

The TS-160 ROBUSTO™ Lite and MikroMak™ Lenses

Experiences of using lenses from *The Infinity Photo-Optical Company*.

By Paul Harcourt Davies *

Introduction

“Sharpness” has long been something of a Holy Grail with all my imaging work: my passion for the smaller things of the natural world has long inspired me to try and capture the hidden beauty as best I can and tack sharp detail is important.

Some prefer to work with the abstract to stimulate emotions whereas I try to evoke responses in different ways, perhaps setting a subject in biting sharp detail in the context of its surroundings (the so-called macro wide-angle) or going beyond life-size to reveal hidden detail. These are different but complementary views.



Sharpness

Something we have to realise from the outset is that *Sharpness is about perception... and thus subjectivity is important.*

We can directly measure resolution in terms of separation of closely spaced pairs of lines but perceived sharpness also depends on Acutance - the transitions in contrast at the edges of details. Nowadays, this is measured via MTF (Modulation Transfer Function) which takes account of Acutance in a practical way. The lighting we employ (diffuse and/or directional) texture and contrast, can all affect the way we perceive something as sharp.

* Award Winning Macro Photographer and Author of 16 Books.

The *MikroMak* lenses ...There is a series of these and I have been using two of them: The 90 mm and a 40 mm (with a 25mm auxiliary lens). These lenses have no iris diaphragm and are set at the Nelson point (more later) to provide optimal performance.



The TS 160 *Robusto*™ *Lite* which is a highly-versatile lens that can be used from Infinity to 16x life-size on a full frame sensor with a clarity and sharpness that are hard to credit.



‘MICRO’ RATHER THAN ‘MACRO’ LENSES

In appearance, these lenses look like typical probe lenses but their design and structure, are quite different for they are ‘micro’ rather than ‘macro’ lenses, a statement that demands some explanation.

Macro lenses - most so-called ‘macro’ lenses from the ranges of the major lens manufacturers vary magnification by employing extension where a lens is moved away from the sensor to spread out the rays. The extension is adjustable via a helical focusing movement with various lens groups employed to correct for aberrations that become exaggerated at close distances. Greater separation (and hence magnification) can be further provided with extension tubes or bellows.



A psychological element plays a part in close-up photography when we work with limited depth of field and we need to choose which parts of the subject to be rendered in sharp detail. We humans are drawn, for instance, to eyes; in fact, anything that evokes an 'eye' such as eyespots on an insect wing, will draw our vision to make contact. If those details are biting sharp we can still tolerate unsharp areas within the same image (almost without noticing), unless we make an effort. Being a macro photographer is not just a case of pointing a camera...composition matters greatly.

TOOLS FOR THE JOB

From the outset (four decades at least) I have always sought to use the best lenses I could afford...that pursuit of the Holy Grail again. Slowly, I was able to acquire specialist lenses such as ... Leitz Photars and Zeiss Luminars and even that magnificent zoom macro unit - the Zeiss Tessovar - which was manufactured for about a year in the 1970's but cost too much to produce.

Through close friend Clay Bolt, my long time collaborator across the pond, I was put in touch with H. Jay Margolis, optical innovator and CEO of *The Infinity Photo-Optical Company*. This is where they produce innovative lenses that are the stuff of legend amongst cinematographers and satisfy the most demanding of scientific workers and cinematographers.

The Infinity Photo-Optical Company produces lenses and accessories that are 'state of the art' - a level beyond those historic lenses mentioned, offering biting sharpness with a startling depth of field. In this account, I deal with two sets of lenses that I have been fortunate to use.

Most “standard” macro lenses allow us to go to life-size (1:1) whether they are 50 mm, 100 mm or longer or, in the realm of the super macro lenses going from around life-size to 4-5x when used on a full frame sensor. Of course, smaller sensors – including Micro 4/3 take a smaller portion of the image circle produced giving rise to the so-called ‘crop factor’.



Micro - The lenses from *Infinity Photo-Optical Company* employ a state-of-the-art microscope lens at the subject end of the tube, not a run-of-the-mill machine lens.

