

## User's Guide

### Camera Housing Systems

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# 1. General Information

Thanks for purchasing a product of the Baumer family. This user's guide explains how to install cameras in an enclosure to protect your vision system and achieve IP 69 K protection.



Read this manual carefully and observe the notes and safety instructions!

## Support

In case of any questions please contact our Technical & Application Support Center.

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## Target group for this User's Guide

This user's guide is aimed at experienced users, which want to integrate camera(s) into an enclosure.

## Intended Use

The enclosure is used to protect a built-in camera in a production environment. Once the camera is mounted in an enclosure, it can be easily adjusted and robustly installed on the machine.

### Notice

Use the enclosure only for its intended purpose!

For any use that is not described in the technical documentation poses dangers and will void the warranty. The risk has to be borne solely by the unit's owner.

## Classification of the safety instructions

In the user's guide, the safety instructions are classified as follows:

### Notice

Gives helpful notes on operation or other general recommendations.



### Caution!



Indicates a possibly dangerous situation. If the situation is not avoided, slight or minor injury could result or the device may be damaged.

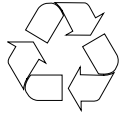
## Disposal



Dispose of outdated products with electrical or electronic circuits, not in the normal domestic waste, but rather according to your national law and the directives 2002/96/EC and 2006/66/EC for recycling within the competent collectors.



Through the proper disposal of obsolete equipment will help to save valuable resources and prevent possible adverse effects on human health and the environment.



The return of the packaging to the material cycle helps conserve raw materials and reduces the production of waste. When no longer required, dispose of the packaging materials in accordance with the local regulations in force.

Keep the original packaging during the warranty period in order to be able to pack the device properly in the event of a warranty claim.

## Warranty Notes

If it is obvious that the device is / was reworked or repaired by other than Baumer technicians, Baumer Optronik will not take any responsibility for the subsequent performance and quality of the device!

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## 2. General Safety Instructions

### Notice

Please observe the instructions and notes in the technical documentation of the camera to be installed!

### ⚠ Caution



The suitability of the product for the users application **with its specific conditions of practice has to be tested and guaranteed by the user himself.**

For special applications, please contact us in writing. We reserve the right to make technical changes.

### ⚠ Caution



Please follow these assembly guidelines carefully when assembling the enclosures, as the IP protection rating stated may otherwise not be reached!

### ⚠ Caution



Inappropriate handling of the enclosure or any parts thereof may lead to a leaky enclosure and may cause damage to the enclosed camera. Baumer can take no liability for damages caused by improper handling.

### ⚠ Caution



The enclosures have been designed for a typical machine vision application where the camera set-up is done once in order to build an application. Frequent disassembly of the enclosure requires all seals and gaskets to be renewed. Please order replacement seals or O-rings from Baumer when disassembling the enclosure.

### ⚠ Caution



Baumer uses the best possible sealing materials for typical applications. However every application is different - please check if our sealing material is durable under the use intended.

### ⚠ Caution



Do not assemble the enclosure if any parts are damaged – this counts especially for the seals and sealing flanges of the enclosure! In doubt – please contact Baumer for advice.

### ⚠ Caution

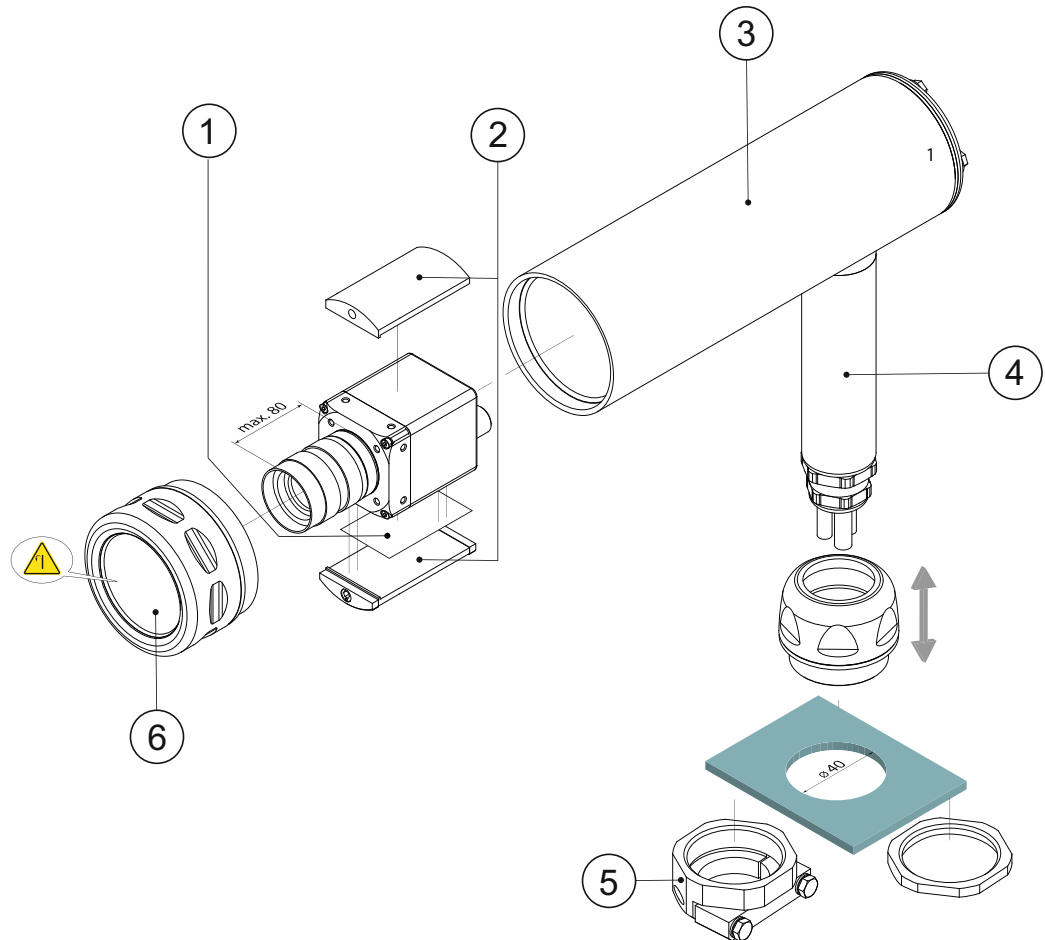


Tighten the tube / rear wall as far as possible and don't use excessive force in case it is not possible to screw the tube / rear wall completely down to the metal middle housing part.

