lens in barrel made by KOMZ, 150mm f/6.3 (w/o name) Plasmatic-type lens in Prontor SVS 0 made by LOMO. Back row from left to right: “Industar-55” 300mm f/4.5 barrel lens made by GOMZ, its successor, the “Industar-37” 300mm f/4.5 barrel lens made by KOMZ, and an “Industar-55y” 140mm f/4.5 enlarging lens made by Belomo.

The suffix “u”, written as “y” in Cyrillic letters, denotes an enlargement lens (fig. 13 top right). The capital “M” suffix stands for modification, but only with respect to the mechanical mount, not the optics. I would like to stress that, although using a given type and name across all formats is helpful for determining the optical construction, it makes it much more difficult to assess the coverage and usefulness of a given unknown lens. In addition, the number following the lens name, which should be unique for a given lens, has occasionally been used twice or more.

The number of Soviet LF lenses originally built for pictorial use is limited. The most common lenses were the Industar-37 and -51 (fig. 13). They only came in barrel and were used for the wooden “FK” and “FKD” view cameras (13x18cm/18x24cm) [39], which are of ancient construction (tailboard), but were actually built until 1987 in Kharkov (Харьков), Ukraine. A simple behind-the-lens shutter with 1s, 1/2s, 1/15s, 1/30s, B, and T, was available occasionally. For a short time (1948-51), НПЗ-Новосибирский приборостроительный завод (NPZ - Novosibirskii priboro-stroitelnyi zavod – Novosibirsk Instrument-making Factory) produced a 9x12 metal view camera on an optical bench, also fitted with the Industar-51 [40]. The I-37 and I-51 also had a few “Industar”-type predecessors with different model numbers, listed in table 5. The wooden FK cameras were

succeeded by the medium format view cameras “Rakurs 670/ Rakurs 672/Kiev 67” from Belomo. That camera was technologically a huge leap compared to the FKD. It featured a monorail design and an electric behind-the-lens shutter, electrically coupled to the camera back.



Fig. 14: Two of the older “Industar 11M” process lenses from the USSR, made by LOMO. They are Apo-Tessar-type lenses. Left: a 300mm f/9 from 1973; Right: a 450mm f/9 from 1970. Scale is in cm.

One of the few shutter-mounted regular LF lenses was the “T-26” triplet made for an instant film folding camera named “Moment”, a copy of the Polaroid cameras from the 1950’s. The same lens was also used in the “Uchenik”, a 9x12cm folding camera for regular sheet film from the same time. There was another 9x12cm technical or press camera named “Techno” in the 1950’s [14] which used shuttered lenses (compare table 5), but the camera as well as the lenses are apparently very rare. In addition to the normal focal length Industar and Triplet lenses, a few “Orion” wide angle lenses were made for LF cameras, including the 80mm one for the “Techno” and the 100mm version shown in fig. 13. These lenses have about 75-100° coverage.

There were also Soviet-made process lenses usable for LF – the ones I am aware of were all made by GOMZ/LOMO in Leningrad/St. Petersburg. The initial line was the Industar-11M series with a maximum opening of f/9, similar in construction to Apo-Tessars (fig. 14). Focal lengths ranged from 300 to 1200mm. The 450mm version was also the standard lens for a large “FKP” wooden tailboard camera for the 30x40cm format. Later, somewhere between 1970 and 1980, these were replaced by at least four series of “RF”, “O-2”, “O-6”, and “PM-1” process lenses. The “RF” lenses are symmetric 6/4 Apo-Planar type constructions with a maximum opening of f/10 or f/15

[41,42] - an exception is the “RF-240”, a wide angle process lens of the Plasmatic type, with a maximum aperture of 5.6, quite a large opening for a process lens. The “O” and “PM” lenses are 4/4 or 6/4 dialytes. Fig. 15 shows a range of these Soviet process lenses.



Fig. 15: Process lenses from the USSR. Front row from left to right: “RF-1” 240mm f/10 (1990), “RF-3” 300mm f/10 (1986), “RF-4” 360mm f/10 (1983), and “RF-5” 450mm f/10 (1987), all 6/4 Planar type lenses with a coverage of 45°. Back row from left to right: “RF-240” 240mm f/5.6 Plasmatic-type lens from 1987; “O-2” 600mm f/10 (1992) and “O-2” 750mm f/10 (1973), both 4/4 Dialyte-type lenses. Scale is in cm.

