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Laser Power Measurement EOS M400-4

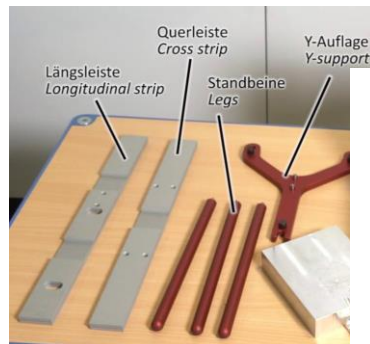
Laser Power Measurement Overview



Within the subsystems incorporated in a PBF-LB machine, the laser (or lasers) is undoubtedly the most critical, as it is responsible for generating the energy that fuses the particulate material.

Checking the laser power is a verification to be carried out before each additive manufacturing job, to ensure that this aspect of the system has not suffered deterioration or alterations.

This check is carried out through a measurement process, assisted by an external device.



EOS M400-4 Power
Measurement Set up Kit



Pocket Monitor



EOS M400-4 Measure Power
Measurement Set up

Laser Power Measurement Personal Protective Equipment (PPE)



The measurement of laser power is a task that can be part of a general process of cleaning, maintenance, and checking between consecutive jobs. The F-theta lens must be cleaned using the appropriate procedure before carrying out the laser power measurement.

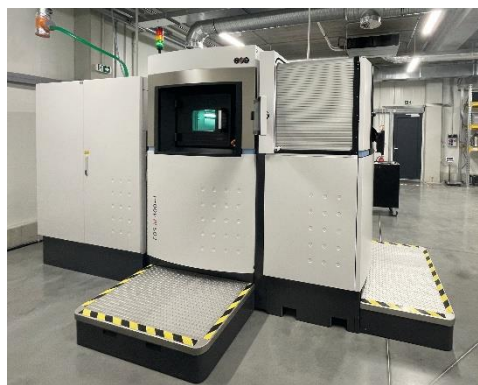
Assuming that the process chamber has to be clean and free of particulate material, the measurement of laser power presents a single main risk to people, which is the risk of burns from direct contact with the part of the measuring device exposed to the laser beam, which can reach temperatures higher than 100°C.



Use of basic PPE is sufficient for a laser power measurement operation. However, a special care must be taken when handling the measuring device once it has been exposed to the laser beam and heat resistant gloves should be worn.

Laser Power Measurement Working Area

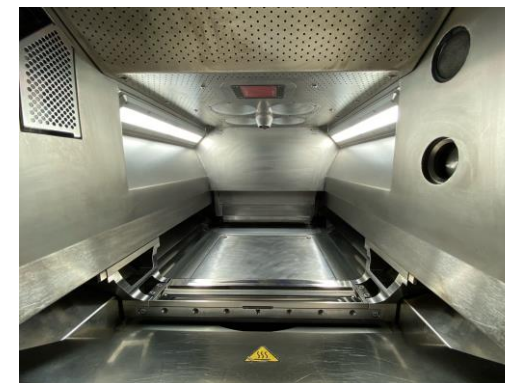
The training scenario could begin by giving an overview of the machine and location of the build chamber, as well as an introduction to different components in the process chamber.



