		GE Power Patrik RAFFEINER Service Engineering Distributed Power GE Jenbacher GmbH & Co OG Achenseestr. 1-3 A-6200 Jenbach, Austria T +43 5244 600 2940 Patrik.Raffeiner@ge.com
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Service Technician Instruction	ST-205	07 August 2017

Engine type **All engine types**

Subject **Technical photography and borescopy**
Basic principles

The Service Technician Instruction ST-205 describes the procedure in principle for technical photography and borescopy as well as a method of compressing images.

AFFECTED ENGINES / SCOPE OF THIS BULLETIN

Jenbacher modules of all types worldwide.

PURPOSE OF THIS BULLETIN / NEED FOR ACTION

This ST is intended to serve as a guideline for the correct procedure when borescoping and photographing components. It also gives information on using cameras and borescopes generally, and describes a method of compressing the images.

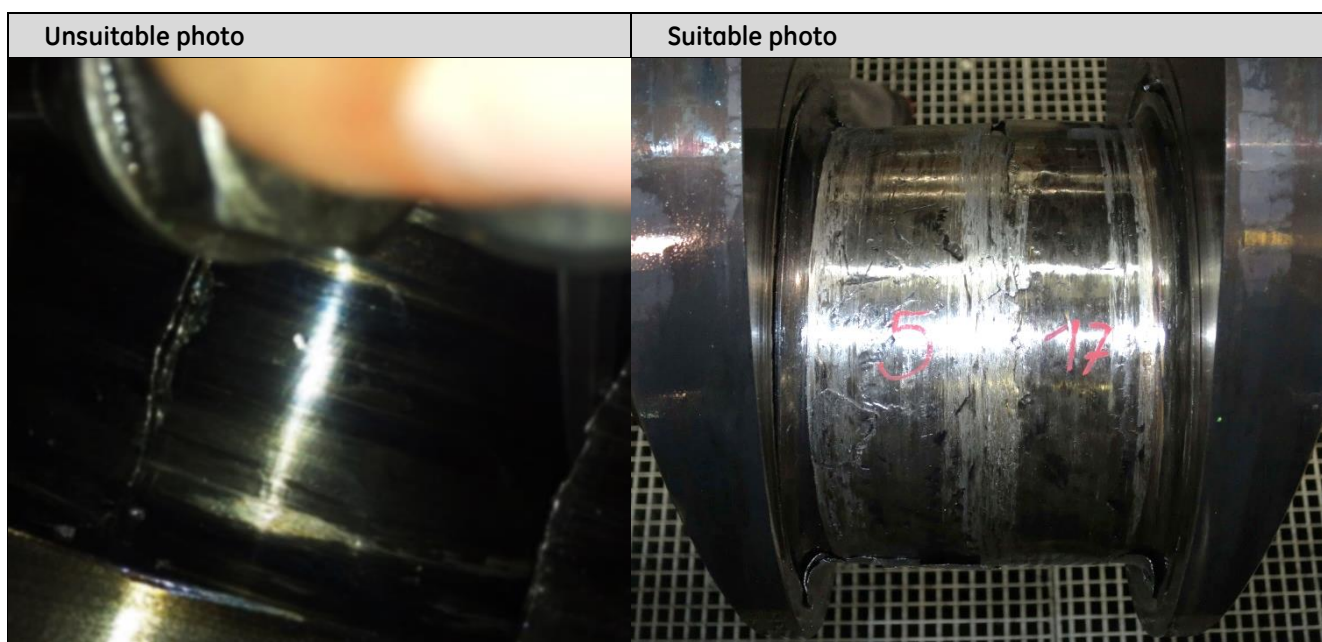


Fig. 1 Photo of bearing damage, received from the field

Fig. 2 Photo taken during an engine examination

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GENERAL GUIDELINES FOR TAKING PHOTOGRAPHS

First, it needs to be mentioned that due to the wide variety of cameras and borescopes (video borescopes) available, no specific information about how to use any individual piece of equipment is given. Instead, general guidelines and information are given that should be observed in order to take good quality photographs.

- 1) Basically, it is important that the photography of a problem or component should have a systematic structure. To put it better, photographs should always be taken from large to small, from outside to inside and from the general view to detail. This gives the viewer a better overall picture, which is often mandatory such as for failure analysis. It is therefore beneficial to take a few general photos of the problem or the component as a first step.