The Soviet Union also produced photomacrography lenses similar to the Luminars from Zeiss Oberkochen or the Leitz Photars. They were originally made by the company Прогресс (Progress) in Leningrad, which had a simple plano-convex lens as symbol. Progress became part of Lomo in 1962, but later versions still show the Progress symbol on the mount while the Lomo symbol might be found on caps, boxes, etc. There were at least three f/4.5 Микропланар (Mikroplanar) lenses and one f/6.3 Коппекрап (Korrektar) lens available [44]. The former ones were - as the name implies - 6/4 Planar constructions (quite asymmetric) with a maximum opening of f/4.5. They had focal lengths of 40mm, 65mm, and 100mm, and optimum magnifications of 20x, 10x, and 3x, respectively. The Korrektar, with a focal length of 150mm at f/6.3, was a 6/4 symmetric Plasmatic type optimized for 0.5x to 1x. All lens barrels contain an adjustable aperture, and the lenses are supposed

to cover 5x7 at their nominal magnifications. The original literature [44] claims resolutions from 420-330 lp/mm for the three Mikroplanars.

Finally, there are the aerial/military lenses. For obvious reasons, there was not much technical information available until a few years ago; now, some numbers on designs and performance came out and can be found [15-18, 43]. Similar to their Western counterparts, aerial lenses tend to be large and heavy and will require some significant machining to adapt them to LF cameras, if possible at all. Fig. 16 shows some Soviet aerial lenses. A good number of them included the use of glass plates or reseau plates next to the film (marked in table 5), which makes pictorial use even more problematic. If the plate is missing or taken out, the correction is affected, but when it is in, any fiducial marks as well as scratches and dust are visible on the negative. Aerial versions of the “Orion” wide angle lenses (Topogon type), mentioned above, exist. A new, revolutionary super wide angle type, developed in the 1940’s, was the unique series of lenses designed by M. Rusinov [20,36] (other transliterations of his name are Rossinov, Roossinov or Roosinov). It was the first lens to use tilted entrance and exit pupils to reduce the light fall off, by employing large outer negative meniscus lenses. This Russar-21 and its successors covered up to 136° and were the forerunners of the Biogon and Super-Angulon wide angles in the West. Rusinov’s lenses differ from their Western counterparts in that the outer negative menisci are deeply curved not only on the inside, but also on the outside, which makes them quite expensive to manufacture, since a very large piece of glass, most of which has to be ground away, is needed. Therefore their outward appearance is similar to the “Orion” lenses, but they are obviously quite different in construction - the Orion’s outer menisci are positive - and coverage. Again due to this appearance, both the “Orion” and the “Russar” have erroneously been offered as “Hypergon copies”, but this is again a different construction. A civilian Russar for 35mm cameras was made (20mm focal length), but LF versions were limited to military and aerial mapping applications. On the long focal lengths side, “Tair” type as well as “Telemar”, “Telegoir”, and other aerial lenses have been offered on the used market. Table 5 lists most of those lenses together with the regular view camera, process, and photomacrography lenses.



Fig. 16: Aerial surveillance lenses from the USSR. Front row from left to right: “Telemar-17” 400mm f/6.3 made by KMZ and “Tair-3N” 300mm f/4.5 (the image circle of this lens is too small for LF, it was probably used for medium format). Back row from left to right: “Uran-9” 250mm f/2.5 made by KOMZ in 1964 and “Tair 16N” 500mm f/4.5, with the official coverage similar to the 300mm. The two “Tair” lenses came as a set in a box and were made in 1977. Scale is in cm.

Table 5: USSR view camera, process, and aerial/military lenses with image circles of 95mm or more. Numbers with * denote calculated or estimated values. The resolution numbers are from several sources, sometimes with different numbers [15-18,43]. Weights can also be different for a given lens, this may be due to different mounts and changes in mounting materials (brass vs. aluminum) over time.

