INVESTIGATION OF THE PERFORMANCES OF SIX HIGH QUALITY SPOTTING TELESCOPES: KITE KSP80HD, KOWA PROMINAR TSN883, LEICA APO-TELEVID 82, NIKON EDG-85, SWAROVSKI ATM80HD AND ZEISS DIASCOPE 85.

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INTRODUCTION.

The spotting telescopes made by Leica, Kowa, Nikon, Swarovski and Zeiss are generally considered as being top quality optical instruments. Many test reports do indeed confirm the high quality of these instruments, although there are also considerable differences between the telescopes of these companies. These differences are found both with respect to their optical properties as well as to different aspects of their user comfort. However, the price of these top quality telescopes of 3000 euros and more makes them, not easily accessible to consumers who are not able or not willing to pay these prices.
In view of this consumer group, Kite developed a high quality 80mm spotting telescope that had to be available at a lower price. The first telescope in the new line is the top one, the Kite KSP 80 HD. It is supplied with top quality optical glass with minimal color dispersion (ED glass). The goal that had to be realized with this 80mm HD telescope was a brilliant, razor sharp image with very good colour reproduction, minimal colour dispersion and excellent contrast. The Nikon EDG 85 telescope also recently entered the market and therefore its performances are investigated here as well. The new Zeiss Diascope 85 telescope is already available, but the majority of the customers interested is waiting for the new 20-75x zoom eyepiece which was intended to be introduced simultaneously with the new Diascope, but it is as yet not on the market because of construction problems. Therefore the new zoom eyepiece will probably be available at the end of 2010 or in the beginning of 2011. Nevertheless we have investigated the performances and data we could obtain of the new Zeiss Diascope already, so the reader knows to a certain extent what to expect. Full test data will be presented when the new eyepiece is available.

TEST APPROACH.

With different methods various aspects of optical quality and user comfort are investigated. For a quick and convenient overview the results of the investigations are listed in three tables. In May 2009 we published a telescope test in which we investigated the performances of four top spotting telescopes among which a preproduction model of the SwarovskiATM80HD. We re-investigated the performances of this telescope on a regular production model and we found that the measured data and its performances are identical to the ones found in the preproduction model as one can see in Table 3.

MEASURES AND WEIGHTS.

The Kite KSP80HD telescope with its zoom eyepiece attached has about the same length as the compact telescopes from Kowa, Leica, Swarovski and Zeiss (39-40 cm). The Nikon EDG 85 is with its length of 45 cm a little longer. The weight differences are larger. Weight is an important factor for user comfort certainly when a telescope together with a tripod has to be carried around for a long time. As can be read in the table the telescope weights differ quite a bit. The Swarovski ATM80HD telescope scores with a weight of almost 1600 grams as the lightest telescope, whereas the Nikon EDG85 is the heaviest telescope with a weight of 2500-2800 gram depending on the degree of user comfort, see Table 1. The weight of the other telescopes is between these two values. The Kite KSP80HD has with a weight of 1946 grams almost the same weight as the Leica APO-Televid 82 with 1920 gram.
Telescopes, which do not have a rubber armouring (Kowa, part of the Nikon body and the old Zeiss Diascope) need, certainly at temperatures below zero Celsius, an ever-ready-case, the weight of which has to be added to the weight of the telescope. The exact weight of the Nikon ever-ready case was not known, since Nikon did not have one available for the investigation, but 250 grams seems to be a fair estimate for it in view of the weight of the other ever ready cases. The Nikon telescopes are supplied with objective and eyepiece caps, which can be removed to reduce the weight of the telescope a little bit.
Quick coupling or decoupling of the telescope to or from a tripod requires a tripod platform, which fits into the fast-coupling device of a tripod. The tripod platforms of the Kowa, Nikon and Zeiss telescopes (both the old and the new 2010 Zeiss Diascope) are not suited for that purpose, so in that case they have to be supplied with a fast coupling device, which makes these telescopes a little higher in price (+ 30 euro) and a little bit heavier (+ 40 gram). In Table 1 the weight scores are listed using the weight with the optimal user comfort as a criterion. The lowest weight with optimal user comfort is printed in italics.

TABLE 1.
Telescope weight and user comfort

Telescope	**Weight telescope**	**Weight telescope plus ever-ready-case**	**Weight telescope plus ever-ready-case plus tripod fast coupling device**	**Score**
Kite KSP80HD with 25-50 x eyepiece	***1946 gram***	**2196 gram (***ever-ready case not necessary***)**	**2236 gram (***ever-ready case and fast coupling device not necessary***)**	**3**
Kowa Prominar 883 with 20-60x eyepiece	**1846 gram**	**2081 gram**	***2121 gram***	**5**
Leica Apo-Televid 82 with 25-50x eyepiece	***1920 gram***	**2232 gram** *(ever-ready-case not necessary)*	**2272 gram** *(ever-ready-case not necessary)*	**2**
Nikon EDG 85	**2525 gram**	**2775 gram**	***2815 gram***	**6**
Swarovski ATM 80 HD with 25-50x eyepiece	***1594 gram***	**1824 gram** *(ever-ready-case not necessary)*	**1864 gram** *(ever-ready-case not necessary)*	**1**
Zeiss Diascope 85 T* FL with 20-60x eyepiece	**1730 gram**	**1965 gram**	***2005 gram***	**4**
New Zeiss Diascope 85 T* FL with 20-75x eyepiece (to be introduced end 2010 or in 2011)	**2073 gram** ***(2213 gram including fast coupling device)***	**+/- 2325 gram** *(ever-ready-case not necessary)*	**+/- 2365 gram** *(ever-ready-case not necessary)*	**5**

USER COMFORT

The telescope tube.