### 3. Housing Set Models

#### 3.1 Housing Base Set B V4A VCXG.I r IP69K

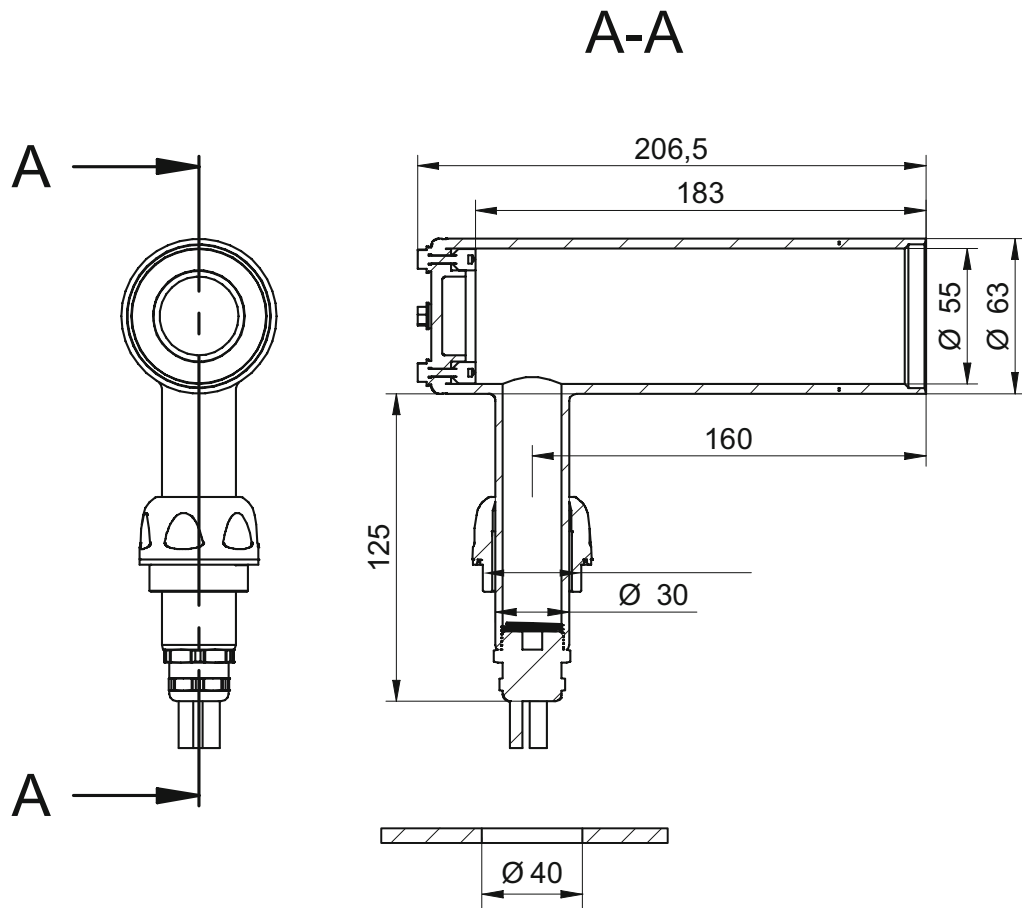
- For lenses up to 55 mm diameter (52 mm front lid) and VCXG.I (.XT) cameras
- Stainless steel 1.4404
- Compact size
- Robust construction
- Vibration-proof mounting
- IP 69K rating
- Design according to EHEDG guidelines: Hygienic design with 3 mm radii (washdown design) and hygienic surface (roughness < 0.8 µm, electropolished)
- Excellent heat dissipation



| No. | Description                            | No. | Description  |
|-----|--|-----|--|
| 1   | Thermal pad                            | 4   | Handle   |
| 2   | Clamp elements for VCXG.I (.XT) camera | 5   | Rotation lock M40 V4A IP69K (11208731), Optional                                 |
| 3   | Housing Base Set B V4A VCXG.I r IP69K  | 6   | Tube M60 V4A IP69K Acryl (11208732) mandatory, tube has to be ordered separately |

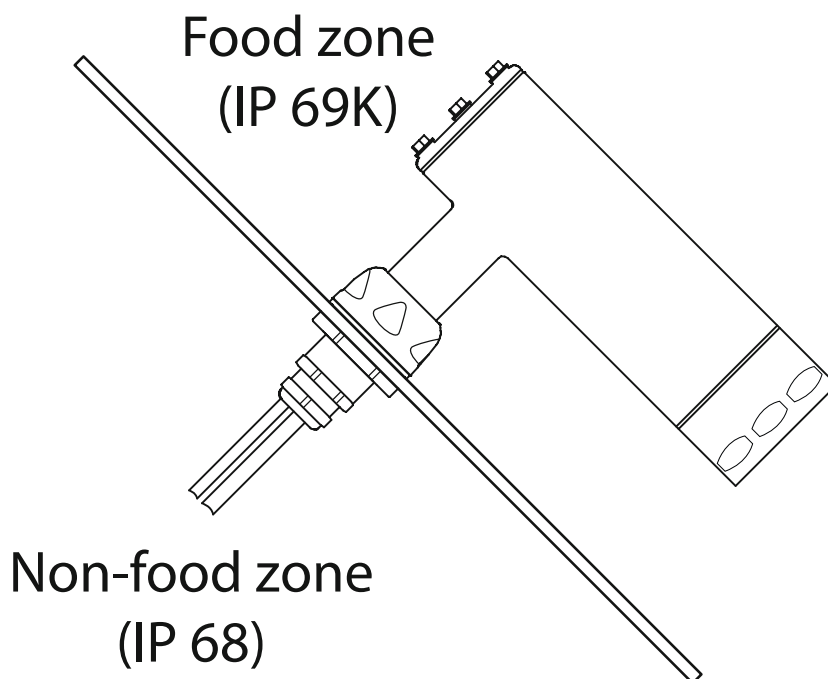
Camera, lens and cables not included.

## Dimensions

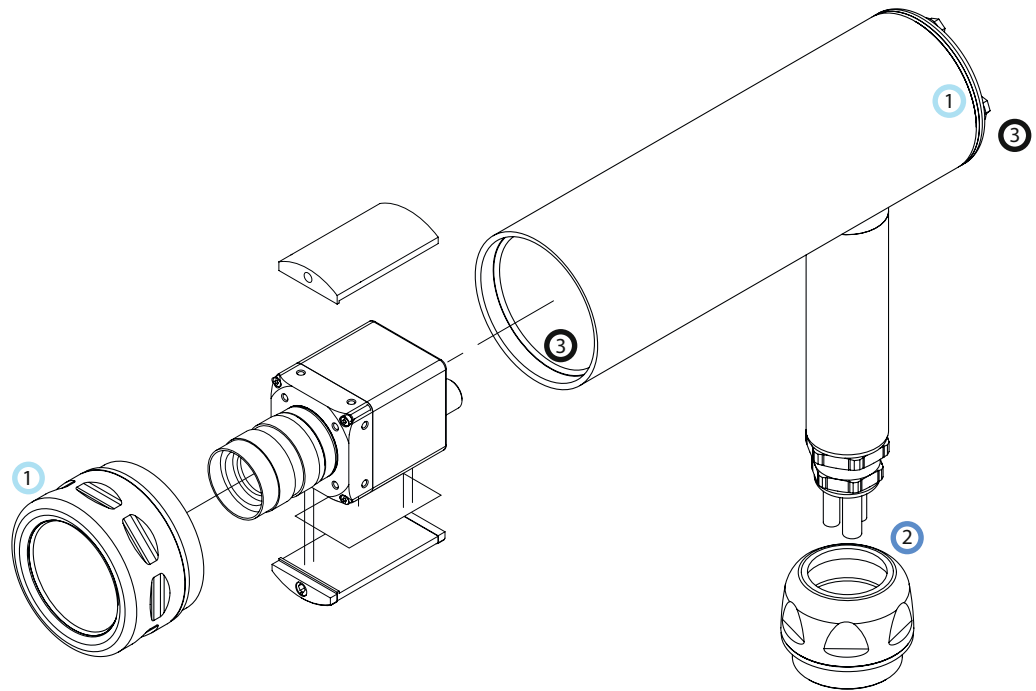


## Mounting and cable exit

Assembly on a machine with cable routing through handle.



## Sealing material



| No. | Material                  |
|-----|---------------------------|
| 1   | Flouroprene® XP41         |
| 2   | TPU - Polyurethane        |
| 3   | EPDM O-Ring (inside only) |

### 3.1.1 Environmental Requirements

|                       |                                     |
|-----------------------|-------------------------------------|
| Storage temperature   | -15 °C (-5 °F) ... +70 °C (+158 °F) |
| Operating temperature | -15 °C (-5 °F) ... 70 °C (158 °F)   |
| Humidity              | 10 % ... 90 % non condensing        |

Ambient temperature above 50 °C (122 °F) requires heat dissipation measures.

#### Notice

The housing improves the temperature management for the camera in use, the environmental temperature may be 5 K higher than in applications without housing.



### 3.1.2 Clamp elements assembly

The mounting with clamp elements ensures flexible camera positioning and good heat dissipation. Follow these steps for a vibration proof camera positioning.