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
(unmarked lens)	Lomo (acc. to the lens caps)	6.3/32	150	6/4*	72*	220*	Modified Prontor- SVS 0	39 slip- on	178			Plasmat type*. Needs size 0 shutter hole.
Apo-Orion2 (Апо-Орион 2)		8/32	500				barrel					
Argon-1 (Аргон-1)	GOI, Arsenal Kiev	3.5	90	7/5	61	108	Barrel, Moment shutter			33	10	Planar derivative; aerial lens
Arktur-1 (Арктур-1)		4.5	180	6/4	70	255	barrel			33	4	Plasmat type
Arktur-2 (Арктур-2)		4	180	6/4	70	255	barrel					
Arktur-2 (Арктур-2)		5/22	175	6/4	46	149*	barrel					
Arktur-3 (Арктур-3)		5	140	6/4	45	116*	barrel		628	33 (30)	3(15)	
Arktik-1 (Арктик-1)		4	105	6/4	62	127	barrel			33	10	Plasmat type
Arktik-2 (Арктик-2)		4	210	6/4	62	255	barrel			26	5	
Arktik-3 (Арктик-3)		4.5	308.9	6/4	52	300	barrel			29	14	
Arktik-A (Арктик-А)		6.3	400	6/4	24	170	barrel			45	12	
Arktik-A3 (Арктик-А3)		4.5	313	6/4	51	300	barrel			21	9	
Arktik-A4 (Арктик-А4)		5	518	6/4	32	300	barrel			24	4	
(Arktik-A5 (Арктик-А5))		5	500	6/4	33	300	barrel			34	15	
Arktik-A6 (Арктик-А6)		5	500	6/4	46	424	barrel			28	15	
R-Arktik (Р-Арктик)		9	150	6/4	50	140	barrel			28	7	
Avrora-2 (Аврора-2)		2.2	197	10/8	16	104	barrel			37	13	reproduction/process lens Number of lens elements includes back and front glass plates
Dinar-1 (Динар-1)		1.8	200	6/5	28	100	barrel					Reseau plate, not included in number of lens elements
Dinar-2 (Динар-2)		1.8	300	6/5	19	100	barrel					
Dinar-3 (Динар-3)		1.8	200	6/5	28	100	barrel			27	19	
Dinar-4 (Динар-4)		1.8	300	6/5	19	100	barrel					
Distorziyushiy (Дисторзирующий)		4.5	140	6/5	100	255	barrel		2300	50	12	Aerial lens, retrofocus construc- tion
Epilyuks (Эпильюкс)		2.5	250	4/4	33	150	barrel					Episcope procection lens
Eridan-2 (Эридан-2)		10	950	5/3	36	650	barrel			57	30	Aerial lens, lens diagram similar to Voigtländer "Oxyn"
F-3 (Ф-3)		4.5	400	5/3	31	222				18	12.5	
Foton 1a (Фотон-1а)		8	1350	6/6	14	330	barrel		20500	40	36	Aerial lens
G-10 (Г-10)		4	210	6/4	62	254						Aerial lens
Goir-1 (Гоир-1)		2.5	100	9/7	75	150	barrel			33	6	Aerial lens
Goir-2 (Гоир-2)		2.5	100	9/7	75	150	barrel			42	19	
Goir-3 (Гоир-3)		3	100	8/6	56	106	barrel			44	16	Last lens acts as glass plate for film?

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Gelios-53 (Гелиос-53)		2.5	200	6/4	31*	110	barrel					Aerial lens
Gelios-67 (Гелиос-67)		1.5	200	6/4	28	100	barrel			32	6	Reseau plate, not included in
Gelios-68 (Гелиос-68)		1.5	200	6/4	28	100	barrel			28	10	number of lens elements
Industar-4 (Индустар-4)	VOOMP	4.5/32	210	4/3	56	222	barrel			25	10	pre-WWII
Industar-11 (Индустар-11)		4.5/90	300	4/3	53*	300*	barrel					
Industar-11 (Индустар-11)		9	150	4/3	150	95	barrel			20	17	
Industar-11M (Индустар-11M)	LOMO	9/90	300	4/3	45	497(1:1)	barrel	55 slip-on	220/665	20	8	process lenses, Apo-Tessar type “M” designates a different mount type
			360	4/3	45	596(1:1)			930	19	8	
			450	4/3	45	746(1:1)			1332	18	7	
			600	4/3	45	994(1:1)						
			750	4/3	45	1242(1:1)						
			900	4/3	45	1492(1:1)						
			1200	4/3	45	1988(1:1)						
Industar-13 (Индустар-13)	GOMZ, KOMZ	4.5/32	300	4/3	56	319	barrel			23		For FKD 18x24
Industar-17 (Индустар-17)		4.5	500	4/3	38	300				32		
Industar-17A (Индустар-17A)		5	476	4/3	35	300	barrel			15	8	Aerial lens
Industar-23 (Индустар-23)	KMZ	4.5/22	110	4/3	52	108	Barrel, Moment shutter			38	13	For “Moskva” 1-4 folding 6x9cm camera (Super-Ikonta copy)
Industar-23u (Индустар-23y)	KMZ, LZOS	4.5/16(32)	110	4/3	52	107	barrel			50	13	Enlarging lens for 6.5x9cm; different mounts exist
Industar-24 (Индустар-24)	KMZ	3.5/22	105/110	4/3	52	107	Moment shutter			23	13	Moskva-5 folding 6x9 camera
Industar-27 (Индустар-27)		3.5	113	4/3	51	108	barrel			27	12	
Industar-36 (Индустар-36)		4.5	150	4/3	55	150	barrel			39	6	
Industar-37 (Индустар-37)	KOMZ	4.5/64	300	4/3	53	300	barrel		1250	20(31)	5(15)	For FKD 18x24, successor of Industar-13
Industar-51 (Индустар-51)	KOMZ	4.5/32	210	4/3	56	222	barrel M60x0.75	60 slip-on	400-300	22	14	For FKD 13x18
Industar-52 (Индустар-52)		5	500	4/3	45	424			3382	25	12	Aerial lens
Industar-55 (Индустар-55)	GOMZ	4.5/32	300	4/3	56*	319*	barrel	80 (screw- in) 87 (slip- on)	1420	42	18	Brass mount
Industar-55 (Индустар-55)		4.5/	140	4/3	56	150	FZ4s shutter, barrel					For “Techno” 9x12cm camera
Industar-55-u (Индустар-55 y)	MMZ	4.5/22-32	140	4/3	55	145	barrel	-	170/207/ 290	36	19	Tessar type enlarging lens for 9x12, different mounts exist
Industar-77 (Индустар-77)	KMZ	4.8 5.6	120	4/3								Two versions with different openings were mad, covers 73x96mm