The telescope tubes of the Kite KSP80HD, the Leica Apo-Televid 82, the Swarovski ATM80HD and the new Zeiss Diascope 85 (this telescope is already available, but its sales are hampered because the new 20-75 zoom eyepiece is not yet available, it will probably be available at the end of 2010 or in the beginning of 2011)) are covered with a hard rubber armouring (all black except for the Swarovski telescope which has a green rubber armour combined with black armour of the hood and part of the prism housing), which protects the telescopes against bumps and it prevents the telescope from generating noise.The Nikon EDG 85 telescope is only partly armoured with hard rubber while the Kowa and the (old) Zeiss Diascope telescopes have a bare metal housing: Kowa with a light-green colour, the old Zeiss Diascope with a green or with a silver colour. A bare metal housing without armouring can be very annoying: it is a potential source of noise if an object hits the telescope and especially at freezing temperatures a metal housing is not something to be handled without gloves. In those circumstances an ever-ready-case helps with its advantages and disadvantages like an increase in price and an increase in weight. When the ever-ready-case is used only for transport of the telescope in a backpack, than a simple nylon bag (as offered in many outdoor shops) is lighter and cheaper. In full sunshine a silver metal housing does not collect as much heat as a coloured housing with or without armouring.

The focussing device

The focussing device of the Kowa, Leica and of the old and the new Zeiss Diascope telescopes is incorporated in a bulge on top of the prism housing. The focussing wheel consists of two parts: a fast focussing wheel and a slower focussing one for accurate focussing. The focussing wheel of the new Zeiss Diascope, however consists of only one single wheel, which functions for fast focussing and also for slow accurate focussing. Turned in one direction the wheel steers the fast focussing and after a stop and overcoming a small resistance it can be turned in the other direction to operate the slower accurate focussing. It is an ingenious construction, but it is also confusing and time consuming, certainly when one starts to use it. A disadvantage of this new focussing construction is also that it needs 6,5 full revolutions to change focus from infinity to close focus or the other way around. That takes quite a bit of time, which can be a nuisance when one wants to follow fast moving objects.

Three telescope manufacturers have chosen another focussing construction namely a wheel which forms an integral part of the telescope body. This construction is found in the Kite KSP80HD, the Swarovski ATM80HD and the Nikon 85 EDG telescopes. That makes these telescopes in principle slimmer and more tightly shaped than the other telescopes. The two different focussing systems have their own supporters, but in my opinion they both work well. When one uses the telescope as a telephoto lens I myself prefer the Kite-Nikon-Swarovski focussing system, but others will undoubtedly favour with similar arguments the other focussing system. The focussing wheels of the Kite, Kowa and Swarovski telescopes turn very smooth with a pleasant turning resistance (the first new Kite telescope had a slightly higher turning resistance, but on request of a user panel that is lowered a little bit to improve fast focussing even more).The focussing wheel of the NikonEDG85 has a fairly high turning resistance, which decreases user comfort. At temperatures below zero Celsius the focussing wheels of the Leica and Zeiss telescopes are more difficult to handle when carrying gloves. The focussing wheel of the Kowa telescope has some margin. Time will learn how that works out after heavy use. There is a big difference in focussing speed of the different telescopes ranging from 0,6 to 6,5 revolutions from close focus to infinity, see Table 3. Kite, Kowa and Swarovski are the fastest ones with approximately 0,6 to 2 revolutions from close focus to infinity or the other way around. In principle the Nikon EDG telescope should also score well in this respect with 0,75 revolutions from close focus to infinity, but the high turning resistance of the Nikon focussing wheel makes it much less comfortable to use. Focussing speed certainly is an important point to keep in mind especially with fast moving objects. A slow focussing speed is in that case very frustrating.

Tripod platform

A vibration free arrangement is an absolute requirement for a steady and razor sharp telescope image. That asks for a sturdy tripod platform of sufficient size. The Kowa, Leica and Swarovski telescopes have a tripod platform of approximately four by four centimetres. The tripod platform of the old Zeiss telescope is smaller. Kite, Kowa, Nikon, Swarovski and Zeiss have supplied their tripod platforms with the two common threads to fix the telescope to a tripod (1/4 inch English thread and 3/8 inch German), Leica has only the English thread, which is the most common one in photography. All telescopes tested have their tripod platform attached to a ring around the telescope tube in which the tube can turn around its axis. The rings are supplied with a stopper system to choose specific angles of the telescope tube. That allows quick finding of desired positions of the telescope tube.
Above the comfort of a fast coupling device for fast un(coupling) to a tripod was mentioned. Only the tripod platforms of Kite, Leica and Swarovski fit by itself directly into the fast coupling device of a (Manfrotto) tripod.For fast coupling of the Kowa, Nikon and Zeiss telescopes on a tripod a fast coupling device of, for example Manfrotto or Gitzo, has to be attached to the tripod platform of the telescope. That increases the weight (+ 40 grams) and the price (+ 30 euros) of these telescopes.

Lenshood, aiming device, optical filters.