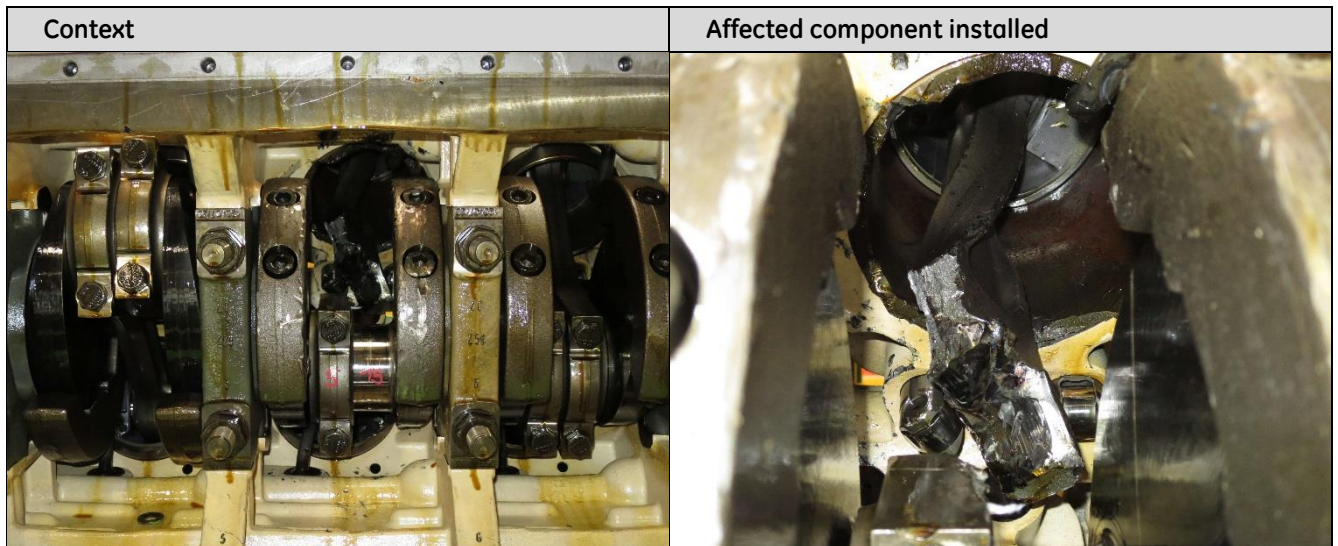


Fig. 3 General view of a conrod breakage

Fig. 4 View of the broken conrod as found



Fig. 5 Conrod fragments removed and put together

Fig. 6 Detailed view of the fracture surface



- 2) It is helpful to take photographs from several different angles. Not only does this give the viewer an overall picture and spatial impression, it also gives a greater choice of photographs from which to select.

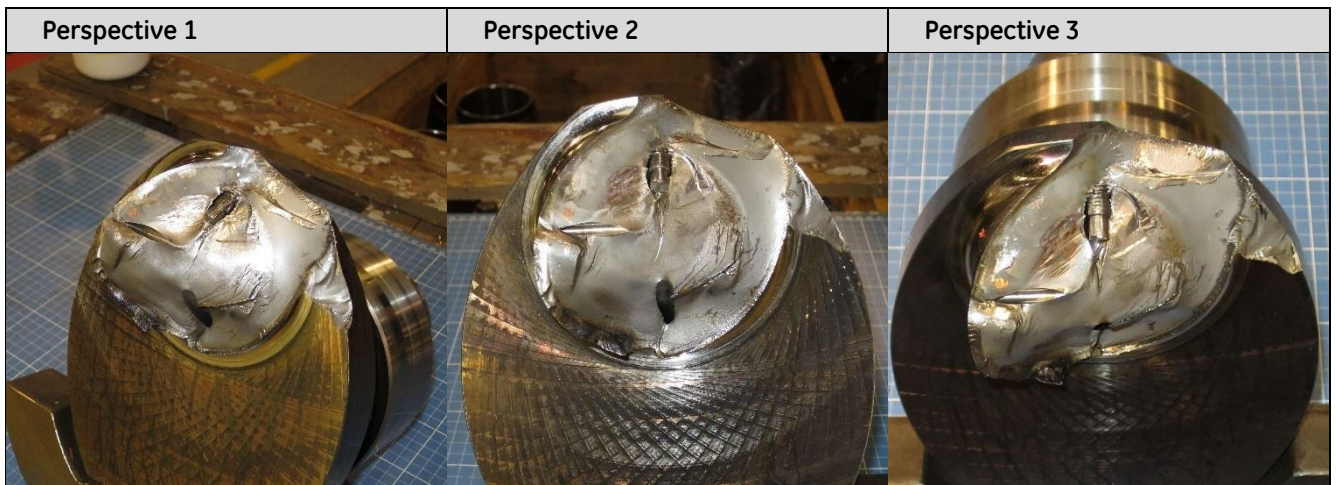


Fig. 7 Fracture surface of a crankshaft

Fig. 8 Fracture surface of a crankshaft

Fig. 9 Fracture surface of a crankshaft

- 3) Furthermore, parts should always be photographed when installed or as found in order to record any installation errors or misalignments, or to imply the course of events in a damage incident (e.g. photo of the conrod matching numbers before disassembly).