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Industar-100-u (Индустар-100 у)		4(4.5)/22	110	4/3			barrel					Enlarging lens for 6x9cm
Industar-A (Индустар-А)		5	500	4/3	44	424	barrel		4200	25	8	Aerial lens
Industar-A2 (Индустар-А2)		5	500	4/3	44	424	barrel			20	4	
Industar-A13 (Индустар-А13)		4.5	297	4/3	46	255	barrel			37	8	Aerial lens
Industar-E-S (Индустар-Е-С)		5.5	213.8	4/3	61	255	barrel					Aerial lens
UF-Industar (УФ-Индустар)		4.5	210	4/3	55	222	barrel			38	1	Ultraviolet lens
Korrektar (Корректар)	Progress, Lomo	6.3/32	150	6/4	?	?	Barrel, M45x0.75					For 0.5x to 1x, symmetric Plas- mat type
Lava-3A (Лав-3а)		3.5	800	?	?	>1000	barrel		6500			
Leningrad-1 (Ленинград-1)		10	1500	4/4	16	424	barrel			41	19	Aerial lens
Leningrad-4 (Ленинград-4)		8	1800	4/4	21	648*	barrel			32	13	Reseau plate, not included in number of lens elements
Leningrad-7 (Ленинград-7)		7	1000	4/4	24	424	barrel			42	18	
Leningrad-8 (Ленинград-8)		6.3	750	4/4	30	424	barrel			45	10	
Leningrad-9 (Ленинград-9)		10	1000	4/4	24	424	barrel			40	20	
Leningrad-12 (Ленинград-12)		7	1200	4/4	25	530	barrel					
Leningrad-13 (Ленинград-13)		12	750	4/4	12	158	barrel			44	37	
Liar-6 (Лиар-6)		5.4	100	8/6	104	308						
Mars-1 (Марс-1)		4.5	500	6/5	17	150	barrel			60	36	Aerial lens, reseau plate,c
Mars-2 (Марс-2)		6.3	750	7/6	17	222	barrel			48	21	
Mars-5 (Марс-5)		4	1000	6/6	24	424	barrel			28	8	Aerial lens
Mars-6 (Марс-6)		4	1000	6/6	24	424	barrel			33	7	Reseau plate not included in number of lens elements
Mars-7 (Марс-7)		6	1800	6/6	22.5	700	barrel			26	7	
Mikroplanar (Микропланар)	Progress, Lomo	4.5/22	40	6/4			Barrel, RMS thread			420	230	For 20x enlargement, asymmetric Planar type
			65				Barrel M33x0.75			410	230	For 10x enlargement, asymmetric Planar type
			100				Barrel M45x0.75			330	150	For 3x enlargement, asymmetric Planar type
Mir-41 (Мир-41)	Belomo (MMZ)	5.6	90	?/?	67*	120						For Rakurs-672/Kiev67 <u>medium</u> format view camera, electric shutters, retrofocus type
MR-3 (MP-3)		6.8	35	6/4	117	114	barrel			37	5	Russar type, reseau plate not included in no. of lens elements

