

Operation Manual

Camera Testing Instrument III



Warranty and Limitation of Liability

Maintenance

Modifications or maintenance must only be carried out by persons explicitly authorised by MÖLLER-WEDEL OPTICAL.

Only original parts of MÖLLER-WEDEL OPTICAL must be used for maintenance.

After maintenance or technical modifications the equipment must be re-adjusted according to the technical instructions.

In case of technical inquiries the numbers on the relevant parts must be indicated.

Liability to Functions and Damage

If the equipment is modified or repaired by not explicitly authorised persons, in case of improper maintenance (as far as not performed by MÖLLER-WEDEL OPTICAL) or in case of improper handling, any liability of MÖLLER-WEDEL OPTICAL is excluded.

Accessories

Electrically driven accessories are permitted on the equipment only if its technically safe application is documented by a notified body (relevant certificate must be available).

Safety Remarks

This equipment must only be used following the operating manual and it is designed for use according to the operating manual.

The year of manufacturing and the serial number of the equipment is documented on the identification label.

Keep the operating manual for later use.

EC Conformity Certificate

The ED conformity certificate is attached to this operating manual.

Table of contents

1. General	1
2. Sub-Assemblies	3
2.1 Measuring Head III.....	3
2.1.1 Measuring Head III-45 S, Ident.-No. 236 103	3
2.1.2 Measuring Head III-45 V, Ident.-No. 236 103	3
2.2 TV Camera with Monitor, Ident.-No. 229 920.....	4
2.3 Swivelling Holder, Ident. No. 223 020	5
2.3.1 Swivelling Arm 278 mm, Ident.-No.: 223 026.....	5
2.3.2 Distance Piece Ident.-No. 223 031,	5
2.4 Plane-Plate of high flatness \varnothing 63 mm, Ident-No. 205 203.....	5
3. Checking of the Adjustment	10
4. Notes on handling the instrument	11
4.1 General	11
4.2 Illumination.....	12
4.3 Adjustment of the test piece to the Camera Testing Instrument.....	14
4.4 Testing of lens adaptation.....	14
4.5 Calculation or estimation of the extent of the misalignment of the test piece.	16
4.6 Testing of the view-finder setting	18
4.6.1 Ground glass view-finder	18
4.6.2 View-finder with split-image range-finder.....	18
4.7 Testing at finite distance settings	19
Appendix	22
Instruction for the adjustment of a TV-Camera	22

1. General

The Camera Testing Instrument III-45 operates on a newly developed autocollimation principle.

It is characterised by high precision, particularly wide measuring range and ease adjustment.

The instrument can be used for testing the adaptation of lenses directly on the camera as well as for identical testing of the flange focal length (distance lens – film-plane) of interchangeable lenses. Moreover the equipment is well suited to check the alteration of the image plane when zoom-lenses are used (error in the control curve). Furthermore testing of the adjustment of reflex view finders with ground glass or aerial image is possible.

With the standard autocollimation method for testing the adaptation of lenses the lens is adjusted so that the observer sees the image of a finely graduated test figure of an autocollimation telescope with identical sharpness to the eyepiece reticle of the autocollimator telescope. The colour change process is also used in which instead of the finely graduated test figure a bright cross-wire on a dark background is used. The image of the cross-wire illuminated with white light in the eyepiece image plane of the autocollimation telescope shows colour fringes if the lens is not correctly adjusted.

With the new process it is not the sharpness of the image which is the criterion of adjustment, but the symmetrical position of position of a single line within a double line. This dispenses with the differing and subjective interpretation of the image sharpness.

Figure 1 demonstrates the principle adjustment.

The middle graphics in Figure 1 shows the autocollimation image with exactly adjusted objective, the single bar is lying symmetrical between the double bar.

The left and right graphics of Figure 1 show the autocollimation images, when the lens is not correctly adjusted. In the left graphics the distance between camera objective and film plane is too short, in the right the distance is too large

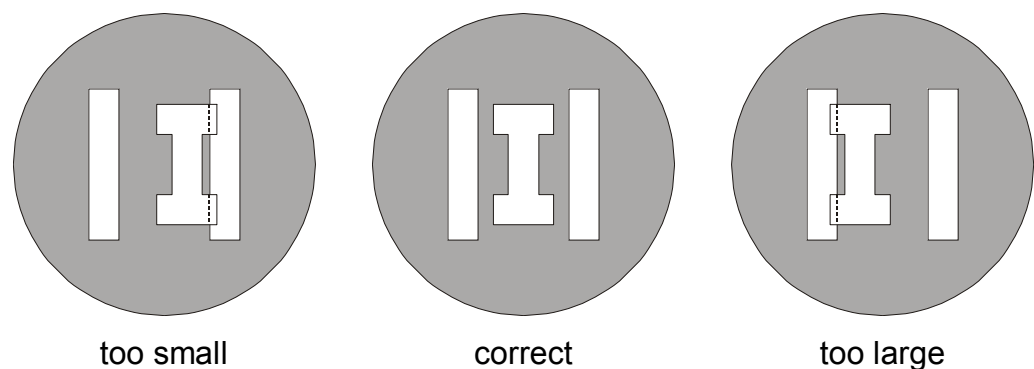


Figure 1: Autocollimation image in dependence of the distance between camera objective - film plane

The dimensions of the reticles in the testing instrument itself are selected so that the symmetrical adjustment of single and double line takes place with maximum precision.