EOS M400-4



EOS M400-4 Build Chamber

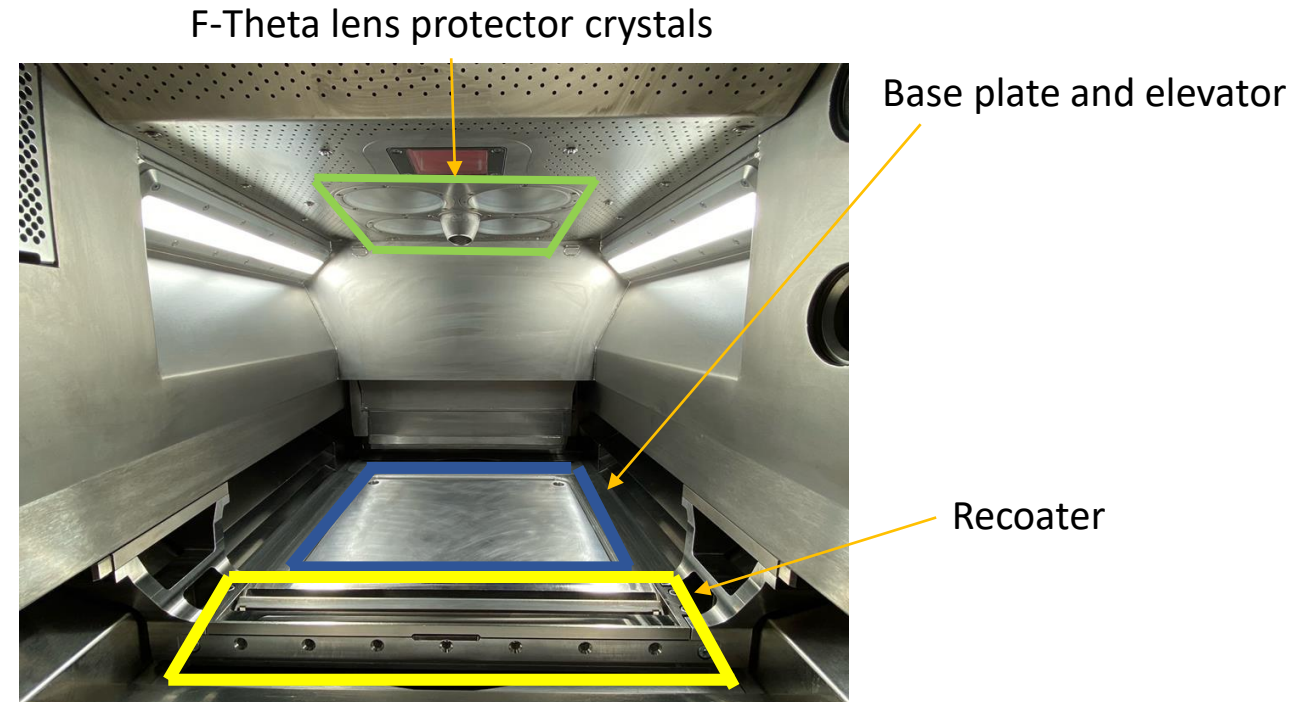


Inside of EOS M400-4
Build Chamber

Laser Power Measurement Working Area – Process Chamber



It could be important to highlight at this point that this case covers the general procedure for measuring the laser power for a specific, multi-laser machine (EOS M400-4), so different methodologies could be applied depending on the specific technology provider and machine. However, the general steps depicted in this experience are of application to any PBF-LB machine but the setting position of the measuring kit could vary slightly.



EOS M400-4 Build Chamber

Laser Power Measurement

Step 1 – Software - Start the Measurement Tool



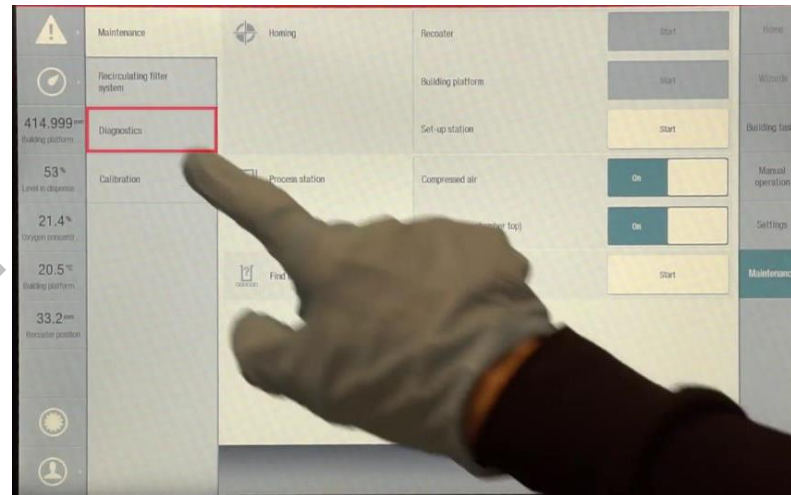
In order to measure the laser power, the first task is to place the recoater under the laser. This is done through machine's specific software options.