All the investigated telescopes have a retractable lens hood. From the telescopes of Kowa, Nikon, Swarovski and Zeiss the lens hood can be pulled out and they also can turn around the telescope tube, the Kite and Leica telescope hoods can only be pulled out and pushed back. The lens hood of the Kowa telescope moves slightly loose on the telescope tube.
Telescopes have a relatively small field of view certainly at higher magnifications. That makes it difficult to find the object quickly especially when that object is moving fast across the field of view. Therefore all telescopes except the Kite KSP80HD and Nikon EDG 85 telescopes have an aiming device for quick finding of the object. The aiming device of the Kowa, Leica and Zeiss telescopes is positioned on top of the lens hood; the Swarovski telescope uses a small tube as aiming device, which is located under the eyepiece. It can be removed from the telescope. All objective mounts are supplied with a thread mount for inserting optical filters; their sizes are listed in table 3. Such large size optical filters are rather expensive. We received notice from the field that the use of a filter with the Swarovski ATM80HD telescope can hamper the use of the hood.

The eyepieces

Each telescope has its own supply of eyepieces. They are listed in table3 together with their field of view. The 20-60x zoom eyepiece is often the favourite choice for birders. In practice a magnification of 60x is not always useful either because the available light does have too low a level to distinguish details as a result of the very small exit pupil at 60x, or because the optical quality is insufficient or because air turbulence hampers the observations. Moreover the field of view becomes rather small at 60x magnification. Kite, Leica and Swarovski have also introduced a 25-50x eyepiece, which seems to have a more universal applicability also because of the larger field of view. The Kite, Leica and Swarovski engineers deserve compliments for the splendid optical performances of these wide angle zoom eyepieces: it is a real asset for birders.
As far as we know now, Kite and Leica will not take a 20-60x eyepiece in their eyepiece programme.
All the investigated telescopes have a bayonet fitting with a locking device for fast exchange of the eyepieces. The new Kite telescope also uses a bayonet fitting for attachment of the eyepiece. To attach the

eyepiece to the telescope body it has to be inserted with its red dot placed opposite a red dot on the telescope body. The eyepiece then has to be pressed into the mount to turn it in the bayonet mount. The eyepiece is fixed in its position with a pin, which is turned in position with a ring underneath the eyepiece, which by a small turn locks or unlocks the eyepiece. Lock and unlock positions are indicated. In the locked position the eyepiece is rock steady coupled to the telescope body. It is a straightforward construction but it requires attention when one does it for the first time. Kowa, Leica and Swarovski use a springy catch as a locking device, which is released by pushing a small button. That works smoothly and all right with the Kowa and Swarovski telescopes, but the (un)coupling of the Leica eyepieces is frequently cumbersome and difficult. The small rubber armoured button of the Leica telescope gives some trouble to uncouple the eyepiece and removal of the eyepiece requires sometimes an Olympic wrestling medal to be successful. In its current old Diascope model Zeiss uses a springy locking device with snaps into position upon a small turn of the eyepiece and the eyepiece is then fairly well locked. That works also fine, it is even quicker than the button locks. The disadvantage of this construction is, however, that upon frequent use the coupling wears out and becomes rather loose with the danger of unwanted unlocking of the eyepiece and unwanted loss of the eyepiece. Zeiss has recognised the problem and therefore the new (2010) Zeiss Diascope is supplied with a push-pin construction to lock and unlock the eyepiece. That is a very simple but effective construction .The locking/ unlocking construction of the eyepieces of Nikon EDG telescope is very user unfriendly. It takes a lot of effort to attach or detach the eyepiece from the telescope body.
All eyepieces have twist-up or pull-out (old Zeiss Diascope) eyecups to accommodate spectacle users. The eyecups of the Kowa and Swarovski telescopes have a thread mount while Leica uses a bayonet, which is kept in place with ball bearings. It takes quite a bit of force to remove the Leica eyecups and it is not easy to put them back into their original position. A thread mount is more comfortable. The material of which the eyecups are made is also of importance. The Leica eyecups, for example, are made of plastic, which is more easily damaged as the metal ones of the Kite, Kowa and Swarovski telescopes. The eyecups of the Nikon EDG and the old Zeiss Diascope telescopes can not be removed by the user of the telescope and when they are damaged the telescope has to be brought to a repairperson. The metal eyecups of the new Zeiss Diascope have a thread mount and can be removed by the user.
The metal and sturdy eyecups of the new Kite telescope can be removed or attached by the user, but it takes a small screw driver to release three small screws and fasten them again when the eyecup needs replacement. When the user can not do that himself or herself, Kite will do that free of charge.
As mentioned, the eyecups of the Nikon EDG 85 telescope can not be removed or fixed to the eyepiece by the user himself for cleaning or replacement. Upon damage to the eyecups, the eyepiece then has to be send to the Nikon dealer or to a repair shop and that is not a source of joy for Nikon users in The Netherlands, since the service quality of Nikon binoculars and Nikon telescopes scores dramatically much lower in The Netherlands then that of the other telescope brands.
The zoom ring of the eyepieces of all telescopes investigated turn smooth and with a pleasant turning resistance with the exception of the zoom ring of the Nikon EDG zoom eyepiece. The Nikon zoom ring is very narrow and it has a high turning resistance which makes the use of it not a pleasure in life. The Nikon eyepiece also does not have any indication of the magnification, it only says "low" for 20x and "high" for 60x and magnification values in between are not indicated. That contributes also to a low score in user comfort for the Nikon telescope.
The eye relief is sufficient for all telescopes to give spectacle users full access to the whole field of view. Surprisingly the Swarovski eyepieces with an eye relief of 17 mm even give access to the whole field of view when using ski goggles, whereas the other telescopes with larger eye relief do not (ski goggles have a larger distance to the eye than normal spectacles).