The setting is very easily reproducible. The standard deviation is in the magnitude of 0.02% of the focal length of the objective under test, supposing an aperture ration of approx. 1 : 2.

It is another advantage of this instrument that a display on a video monitor is possible without any loss of precision. By this observation of the image is more convenient and setting becomes controllable.

Above all misalignments and/or misinterpretations do not longer occur as the symmetry-criterion is unequivocal and does not depend on the operator.

With eyepiece-observation one has to ensure that the eyepiece reticle image (a cross line) appears sharp. Possible misalignments lead to wrong results when testing the lens setting.

2. Sub-Assemblies

The Camera Testing Instrument III-45 in its standard version consists of three main groups, which are also available separately (s. a. Figure 2):

- 2.1 Measuring Head
- 2.2 Video Camera with Monitor
- 2.3 Swivelling Holder

2.1 *Measuring Head III*

including cold-light-source with flexible light wire bundle with two branches, eyepiece and adapter for a video camera, however without video camera, monitor and swivelling holder.

With a filter changer (green-white).

With a spare halogen mirror-lamp 15 V 150 W.

The measuring head is available in two versions:

2.1.1 Measuring Head III-45 S, Ident.-No. 236 103

free aperture 45 mm.

Suitable for lenses with focal lengths of 6 to approx. 300 mm for testing the flange focal length in the infinity setting.

2.1.2 Measuring Head III-45 V, Ident.-No. 236 103

free aperture 45 mm

Suitable for lenses with focal lengths of 6 to approx. 300 mm for testing the flange focal length in the range 8 m to infinity and for the determination of the misalignment of the lens, ground-glass-screen and split-image.

The version III-45 S has a fixed receiving unit. Here the testing is done in the infinity setting, which represents the usual method of checking the adjustment of a lens.

The version III-45 V, however, has an adjustable receiving unit. In addition to the infinity setting it is possible to determine the misalignment of the lens to the film-plane (in μm).

For this purpose the receiving unit is set so that the symmetry-criterion is fulfilled again. The value at the drum of the receiving unit is an indication the misalignment of the lens. The absolute amount can be easily derived from the read-off at the drum and the focal length of the lens.

The free aperture of 45 mm diameter of the measuring head determines the maximum possible test field diameter of the lens.

Example:

- Measuring Head III-45 S or III-45 V.
- Lens focal length 140 mm.
- Maximum aperture ratio

$$45 / 140 \approx 1 : 3.$$

2.2 TV Camera with Monitor, Ident.-No. 229 920

for connection of the Measuring Heads -...,
consisting of TV-Camera, connection cable and TV-Monitor.

The TV-camera is already fixed at the Measuring Head when the Camera Testing Instrument has been ordered with TV-Monitoring set. In case the user prefers to adapt a different type of TV-camera the adapter has to be readjusted in order to have the camera properly adapted.

An instruction on how to readjust the adapter can be furnished on request.

For a correct adaptation a plane plate of high flatness is required (s. sec. 2.4).

2.3 Swivelling Holder, Ident. No. 223 020

(including Swivelling Arm and Tilttable Supporting Table)

Above all for the versatile applications in laboratories and repair shops the use of this swivelling has been well proven.

The Cover photo and Figure 3 and Figure 4 are showing different applications.

The Swivelling Arm with a length of 157 mm is suitable for fixation of film cameras of all sizes, small-size and medium-size cameras and allows adjustment to the Measuring Head.

In addition to this method small-size- and pocket-cameras can be put onto the Tilttable Supporting Table for rapid adjustment to the Measurement head. In this case the Swivelling Holder is in its perpendicular position.

For testing larger film-cameras the following accessories are recommended:

2.3.1 Swivelling Arm 278 mm, Ident.-No.: 223 026

2.3.2 Distance Piece Ident.-No. 223 031,
in order to increase the height of the rotation axis by 130 mm against the basic level.

2.4 Plane-Plate of high flatness \varnothing 63 mm, Ident-No. 205 203

This plate is characterised by a high flatness. By means of this plate it is possible to precisely check the adjustment of the Measuring Head in the infinity setting. Instead of the camera to be tested the Plane-Plate has to be put under the free aperture of the Measuring Head.

When correctly set to infinity both test-figures are symmetrical to each other. Above all the Plane-Plate is necessary, when the user wants to adapt a TV-Camera by himself.