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
MR-102 (MP-102)		6.3	100	6/4	102	255	barrel			45	8	Aerial lens russar type, reseau plate
MRO-1 (MPO-1)		6.8	70	8/5	122	255	barrel			33	4	Topographic lens (distortion 30µm), Russar derivative, back side of last lens might act as reseau plate
MRO-2 (MPO-2)	Belomo	8	100	6/4	102	255	barrel			44	11	Topographic lens (distortion 25µm), Russar type, reseau plate, not included in number of lens elements
Neptun-1 (Нептун-1)		4.5	100	5/5	96	222	barrel			33	10	Related to the Topogon, with a an additional lens
Neptun-2 (Нептун-2)		4.5	210	5/5	90	424	barrel			30	8	
Neptun-3 (Нептун-3)		4	50	6/5	87	95	barrel			58	11	
Neptun-8 (Нептун-8)		4.5	180	6/5	80	300	barrel			52	9	
Neptun-A4 (Нептун-A4)		4.5	210	6/5	71	300	barrel			37	9	
O-2 (O-2)	LOMO	10/90	600	4/4	41	897*(1:1)	barrel	85 screw-in	996/2070	17(28)	5(12)	Process lenses, dialyte type
			750			1122*(1:1)			4276	25	12	
O-6 (O-6)	LOMO	10/90	800	4/4 or 6/6?	40*	1165*(1:1)	barrel					Process lens, probably a dialyte
OB-19 (ОБ-19)		1.8	250	6/5	25	113	barrel			35	9	Aerial lens
OB-20 (ОБ-20)		6.3	210	6/4	56	222	barrel			48	8	Plasmat type; with reseau plate
OF-41 (ОФ-41)	GOMZ	4.5	400	5/3	31	255	barrel		2900	14	10	Early aerial lens
OF-233 (ОФ-233)		2.5	210	7/4	50	196	barrel			30	15	Soviet version of the Aero-Ektar
OR-451 (OP-451)	KOMZ	6.2	488	6/6	35*	620 (1:1)	barrel		2270	12	7	Process lens
OR-451M (OP-451M)			489.5	6/6			barrel					Process lens
OR-452		6.3	470	6/6	37*	620 (1:1)	barrel		2620	15	7	
Orion-1 (Орион-1)		6.3	100	4/4	94	215	barrel			50	10	
Orion-1a (Орион-1a)	GOI	6.3/	200	4/4	92	415	barrel			43	5	Aerial reconnoissance, Topogon-type
Orion-1b (Орион-1b)		6/	100	4/4	96	222	barrel			49	10	
Orion-1m (Орион-1m)	Belomo	6.3	200		92	414*	barrel			32	6	
Orion-2 (Орион-2)		6	150	4/4	80	255	barrel			30	9	Topogon type
Orion-3 (Орион-3)		6	180	6/4	70	255	barrel			40	9	Topogon-based, outer lens elements are cemented
Orion-4 (Орион-4)		5	150	6/4	85	255	barrel			40	9	
Orion-5 (Орион-5)		4	210	6/4	70	300	barrel			27	7	
Orion-6 (Орион-6)		4	180	6/4	80	300	barrel			40	2	
Orion-8 (Орион-8)		4	150	4/4	80	255	barrel			52	8	
Orion-16 (Орион-16)		6.3	100	4/4	85	183	barrel					
Orion-17 (Орион-17)		6.3	100	6/4	60	113	barrel			52	26	
Orion-18 (Орион-18)	Lomo	6.3/22	100	6/4	55-75	104-	barrel			160	78	Topogon-type reproduction lens, Aerial lens?
Orion-18R (Орион-18P)	KOMZ	8/22	100	6/4	60	115*	barrel		190	60	45	Microfilm reproduction

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Orion 19a (Орион-19a)		6.3	500	6/4	60	583	barrel			50	1	
Orion-20 (Орион-20)		6.3	200	6/4	65	255	barrel			52	17	Photogrammetry lens (distortion 40µm); reseau plate, not included in number of lens elements
Orion-21 (Орион-21)		6.3-6.8	150	4/4	92	312	barrel			30	12	Reseau plate, not included in number of lens elements
Orion-22 (Орион-22)		6.3	150	4/4	92	312	barrel			34	10	
Orion-26 (Орион-26)		5.6	200	6/4	65	255						Photogrammetry lens (distortion 5µm)
Orion (Орион)		6	50	?	97	110	barrel					Aerial lens
Orion- (Орион-)		6.3/	80	4/4	86*	150*	FZ4s shutter					For "Techno" 9x12cm camera, double gauss type
Orthoanastigmat (Ортоанастигмат)		18	150	4/2	67	222	barrel			42	6	Protar V type
Orthoanastigmat (Ортоанастигмат)		8	190	6/2	58	222	barrel			40	10	Inverse Dagor type
Orthoprotar (Ортопротар)		18	250	6/2	54	255	barrel			39	10	Inverse Dagor type
Orthodinar-1 (Ортодинар-1)		2	210	6/4	55	222	barrel			22	1	Planar type
Orthodinar-3 (Ортодинар-3)		2.5	105	6/4	54	108	barrel			42	5	
Orthogon-1 (Ортогон-1)		6.8	75	11/7	119	255	barrel		5300	50	9	"Topographic"(photogrammetric) lens, Aviogon-Biogon type, Ortogon-1 uses an LiF lens element, the Ortogn-8 an aspherical element. Reseau plate, not included in number of lens elements
Orthogon-3 (Ортогон-3)		6.8	75	11/7	118	255	barrel			49	9	
Orthogon-4 (Ортогон-4)		6.8	77	11/7	118	255	barrel			47	8	
Orthogon-5 (Ортогон-5)		6.3	100	11/7	102	255						
Orthogon-7 (Ортогон-7)		5.6	140	8/7	85	255						
Orthogon-8 (Ортогон-8)		7	55	11/6	133	255	barrel					
Orthogon-10 (Ортогон-10)		4.5	75		120	255						
Orthogon-10 (Ортогон-10)		5.6	140	8/6	85	255						
Orthogon-21A (Ортогон-21A)		5.6	140		84	255						
Orthometar (Ортометар)		6.3/45	400									Aerial? Looks similar to Telemar-17
Orthoniar-13 (Ортоннар-13)		7	500	4/4	29	255				30-35	20	Dialyte
PM-1 (ПМ-1)	LOMO	15/90	900	6/4	45	1491*(1:1)	barrel		3980	26	15	Similar to the 6-element long Rodenstocks Apo-Ronars or the long Zeiss Apo-Germinar
			1200		38	1653*(1:1)			6564	23	12	
R-2 (P-2)		8.2	55		136	255				36	13	Aerial lens
Radon-1 (Радон-1)		5	500	6/4	46	424	barrel			33	9	Aerial lens, double Gauss derivative, reseau plate not included in number of lens elements
Radon-2 (Радон-2)		7	600	6/4	61	707	barrel			40	18	
Radon-3 (Радон-3)		7	500	6/4	61	583	barrel			48	22	
Reproduktionnyy (Репродукционный)		7.15/16	360	8/6	33*	420 (1:1)			22000	20	5	Symmetric, for 1:1
Reproduktionnyy (Репродукционный)		5.8	150	6/4	35	95	Barrel					