1. Remove the blue cover foil from the double sided adhesive heat conductive tape.

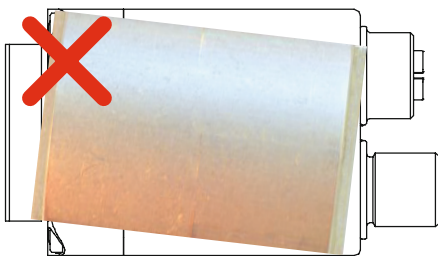


2. Place the clamp element with the adhesive tape on the top side of the camera.

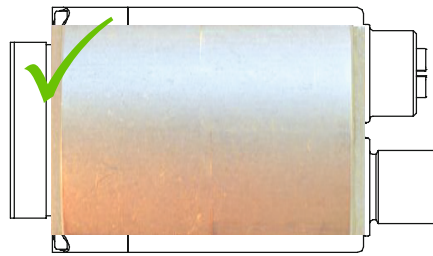
#### Notice

The alignment of the clamp element (straight and in the centre of the camera) determines the orientation of the camera inside the enclosure.

The more accurate the positioning of the clamp element, the more accurate the camera positioning later inside the enclosure.



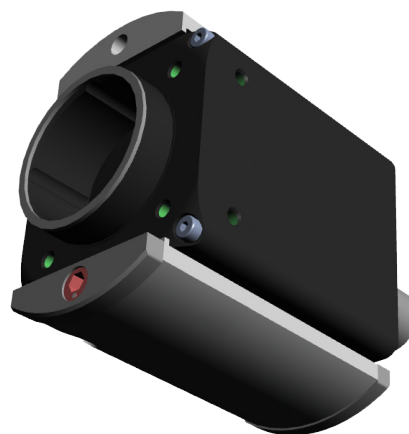
Clamp element misaligned



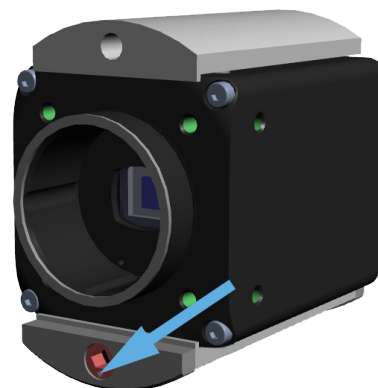
Clamp element correctly placed (straight and centred)

3. Place the quick-lock element loose onto the opposite side of the camera body.

No adhesive tape is required here, as the clamp element block already determines the camera orientation.



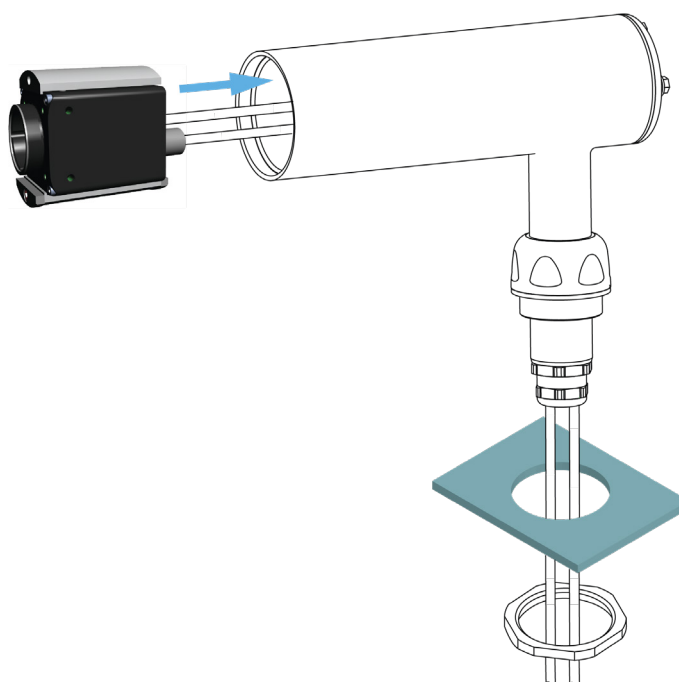
4. The dot mark on the two eccentric screws should face the camera, prior to insertion of this assembly into the enclosure profile (otherwise the camera assembly is too high to fit into the enclosure).



5. Insert the camera assembly into the enclosure. At this point, the camera cables should already be attached to the camera.

#### Notice

The rubber cable gland seal insert can be mounted later – this makes it easier to mount the camera into the enclosure! Do not forget to feed the cables through the cable gland nut first!

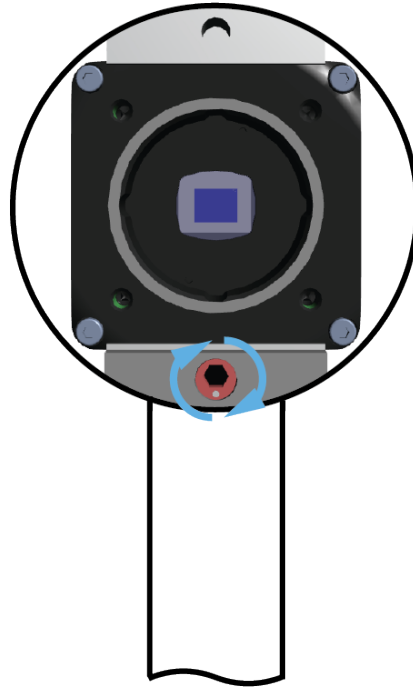


6. In order to secure the camera assembly in position, turn the eccentric screw at the front clockwise or anti-clockwise!

The clamp elements are fully extended, if the dot mark points to the enclosure wall.

However, depending on the camera tolerances, it might not be required to fully extend the clamp elements – a quarter turn might be sufficient. A fastening torque of 2Nm is sufficient in order to reach a clamping force of 900N, so a firm but not excessive tightening is recommended.

Position the lens so that it protrudes no more than 23 mm from the edge of the Housing Base Set B, otherwise the tube will not fit!

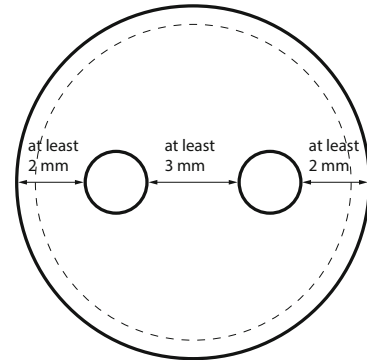


### 3.1.3 Cable gland

#### Notice

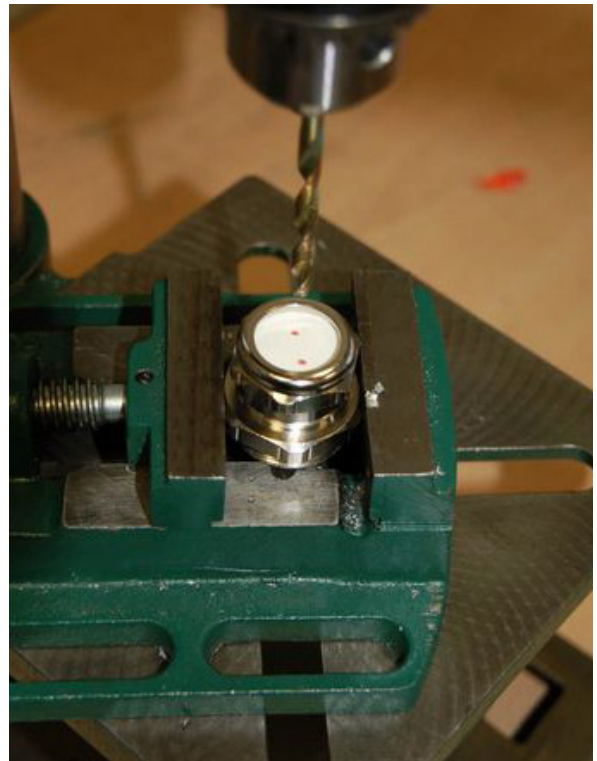
The cable gland maintains the high IP68 rating if done carefully!

1. Position the holes evenly across the seal insert with at least 2 mm distance to the rim of the cable gland and 3 mm distance between the holes.