OPTICAL QUALITY.

Optical quality of a telescope is the key element for top level telescopes. Important parameters of the optical quality are image brightness, sharpness of the full image, perfect colour reproduction and good correction of optical aberrations like colour dispersion, spherical aberration, curvature of field, astigmatism, coma etc.

(a) luminosity- image brightness.

*The **luminosity** of a telescope or binocular is **fully determined by** the **size of the exit pupil and** the **light transmission** of the optical system. High luminosity is a very important basis for optimal image brightness. To make things more complicated: colour reproduction of the optical system also plays a role for the establishment of image brightness observed with the human eye.*
*The **exit pupil P** is defined as the objective diameter **(O)** divided by the magnification **M** in a mathematical expression written as **P=O/M.** It means that a larger objective diameter yields a larger exit pupil at the same magnification. This yields in principle a higher luminosity unless the light transmission of the optical system is low. Often objective diameter, magnification and exit pupil do not have the exact values as printed on the telescopes or binoculars. Therefore the values of these properties were measured and the results are listed in Table 3 below.*
The exit pupil is related to the size of the pupil of the human eye, which is small in full daylight (2 mm) and grows larger at low light levels (8-10 mm at a young age and 4-5 mm when you are over 45 years of age). A telescope with its exit pupil of 4,4 to 1,5 mm is therefore not very well suited as a night observation

instrument. With these restrictions in mind it is understandable that for an optimal performance at low light levels a high light transmission is of importance.

***The light transmission** is the percentage of the incoming light, which is transmitted by the optical system of a telescope or binocular. Part of the light that enters the telescope is namely lost for image formation by (a) absorption of light by lenses and prisms of the telescope (this is a small amount with modern optical glass) and (b) through reflection of light on glass-air surfaces. High quality coatings reduce reflection losses to a large extent. Nevertheless even with top telescopes still 15-20% of the incoming light is lost.*

***Light transmission** is measured with special equipment. The obtained transmission spectra yield the following information:*

- High light transmission over a broad spectral area (blue- green-red) is an important basis for a bright image.

-The shape of the transmission spectrum gives information about the colour reproduction of the optical system: a low transmission in the blue part of the spectrum (450-500nm) and a much higher transmission in the green-yellow region (550-600 nm) results in a yellow bias of the colour reproduction. A flat transmission spectrum over a broad spectral area of 500-560 nm yields a good colour reproduction. The spectral area of 500-560 nm has to do with the light detecting pigment system in the human eye. That consists at daylight of colour sensitive cones with optimum sensitivity around 555 nm. At low light levels the cone system does not work anymore and light detection is taken over by the very sensitive rods in the eye, which have their optimal sensitivity around 500-505 nm.

As written above the luminosity of a telescope is determined by the combination of the size of the exit pupil and the amount of light transmitted by the optical system. The Kowa, Nikon and Zeiss telescopes are expected to have in principle with their objective diameters of respectively 88 and 85 mm a higher luminosity at magnifications for which the exit pupils amount 44,-3,2 mm (approximately 20-27x) as compared with the Kite, Leica and Swarovski telescopes (which have maximum exit pupils of approximately 3,1-3,2 mm). In reality the situation is more complicated because of the differences in light transmission between the telescopes. The transmission measurements show that the light transmissions of the Kowa and the old Zeiss Diascope telescopes at 500 nm, the spectral area of optimum sensitivity of the human eye at low light levels, are considerably lower than the light transmission of for example the Nikon EDG 85 and Swarovski ATM80HD telescopes. The result is that the performance at low light levels of the 88mm Kowa and 85 mm Zeiss telescopes is less then one would expect in comparison with the 80-82 mm telescopes from the Kite, Leica and Swarovski telescopes at magnifications where all telescopes have identical exit pupils (3,1 mm and smaller).

With regard to the light transmission of the different telescopes: we measured the highest scores for the SwarovskiATM80HD, the Nikon EDG85 and the Kite KSP80HD telescopes followed by the Leica APO-Televid 82, the Kowa Prominar TSN 883 and the Zeiss Diascope 85. For number freaks we have to mention that transmission differences of 2% or less are very difficult to observe with the human eye.

(b) colour reproduction

Colour reproduction of the Swarovski ATM80HD telescope is perfect and it is also very good for the Kite and Nikon telescopes with a tiny red preference for the Nikon EDG telescope. For an explanation see the degree of flatness of the transmission curves in the wavelength range 500-600 nm. The Leica Apo-Televid 82 scores also good followed by the Kowa Prominar TSN 883 and the old Zeiss Diascope 85. The colour reproduction of the two latter ones moves slightly to the yellow part of the spectrum, but it is much stronger for the Zeiss telescope than it is for the Kowa telescope. In photography such a yellow bias is indicated as "warm" but birders need a perfect colour reproduction. The differences in colour reproduction are clearly visible by a trained observer. The Nikon EDG telescope has a small pink preference, but that is not disturbing and many users will not notice it. But as I wrote before: birders ask for perfect colour reproduction.