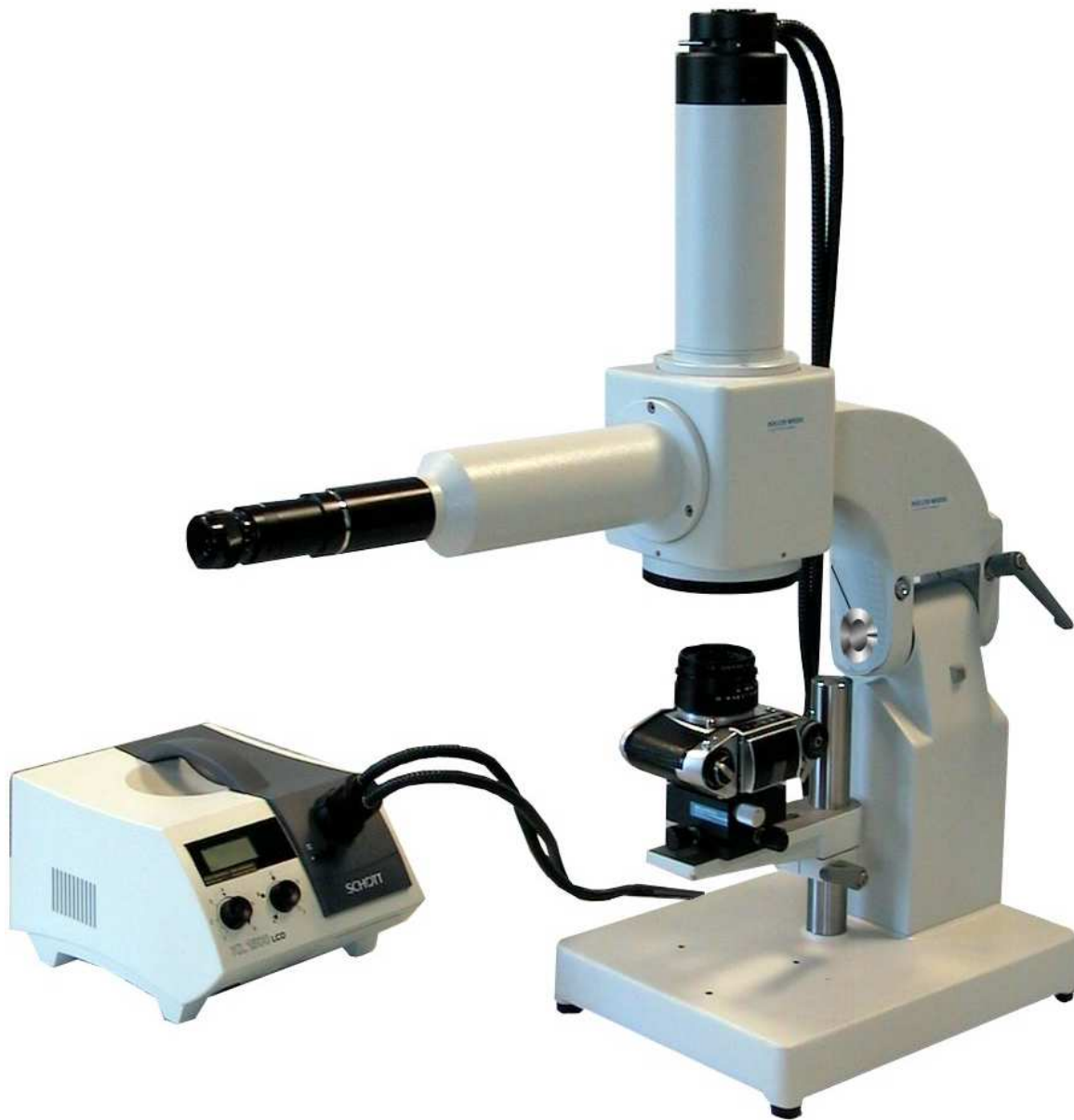


Figure 3: Camera Testing Instrument III-45 S
Configuration for testing of flange-to-film distance of still cameras.
Viewing with eyepiece.