1. On machine HMI select "diagnostics" option

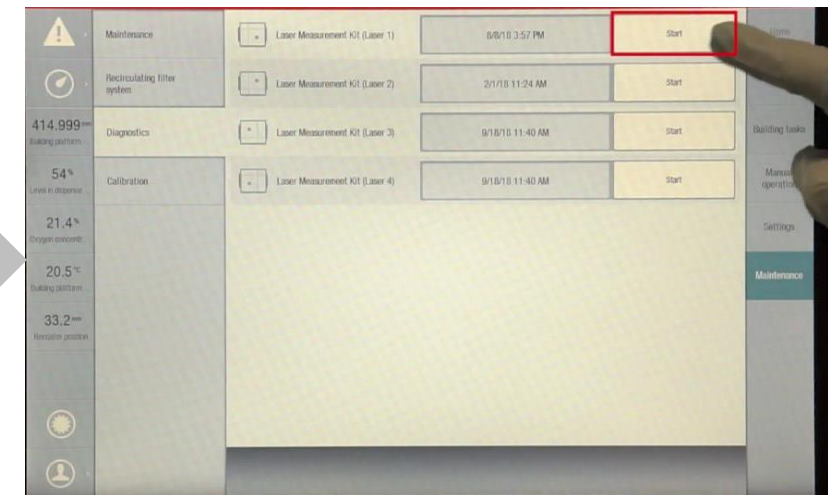
2. Select "start" for Laser Measurement Kit (Laser 1)



EOS M400-4 HMI



EOS M400-4 HMI - Diagnostics



EOS M400-4 HMI – Diagnostics - Start

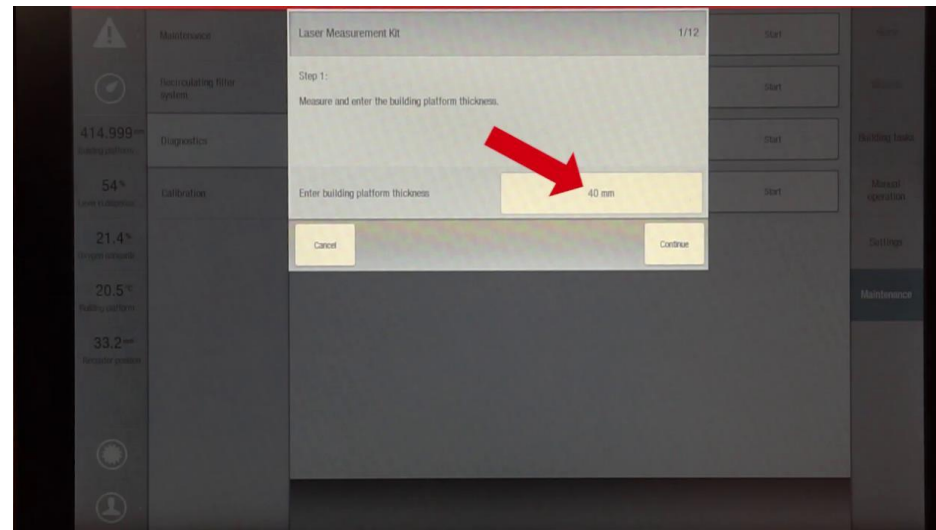


Laser Power Measurement

Step 2 – Software - Set the Layer Height



Just after the previous selection, a new window will be shown, leading to the selection of the measured base plate thickness.



1. On HMI, input the measured base plate thickness

EOS M400-4 HMI – 40 mm plate
thickness data input



Laser Power Measurement

Step 3 – Software - Process Chamber Inspection

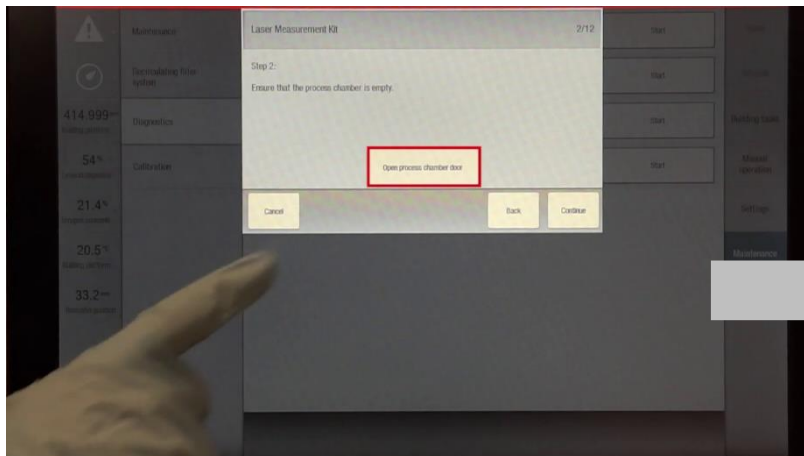


Just after the previous selection, a new window will be shown, leading to the selection of an option for chamber door to open. It must be empty and clean.