(c) colour aberrations c.q. colour dispersion

The investigated telescopes all have colour correction lenses. That means that they contain optical elements with minimal colour dispersion. For that purpose Kowa has incorporated in the optical system of its objective a lens element consisting of calcium fluoride, a mineral with very low colour dispersion. Calcium fluoride has also some disadvantages: it withers quickly when exposed to humid air. That problem can be solved efficiently with a good coating. Furthermore calcium fluoride is sensitive to sudden temperature jumps with the risk of cracking. Kowa has solved the calcium fluoride vulnerability problem by incorporating the calcium fluoride element between other less vulnerable glass elements in the five lens objective. Zeiss also uses a fluoride containing element in its objective with the same vulnerability problem and Zeiss has solved that problem in an identical way as Kowa. Kite, Leica, Nikon and Swarovski have also used lenses with low colour dispersion cf. the indications APO (Leica) and HD (= High Definition) (Kite and Swarovski). In all telescopes except in the Swarovski ATM80HD a very thin yellow line around the edge of the image can be observed. That could be a remnant of colour dispersion, but it is in no way a problem for the observer.

(d) field curvature/edge sharpness

The sharpness at the edges of the image of the Swarovski ATM80HD and the Nikon EDG85 is excellent. Kite, Kowa and Leica are also performing very well in this respect. The Zeiss Diascope 85 with 20-60x zoom eyepiece clearly has an area of blur at the edge of the image which is not pleasant, considering the relative small fields of view of telescopes.

DIGISCOPING

All the investigated telescopes provide for a camera adapter to couple a mirror reflex camera to the telescope. The camera adapter-telescope combination functions as a telephoto lens with a long focal length (800-2000mm) and a small working diaphragm (F = 11-16). Nikon even has a 3,5x zoom camera adapter available, which requires a very stable tripod for sharp pictures and also very high sensor sensitivities because of the very small working diaphragm.

All telescope producers also have accessories for digiscoping which means that they all have accessories which make it possible to use the telescope as a telephoto lens using a compact camera. The available accessories are listed in Table 3.

PERFORMANCE AT LOW TEMPERATURES

At temperatures of minus 10 to minus 20 degrees Celsius, the focussing system, zoom mechanism and twist-up eye cups of the Kite, Leica, Swarovski and Zeiss telescopes perform excellent. With the Kowa Prominar the friction of all these systems is slightly increased at these low temperatures, but is not a problem for their performance, they still can be turned well. We did not put the Nikon EDG telescope in the freezer, since already at room temperature all systems mentioned work with a lot of friction and that usually does not improve at lower temperatures. With gloves the broad focussing rings of the Kite, Nikon and Swarovski telescope are easy to use, be it that the turning resistance of the Nikon telescope, which is already high at room temperature, may increase further. Both focussing rings of the Kowa telescope can also be used well with gloves, but the user comfort of the focussing rings of the Leica and Zeiss telescopes is less since the rings are more difficult to use with gloves.

WARRANTY AND SERVICE

Kite has acquired a very good after sales service reputation (Reference: the optics shop of the Dutch Bird Protection Association). The service of Kowa goes through its dealer Benel in Hoogeveen, The Netherlands. The company has a repair person available in The Netherlands who performs the majority of the repairs. If the repair person can not solve the problem, the telescope is sent to Kowa. The appointment is that the customer receives on request a written statement about the expected duration of the repair and about the costs of the repair.

In The Netherlands Leica had acquired a not so good reputation with regard to repairs: expensive and long waiting times. Leica dealer Transcontinenta has handled that problem drastically and starting from January 1, 2009 repairs were handled under courtesy that means: with no or with very low costs (unless the damage is caused by carelessness of the client) and repairs are performed as fast as possible. There are however indications that the service quality of the repair company in charge is not always reliable and also that the service level depends to a great extent on the dedication of the service person who is in charge of Leica sales and services.

In The Netherlands the situation for Nikon telescopes and Nikon binoculars is more complicated. Several large telescope/binocular dealers refuse to sell Nikon binoculars and binocular telescopes for the following reasons:

-a- the largest amount of sales of Nikon products is in the field of photography and Nikon delivers a lot of camera's and photographic equipment to camera shops. The profit margins of the shopkeepers are coupled to the amount of camera sales. As a consequence camera dealers stunt with the prices of Nikon binoculars to such an extent, that they sell them at prices, which are even lower than the cost prices specialised binocular/telescope shops have to pay to Nikon for the instruments. Because of that situation many of these specialised binocular/telescope shops refuse to sell Nikon binoculars and Nikon telescopes, since they consider this situation as an unacceptable competition. The consumer does not suffer from it a bit, since there are plenty of other top quality binoculars and telescopes on the market to replace Nikon.

-b- The service offered by Nikon in The Netherlands stays far behind the service quality offered by other well known binocular-telescope producers.

-c- the price of Nikon telescopes is dependent on the dealer.

According to information obtained from a large number of retailers, Swarovski scores higher than the other manufacturers in terms of service. It provides a fast service at little or no cost, depending on the nature of the fault.

Zeiss has a good service through its dealer Technolyt in Wormerveer, The Netherlands, who does most of the repairs by its own repair person. When repair problems are too complicated the telescope is sent to Zeiss, which has an excellent repair department in Germany. Technolyt has so much confidence in the quality of the Zeiss telescopes that it has increased the warranty term of the Zeiss telescopes and binoculars with 20 years on top of the ten years warranty by Zeiss.