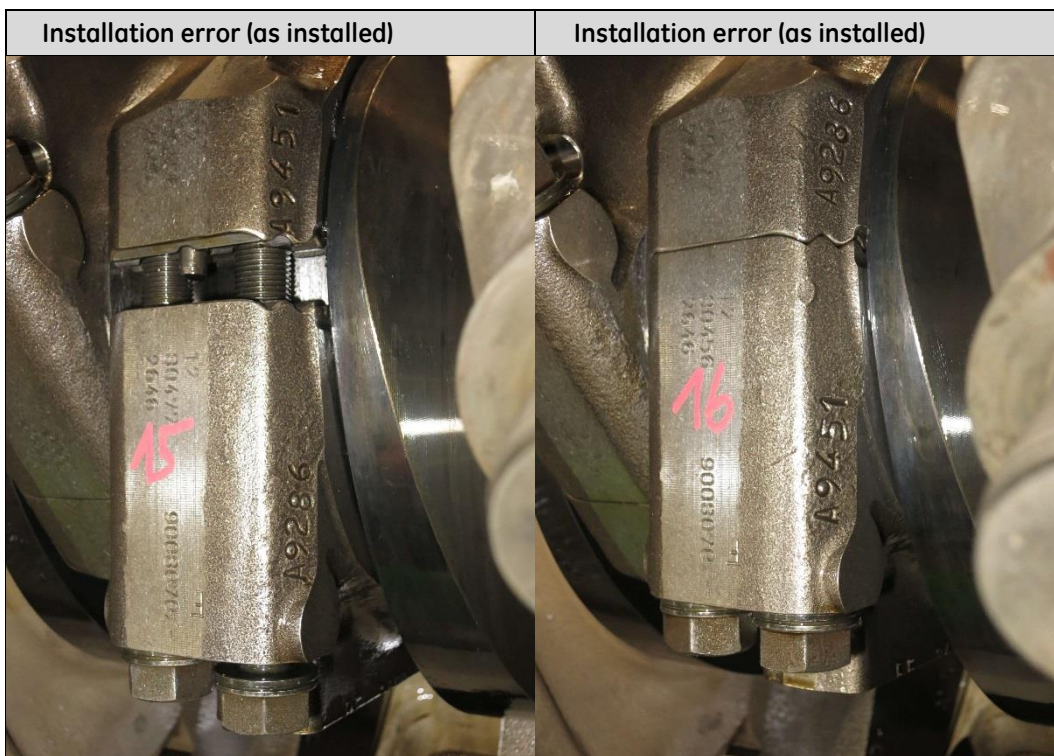


Fig. 10 Wrong assembled big-end caps
See the matching numbers

Fig. 11 Wrong assembled big-end caps
See the matching numbers

- 4) The parts can then be removed and examined afterwards. It is essential to photograph any deposits or unusual dirt contamination, such as oil coke on the piston rings, before the parts are cleaned. Even if there are no deposits, it is advisable to record this in a photo.



- 5) It must also be ensured that rear faces, adjacent components, "counterparts" or components that mutually affect each other are photographed as well. For example: big-end bearing → conrod, camshaft → tappet → tappet guide, piston → cylinder liner, etc. It is also advisable here to record the situation where no damage or unusual features are visible.



Fig. 12 Pressure point on a big-end bearing running surface

Fig. 13 Oil coke deposits on a big-end bearing back

Fig. 14 Oil coke deposits on a big-end cap

- 6) Components that are dirty or coated in a film of oil should be cleaned. When doing so, remember that the fracture surfaces in particular are very sensitive (to corrosion) and the greatest care must be taken when cleaning these. It is absolutely essential to spray the fracture surfaces with corrosion inhibitor after cleaning and photography. Contact with fingers should be avoided, as this can result in corrosion of the fracture surface microstructure and render it useless for evaluation under certain circumstances.
- 7) If the affected components are marked with part numbers, production years, matching numbers, manufacturer's information etc., these markings should also be photographed. For example, the positions of the conrod matching numbers are shown in ST-030.



Fig. 15 Production year, serial number and part number of a Type 6 engine conrod

Fig. 16 Part number and epsilon of the Type 6 engine steel piston



IMPORTANT



To avoid confusion, the engine type plate (and any additional plate present) of the engine in question should always be photographed and this photo included with the other photos that are sent. Make sure that the engraved numbers are clearly visible and legible in the photo. Wipe the type plate with a dirty glove if necessary to make the engraving more clearly visible.

8) The last point, which also applies to all the above points, is the labelling of the components. EVERYTHING which is photographed must be correspondingly labelled. The most important labelling attributes are:

- a) cylinder number, or main bearing number
- b) position of the parts when installed (e.g. 6 o'clock position of the cylinder liner or piston, upper and lower big-end bearing shells, etc.)
- c) views (front, rear, flywheel end, vibration-damper end, etc.)

Photographed components should always be clearly and unambiguously labelled so that they can be unequivocally identified. Parts can be marked directly with a pen, for example, or an additional text box can be inserted later, or the file image can be given an identifiable name, avoiding local special characters (e.g. Cyrillic, Chinese, etc.).

Labelling is especially important when working with endoscopes!