- These are no compromise lenses employing the very best engineering in their physical construction and optical design. In basic terms, each lens consists of a front objective producing an internal ‘aerial’ image — a projected image ‘in space’ — somewhere inside the lens tube.
- Behind that there is a highly corrected lens grouping that serves to magnify the projected image within the lens system and bring the rays to a sharp focus on the camera sensor. This system allows a lens to stay in focus from infinity to close up with only small adjustments necessary in use. The depth of field created by the objective lens is retained.
- Uniquely, the *Robusto* lenses employ a diaphragm which is not used to control aperture and change depth of field but to set the Nelson point...which provides the best possible balance between magnification, contrast and the image degeneration that sets in because of the optical phenomena of diffraction, a real bugbear in macro work.

- The *MikroMak* lenses have no variable iris diaphragm and are factory set to this point - any deviation causes only very slight deterioration in performance of the lens. In contrast, the TS-160 has an iris diaphragm but, being essentially a microscope lens, this controls contrast, resolution and residual aberrations rather than exposure. In this sense the variable iris is analogous to the iris in the condenser of a laboratory microscope with no f/stops to be found since they are not relevant to using the TS-160.
- The *MikroMak* and *Robusto* lenses look like probe lenses or endo/boro-scopes but are very different in construction in that they utilise a conventional camera lens separated from the sensor by a series of relay lenses within the 'tube' down which the light rays pass. It is set at a small aperture to give reasonable depth of field before diffraction affects the image too much. In general, the more glass you add to any lens the harder it is to get top optical quality where sharpness is concerned. The trade-off claimed is that such a lens allows you to take photos you might otherwise not get: video work is more forgiving in this respect than stills photography. This is not a factor with the image projection systems employed in The *MikroMak* and *Robusto* series lenses.



An Over-View

The opportunity to use these lenses for the past 2 years has been an eye-opener in more ways than one. I was sent the first two lenses, The *MikroMak* objectives, shortly after I returned home to Italy, from the UK in 2019, escaping lockdown by a whisker. Confined to a narrow radius of travel near home, meant those two lenses allowed me to look anew at the small worlds around me...a world I thought I knew.

Some of those images I have used to illustrate this article along with my experiences and observations of using both the *MikroMak* lenses and the TS-160 Robusto Lite.

A. *MikroMak* lenses a 40mm (with 25mm supplementary) and a 90mm

There is a range of focal lengths available from 40mm (25mm with an additional screw-on lens) to 120mm...I have the 40mm and 90mm at home. *The Infinity Photo-Optical Company* provide comprehensive technical information via the link

<https://www.infinity-usa.com/wp-content/uploads/MikroMak-OEM-Handbook-090321-1.pdf>

Recently, one of the *Infinity Photo-Optical Company* objective lenses was used on the space station to film the Bose-Einstein condensate, long known in theory but which, as those who have studied thermodynamics or statistical mechanics will know (how could we forget) was something special since it can only be observed close to absolute zero -273°C .