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
RF-1 (PΦ-1)	LOMO	10/64	240	6/4	43	398*(1:1)	barrel	47 slip-on	190			Apo-Planar type process lenses
RF-3 (PΦ-3)			300			497*(1:1)		51 slip-on	259/656	35	18	
RF-4 (PΦ-4)			360			596*(1:1)		58 slip-on	410/798	35	17	
RF-5 (PΦ-5)			450			746*(1:1)			965	35	15	
RF-96 (PΦ-96)		6.3	100	6/4	96	222	barrel			41	6	Russar type
RF-102 (PΦ-102)		6.3	100	6/4	102	255	barrel			40	11	
RF-102 (PΦ-102)		6.3	75	6/4	75	115			280	30	10	
RF-102 (PΦ-102)		6.3	50	6/4	102	127	barrel			40	9	
RF-108 (PΦ-108)		6.3	100	6/4	108	275	barrel			48	9	Process lens
RF-150 (PΦ-150)	LOMO	5.6/64	150	6/4?			barrel					
RF-240 (PΦ-240)	LOMO	5.6/64	240	6/4	75*	737 (1:1)	barrel	67*	475			
Rodina-2 (Родина-2)		8.2	45	8/6	140	255	barrel					
Rodina-2B (Родина-2Б)		8.2/16	55	8/6	133	255	barrel					2 inner lens elements are plain glass plates
Rodina-26 (Родина-26)		8.2	55	8/6	134	255	barrel			36	12	
Russar-1 (Руссар-1)		6.3	100	4/4	100	238						Topogon type!
Russar-2 (Руссар-2)			70									
Russar-5 (Руссар-5)			135		90							Topogon type!
Russar-19 (Руссар-19)		6.3	100									
Russar-21 (Руссар-21)		18	55-60	6/4	133	255	barrel					Aerial lenses
Russar-22 (Руссар-22)		8	70	6/4*	122	255	barrel			26	4	
Russar-25 (Руссар-25)		6.3	100	6/4*	110	255				23	4	
Russar-25A (Руссар-25А)		6.8	70.48	6/4*	122	254	barrel			20	10	WWII super wide angle aerial lens with fixed aperture and built-in yellow filter
Russar-25D (Руссар-25Д)		7.7	250	7/5	110	707	barrel		18000	25	10	
Russar-29 (Руссар-29)		6.8	70	8/5	122	255	barrel			26	12	Aerial lenses
Russar 29b (Руссар-29б)		9	70	7/4	122	255	barrel			35	12	
Russar-30 (Руссар-30)	LOMO	7.2	120	8/5	121	424	barrel					Aerial lenses
Russar-31 (Руссар-31)		8	180	9/4	121	636	barrel					
Russar-33 (Руссар-33)		6.8	100	8/5	122	360	barrel			25	8	
Russar-35 (Руссар-35)		9	200	8/4	65	255				35	30	
Russar-38 (Руссар-38)		7.7	36	9/5	148	255	barrel					
Russar-43 (Руссар-43)		6.8	140	9/5	85	255				40	20	
Russar-44b (Руссар-44б)		6.8	100		104	255				34	18	
Russar-49 (Руссар-49)		6.8/22	60	8/5	98	138*	barrel		600	25	10	
Russar-49b (Руссар-49б)		6.8	100		102	255						
Russar-54 (Руссар-54)		6.8	70		122	255				30	12	
Russar-62 (Руссар-62)		9	50	12/7	136	255	barrel			40	15	
Russar-63 (Руссар-63)			100	8/6								Aerial lenses, reseau plate, not included in no. of lens elements