CONCLUSIONS

The final score is clear: the Swarovski ATM80HD telescope scores as the best telescope in this test: it has the lowest weight of the telescopes tested, excellent optical performance, a very high level of user comfort and an excellent service, but it is also an expensive telescope.
The new Kite 80 HD telescope scores second. The optical quality and the level of user comfort is high. It is a very good telescope for its price and it can compete with all the other top telescope brands which are investigated here. The demands for the construction of this telescope put upon the Japanese manufacturing by Kite are all very well fulfilled: the Kite KSP80HD telescope is a real asset for the birding market.
The Leica Apo-Televid 82 scores third and has almost the same price as the Swarovski ATM80HD telescope. Although it is a good telescope it has a number of weak points like: the user unfriendly coupling mechanism of the eyecups, the vulnerability of the plastic eyecups, the difficult to handle uncoupling of the eyepieces and the slow focussing speed. It seems that the initial problems of jamming of the focussing wheel after using the telescope for a short time are mastered now by Leica. There may be some concern about the service level of Leica in The Netherlands, since that seems to depend on the dedication of the repair company and of the salesperson who is in charge.
The Kowa Prominar TSN 883 telescope is also a good telescope but with the Kite KSP80HD on the market it will have a hard time to convince consumers, since it is rather heavy, does not have a hard rubber armour and an incorporated fast coupling tripod platform. Moreover the optical performance of the Kowa telescope is slightly less than that of the Kite KSP80HD.
The Nikon EDG 85 has a very good optical performance, but it is for many users far too heavy, too big and too expensive. That combined with the very low level of user comfort (high turning resistance of the focussing wheel, very narrow zoom ring and very high turning resistance of the zoom ring, difficult to handle eyepiece coupling construction, eyecups not removable by the user himself, no fast coupling device for attachment to a tripod) will scare quite a few customers. Add that to the service and price problems of the Nikon telescopes and it is clear that Nikon still has to do a lot of home work before the Nikon EDG 85 will be popular among birders and other critical consumer groups. Nikon offers users a nice programme of different eyepieces.
The final performance scores of the Kowa Prominar 883 and the Nikon EDG 85 telescope are not far apart, see Tables 2 and 3 while the old Zeiss Diascope 85 telescope closes the row. The differences in the final scores of the Kowa and Nikon telescopes are on specific points, which may be of importance for birders (weight, optical performance, tripod coupling, field of view, image brightness/transmission, colour reproduction, level of user comfort, price).
The old Zeiss Diascope 85 telescope has in this test the lowest score. Undoubtedly Zeiss also has realised that the Diascope needed a quality update and that has come with the new Zeiss Diascope. The differences between the old and the new Zeiss Diascope 85 are:
-1- The optical construction of the new Diascope is identical to the old Diascope, but the new Diascope has a new type of coating, which according to Zeiss should give it a better colour reproduction and a higher light transmission. Moreover the amount of stray light is diminished considerably in the new Diascope compared with the old Diascope (information from Zeiss Germany)
-2- the new Diascope has a hard rubber armouring
-3- the new Diascope now has a locking device to keep the eyepiece in its mount.
-4- the new Diascope 85 is supplied with a new 20-75x zoom eyepiece. The optical quality of the new eyepiece is much better than the optical quality of the old 20-60x eyepiece. I conclude this from the performance of the prototypes I have seen. This new eyepiece is rather heavy and it has a similar rubber protection cap as supplied with the Swarovski ATM telescopes
-5- the eyecups of the new 20-75 zoom eyepiece have a thread mount so they can be removed by the owner for cleaning or replacement.
-6- the focussing construction of the new Diascope consists of one single focussing wheel, which serves fast focussing when turning it in one direction and it serves slow accurate focussing when turning it in the opposite direction. The number of resolutions from close focus to infinity amounts to 6,5 revolutions and that is rather time-consuming. Moreover the change in turning direction form fast focus to slow focus can be confusing when one starts to use it and it takes time. Although it is a by itself an ingenious construction, it will in my opinion make a number of consumers think because of its user complexity.
-7- The new Zeiss Diascope 85 with its new 25-75x eyepiece has a weight of approximately 2100 gram and that is on the heavy side for some users.
-8- The new Zeiss Diascope 85 has a price of 3178 euro, which puts it also in the higher price range. The new Zeiss Diascope undoubtedly is a good telescope, but if we take into account the different properties we know now already, without being able to test it in detail, I think that Zeiss will have to fight hard to beat a number of the top telescopes tested here, like the Kite, Leica and Swarovski telescopes.

Before the reader buys a telescope in this price segment it is advisable to investigate the properties of the different telescopes carefully and compare their performances in accordance with your own

demands. Perhaps you can use the score list above and write your own observations in it to construct your own score list before you cut the expensive Gordian knot.

CONCLUSIONS

Score list of performances. A score of 1 means that the telescope scores highest on a particular point etc. As a consequence of the application of that method the telescope with the smallest number of points has the best overall performance.