2. Drill the holes with a vertical axis drilling machine - no hand held ones!

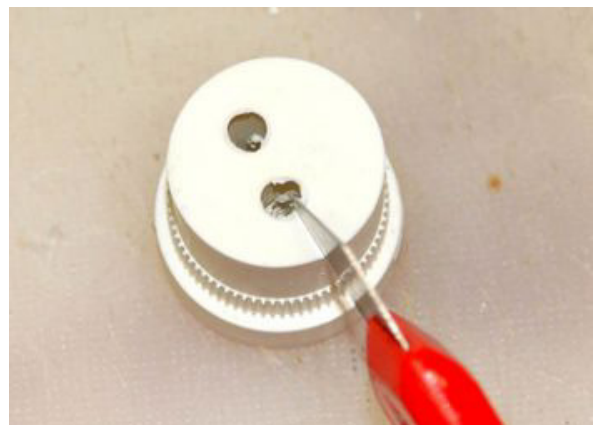
Use a normal HSS drill bit, with diameter about 0,5 mm larger than the cable diameter (this makes an exact hole with the soft material).



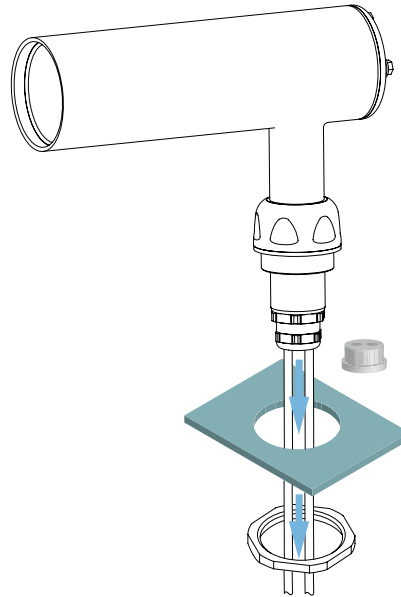
3. After drilling, slit the seal insert radial from the holes to the outside, using a sharp cutting knife.

#### Notice

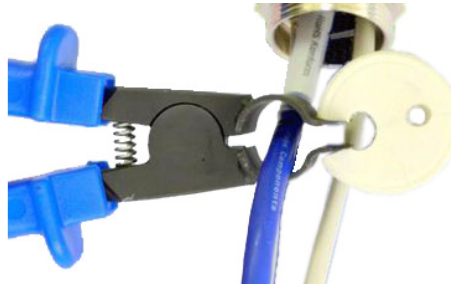
Do not use a sawing motion, but rather cut straight through for a cleaner cut.



4. Feed the cables through the nut and the cable gland.



5. After cable and camera positioning insert the cables from the side into the seal insert. These special pliers are helpful – alternatively use a screwdriver to open up the cut in the cable gland seal.



**Notice**

Take care not to damage the cable gland seal during this process!

6. Push the seal insert with the cables into the cable gland.

Tighten the cable gland nut with the recommended fastening torque (15 Nm).



**Caution**

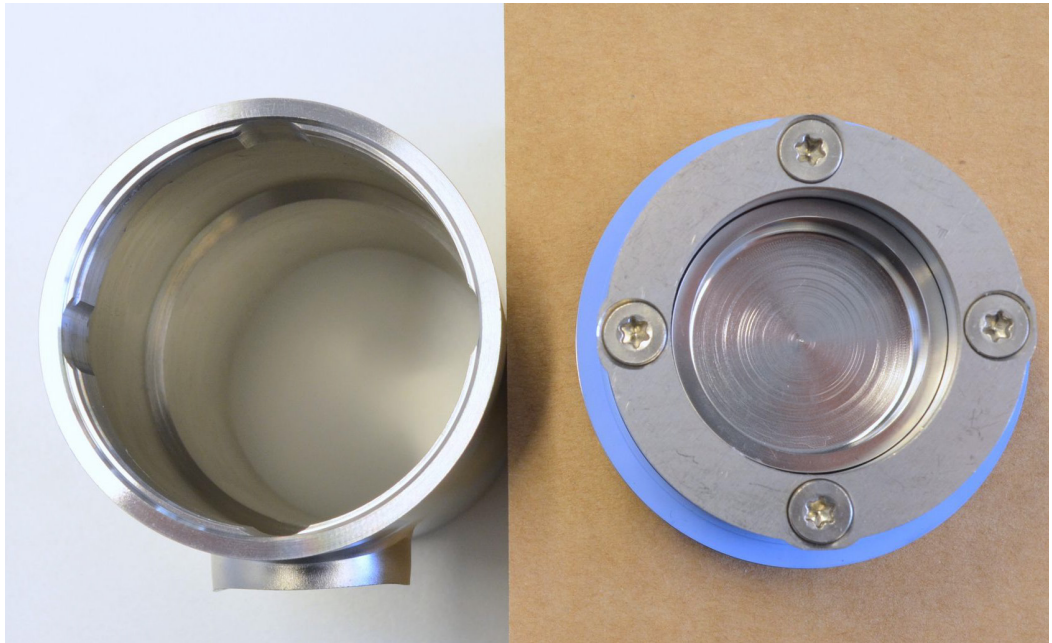


Tighten the cable glands with the recommended fastening torque. Excessive fastening torque may damage the sealing O-rings.

Insufficient tightening torques may reduce the protective rating (i.e. from IP67 to IP54).

### 3.1.4 Rear wall assembly

The rear wall preparation is done ex works from Baumer. However – please note these steps in case the rear wall has been dismantled.

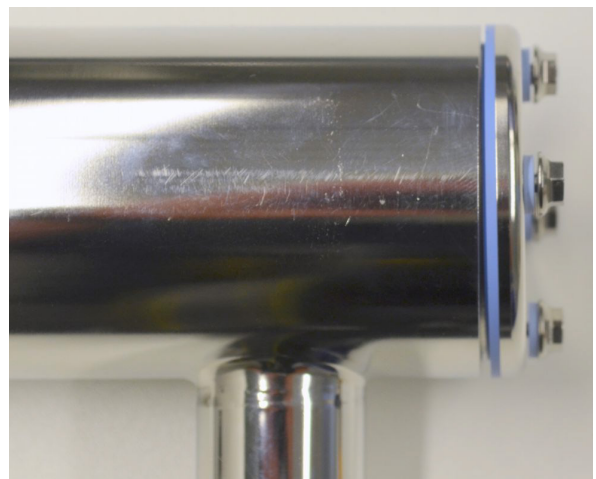


Housing Base Set B with bayonet rear wall

1. Place the rear wall on the back of the housing. To do this, insert the protruding noses into the grooves.



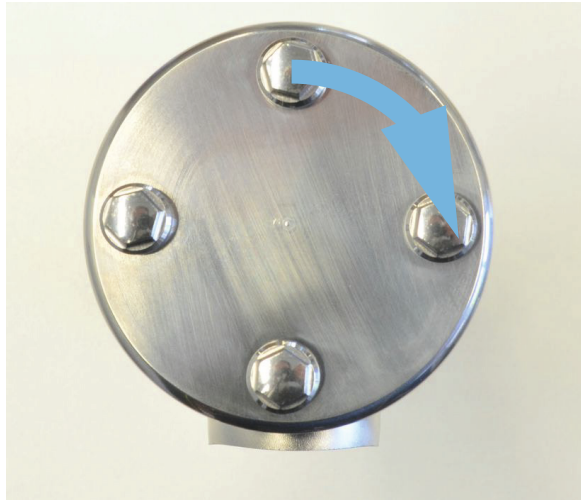
To do this, loosen the 4 screws by approx. 1.5 mm (2 turns).



3. Turn the rear wall clockwise one eighth turn (45°) until it stops.

**Notice**

If no stop is noticeable, then you must tighten the screws a little.