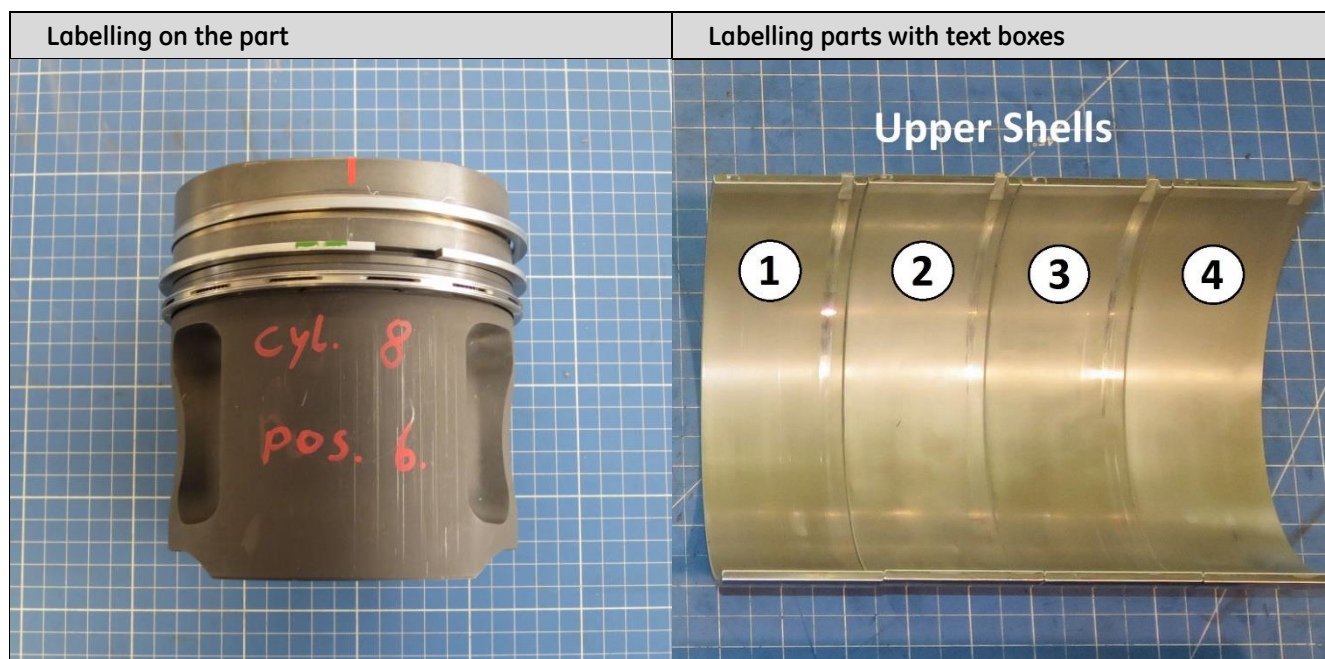


Fig. 17 6 o'clock markings on an aluminium piston

Fig. 18 Labelling big-end bearings with text boxes

9) The use of mobile phone cameras should be avoided if possible, since only the latest mobile phone cameras give anything like the quality of an average digital camera.



CAMERA

As already mentioned above, no detailed instructions can be given due to the large variety of cameras available. However, the points set out below apply in the same or similar ways to all cameras:

- The best results are generally always obtained using **AUTO (automatic mode)**, or "P mode" (automatic programme) if available. **Caution! "A" stands for aperture and not auto.**
 - It is important to have the camera focussed on the desired subject. Avoid having only the background in sharp focus while the "important" parts are blurred. Problems often arise particularly when photographing bores, as it may be difficult to focus on the bore and not the surface. However, the following method can be used:

On almost all cameras, pressing the shutter button halfway before taking the photograph focuses the camera on the desired subject. If this is not possible, for example with a bore, focus on the surface with the shutter button half pressed. The focus will not change any more if the shutter button is held. The camera can now be moved towards the bore as required. After moving, the focus will be correspondingly deeper in the bore.

A few trial attempts will no doubt be necessary to take a good photograph using this method.

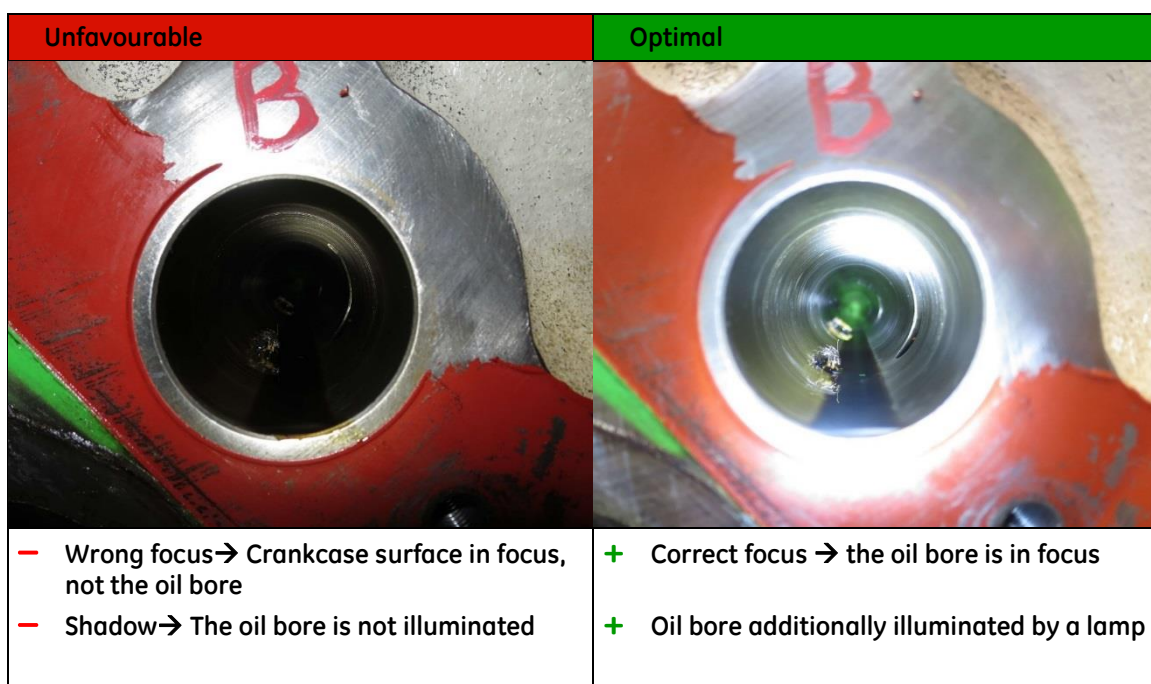


Fig. 19 Example of incorrect focusing and lighting

Fig. 20 Example of optimal focusing and lighting using an additional light source

TIP

The camera always moves a little when the shutter button is pressed, which causes the pictures to shake slightly. Use of a timer is recommended to avoid this. The timer is best set to one or two seconds.

- A suitable background should be selected for close-up or detailed views. A neutral-colour monochrome mat is ideal for this. Experience shows that medium to dark colours and mid-grey shades are suitable. Failing this, tables and clean workbenches are also suitable provided that they do not have a coarse pattern or grain. In an emergency a couple of sheets of paper or cardboard can be used, although it should be noted here that cameras have problems with very light backgrounds and dark subjects due to the high dynamic range of the photos, and the actual subjects often appear much too dark.