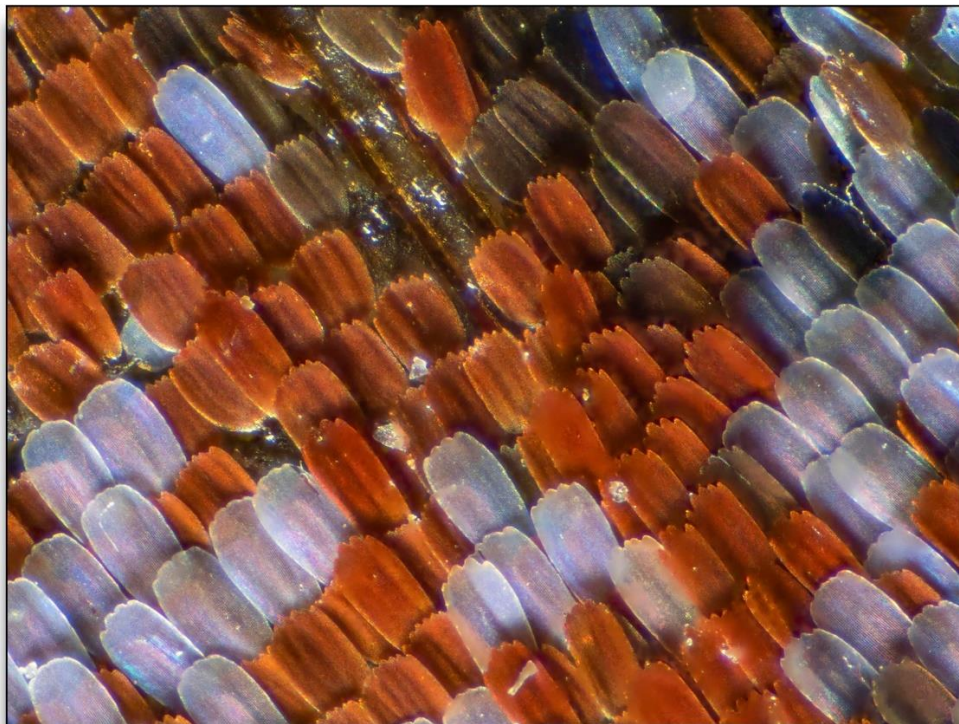
Construction

The lenses exude high-quality in their metal construction: focusing is precise and they are clearly built to last yet come in compact structures. These are 'probe-like' lenses which are, of essence, longish and reasonably thin allowing them to be used in places that bulky optics with large front elements cannot be employed.



B. TS-160 Robusto LITE with Micro HM, Macro Objective 0 - 4x and SFX-2 Lens

The TS-160 Robusto Lite lens is essentially a universal system for photography from Infinity to 16 times life-size and beyond and is being discovered and exploited by many top video photographers whether working within the wildlife and nature sphere or in commercial and creative work where the versatility is exploited to create a whole new approach to macro work. The standard setup comes with the main lens body and its lens, plus an interchangeable macro objective for 0 to 4 times life-size (conveniently, the image is not inverted with this).



Then there is the SFX-2 lens which works best from Infinity to about 30cm distant as a long-range macro objective that can give you focus from close distances to infinity within the same frame.



<https://www.infinity-usa.com/wp-content/uploads/InfiniProbe-TS-160-OEM-Handbook-030122.pdf>

The SFX-2 (and other SFX lenses) can open up so much for the creative photographer because of the ability to keep things from infinity to close up in sharp focus when it is first focused on infinity. Many regard it as an extremely versatile special effects lens.

There are distinct ways of focusing the lenses - designated **Active Focusing** and **Passive Focusing** in the instructions

Active Focusing: With the Micro HM and the 0-4 macro lens: you focus the lens on the object you wish to photograph where, in effect, the focus converges on the object. This means you can focus on your subject at a distance and move in to see it become a single frame at considerable magnification. Instead of being limited to a single working distance, you can choose whatever standoff you wish. In this way you never lose sight of your object as you focus closer and closer. As you focus, detail (resolution) increases and depth of field gets shallower. If you need more depth of field, then you move back to get what you need. The depth of field and magnification are then balanced for optimal results.

Passive Focusing - This method is used with SFX - 1, 2 and 3: it necessitates first setting the focus on infinity via a slight adjustment to the focus ring. Each of these lenses is optimally corrected to be focused on infinity and not refocused: everything is then in focus from infinity to the closest distance given in the ranges below:

- SFX -1 (100mm*) to c.50cm (20 inches)
- SFX -2 (50mm*) to c.15cm (6 inches)
- SFX -3 (33mm*) to c.5cm (2 inches)

* General equivalent focal length

NB. Distances are measured from the lens front.

I also find I can get surprisingly sharp images when using the SFX2 in its active mode and focusing on a subject closer than 15cm.



The Lenses in Use.... Observations & Hints

Inverted Image - soon mastered

Some might be put off by the fact that the image is inverted (except for the macro 4x auxiliary lens when used with the TS-160 Robusto Lite. Initially it can be confusing but quickly becomes second nature.

This inversion is exactly as it would be in a monocular microscope where moving a slide to the left sends the image to the right in your field of view: move the slide forward and the image appears to move backwards.

A positive advantage is that the image is as sharp as you can possibly get it because no extra elements are inserted in the optical train. In practice you soon get used to it and the results are so good it makes you want to master the lens. The lenses from Infinity Photo-Optical come with a T2 mount and a vast range of adapters for different camera systems is available. The image circle will easily cover full frame (35mm)

Focusing is manual, there is no autofocus or any other electronic coupling with the camera. In use it is not a problem since modern mirrorless cameras let you use manual mode and see exactly what you are taking on the EVF.



Aperture

The MikroMak lenses have fixed aperture which is set to the Nelson Point. They can be utilised for Z- axis image stacking where you need fewer steps to generate a stack because of the greater depth of field and overlap of zone of focus from one step to the next.