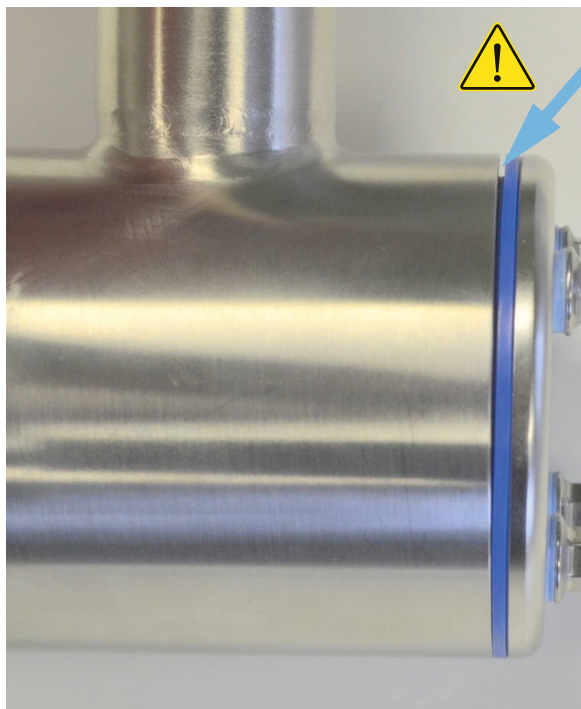


4. Tighten the screws crosswise only so far that the light blue cover seal is flush with the surface of the housing.

Do not tighten the lid so tight that the seal forms a bead and protrudes over the housing!



Avoid gaps between seal and enclosure!



5. After assembly, the internal view should look like this.

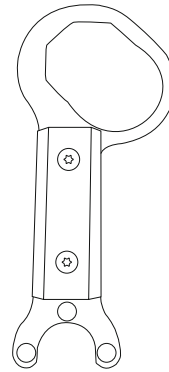




### 3.1.5 Tube assembly

#### Optional Tool

Housing V4A IP69K Mounting Tool (11208719)

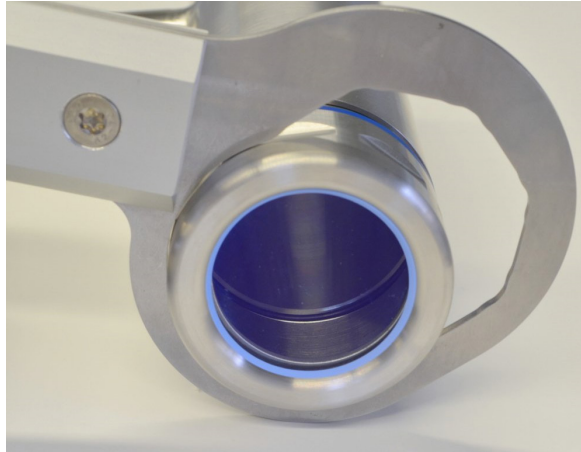


1. After positioning the camera, mount the Tube M60.

Check the sealing surfaces for possible damages and scratches.

Feed the mounting tool over the enclosure lid at the round hole end.

Slide the tool over the lid in a way that it sits between the jaws of the tool. Insert the enclosure completely and straight into the tool in order to avoid scratching the enclosure lid!



Tighten the lid firmly until no gaps are visible at the seal.


Do not tighten the lid so tight that the seal forms a bead and protrudes over the housing!



### 3.1.6 Approved cables

| Article number     | Designation                            | Smallest bending radius, fixed installation | Suitability @ IObj ≤ 50mm |       |     |
|--------------------|--|---|---------------------------|-------|-----|
| <b>VCXG.I(.XT)</b> |  |   |                           |       |     |
| 11101979           | Cable GigE M12X/RJ45, 5.0m             | 25.6 mm                                     | yes                       |       |     |
| 11117630           | Cable GigE M12X/RJ45, 10.0m            |   |                           |       |     |
| 11117632           | Cable GigE M12X/RJ45, 15.0m            |   |                           |       |     |
| 11117633           | Cable GigE M12X/RJ45, 20.0m            |   |                           |       |     |
| 11185139           | Cable GigE M12X/RJ45, 2.0m, STP, flex  | 35.34mm                                     | no                        |       |     |
| 11195760           | Cable GigE M12X/RJ45, 5.0m, STP, flex  |   |                           |       |     |
| 11195761           | Cable GigE M12X/RJ45, 10.0m, STP, flex |   |                           |       |     |
| 11195762           | Cable GigE M12X/RJ45, 15.0m, STP, flex |   |                           |       |     |
| 11196995           | Cable GigE M12X/RJ45, 20.0m, STP, flex |   |                           |       |     |
| 11185190           | Cable GigE M12X/RJ45, 30.0m, STP, flex |   |                           |       |     |
| 11201118           | ESG 34JP0200GS                         |   |                           | 30 mm | yes |
| 11195097           | ESG 34JP0500GS                         |   |                           |       |     |
| 11195098           | ESG 34JP1000GS                         |   |                           |       |     |
| 11195099           | ESG 34JP2000GS                         |   |                           |       |     |
| 11201128           | ESW 33JP0200GS                         |   |                           |       |     |
| 11195094           | ESW 33JP0500GS                         |   |                           |       |     |
| 11195095           | ESW 33JP1000GS                         |   |                           |       |     |
| 11195096           | ESW 33JP2000GS                         |   |                           |       |     |
| <b>VCXG</b>        |  |   |                           |       |     |
| 11150185           | Cable GigE RJ45s/RJ45, 5.0 m, chain    | 39.6 mm                                     | yes                       |       |     |
| 11150302           | Cable GigE RJ45s/RJ45, 10.0 m, chain   |   |                           |       |     |
| 11150186           | Cable GigE RJ45s/RJ45, 15.0 m, chain   |   |                           |       |     |
| 11150188           | Cable GigE RJ45s/RJ45, 20.0 m, chain   |   |                           |       |     |
| 11173256           | Cable GigE RJ45s/RJ45, 10.0m, flex v2  | 42 mm                                       | yes                       |       |     |
| 11173257           | Cable GigE RJ45s/RJ45, 20.0m, flex v2  |   |                           |       |     |
| 11173258           | Cable GigE RJ45s/RJ45, 30.0m, flex v2  |   |                           |       |     |
| 11118810           | Z-ESG 32FP0500G                        | 29.5 mm                                     | yes                       |       |     |
| 11138385           | Z-ESG 32FP1000G                        |   |                           |       |     |
| 11105262           | Z-ESW 31FH0500                         | 25.5 mm                                     | yes                       |       |     |
| <b>VCXU</b>        |  |   |                           |       |     |
| 11140628           | KSG U2/KSGU6GV0300G                    | 58 mm                                       | yes                       |       |     |
| 11140627           | KSG U2/KSGU6GV0500G                    | 125 mm                                      | no                        |       |     |

## 4. IP rating and chemical resistance

| ⚠ Caution   |   |
|---|---|
|  | As a large number of chemical substances are used, we ask for your understanding that we can not test them all.                         |
|   | The chemical substances must be tested on an discreet area of the device under application conditions to evaluate if they are suitable. |

### 4.1 IP Protection Classes (EN 60529)

#### Solid particle protection

The first digit indicates the level of protection that the enclosure provides against access to hazardous parts.