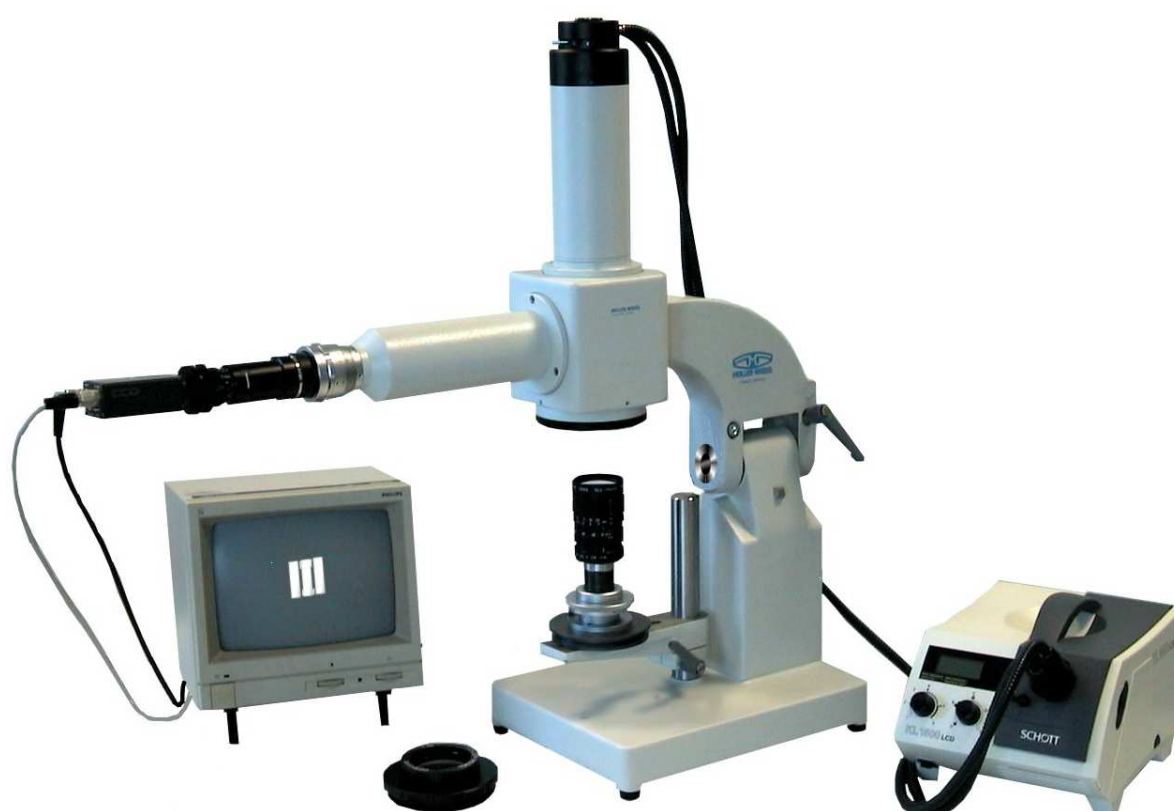


Figure 4: Camera Testing Instrument III-45 V
Configuration for testing of control curve of zoom objective.
Viewing with TV-camera and monitor.

3. Checking of the Adjustment

It is recommended to check the proper infinity setting of the Camera Testing Instrument from time to time. This is done most simply with the help of a very plane glass plate with a matted rear surface of a minimum diameter of 30 mm (e.g. MÖLLER-WEDEL OPTICAL flat, working grade, Ident.-No. 205 104 of 50 mm diameter but with matted rear surface).

It is also possible to use a very flat surface mirror (e.g. MÖLLER-WEDEL OPTICAL Reflecting Mirror Ident.-No. 205 203 of 63 mm diameter).

Plane glass plate or surface mirror should be approximately parallel, if used at the same time for the alignment of the camera (see sec. 4.3).

Surface mirrors or plane surfaces of insufficient flatness give rise to false test results. For the test, arrange the surface mirror or the plane glass plate under the Measuring Head and tilt it so that the image will be situated centrally in the field of view of the telescope eyepiece or centrally on the monitor screen.

If the instrument is adjusted accurately, the test figures (single bar and double bar) will be positioned symmetrical to each other.(see middle graphics in Figure 1) . If this is not the case, the instrument has to be sent to MÖLLER-WEDEL OPTICAL for realignment.

When used with the telescope tube, it must be ensured that the crossline of the eyepiece reticle imaged sharply, too. A setting error leads to incorrect assessment.

If it is found when on using the TV camera, that the symmetrical setting of the test figures is not correct, it must be checked at first whether the TV camera needs readjustment. For this purpose unscrew the TV camera with the black tube and screw on the telescope tube instead. Now, if

with correct setting of the eyepiece in relation to the eyepiece reticle the symmetrical setting is found to be correct, the TV camera has to be re-adjusted.

When a surface mirror is used in this test two, and at greatest brightness even three test figures of different brightness can be seen (these images do not appear in normal lens testing).

The test group of the greatest brightness, which also moves when the surface mirror is tilted, is the one to be assessed. The darker test group remains stationary in the centre of the field of view, when the mirror is tilted.

(Note: In the lens test the position of the visible image on the monitor or in the eyepiece is independent of an angular or positional change of the test piece).

The checking of the adjustment of the Camera Testing Instrument is even more simple if a sample lens in a suitable mount with a mirror in the focal plane is used. This very precisely adjustable system is used as a testing unit. This mode of checking the instrument is recommended for use in particular when the testing instrument has a special setting. (Consideration of field curvature, deformation of the film, etc.)

4. Notes on handling the instrument

4.1 General

The testing of the lens adaptation can be carried out by using the telescope tube on the receiver unit as well as by means of the TV camera and monitor. Reproducibility is equally good in both cases. However, when the telescope tube is used errors may occur if the observer has failed to ensure that the eyepiece has its reticle in sharp focus. For this reason, and also because of the convenient and less fatiguing adjust-

ment in mass production, the use of the television equipment is recommended in any case.

Each Camera Testing Instrument is supplied with the telescope tube, even when the instrument is equipped with a TV unit. This telescope tube, which comprises an eyepiece with a cross-line reticle, may be used as a replacement unit in case the TV unit is defective. It can be used for a test according to that described in section 3.

When the telescope tube is used, turn the receiver unit after loosening the two hexagonal socket-head screws on the flange of the instrument so that the eyepiece reticle cross-line is at approx. 45° to the vertical. In this position the correct setting of the eyepiece in relation to the reticle can be checked additionally, in that the displacement of the lines of the cross-line in the individual bars of the test figure is observed. If the eyepiece is not correctly adjusted, the cross-line images will be mutually displaced, as illustrated in Figure 5.