1. On HMI select
"Open process
chamber door"

2. Check the
process chamber
is empty

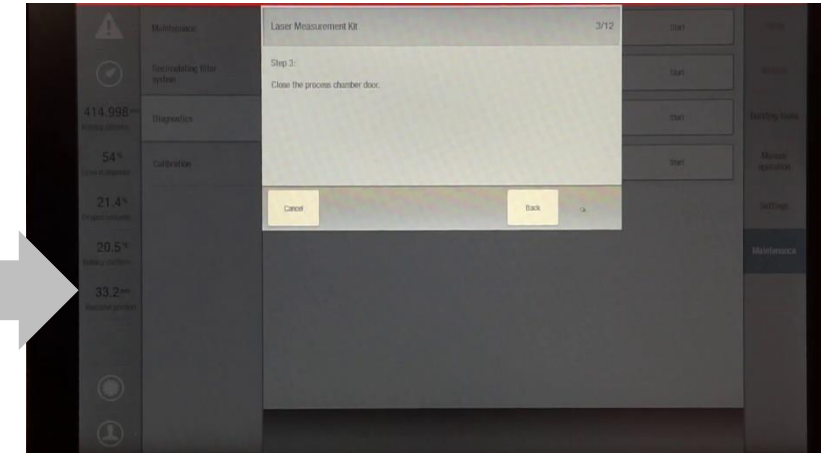
3. On HMI select "Next"
on the "Open process
chamber door" page



EOS M400-4 HMI – Open process
chamber door option



EOS M400-4 Process Chamber



EOS M400-4 HMI

Laser Power Measurement

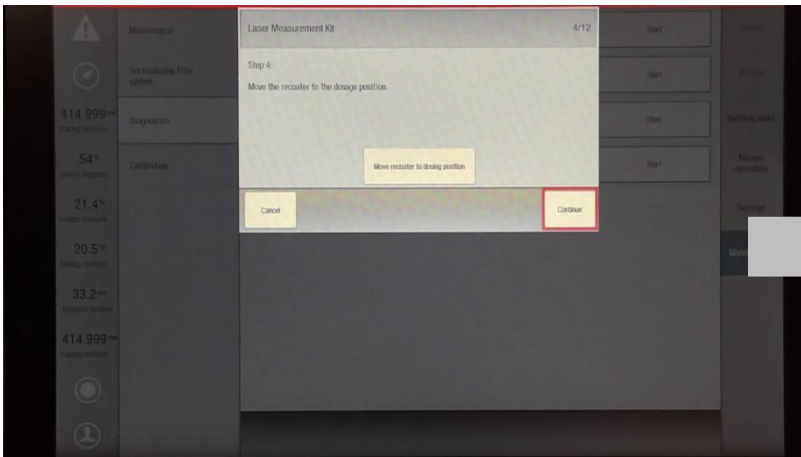
Step 4 – Software - Moving the Recoater and the Building Platform to a Measured Position



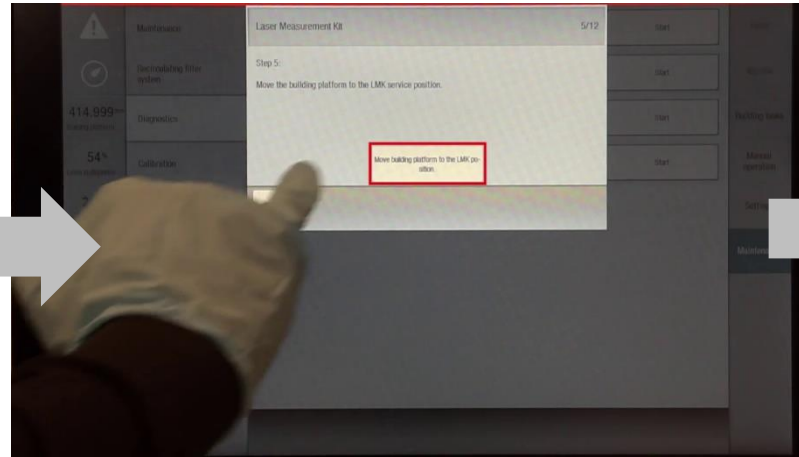
For placing the measured ancillary, both the recoater and the building platform have to be moved to the required position. Just after the previous selection, both successive windows will be shown, leading to options that allows these tasks to be done.