The advantages of selecting a good background are:

- in order to prevent reflections on shiny surfaces such as cylinder liners (clean backing, monochrome, no coarse pattern)
- in order to improve the white balance of the camera
use neutral colours → no bright colours and not white or too light

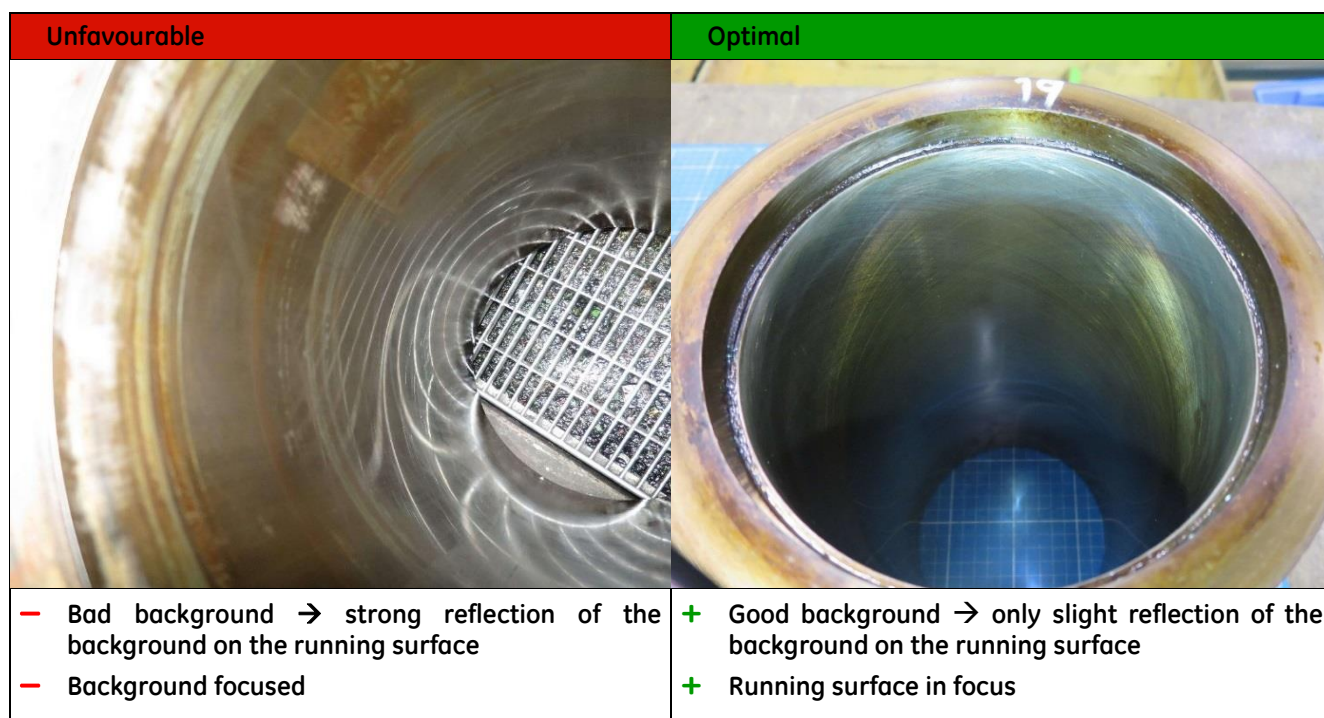


Fig. 21 Example of an unfavourable background selection

Fig. 22 Example of an optimal background selection

- The best photos are almost always taken using a flash. One advantage of this is that the photos have less camera shake under both good and bad light conditions, and are therefore sharper. However, flash photos tend to be underexposed if there is a light background or reflections. The following aspects should therefore be observed:
 - When taking photographs, do not get too close to the subject (especially in the case of small or reflective parts). It is better to stand back from the component and take a photo by using the zoom. Not only does this give more even lighting (less likely to result in under- or overexposure), but it also reduces any barrel distortion of the subject.
 - Taking photographs "straight on" (90°) of reflective surfaces should be avoided. We advise offsetting the camera a little. The difference between an incorrectly lit and a good photo is often only a few centimetres.
 - Especially when photographing bores, it must be kept in mind that the flash throws an additional shadow that can hide some places. Different angles or an additional light source (lamp) can produce a better photo here as well. The flash should be switched off when using an additional light source.

- Errors in the white balance can occur when using additional light sources. The result is then photos with a brown, green or blue tinge, depending on the light source used.