| Level (1st digit) | Effective against | Description  |
|-------------------|-------------------|--|
| 5                 | Dust protected    | Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment. |
| 6                 | Dust tight        | No ingress of dust; complete protection against contact (dust tight). A vacuum must be applied. Test duration of up 8 hours based on air flow.         |

| Level (2st digit) | Effective against                           | Description  |
|-------------------|---|--|
| 4                 | Splashing of water                          | Water splashing against the enclosure from any direction shall have no harmful effect, utilizing either: a) an oscillating fixture, or b) A Spray nozzle with no shield, Test duration: 10 min.  |
| 5                 | Water jets                                  | Water projected by a nozzle (6.3 mm) against enclosure from any direction shall have no harmful effects. Test duration: 1 min/m <sup>2</sup> for at least 3 min, 12.5 l/min @30 kPa at 3 m distance.                                   |
| 6                 | Powerful water jets                         | Water projected powerful jets (12.5 mm nozzle) against the enclosure from any direction shall have no harmful effects. Test duration: 1 min/m <sup>2</sup> for at least 3 min, 100 l/min @30 kPa at 3 m distance.                      |
| 6K                | Powerful water jets with increased pressure | Water projected in powerful jets (6.3 mm nozzle) against the enclosure from any direction, under elevated pressure, shall have no harmful effects (DIN40050, not IEC 60529). Test duration: 3 min, 75 l/min @1000 kPa at 3 m distance. |
| 7                 | Immersion up 1 m depth                      | Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time Test duration: 30 min, 1 m below water surface.                                       |
| 8                 | Immersion 1 m or more depth                 | The equipment is suitable for continuous immersion in water. Water can enter in such a manner that it produces no harmful effects. Manufacturer specified duration and water depth (> IPx7, 3 m typical).                              |
| 9K                | Powerful high temperature water jets        | Protected against close-range high pressure / temperature spray downs. Test duration: 30 s each of four angles, spray nozzle with 80 °C water at 8 - 10 MPa (80 - 100 bar) and a flow rate of 14 - 16 l/min.                           |

Lower IP ratings are not automatically included in the higher classes, e.g. IP66 is not part of IP67 and IP68 / IP69K do not include any other ratings!

Testing time and depth of IP68 is specified by the manufacturer (not unlimited time!).

Suitable cables have to be used in combination with the cable glands to fulfil the IP protection class.

## 4.2 Chemical resistance of sealing materials

### 4.2.1 EPDM, TPE

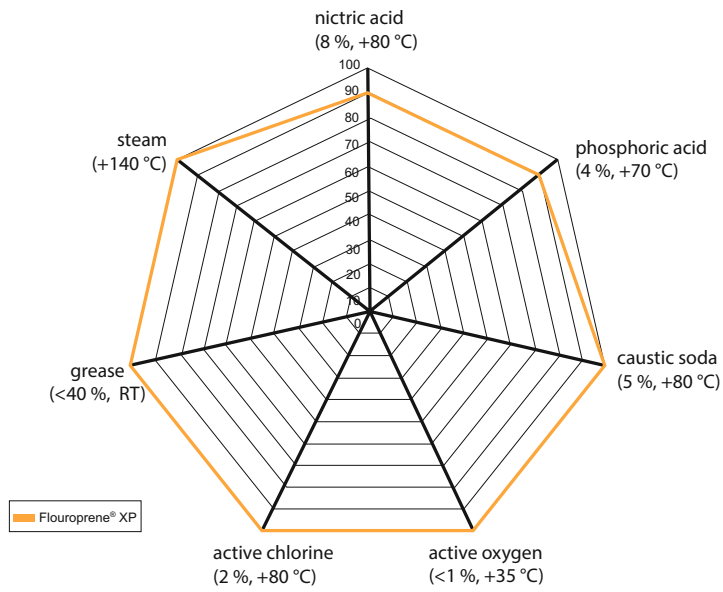
This table has been compiled from several sources, the classification may therefore vary and is a general guideline only!

1 = very good chemical resistance; 2 = good resistance; 3 - 4 = limited resistance; 5 - 6 not resistant

|   | EPDM           | TPE             |
|---|----------------|-----------------|
| temperature (min.; max.)                      | -40; 120 (150) | -40; 130        |
| ageing  | 1              | 1               |
| ozone   | 1              | 1               |
| gas permeability                              |                |                 |
| suitable for food appl.                       |                |                 |
| water   | 1              | 1               |
| hot water (100 °C)                            | 1              |                 |
| see water                                     | 2              | 1               |
| steam   | 1              |                 |
| chlorine                                      | 3              |                 |
| chlorine (gaseous, 20 °C)                     | 3              | 3               |
| <b>hydrocarbons:</b>                          | 5              | 2               |
| mineral oil                                   | 5              | 2               |
| petrol  | 5              | 3               |
| diesel  | 3              |                 |
| alcohol                                       |                |                 |
| ethanol (20 °C)                               | 1              | 1               |
| ketone  | 2              |                 |
| acetone (100 %, 20 °C)                        |                | 3               |
| ammonia, diluted (10 %, 20 °C)                |                | 3               |
| servo steering fluids                         |                | 5               |
| break fluids based on Glycol-ether            | 1              | 5               |
| cyclohexane                                   |                |                 |
| <b>Acids:</b>                                 | 2              |                 |
| acetic acid 30 %                              | 3              |                 |
| acetic acid 50 %                              | 3              |                 |
| acetic acid (100 %, 20 °C)                    | 5              | 2               |
| silicic acid, diluted, (60 °C)                | 2              |                 |
| phosphoric acid, diluted (20 °C)              |                | up to<br>85 % 2 |
| nitric acid, concentrated                     | 5              |                 |
| nitric acid, diluted (50 %, 20 °C)            | 3              | up to<br>30 % 2 |
| hydrochloric acid (20 °C)                     | 2              |                 |
| hydrochloric acid, diluted<br>(30 %, 20 °C)   | 2              | up to<br>10 % 1 |
| sulfuric acid, concentrated (50 °C)           | 2              |                 |
| sulfuric acid, diluted (20 °C)                | 2              | up to<br>98 % 1 |
| citric acid (up to 10 %, 40 °C)               | 1              | 2               |
| <b>Bases:</b>                                 | 2              |                 |
| caustic soda, diluted (10 %, 20 °C)           | 2              | up to<br>50 % 2 |
| bleaching lye (20 °C)                         |                |                 |
| potassium hydroxide, diluted<br>(50 %, 20 °C) | 5              | up to<br>10 % 2 |
| soap solution (20 °C)                         | 1              | 1               |
| suds  |                |                 |

## 4.2.2 Flouroprene® XP

The resistance of Flouroprene® XP to various chemicals is shown in the following figure.



### 4.2.3 Acrylic glass

Explanation of the characters and abbreviations of the following result lists:

---

|      |   |  |
|------|---|--|
| Conc | = | concentration of the test chemical in max. possible chemical purity or aqueous solution                              |
| Mat  | = | material, i.e. type of semi-finished product from which the test specimens were made                                 |
| 233  | = | PLEXIGLAS® GS  |
| SP   | = | Stress crack resistance ("Röhms test method", bending test)  |
| CB   | = | Chemical resistance (similar to DIN 53476)   |
| EZ   | = | Contact time for chemical resistance test in days, for short time test (1 minute)                                    |
| GB   | = | Overall assessment, i.e. critical summary of visual assessments of stress cracking behaviour and chemical resistance |

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+ = resistant

o = conditionally resistant

- = not resistant

#### 4.2.3.1 Alcohols, mono- and polyhydric

| Chemical Conc                            | Mat | SP | CB | EZ | CB-assessment               | CB-short term check | GB |
|--|-----|----|----|----|-----------------------------|---------------------|----|
| <b>1-butanol</b>                         |     |    |    |    |                             |                     |    |
| 100 %                                    | 233 | -  | -  | 28 | crack formation, swollen    | no change           | -  |
| <b>1-hexanol</b>                         |     |    |    |    |                             |                     |    |
| 98%                                      | 233 | -  | +  | 28 | no change                   | no change           | o  |
| <b>1-methoxy- 2-propanol</b>             |     |    |    |    |                             |                     |    |
| 99%                                      | 233 | -  | -  | 1  | strongly swollen, dissolved | no change           | -  |
| <b>1-pentanol</b>                        |     |    |    |    |                             |                     |    |
| 100%                                     | 233 | -  | O  | 28 | crack formation, swollen    | no change           | -  |
| <b>2-propanol</b>                        |     |    |    |    |                             |                     |    |
| 100%                                     | 233 | -  | -  | 7  | crack formation, swollen    | no change           | -  |
| <b>cyclohexanol</b>                      |     |    |    |    |                             |                     |    |
| 99,5%                                    | 233 | -  | +  | 28 | no change                   | no change           | o  |
| <b>ethanol</b>                           |     |    |    |    |                             |                     |    |
| 100%                                     | 233 | -  | -  | 7  | soft, swollen               | no change           | -  |
| 50%                                      | 233 | -  | -  | 7  | swollen                     | no change           | -  |
| <b>ethylenglykol (freeze protection)</b> |     |    |    |    |                             |                     |    |
| 50%                                      | 233 | +  | +  | 28 | no change                   | no change           | +  |
| <b>glycerine</b>                         |     |    |    |    |                             |                     |    |
| 98%                                      | 233 | +  | +  | 28 | no change                   | no change           | +  |
| <b>methanol</b>                          |     |    |    |    |                             |                     |    |
| 100%                                     | 233 | -  | -  | 1  | soft, swollen               | no change           | -  |
| <b>phenol (dissolved in water)</b>       |     |    |    |    |                             |                     |    |
| 5%                                       | 233 | -  | -  | 1  | white, sticky, swollen      | no change           | -  |