1. On HMI select "Move recoater to dosage position"

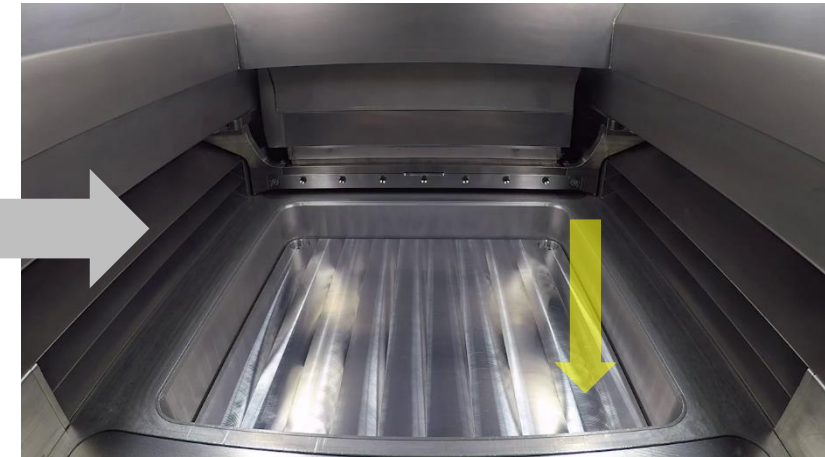
2. On HMI, select "Move building platform to the LMK position"



EOS M400-4 HMI – Confirm



EOS M400-4 HMI - Move recoater to dosage position



EOS M400-4 process chamber – LMK position





Laser Power Measurement

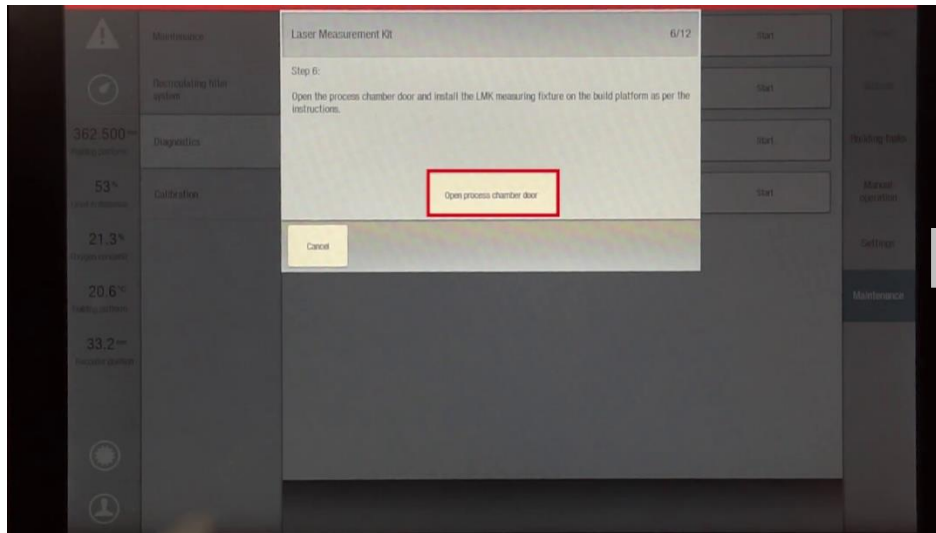
Step 5 – Software - Process to Mount the Laser Measurement Kit



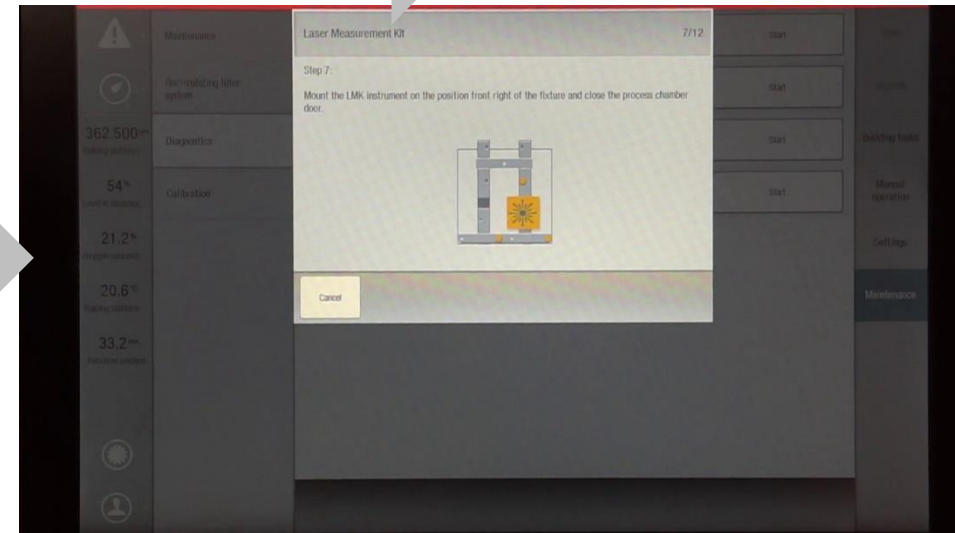
Whenever the previous stages are done, the process chamber will be opened again, this time to start the mounting of the laser power measurement kit.