However, the innate depth of field has meant I have often not stacked images - there is a more natural rendition of the image without the sometimes 'clinical' back-to-front sharpness that z-axis stacking produces. In practice, when we focus on a foreground object, we are not aware of the background before making a conscious effort where our eyes refocus and the background comes into sharp relief ...an entirely personal take, of course.

Focusing in practice ...covered above with reference to *Active* focusing with the MikroMak and Micro HM lens for the Robusto TS-160 Lite and *Passive* focusing with the SFX -1,2 and 3

The Nelson Point...the key to sharpness

The Nelson point is the theoretical point where contrast and resolution are optimised relative to aperture and working distance.

This is central to getting optimal performance with microscope-configured optics. *MikroMak* lenses are factory set to the Nelson Point whereas the TS-160 Robusto Lite can be set by means of the Variable Iris for optimal image quality.

Fortunately, the Nelson Point can be seen directly when a sudden slight "jump" in contrast happens as the iris is closed down. It quickly becomes obvious with a bit of practice.



The best results are generally obtained when the Iris is set to the white dot engraved on it.

With the TS-160 Robusto Lite all the attachable lenses are calculated to give of their best imagery at this point and, in practice there is only one Iris position (with slight tolerances) to which the Micro HM and SFX Lenses (see below) need be set. Using it closed down or opened will degrade the image more or less.

NB, The Macro 4x lens will provide good results even opening up the diaphragm because it operates on slightly different principles. The image in this case is not inverted and it provides a great general purpose macro set up.

Lighting - the importance of oblique lighting

Over the decades and many tens of thousands of macro images I have evolved lighting techniques and setups that have worked well for me. Currently, with a Micro 4/3 outfit based around a 60 mm F2 .8 Olympus macro lens I have used natural light where possible sometimes with a pair of LED cube lights to light the foreground and at other times a modified Olympus macro flash. In the field, set shutter speed carefully to make sure that a natural background is maintained by mixing flash and ambient light where possible. With a Nikon outfit I use a Nikon macro flash set up based around the SB200 flash units.

Many photographers employ heavily diffused lighting, regarding even the most natural of reflections as anathema. Highly reflective insects, such as beetles with shining elytra definitely benefit from diffuse lighting because bright highlights due to specular reflection are eliminated.



However, when using the *MikroMak* lenses it is important to remember they are microscope lenses in structure and diffuse lighting does not bring out the optimal performance. Initially, I saw no reason to change my mode of lighting: I achieved pleasing results but they were lacking the critical definition I felt I should get. Advice from Jay Margolis suggested that there had to be plenty of oblique lighting – directional lighting - to make use of higher orders of diffraction that become important in such lenses and improve resolution....this is the same with laboratory microscopes That certainly did the trick and now I focus with LED lighting and capture the image with oblique flash lighting.

If you read up on the basic theory of the microscope you will see that the resolution is calculated from the diffraction of light rays from an idealised subject...all part of the learning curve to master these lenses.

My Set-up..

Infinity Optical Company provide a number of adapters that fit the lens barrel and will carry both Canon and Nikon macro flash units.