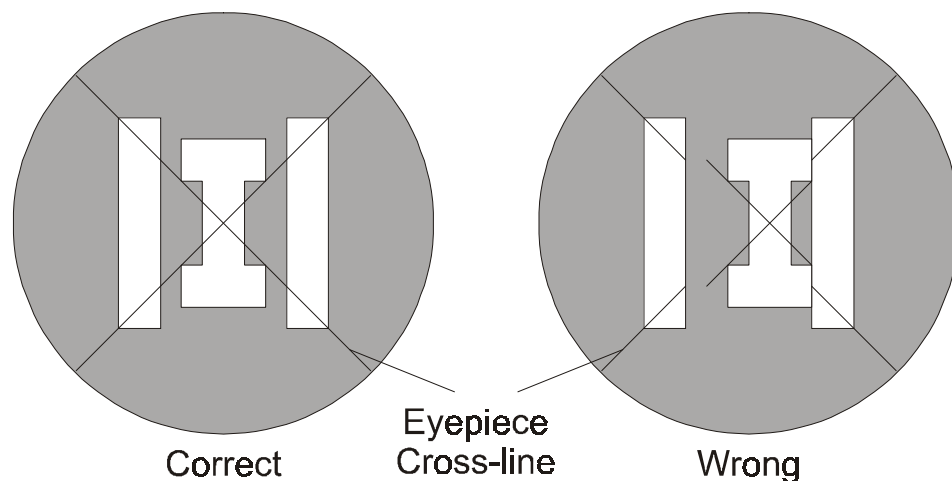


Figure 5: Adjustment of the eyepiece

4.2 **Illumination**

The illumination of the reticle is to be set so that no overmodulation occurs. Adjust the intensity at the control knob on the cold light illumination to an appropriate setting.

When TV camera and monitor are used, special attention is to be given to the optimum setting of brightness and contrast. This adjustment should be carried out with minimum focal length of the zoom lens to be adjusted.

If double and single bars show different brightness when the plane mirror is used, transpose the light guide plug in the illumination unit after loosening the clamping screw (plug-in socket).

The test is generally carried out with green filter illumination. The lever of the filter changer on the top will then be on the left-hand position (green mark).

If in special cases the brightness is insufficient (e.g. with lenses of very short focal length and small aperture, or on adjusting groundglass viewfinders etc.), it is possible to switch to white light illumination (right-hand position, white mark). Due to chromatic aberrations of the lenses under test, the image will then in general have less sharp contours.

Whenever possible the cold-light illumination should not be used with full power in order to extend the lifetime of the lamp.

The very long-life lamps have to be substituted when the brightness becomes inadequate due to tarnish inside the bulb.

When testing long focal length optics the image may appear too bright even with the power supply set to lowest power. Excessive brightness can lead to a glare of the TV-image deteriorating the accuracy. This can be remedied by slightly pulling out the light conducting fibre in its adapter on the measuring head. If this procedure still doesn't yield to sufficient improvement a plane parallel absorption filter with high grade planarity should be placed on top of the specimen.

4.3 *Adjustment of the test piece to the Camera Testing Instrument*

The test piece must be positioned approximately centric to the aperture of the testing instrument. On testing cameras with zoom lenses it is strongly recommended to perform a rough prealignment with a longer focal length, to be followed by the final adjustment at the shortest focal length. In the case of lenses with fixed focal length the adjustment can be tested by closing the diaphragm. On decreasing diaphragm diameter single and double bar should darken or disappear simultaneously.

The distance of the lens to be adjusted to testing instrument should if possible not substantially exceed 100 mm. It is necessary for the optical axis of the test piece to run approximately parallel to the axis of the instrument. In the basic adjustment of the testing equipment this is best checked by placing an approximately plane-parallel glass onto the lens under test. If the adjustment is correct, the reflected image of the test marks will then be positioned in the centre of the monitor or eyepiece image field.

For series testing ensure a constant position of the test piece in relation to the testing instrument with the help of a suitable device, so that additional adjustment is not necessary.

4.4 *Testing of lens adaptation*

The adjustment of the lens of cameras with zoom lenses in relation to the film plane is generally done at the shortest focal length and with the diaphragm fully open, since at the shortest focal length incorrect settings show up particularly well as unsharpness of the image. Moreover, the adjustment at shortest focal length is particularly accurate. The relative unsharpness of the image at very short focal lengths of the test piece is due to diffraction effects caused by the small absolute lens aperture and to the exceptional high magnification by the Testing Instrument. The high reproducibility of the adjustment is not affected by the unsharpness of the image (approx. $\pm 2 \mu\text{m}$ with $f=7/1:1.8$).

When the test piece is set to longer focal lengths, the test figures present sharp contours, but the accuracy of the setting is somewhat less. In the testing of the whole zoom range the brightness of the cold-light illumination is to be controlled so that no overmodulation of the test images occurs. A readjustment of the monitor brightness may also become necessary.

If the lens is adjusted correctly at the shortest focal length and increasingly incorrect setting occurs with longer focal lengths, it may be assumed that the error lies in the setting of the basic lens.

The basic lens too can be adjusted with the help of the camera testing instrument, if the adjustment is to be "infinity".

In the adjustment of lenses in mass production field curvature, and film deformation too, can be taken into consideration when the testing instrument is supplied especially adjusted for the type of lens in question. The user may also carry out such an adjustment in accordance with a tested lens of the type in question, provided the Camera Testing Instrument is procured together with an adjustable receiver unit.

With some lenses a change in the symmetrical position takes place on stopping down. This phenomenon, described as difference in diaphragm, originates from the spherical aberration of the lens.