Table 2.
Score of performances

Telescope	**Kite KSP80 HD**	**Kowa Prominar 883**	**Leica Apo-Televid 82**	**Nikon EDG 85**	**Swarovski ATM80HD**	**Zeiss Diascope 85 FL (old) And (new)**
Weight	3	4	2	6	1	4 (old) 5 (new)
Focussing speed	1	2	5	3	2	6 (old) 6 (new)
Colour reproduction	3	5	4	2	1	6 1 (new)?
Rubber armouring of the telescope body	1	6	1	2	1	6 (old) 1 (new)
Light transmission: 550nm (daylight viewing) 500nm (night viewing)	 3 3	 5 5	 4 4	 1 2	 2 1	 5 (old) 5 (old)
Sharpness at the edges	1	2	2	1	1	3 (old)
Remnants of colour dispersion	1	1	1	1	1	1
Eyecup quality and comfort of use	1	1	3	6	1	6 (old) 1 (new eyepiece)
Fast coupling on tripod	1	6	1	6	1	6 (old and new)
Price	1	2	4	6	5	3 (old and new)
Total score price excluded	**18**	**37**	**27**	**30**	**12**	**48 (old)**
Total score price included	**19**	**39**	**31**	**36**	**17**	**51 (old)**
Final score	**2**	**5**	**3**	**4**	**1**	**6**

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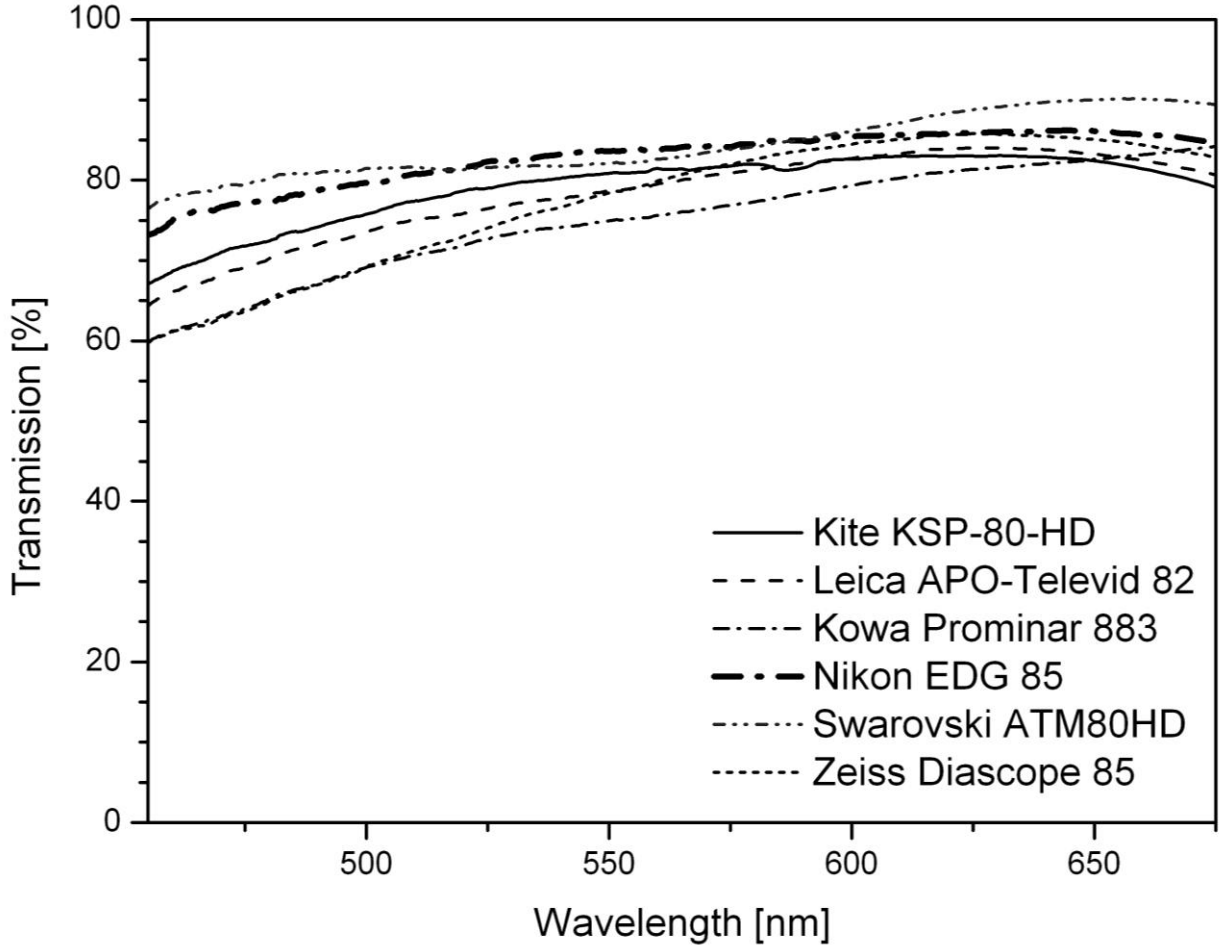
Table 3
Telescope data