1. On HMI select
"Open process
chamber door"

2. Proceed to mount the
laser measurement kit



EOS M400-4 HMI - Open process chamber door



EOS M400-4 HMI

Laser Power Measurement

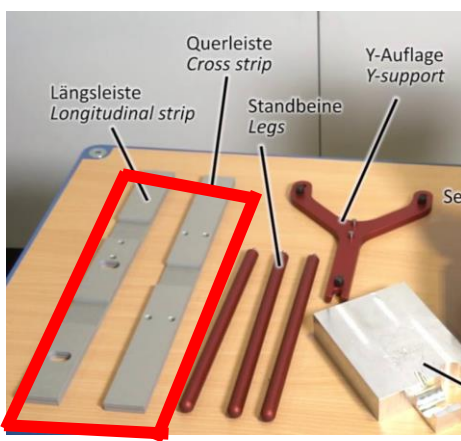
Step 6 – Ancillary Equipment for the Measurement Device



In this specific training scenario, the correct placement of the measuring device is achieved a specific tooling, which is placed in the process chamber to enable the placement of the device that will measure the laser power.

1. Take the longitudinal strips from the laser power measurement kit

2. Place the longitudinal strips in the machine chamber



Longitudinal Strips



Longitudinal Strip Placement on the EOS M400-4 Build Chamber



Laser Power Measurement

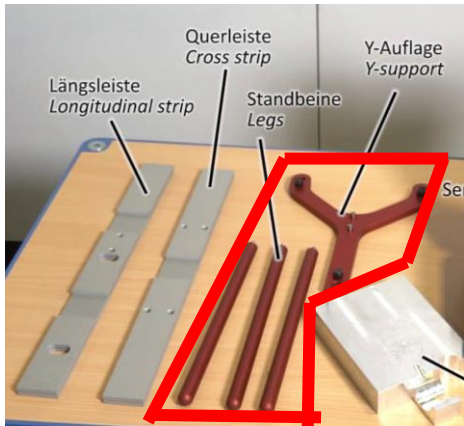
Step 6 – Ancillary Equipment for the Measurement Device



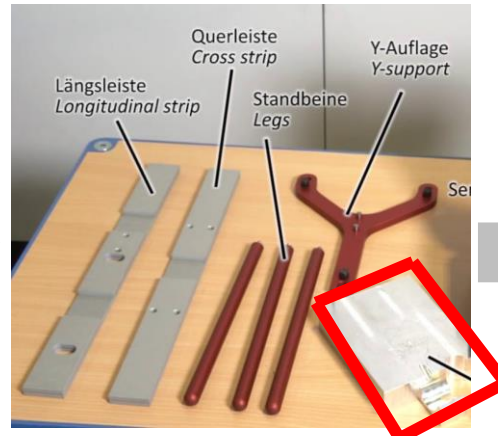
3. Mount the Legs
on the Y-support

4. Mount the Pocket
Monitor holder on the
previous assembly

5. Place the assembly
in the laser measurement
position



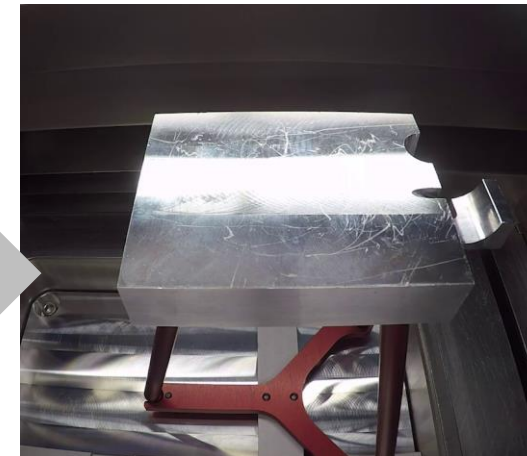
Legs and the Y-support



Pocket Monitor Holder



Power Measurement Assembly



Laser Power Measurement

Step 7 – Check of the Measuring Device



In order for the measures to be accurate, the temperature of the measuring device must be under specifications (ambient temperature $\pm 0,5\text{ }^{\circ}\text{C}$). This is done through the own device, that counts with a temperature function.