The Camera Testing Instrument III-45 has a free aperture of 45 mm. The free aperture of the Measuring Head determines the maximum useful test field diameter of the lens.

In principle lenses of any focal length can be adjusted with this Testing Instrument. However, it must be realised that at longer focal lengths the diameter will be limited to 45 mm diameter automatically by the instrument aperture.

Example 1:

Focal length of test piece	50 mm
Aperture ration	1 : 1,4
Resulting absolute aperture	36 mm

This lens can be tested or adjusted with fully open aperture.

Example 2:

Focal length of test piece	100 mm
Aperture ration	1 : 1,4
Resulting absolute aperture	71 mm

If the measurement is carried out with the Camera Testing Instrument III-45, the lens to be tested will also be adjusted or tested only with an aperture of 45 mm diameter. This corresponds to an aperture ratio of 1 : 2.2.

Normally a surface mirror is used as a reflective surface in the image pane of the test piece. If the deformation of the film plane is also to be considered, a well-reflecting fine-grain film can in many cases also been used as a reflective plane. Sometimes it is also possible to check the adjustment with running film.

4.5 Calculation or estimation of the extent of the misalignment of the test piece

On the Camera Testing Instrument III in the standard version which is set to "infinity", the extent of the misalignment of the test piece can be roughly estimated as follows:

If the central section of the middle bar with its right-hand or left-hand edge just contacts one of the inside edges of the double bar (see Figure 6), the setting error of the test piece is in the order of the f-no. of the test piece times its focal length in μm .

Example:

Focal length of test piece	20 mm
Setting error if in contact	56 µm

The direction of the setting can be derived from the position of the single bar:

If the middle bar is shifted to the left, the distance lens-film plane is too small; if it is shifted to the right, the distance is too large. All this on the assumption that the TV camera is in the correct height in relation to the testing instrument.

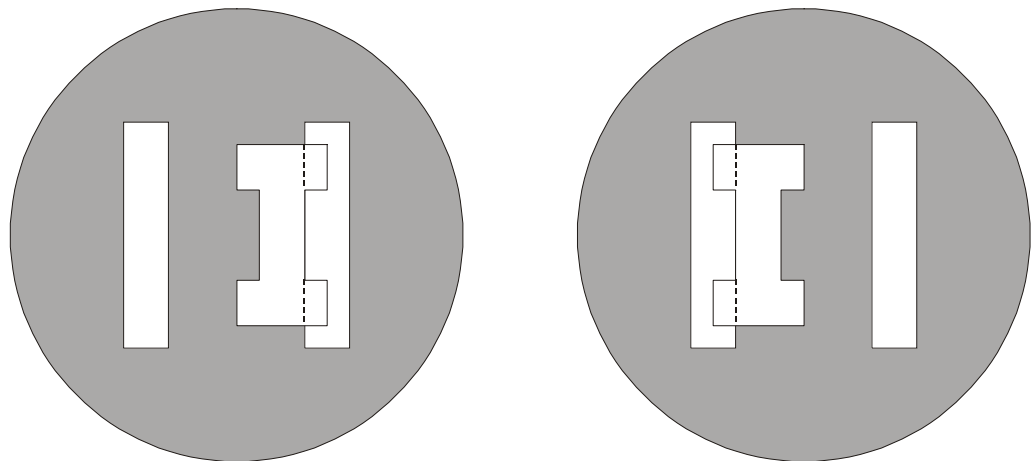


Figure 6: Autocollimation image for estimation of the misalignment of the objective.

If the instrument is equipped with an adjustable receiver unit the extent of the misalignment can be determined with high accuracy.

For this purpose the receiver unit is adjusted so that the test figures are positioned symmetrically to each other. From the amount x of adjustment from the 0 (= ∞) position, which can be read off the receiver unit, the amount of setting error can be calculated as follows:

$$y[\mu\text{m}] = 0.0055 \cdot x[\text{mm}] \cdot f^2[\text{mm}^2]$$

Wherein f is the focal length of the test piece in mm and is the amount of adjustment in mm, to be read at the receiver unit.

Example:

Focal length of test piece	20 mm
x (adjustment of receiver unit)	2.2 mm
Misalignment of the lens	$y = 0.0055 \cdot 2 \cdot 20^2 \mu\text{m} = 4.4 \mu\text{m}$

4.6 Testing of the view-finder setting

4.6.1 Ground glass view-finder

The test may be carried out so that the symmetrical adjustment of the test figures in the ground glass-view finder is assessed, after the position of the lens in relation to the film plane has been first checked.

In the case of zoom lenses this test should be carried out at a longer focal length. It is recommended to select a focal length where the adjustment of the lens with respect to the film-plane is also correct.

In miniature reflex cameras, and also in some film cameras with ground glass view-finders, it is possible to perform the test as in lens adaptation, i.e. the reflection of the ground glass is used. The set-up is similar as when the adaptation of lenses is tested. If the brightness of the image on the monitor is insufficient, it is possible to switch to white light illumination.

4.6.2 View-finder with split-image range-finder

The test set-up here is similar as in the test lens adaptation. Adjust the camera and the testing instrument so in relation to one another that the split edge extends approximately centrally and at right angles to the test figure. After the eyepiece of the view-finder has been correctly set, the image should be assessed in the following manner:

The adjustment of view-finder optics is correct, if symmetrical adjustment exists in the upper and lower part of the split image. The split wedges lies correctly in the beam, if there is no displacement between the upper and lower image of the test figure in the wedge. Figure 7 illustrates the different possibilities.