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Russar-67 (Руссар-67)				11/9	120							
Russar-68 (Руссар-68)		7	350	6/4	40	255				39	24	Topogon-related!
Russar-71 (Руссар-71)		6.8	100	10/6	103	255				55	26	Aerial lenses, reseau plate, not included in number of lens elements
Russar-73 (Руссар-73)				13/9	120							
Russar-77 (Руссар-77)				5/5	8							Long focus lens!
Russar-80 (Руссар-80)		6.8	70	11/8	122	255				48	21	Lens elements include front and back glass plates
Russar-93 (Руссар-93)		4.5			100							Aerial lenses
Russar-96 (Руссар-96)												
Russar (Руссар)	Arsenal	6.3	60		85	110	shutter					Prototype for "Reporter" camera
Russar-Plazmat (Руссар-Плазмат)		6	200		41	150*				40-45	18-20	Aerial lens, Plazmat type
		6.3	200		65	255				40	20	Aerial lens, Plazmat type
		6	350		41	255				35	15	
Saturn (Сатурн)		2.5	250	4/4	48	222	barrel			39	4	
Saturn-2 (Сатурн-2)		3.5	500	4/4	28	255	barrel			30	4	
Sekstar-1 (Секстар-1)		7	750	6/6	43	583	barrel			48	24	Reseau plate, not included in number of lens elements
Sekstar-2 (Секстар-2)		7	1000	6/6	33	583	barrel			38	22	
Shirokougolnyy Orthoskopicheskiy Ob'yektiv (Широкоугольный Ортоскопический Объектив)		6.8	100	6/5	100	222	barrel		550	42	9	Retrofocus
Spherogon-3 (Сферогон-3)		3	100	6/2	120	210	barrel			64	48	Hologon precursor; the two cells are connected with vaseline as a 7 th lens!
Sputnik-1 (Спутник-1)	GOI	6.3	200		90	400						
T-26	GOMZ	6.8/	135	3/3	52	132*	'Moment' shutter					Triplet for "Moment" and "Uchenik" folding cameras
Tair-7 (Таир-7)		4.5	300	3/3	22	113	barrel			42	18	
Tair-8 (Таир-8)			500	3/3	13	113				42	19	
Tair-16 (Таир-16)			450	4/3	14	127			3000	58	25	
Tair-10 (Таир-10)			750	4/3	10	127				40	20	
Tair-30 (Таир-30)			300	4/3	20	108				30	11	
Tafar-3 (Тафар-3)		6	350	6/4	40	255				30-35	14-16	Aerial lens, symmetric
Telegoir-1 (Телегоир-1)		6.3	1000	6/4	24	424	barrel			47	19	Aerial telephoto type
Telegoir-2 (Телегоир-2)		6.3	500	6/4	17	150	barrel			48	24	
Telegoir-3 (Телегоир-3)		8	1200	6/4	20	424	barrel			44	25	
Telegoir-5 (Телегоир-5)		7	1000	6/4	24	424	barrel			43	15	
Telegoir-7 (Телегоир-7)		8	1800	6/4	13	424	barrel			40	30	
Telegoir-9 (Телегоир-9)		7	1000	6/4	14.5	255	barrel			50	40	Aerial telephoto types, reseau plate, not included in number of lens elements
Telegoir-11 (Телегоир-11)		8	1200	6/4	20	424	barrel			50	40	
Telegoir-12a (Телегоир-12a)		8	3000	7/5	13	707	barrel			36	29	
Telemar		6.3	750	4/4*						30		
Telemar-2 (Телемар-2)		6.3	750	4/4	30	424	barrel		6330	42	8	Aerial telephoto lens