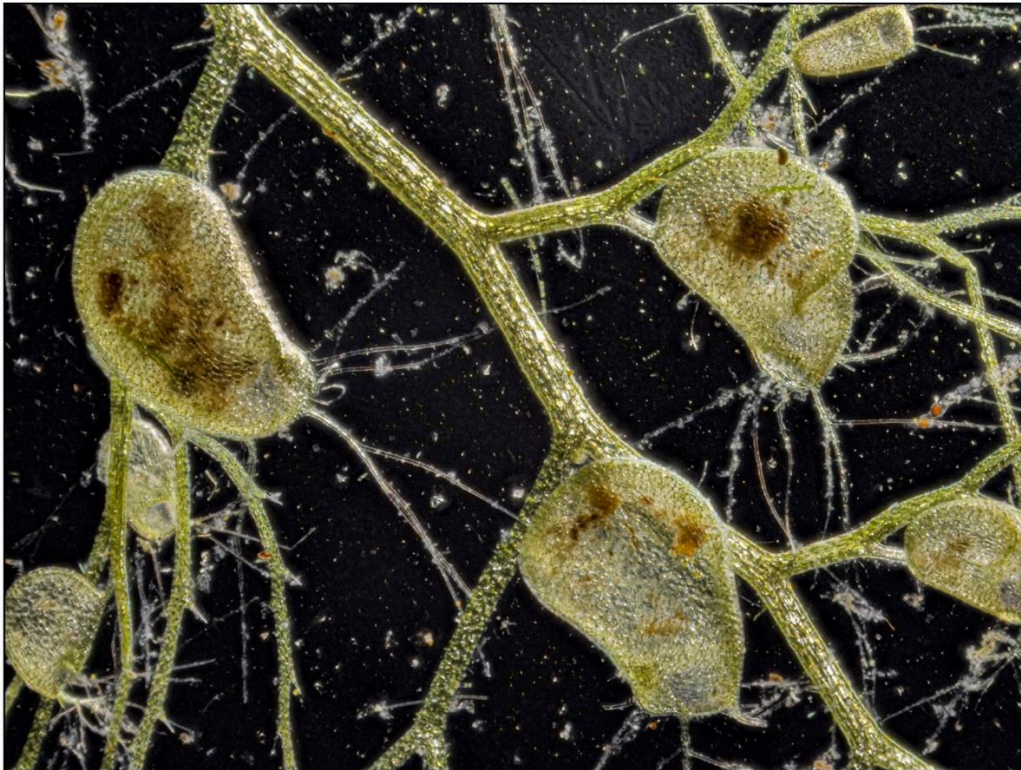


As a long-time experimenter, I have boxes of 'stuff'...all sorts of bits left from projects over the decades that allowed me to fit the small and highly portable Olympus STF-8 macroflash system and make a set up that could either be hand-held or mounted upon some kind of stand for studio work.

For those, who enjoy creating their own rigs it is possible to make a rigid stand from a redundant microscope stand. In this case I had to hand a redundant Leitz Diavert stand, bought for spares, that could be quickly modified to create a rock-solid support with precise focus for indoor work.

Ideal Cameras ...

The comprehensive guidance available on-line from Infinity Photo-Optical Company makes it clear that these are best used with cameras that have a high ISO capability. The lenses employ image projection, being microscope systems.



The small effective protected light transmission benefits from use of a camera with enhanced sensor sensitivity so that higher shutter speeds can be used, particularly when hand holding.

The image circle for the *MikroMak* lenses will also cover a full frame sensor but when used with larger sensors those light ray spread out more and the intensity of light falling on the sensor decreases...the inescapable consequences of the Inverse Square Law.

The bulk of my photography employs the Micro 4/3 system with a mix of Olympus and Leica/Panasonic lenses as well as whole armoury of so-called legacy lenses and adapters to fit the camera bodies to an array of microscopes and home built 'macrosopes'.

This means I am using sensors of a reduced size but with the TS-160 Robusto Lite lens I have removed the rear T24 extension tube (via a simple grub screw) since it just serves to expand the image circle to fill full frame. The result is a brighter image with which to focus and more light on the sensor. I am delighted with the results.



Post Processing...

For commercial reasons, no camera manufacturer will reveal precisely the algorithms that they employ. Suffice it to say that the results we see on the camera's LCD or later on a computer screen, is many steps divorced from what one might regard as 'reality', however we want to interpret that word. I now use the programs from TOPAZ which work extremely well with the images I can generate using these lenses and the Panasonic camera bodies.

I use TOPAZ DeNoise which seems to mitigate the use of the smaller sensor and also introduces a very subtle level of sharpening and data recovery via the AI algorithms upon which it is based. Sharpen AI also works well and sometimes I employ both together - beginning with the noise reduction - on a raw file before any further manipulation takes place. For making enlargements that fill your wall Gigapixel AI works better than anything comparable I've have previously used.

Conclusion...

These are my personal experiences with some remarkable optics based upon 2 year's intensive use of two *MikroMak* lenses, and with the TS-160 Robusto Lite, time to becoming fully acquainted with their capabilities... and pushing mine. With equipment of this quality and versatility new areas are opened...I am still learning.



Make no mistake, these are top of the range optics with unique capabilities and there are no compromises made in quality of performance or construction. Ultimately, it really does depend what you want and whether you are prepared to compromise on image quality. One thing I do know is that the versatility and quality of these lenses has opened up numerous new opportunities...imagination is the limit and in macro photography limits are there to be pushed.