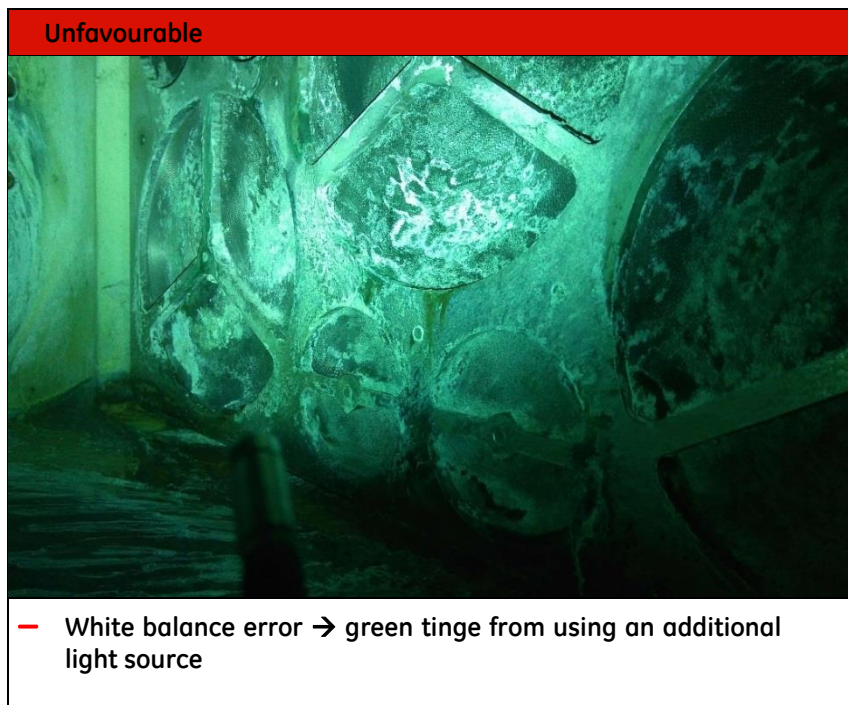


Fig. 23 Example of unfavourable use of an additional light source

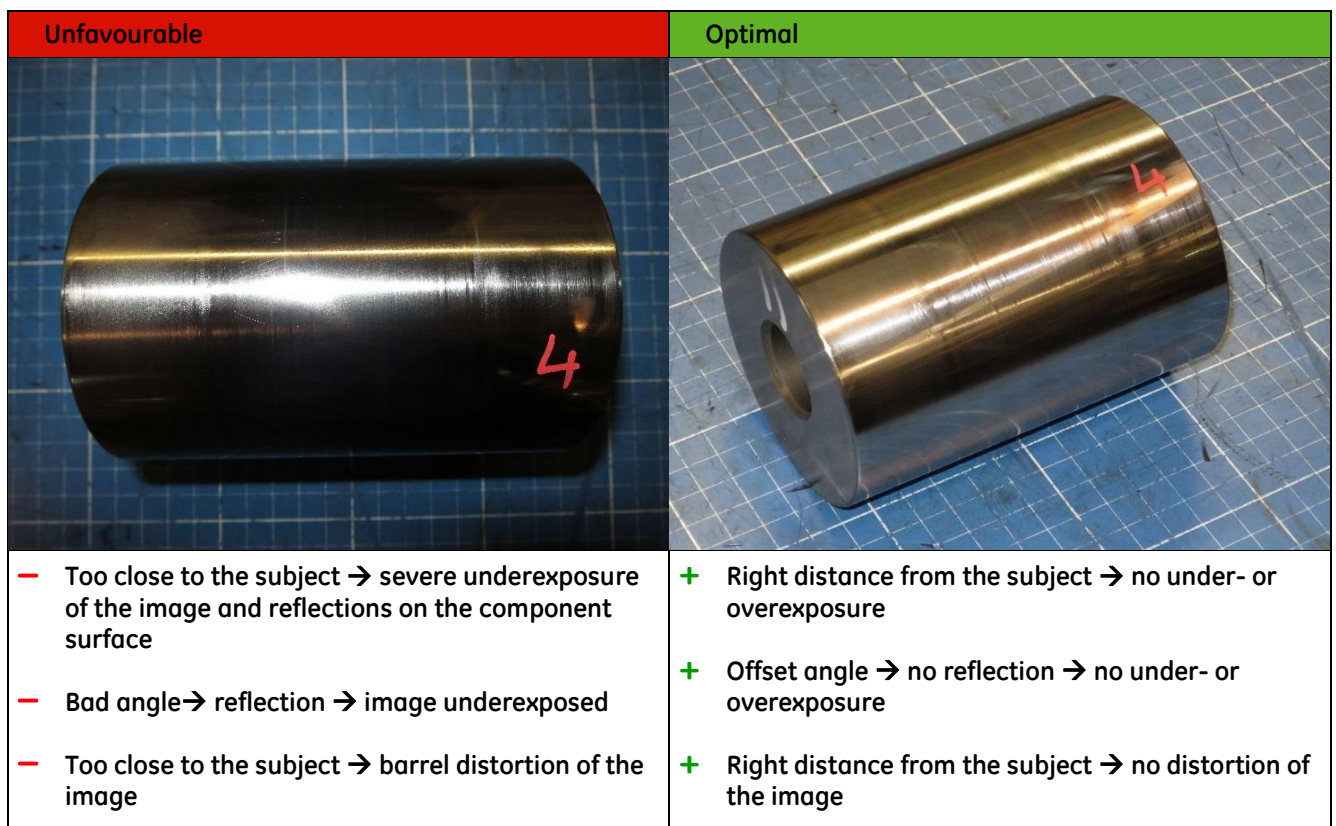


Fig. 24 Example of unfavourable use of flash

Fig. 25 Example of optimal use of flash



- All pictures should best be checked on the camera screen (if available) immediately after they are taken. If the quality of the photo is inadequate despite all the above precautions (blurred, underexposed, overexposed, etc.) the cause may be one of the following:

Possible reasons for mistakes and how to rectify them





Camera shake	Blurred	Underexposed	Overexposed
			
<ul style="list-style-type: none">• Stable support: rest the camera, hand or elbow on something when taking the photograph. <p>Use a timer, see TIP above,</p>	<ul style="list-style-type: none">• Check the camera lens: may be dirty, oily, marked by fingerprints, etc.	<p>Flash obscured?</p> <ul style="list-style-type: none">• Careful with your fingers! Do not obscure the flash. <p>Wrong ISO setting? ISO setting too small instead of neutral. On many cameras, the shutter speed can be varied manually from -2 to +2 aperture settings; it should be set to 0.</p>	<p>Too close to the subject?</p> <ul style="list-style-type: none">• Step back and zoom in <p>Unfavourable angle?</p> <ul style="list-style-type: none">• Change the angle to the subject slightly. <p>Wrong ISO setting? ISO setting too high instead of neutral On many cameras, the shutter speed can be varied manually from -2 to +2 aperture settings; it should be set to 0.</p>

Fig. 26 Example of an image with camera shake

Fig. 27 Example of a blurred image

Fig. 28 Example of an underexposed image

Fig. 29 Example of an overexposed image

GENERAL GUIDELINES WHEN ENDOSCOPING/VIDEOSCOPING

As already mentioned under the general guidelines for photographs, due to the wide variety of endoscopes there is no specific information about how to use any individual piece of equipment is given. Instead, general guidelines and information are given that should be observed in order to take good quality photographs

- The points mentioned in the "General Guidelines for taking photographs" section apply here as well:
 - 1) systematic structure
 - 2) several different views
 - 5) adjacent components
 - 8) labelling**

essentially also when using an endoscope. The labelling of the images is especially emphasised, as the parts themselves cannot be directly marked with a pen when using an endoscope. Experience shows that it is advisable to either write down the respective positions on a piece of paper and then take the photo with the endoscope, or to photograph the cylinder number on the ignition rail if still present.


- It is also important to ensure in advance that the correct equipment is brought along. This includes the right lenses (various focal lengths) and the correct working diameter of the endoscope.




ENDOSCOPE

Endoscopes include rigid and flexible endoscopes and all their various types. The most modern type of flexible endoscope is a video endoscope, often called videoscope. Digital imaging has made video endoscopes the most widespread method of image transmission. The focus here is therefore on endoscopy with a video endoscope.

- Video endoscopes should be operated in automatic mode, the same as cameras. Often no other mode is provided.
- Care must be taken when endoscoping to ensure that the lens does not become dirty. Particular care should be taken with oily bores.
- When photographing, whether with a videoscope or an endoscope, a stable lens position must be ensured. This applies especially under low light conditions, as in this case the exposure times are longer and the danger of camera shake is greater.

 **CAUTION**

**Do not turn the engine!**
The endoscope must be removed before turning the engine!

COMPRESSING AND SENDING IMAGES

Before one or more images can be sent, whether by e-mail or as part of a service request, etc., all images should be compressed. The aim of this is to reduce the size of the files while retaining almost all the quality of the images. Any reduction in the absolute resolution (pixels) is to be avoided. This is best done with a batch program that can compress several images or a complete folder. A program of this kind for GE employees can be found on the myTech page. <https://ge.service-now.com/mytech/>

We advise the following procedure for downloading the program and compressing the required images:

1. Open the above link. This will take you to the Mytech start-up page.
2. Click on "Start new chart" in the pop-up window.
3. Open the "**Request** *new technology*" drop-down menu at the top of the screen.
4. Click on "Windows software" under **Software**→. (Note: The program is only available for Windows systems!!)
5. Enter "Mass Image Compressor" in the search field in the middle of the box and click on Start.
6. The desired program is shown as the first search result. Select this by clicking on it.



Fig. 30 Mass Image Compressor search result

7. A new window will open. Continue by clicking on "Download now".

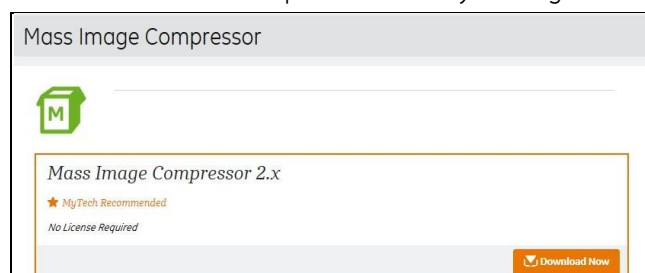


Fig. 31 Download Mass Image Compressor



8. Another window will open. To continue, accept the "Acceptable use of GE Information Resources" and "Tax Guidelines" and click on Submit Request.