Telescope	**Kite KSP 80 HD**	**Kowa Prominar TSN 883**	**Leica Apo-Televid 82**	**Nikon EDG 85**	**Swarovski ATM 80 HD**	**Zeiss Diascope 85 T* FL (old)**
Weight (grams)	1946 g +25-50x eyepiece)	1846 g (+ 20-60x eyepiece)	1920 g (+ 25-50x eyepiece)	2525 g (+ 20-60x eyepiece)	1594 g (+25-50x eyepiece)	1730 g (+ 20-60x eyepiece) **New Diascope**: 2073 g (+20-75x eyepiece)
Close focus	3,8 m	5,2 m	3,7 m	4 m	4,8 m	4,5 m
Watertight	Yes	Yes	Yes	Yes	Yes	Yes
Nitrogen filled	Yes	Yes	Yes	Yes	Yes	Yes
Type of prism	Schmidt roof	Schmidt roof	Schmidt roof	Schmidt roof	Schmidt roof	Schmidt roof
Phase correction coating	Yes	Yes	Yes	Yes	Yes	Yes
Available eyepieces and their field of view (m/1000m)	**25-50x** (39-28 m/1000m)	**25x:** (37 m/1000m) **30x:** (42 m/1000m) **20-60x:** (38-19m/1000m)	**32 x:** (40m/1000m) **25-50x:** (41-28 m/ 1000m)	**20x** (58m/1000m) **30x** (42m/1000m) **38x** (33m/1000m) **50x** (24m/1000m) **25x** (42m/1000m) **20-60x** (38-19m/ 1000m)	**20x:** (60m/1000m) **30x:** (42m/1000m) **25-50x:** (42-27m/ 1000m **20-60x:** (36-20m/ 1000m	**40x:** (30 m/1000m) **20-60x:** (43-20m/1000m) **Digitaal camera eyepiece DC4 40x** (30m/1000m) **NEW Diascope:** **20-75x** (40-16m/100m)
Number of focussing rotations from close focus to infinity	0,6	2	5	0,75	2,25	6 (old) 6,5 (new)
Measured exit pupil **P** (mm)	25x: 3,1 mm 50x: 1,6 mm	20x: 4,3 mm 60x: 1,5 mm	25x: 3,1 mm 50x: 1,6 mm	20x: 4,0 mm 60x: 1,3 mm	25x: 3,2 mm 50x: 1,6 mm	20x: 4,4 mm 60x: 1,45 mm
Measured objective diameter **O** (mm)	80, 0 mm	87,6 mm	81,2 mm	85,0 mm	80,0 mm	85,0 mm
Calculated magnification **M= O/P**	25,8x 50x	20,4x 58,4x	26,2x 50,7x	21,2x 65,4x	25x 50x	19,3x 58,6x
Light transmission 500 nm (night vision) 555 nm (day light vision)	 77% 81%	 69% 75%	 74% 79%	 80% 83%	 82% 82%	 69% 79%
Eyecups	Twist-up, removable	Twist-up, removable	Twist-up, difficult to remove	Extractable, not removable	Twist-up, removable	Pull-out, not removable
Eye relief (mm)	25x: 18 mm 50x: 17 mm	20x: 17 mm 60x: 16,5 mm	25x: 19 mm 50x: 19 mm	20x: 18,4 mm 60x: 18,4 mm	25x: 17 mm 50x: 17 mm	20x: 16 mm 60x: 16 mm
Suited for: Spectacle users: Skigoggle users:	 Yes No	 Yes No	 Yes No	 Yes No	 Yes Yes	 Yes No
Colour reproduction	Good, almost neutral	Very small yellow bias	Almost neutral	Very small red preference	Perfect	Visible yellow bias
Filter thread Mount	M82x0,75	95 mm	E82		M 82x0,75	M 86x1
Tripod platform (mm)	42x42 mm	44x49 mm	42x42 mm	40x100 mm	42x45 mm	28-32x45 mm
Rubber armouring	Yes	No	Yes	Partly	Yes	No
Ever-ready-case	Yes, 90 euro, 250 gram	Yes, 85 euro, 235 gram	Yes, 180 euro, 312 gram	Yes, 99 euro	Yes, 205 euro, 230 gram	Yes, 179 euro, 235 gram
Other available accessories	- Mirror reflex camera adapter 900 mm - Digital camera adapter - Kite carbon tripod	- Photo and video adapters - Digital camera adapters - Fluid pan head tripod	- Mirror reflex camera adapter - Digital adapter	- FSA-L2 SLR –3,5x zoom camera adapter - Digital Camera Bracket FSB for use with digital compact camera's	- 3 tripods, - Tripodhead FH 101, - TLS 800 mirror reflex camera adapter, - digital camera adapter	- Digital camera eyepiece DC4 - Mirror reflex camera adapter - Quick camera adapter (photo and video) - Tripod - Astro adapters
Warranty	30 years	5 years	10 years	10 years	10 years	10 years Zeiss plus 20 years Technolyt
Price Body Price eyepiece **Price complete set**	 **2750 euro**	2539 with zoom eyepiece 20-60x **2539 euro** **N.B. in 2011 the price will be +/-15% higher = 2920 euro**	2499 euro 700 (25-50x) euro **3199 euro**	 **3627 euro**	2570 euro 710 (25-50x) euro **3280 euro**	2289 euro 569 (20-60x) euro **2858 euro (old)** **3178 euro for the new Diascope with 20-75x eyepiece**
Final test score	**2**	**5**	**3**	**4**	**1**	**6**


Transmission [%]
100
80
60
40
20
0
500
550
600
650
Wavelength [nm]
Kite KSP-80-HD
Leica APO-Televid 82
Kowa Prominar 883
Nikon EDG 85
Swarovski ATM80HD
Zeiss Diascope 85