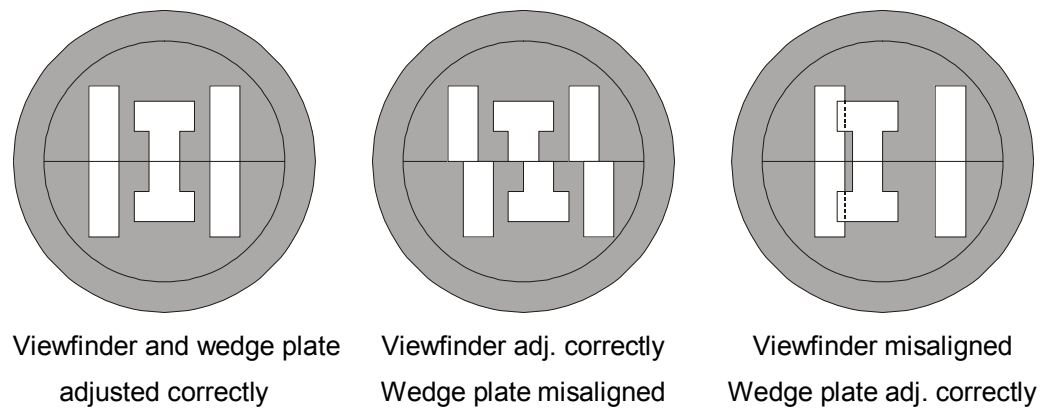


Figure 7: Autocollimation images for adjustment of viewfinders and wedge plates.

With some view finders the upper part of the double bar and in the lower part the single bar will be visible only or vice versa. In this case the symmetry of both the image halves is to be judged at the horizontal intersection line.

4.7 **Testing at finite distance settings**

For testing of finite distance settings (<1m) several ancillary lenses n be supplied which are to be placed in front of the Measuring Head III-45. Each of the available lenses is for one single distance only.

As standard three different ancillary lenses may be chosen: 1.0 m, 1,5 m or 2,0 m. Upon request special lenses can be offered, e.g. for fix-focus setting at 6 m or 10 m.

When testing at "infinity" the distance of the camera to the Measuring Head is not critical and can be set more or less at any choice.

However, when testing at finite distance settings a reference distance "Reference plane of camera - Measuring Head" has to be kept. (Reference plane of the camera is normally the film plane).

In the standard version of the ancillary lenses 1.0 m, 1.5 m and 2.0 m this reference distance is defined as 200 mm.

Figure 8 shows the optical background:

The image of the ancillary lens is regarded as object from the objective of the camera and imaged into the corresponding image plane. If film-plane and image plane coincide, the symmetry criterion is fulfilled and the middle bar is symmetrically located in the double bar.

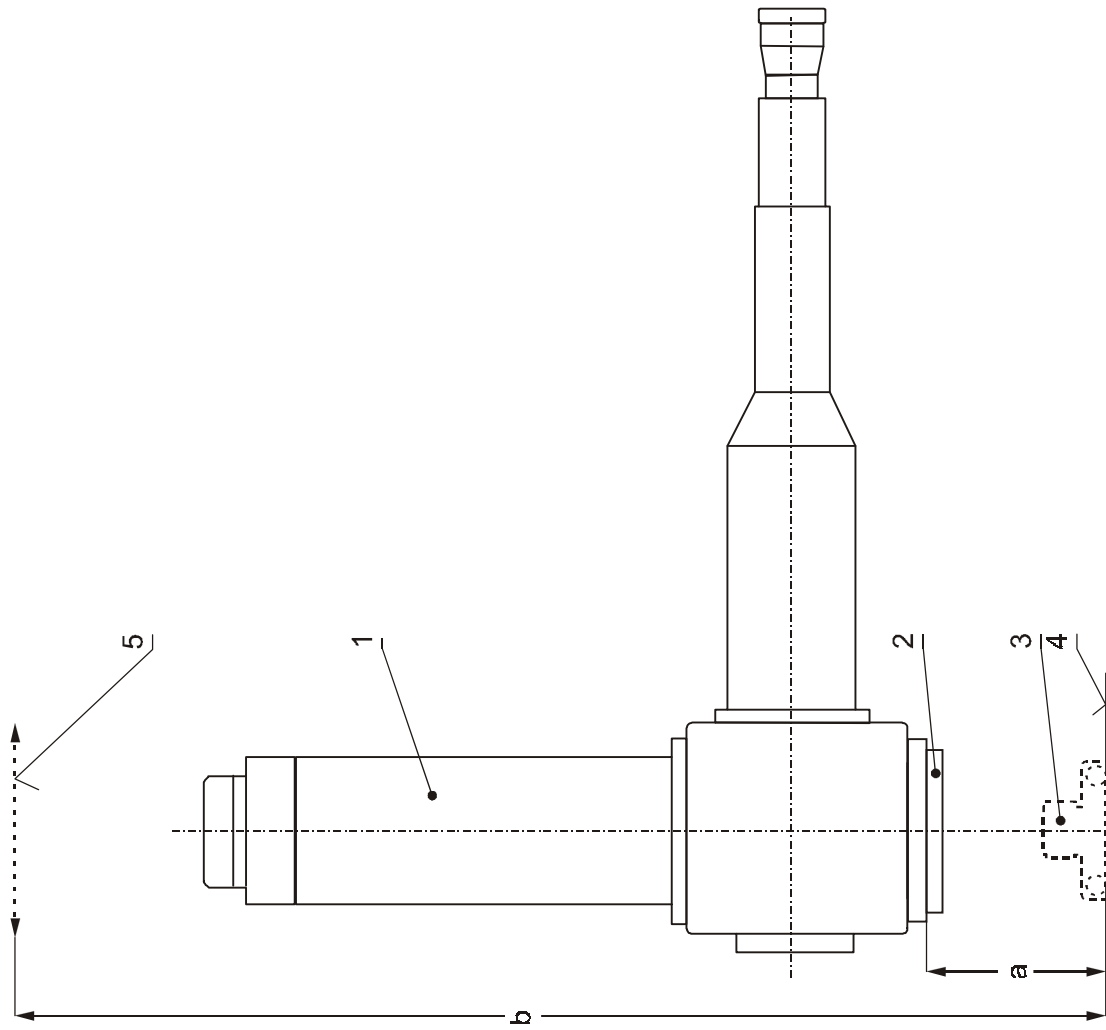
If the reference distance "Reference plane - Measuring Head" is not kept the test will be carried out at a different object distance than that engraved on the mount of the ancillary lens.