Fig. 32 Acceptable use of GE Information und Tax Guidelines

9. Another pane will open. Follow the link below.

Fig.. 33 Installation instructions

10. You will now be directed to a new page. Click on the green download button to start the download.

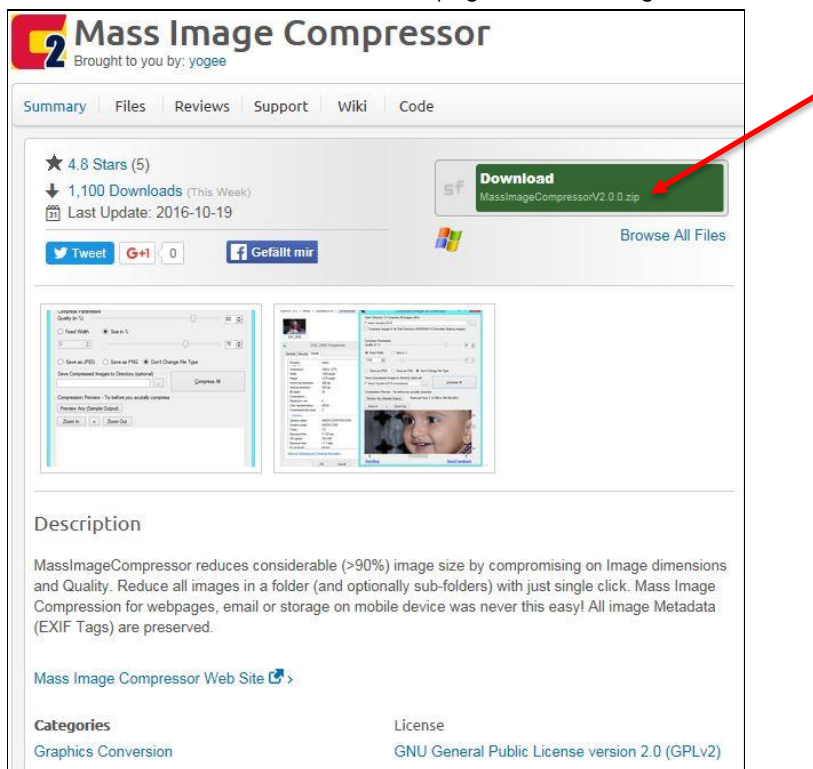


Fig. 34 Download page



11. Then open the downloaded files and run the setup.exe.
12. Follow the installation process and complete the program installation.
13. Now open the program.

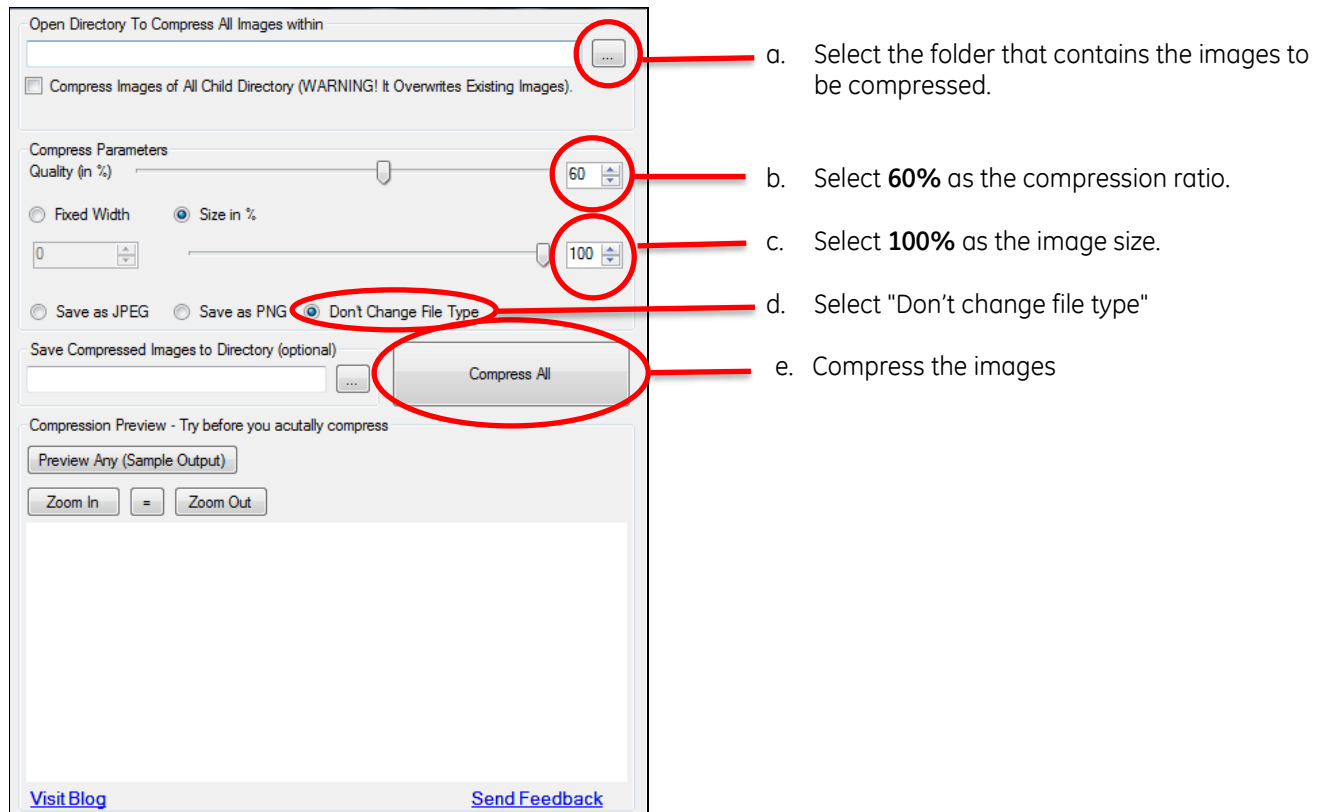


Fig. 34 Image Mass Compressor user interface

14. An additional folder will now be created in the target folder, in which the compressed photos will be saved. The original images will remain unchanged and the compressed images are available for further use.

RELEVANT DOCUMENTS

When working on GE Jenbacher modules, all applicable local regulations must of course be observed in addition to our documentation. We would like to draw particular attention in relation to this Service Technician Instruction to the fact that the following documents must also be observed:

- Service Technician Instruction ST-030: Correct fitting and handling of connecting rods
- Technical Instruction TA 1100-0111: General Conditions – Operation & Maintenance
- Technical Instruction TA 2300-0005: Safety regulations

REVISION CODE

INDEX	DATE	DESCRIPTION / REVISION SUMMARY
01	Aug. 07, 2017	First version of this document

Table 01: Revision history