#### 4.2.3.2 Organic solvents, fuels

| Chemical Conc                                  | Mat | SP | CB | EZ | CB-assessment             | CB-short term check | GB |
|--|-----|----|----|----|---------------------------|---------------------|----|
| <b>butyl acetate (acetic acid butyl ester)</b> |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 1  | strong swollen, solved    | no change           | -  |
| <b>vinegar ester (ethyl acetate)</b>           |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 1  | strong swollen, solved    | no change           | -  |
| <b>pentyl acetate (amylacetat)</b>             |     |    |    |    |                           |                     |    |
| 98%  | 233 | -  | -  | 28 | swollen, solved           | no change           | -  |
| <b>acetone</b>                                 |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 28 | strong swollen, solved    | no change           | -  |
| <b>cyclohexanone</b>                           |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 7  | sample strongly dissolved | no change           | -  |
| <b>diethyl ketone</b>                          |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 1  | strong swollen, solved    | no change           | -  |
| <b>ethyl methyl ketone</b>                     |     |    |    |    |                           |                     |    |
| 99,5%  | 233 | -  | -  | 1  | strong swollen, solved    | no change           | -  |
| <b>cyclohexane</b>                             |     |    |    |    |                           |                     |    |
| 99,5%  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>iso-octane</b>                              |     |    |    |    |                           |                     |    |
| 99,5%  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>n-heptane</b>                               |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>n-hexane</b>                                |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>formamid</b>                                |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>N-methylformamide</b>                       |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 7  | swollen, dull             | no change           | -  |
| <b>perchlorethylene (tetrachlorethylene)</b>   |     |    |    |    |                           |                     |    |
| 99%  | 233 | -  | -  | 28 | matt, surface soft        | no change           | -  |
| <b>shellsole T</b>                             |     |    |    |    |                           |                     |    |
|  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>Turpentine replacement</b>                  |     |    |    |    |                           |                     |    |
|  | 233 | -  | +  | 28 | no change                 | no change           | o  |
| <b>turpentine oil (DAB 7)</b>                  |     |    |    |    |                           |                     |    |
|  | 233 | -  | +  | 28 | no change                 | no change           | o  |



|                                    |     |   |   |    |                          |               |   |
|------------------------------------|-----|---|---|----|--------------------------|---------------|---|
| <b>carbon tetrachloride</b>        |     |   |   |    |                          |               |   |
| 99%                                | 233 | - | - | 1  | swollen, slightly solved | no change     | - |
| <b>diesel fuel (DIN 51601)</b>     |     |   |   |    |                          |               |   |
|                                    | 233 | - | + | 28 | no change                | no change     | o |
| <b>FAM test fuel (DIN 51604 A)</b> |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 1  | strong swollen, sticky   | no change     | - |
| <b>FAM test fuel (DIN 51604 B)</b> |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 1  | swollen, solved          | slightly dull | - |
| <b>FAM test fuel (DIN 51604 C)</b> |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 1  | swollen, solved          | no change     | - |
| <b>Fuel no. 1 (DIN 53521)</b>      |     |   |   |    |                          |               |   |
|                                    | 233 | - | + | 28 | no change                | no change     | o |
| <b>Fuel no. 2 (DIN 53521)</b>      |     |   |   |    |                          |               |   |
|                                    | 233 | - | + | 28 | no change                | no change     | o |
| <b>Gasoline Normal (unleaded)</b>  |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 28 | swollen, yellow          | no change     | - |
| <b>Gasoline Normal (leaded)</b>    |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 28 | light brown discoloured  | no change     | - |
| <b>Gasoline Super (unleaded)</b>   |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 28 | swollen, yellow          | no change     | - |
| <b>Gasoline Super (leaded)</b>     |     |   |   |    |                          |               |   |
|                                    | 233 | - | - | 7  | swollen, soft, yellow    | no change     | - |
| <b>petroleum</b>                   |     |   |   |    |                          |               |   |
|                                    | 233 | - | + | 28 | no change                | no change     | o |

#### 4.2.3.3 Acids (organic and inorganic)

| Chemical Conc                               | Mat | SP | CB | EZ | CB-assessment               | CB-short term check  | GB |
|---|-----|----|----|----|-----------------------------|----------------------|----|
| <b>citric acid</b>                          |     |    |    |    |                             |                      |    |
| 10%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| 38%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>formic acid</b>                          |     |    |    |    |                             |                      |    |
| 5%  | 233 |    | +  | 28 | no change                   | no change            |    |
| <b>acetic acid</b>                          |     |    |    |    |                             |                      |    |
| 100%  | 233 | -  | -  | 1  | samples dissolved           | no change            | -  |
| 5%  | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>hydrofluoric acid</b>                    |     |    |    |    |                             |                      |    |
| 40%   | 233 | -  | -  | 1  | swollen, soft, white        | slightly swollen     | -  |
| <b>lactic acid</b>                          |     |    |    |    |                             |                      |    |
| 20%   | 233 | -  | +  | 28 | no change                   | no change            | o  |
| 90%   | 233 | -  | -  | 7  | strong swollen, white, soft | no change            | -  |
| <b>oxalic acid</b>                          |     |    |    |    |                             |                      |    |
| 8,7%  | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>Phosphoric acid</b>                      |     |    |    |    |                             |                      |    |
| 50%   | 233 | -  | +  | 28 | no change                   | no change            | o  |
| 85%   | 233 | -  | -  | 1  | strong swollen              | no change            | -  |
| <b>nitric acid</b>                          |     |    |    |    |                             |                      |    |
| 10%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| 40%   | 233 | -  | +  | 28 | no change                   | no change            | o  |
| 65%   | 233 | -  | -  | 1  | very strong swollen, soft   | matt, white, swollen | -  |
| <b>hydrochloric acid</b>                    |     |    |    |    |                             |                      |    |
| 10%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| 32%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>sulphuric acid</b>                       |     |    |    |    |                             |                      |    |
| 3%  | 233 | +  | +  | 28 | no change                   | no change            | +  |
| 30%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| 98%   | 233 | -  | -  | 1  | strong swollen              | matt, white, swollen | -  |
| <b>sulphamic acid (amidosulphonic acid)</b> |     |    |    |    |                             |                      |    |
| 18%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>tartaric acid</b>                        |     |    |    |    |                             |                      |    |
| 50%   | 233 | +  | +  | 28 | no change                   | no change            | +  |
| <b>oleic acid</b>                           |     |    |    |    |                             |                      |    |
| 99%   | 233 | -  | +  | 28 | no change                   | no change            | o  |

#### 4.2.3.4 Leach

| Chemical Conc           | Mat | SP | CB | EZ | CB-assessment | CB-short term check | GB |
|-------------------------|-----|----|----|----|---------------|---------------------|----|
| <b>Ammonia solution</b> |     |    |    |    |               |                     |    |
| 10%                     | 233 | +  | +  | 28 | no change     | no change           | +  |
| 25%                     | 233 | +  | +  | 28 | no change     | no change           | +  |
| <b>Caustic soda</b>     |     |    |    |    |               |                     |    |
| 1%                      | 233 | +  | +  | 28 | no change     | no change           | +  |
| 10%                     | 233 | +  | +  | 28 | no change     | no change           | +  |
| 30%                     | 233 | +  | +  | 28 | no change     | no change           | +  |