Example 1:

- Engraved distance 1.5 m
- Actual distance "Reference plane - Measuring Head"
0.5 m instead of 0.2 m
- Difference $0.5 \text{ m} - 0.2 \text{ m} = + 0.3 \text{ m}$
- Actual testing distance $1.5 \text{ m} + 0.3 \text{ m} = 1.8 \text{ m}$

Example 2:

- Engraved distance 2.0 m
- Actual distance "Reference plane - Measuring Head"
0.1 m instead of 0.2 m
- Difference $0.1 \text{ m} - 0.2 \text{ m} = - 0.1 \text{ m}$
- Actual testing distance $2.0 \text{ m} - 0.1 \text{ m} = 1.9 \text{ m}$



Set-up for testing at short distances

- 1** Measuring head
- 2** Ancillary lens
(as standard 1 m, 1,5 m oder 2 m)
- 3** Camera
- 4** Reference plane
(corresponds to film plane)
- 5** Intermediate image plane of ancillary lens
(corresponds to object plane of camera)
- a** Distance reference plane - ancillary lens
(in the standard versions of the ancillary lenses b is 200 mm)
- b** Object distance with prescribed distance b
(Corresponds to the distance engraved in the mount of the ancillary lens)

Figure 8: Set-up for testing at short distances

Appendix

Instruction for the adjustment of a TV-Camera to the Camera Testing Instrument

This instruction applies only in cases in which the Camera Testing Instrument has been supplied without a TV-camera. When extending the installation by a TV-system proceed as follows:

1. Install the Measuring Head vertically or horizontally.
2. Screw the eyepiece adapter to the objective tube.
3. Loosen the two screws with hexagonal recessed hole of the clamp fixture for the objective tube. Rotate the latter so that the crossline of the eyepiece reticle is approx. 45° to the perpendicular.
4. Install a plane plate in front of the free aperture of the Measuring Head. The plane plate should be adjustable in angle. Use an uncoated plate that is ground on its rear surface, having a planarity of $\lambda/5$ p-v or better within the 30 mm diameter of use.
Alternatively a surface mirror with accordingly planarity can be used. The double images produced by the mirror do not disturb the procedure of adjustment. For positioning of the surface mirror only the brightest image is to be considered.
5. Switch on the cold-light illumination.
6. Adjust the plane plate parallel to the exit aperture of the Measuring Head. The images of the single and double bar will appear then approximately in the centre of the eyepiece-sided field of view.
7. Adjust the sharpness of the crossline of the eyepiece reticle. The single bar has to be symmetrical to the double bar (see middle graphics in Figure 1). If this is not the case the Measuring Head is

misaligned and has to be sent to
MÖLLER-WEDEL OPTICAL for realignment.

8. Screw off eyepiece and its adapter.
9. Screw the adapter to the TV-camera. then screw both to the objective tube.
10. Connect TV-camera to monitor. Switch on camera and monitor.
11. The images for the single and double bar now appear on the screen. In case the adapter is not correctly match, the bars are not symmetrical to each other.
12. For accurate adjustment, shorten the loose spacer ring between the adapter (Ident.-No. 236 215) and the telescope tube such that the single and the double bar are symmetrical to each other.
The shortening the spacer ring may not be necessary if the TV-camera has a special setting device.
In this case the coarse setting adjustment should be accomplished with the aid of the loose spacer ring and the fine adjustment by using the setting device.
13. In case that the image erection has to be corrected follows the procedure below:
Remove the adapter with TV-camera from the Measuring Head and loosen the three fixing screws inside the adapter. Reattach the adapter at the Measuring Head and adjust the image erection by rotating the TV-camera. When finished fix the three fixing screws.
14. The basic adjustment of the Camera Testing Instrument should be checked according to 7. from time to time.