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Telemar-7 (Телемар-7)		7	1000	4/4	24	424	barrel			36	20	
Telemar-7a (Телемар-7a)		7	1000	4/4	24	424	barrel			30	24	
Telemar-8 (Телемар-8)		8	1200	4/4	20	424	barrel			32	18	
Telemar-8a (Телемар-8a)		8	1200	4/4	20	424	barrel			34	20	
Telemar-11 (Телемар-11)		4.5	300	4/4	22	113	barrel			38	21	
Telemar-12 (Телемар-12)		8	1800	4/4	22	707	barrel			27	11	
Telemar-17 (Телемар-17)	KMZ	6.3	400	4/4	30	222	barrel	75 slip- on (bayonet)	2200	42	14	Telephoto; aerial lens, or for the 13x18cm "FK" camera
Telemar-18 (Телемар-18)		8	1000	4/4	32	583	barrel			58	18	
Telemar-19 (Телемар-19)		7	1000	4/4	24	424	barrel			55	33	Aerial telephoto lens
Telemar-A2 (Телемар-A2)		6.3	750	4/4	30	424	barrel			40	15	
Teleob'yektiv (Телеобъектив)		4.5	400	5/3	31	222	barrel			24	17	
Teleob'yektiv (Телеобъектив)		6.3	500	4/2	25	222	barrel					Aerial telephoto lens
Teleob'yektiv (Телеобъектив)		6.3	500	5/3	25	222	barrel			22	17	
Teleob'yektiv (Телеобъектив)		6.3	700	5/3	23	300	barrel			29	5	
Teleob'yektiv (Телеобъектив)		6.3	700	5/3	24	300	barrel					
Teleob'yektiv (Телеобъектив)		5.5	190	5/3	32	109	barrel			42	7	
Teleob'yektiv (Телеобъектив)		5.5	235	5/3	35	150	barrel			42	8	
Teleob'yektiv (Телеобъектив)		5	600	5/5	28	300	barrel			27	3	
Teleob'yektiv (Телеобъектив)		4.5	250	5/3	33	150	barrel			38	15	Aerial telephoto lens
Teleob'yektiv -A (Телеобъектив-A)		7	1000	5/3	17	300	barrel			38	20	
Tessar (Тессар)		4.5	300	4/3	53	300	barrel			32	14	
Tessar (Тессар)			500		33	300			4200	36	18	
Tessar (Тессар)			500		33	300			4200	39	35	Aerial lens
Tessar (Тессар)		5.7	700		24	300				26	10	
Tessar (Тессар)		6.8	1000		17	300						
Titan-2 (Титан-2)		10	3000	5/4	13	684	barrel			26	13	Reseau plate, not included in number of lens elements
Titan-3 (Титан-3)		10	3000	5/4	8	424	barrel			29	22	
Triar-8 (Триар-8)		6/	1000	3/3	17	300	barrel		9300			
Triplet (Триплет)		12/	600	3/3	21	222	barrel		700	62	6	Aerial lens
UF (УФ)		6.3	250	5/3	30	127	barrel					UV lens; triplet with triple ce- mented center lens

lens name	manu- facturer	max./min. aperture	focal length [mm]	lens elements/ groups	coverage [°]	image circle [mm]	mount/ shutter	filter size [mm]	weight [g]	center resolution [lp/mm]	corner resolution [lp/mm]	remarks
Uran-2 (Уран-2)		2	210	7/5	56	222	barrel			23	7	Aerial lenses; some used as projection lens, the long focal lengths used for satellite tracking cameras
Uran-5 (Уран-5)		2.5	105	6/5	62	127	barrel			28	11	
Uran-9 (Уран-9)	KMZ	2.5	250	7/5	54	255	barrel		9500	30	10	
Uran-10 (Уран-10)	KMZ	2.5	100	7/5	61	113	barrel			42	15	
Uran-11 (Уран-11)		2.5	250	7/5	54	255	barrel			29	2	
Uran-12 (Уран-12)		2.5	500	7/5	33	300	barrel		4700	38	17	
Uran-15 (Уран-15)		2.5	500	7/5	38	300	barrel			27	12	
Uran-16 (Уран-16)		3.5	750	7/5	30	424	barrel			36	18	
Uran-19 (Уран-19)		2.5	250	7/5	54	255	barrel			34	9	
Uran-24 (Уран-24)		3	500	7/5	45	424	barrel			30	2	
Uran-25 (Уран-25)		2.5	200	7/5	34	122	barrel			44	22	
Uran-27 (Уран-27)	KMZ	2.5	100	7/5	61	113	barrel			48	7	
Uran-28 (Уран-28)		2.5	300	7/5	46	255	barrel			32	7	Reseau plate, not included in number of lens elements; the T stands for thermal resistance
T-Uran -1 (T-Уран-1)		3.5	750	7/5	30	424	barrel		30000	41	13	
Vega-5u (Бера-5у)	MMZ, Belomo, AOMZ	4/11	105	5/4	54	107	barrel		272	56	24	Enlarging lens for 6x9, different mounts and manufacturers
Vega-22UC (Бера-22УЦ)		5.6/16	103		52	100	barrel			65	20	Enlarger lens with built-in filter module for color printing
Vega-23 (Бера-23)	MMZ, Belomo	3.5/22	150	5/4?	33	89*	barrel					For Rakurs-672/Kiev67 <u>medium</u> format view camera, electric shutters
Vega-24 (Бера-24)		4/22	210		25	93*						
VRO-1-300 (BPO-1-300)		5.6	300	6/4	60*	692 (1:1)	barrel		1300	15	10	Copy lens for 1:1, Plasmat type n
ZMT-14 (ЗМТ-14)		4.5	500		28	250*	barrel		20000			Aerial lens 400-900nm spectral range
Zerkalno-Linzovyy (Зеркально-линзовый)		1.4	200	4/4	30	108	barrel			68	7	Catadioptric lens
Zerkalno-Linzovyy (Зеркально-линзовый)		25	8200	5/5	1°45'	250	barrel			20	12	Catadioptric lens for satellites
Zerkalno-Linzovyy (Зеркально-линзовый)		10	4000	5/4	2°35'	180	barrel			29	22	Catadioptric lens

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