#### 4.2.3.5 Salts, inorganic and organic (saturated solutions)

| Chemical Conc                              | Mat | SP | CB | EZ | CB-assessment       | CB-short term check | GB |
|--|-----|----|----|----|---------------------|---------------------|----|
| <b>aluminium chloride</b>                  |     |    |    |    |                     |                     |    |
| 42%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>iron(II) sulphate</b>                   |     |    |    |    |                     |                     |    |
| 21%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>iron(III) chloride</b>                  |     |    |    |    |                     |                     |    |
| 48%  | 233 | +  | o  | 28 | slightly brown      | no change           | o  |
| <b>potassium aluminium sulphate (alum)</b> |     |    |    |    |                     |                     |    |
| 5%   | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>potassium carbonate</b>                 |     |    |    |    |                     |                     |    |
| 50%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>potassium chloride</b>                  |     |    |    |    |                     |                     |    |
| 25%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>potassium nitrate</b>                   |     |    |    |    |                     |                     |    |
| 24%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>potassium permanganate</b>              |     |    |    |    |                     |                     |    |
| 6%   | 233 | +  | +  | 28 | matt, surface brown | no change           | +  |
| <b>potassium sulphate</b>                  |     |    |    |    |                     |                     |    |
| 10%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>copper sulphate</b>                     |     |    |    |    |                     |                     |    |
| 17%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>magnesium sulphate</b>                  |     |    |    |    |                     |                     |    |
| 21%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium acetate</b>                      |     |    |    |    |                     |                     |    |
| 32%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium carbonate (soda)</b>             |     |    |    |    |                     |                     |    |
| 2%   | 233 | +  | +  | 28 | no change           | no change           | +  |
| 20%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium chloride (common salt)</b>       |     |    |    |    |                     |                     |    |
| 10%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium phosphate</b>                    |     |    |    |    |                     |                     |    |
| 20%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium dihydrogen phosphate</b>         |     |    |    |    |                     |                     |    |
| 50%  | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>disodium hydrogen phosphate</b>         |     |    |    |    |                     |                     |    |
| 8,5%                                       | 233 | +  | +  | 28 | no change           | no change           | +  |
| <b>sodium hydrogen sulphate</b>            |     |    |    |    |                     |                     |    |

|   |     |   |   |    |                   |           |   |
|---|-----|---|---|----|-------------------|-----------|---|
| 40%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>sodium nitrate</b>                   |     |   |   |    |                   |           |   |
| 45%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>sodium sulphate (Glauber's salt)</b> |     |   |   |    |                   |           |   |
| 25%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>sodium chlorate</b>                  |     |   |   |    |                   |           |   |
| 49%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>sodium thiosulfate</b>               |     |   |   |    |                   |           |   |
| 41%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>zinc chloride</b>                    |     |   |   |    |                   |           |   |
| 50%                                     | 233 | o | + | 28 | no change         | no change | o |
| <b>zinc sulphate</b>                    |     |   |   |    |                   |           |   |
| 35%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>urea</b>                             |     |   |   |    |                   |           |   |
| 51%                                     | 233 | + | + | 28 | no change         | no change | + |
| <b>hydroquinone</b>                     |     |   |   |    |                   |           |   |
| 6,7%                                    | 233 | - | o | 28 | brown discoloured | no change | - |

#### 4.2.3.6 Inorganic compounds

| Chemical Conc   | Mat | SP | CB | EZ | CB-assessment | CB-short term check | GB |
|---|-----|----|----|----|---------------|---------------------|----|
| <b>hydrazine</b>  |     |    |    |    |               |                     |    |
| 15%   | 233 | +  | +  | 28 | no change     | no change           | +  |
| <b>hydrogen peroxide (hydrogen superoxide, perhydrol)</b> |     |    |    |    |               |                     |    |
| 3%  | 233 | +  | +  | 28 | no change     | no change           | +  |
| 30%   | 233 | +  | +  | 28 | no change     | no change           | +  |
| <b>sodium hypochloride</b>                                |     |    |    |    |               |                     |    |
| 12%   | 233 | +  | +  | 28 | no change     | no change           | +  |
| <b>water, fully desalinated</b>                           |     |    |    |    |               |                     |    |
|   | 233 | +  | +  | 28 | no change     | no change           | +  |

#### 4.2.3.7 Organic compounds

| Chemical Conc   | Mat | SP | CB | EZ | CB-assessment | CB-short term check | GB |
|---|-----|----|----|----|---------------|---------------------|----|
| <b>dibutylphthalate</b>                                       |     |    |    |    |               |                     |    |
| 99%   | 233 | -  | -  | 28 | solved        | no change           | -  |
| <b>diisobutylphthalate</b>                                    |     |    |    |    |               |                     |    |
| 97%   | 233 |    | +  | 28 | no change     | no change           |    |
| <b>paraffin, thin liquid</b>                                  |     |    |    |    |               |                     |    |
| 100%  | 233 | +  | +  | 28 | no change     | no change           | +  |
| <b>sebacic acid bis-2-ethyl hexyl ester (dioctylsebacate)</b> |     |    |    |    |               |                     |    |
|   | 233 | -  | +  | 28 | no change     | no change           | o  |
| <b>tricresyl phosphate</b>                                    |     |    |    |    |               |                     |    |
|   | 233 | -  | +  | 28 | no change     | no change           | o  |
| <b>castor oil</b>   |     |    |    |    |               |                     |    |
|   | 233 | -  | +  | 28 | no change     | no change           | +  |
| <b>Soya bean oil</b>  |     |    |    |    |               |                     |    |
|   | 233 | -  | +  | 28 | no change     | no change           | o  |
| <b>triethanolamine</b>  |     |    |    |    |               |                     |    |
| 98%   | 233 | +  | +  | 28 | no change     | no change           | +  |

## 5. Cleaning

### 5.1 Cleaning and care of acrylic glass (Tube M60)

Acrylic glass must not come into contact with organic solvents such as diluents, alcohols, fuels, etc. Also normal window cleaners usually contain alcohol.

Dilution fumes in workshops are also harmful. These substances react with acrylic glass and cause the material to become brittle and build up internal stresses. These can remain invisible for a longer period of time.

#### Acrylic glass will not forget anything!

First remove most of the dust with a rubber bellows. Never blow with your mouth. This causes saliva particles on the glass that leave difficult to remove stains.

Next, remove the dust on the glass with a very soft brush. Do not touch the brush bristles with your fingers, as this will cause grease and smudges. Do not exert too much pressure.

As long as the disc is only contaminated with loose dirt, it should be cleaned with a bellows as available from the photo area for cleaning lenses and sensors.



For heavier dirt wash the glass first with plenty of water from dust and sand grains. In the case of solid dirt, a thin soapy solution can then be used to reinforce the cleaning action. For this purpose household dishwashing detergents or special acrylic cleaners can be used.

Never use cleaners for true glass windows! These contain alcohol and other solvents and can lead to lasting damage even after one-time use. Use a sponge or polishing cloth and clean carefully. Care must be taken to ensure that there is no scratching dirt particles!

Special acrylic cleaners also contain solvents. These are dosed so that they do not damage on smooth surfaces and edges. However, if the glass is already damaged, the cleaner penetrates into small cracks and holes and acts longer there, tensions can also occur. It is therefore necessary to rinse with water. Finally, acrylic cleaner can be applied evenly to the surface with a soft cloth. This makes the cover glass dirt-repellent and antistatic.

#### Caution!



Ensure that no residues of the cleaning agent or scratches remain on the glass. These can permanently damage the reproducibility of the results from the camera inside.



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