1. Take the measuring device

2. Loosen the adjustment screw and open the device

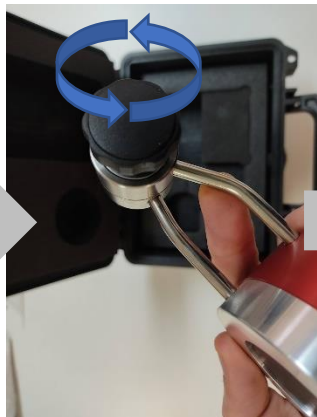
3. Press the “TEMP” button. Read the temperature value

¿Temp Ok?

4. Compare recorded temperature value to one of a facility.
Yes → Step 4
No → Wait until temp ok



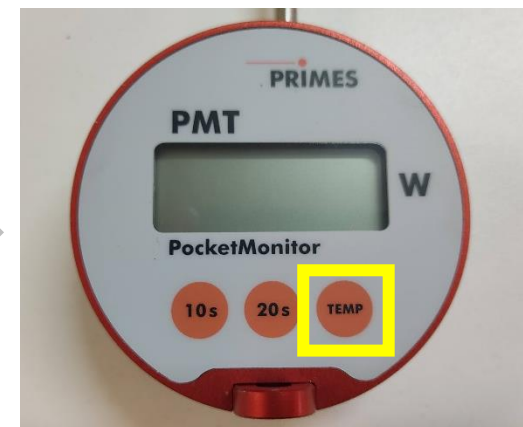
Measuring Kit



Measuring Device Adjustment Screw



Measuring Device

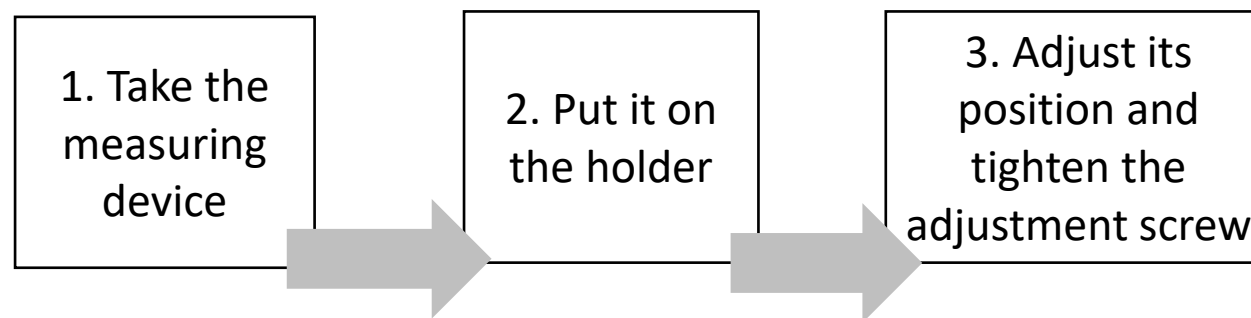


Measuring Device - Temp Button

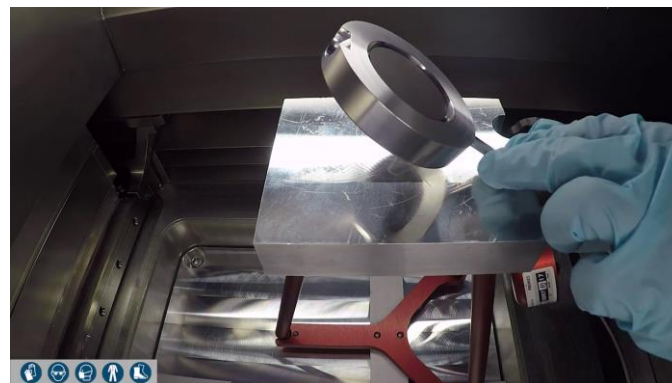


Laser Power Measurement

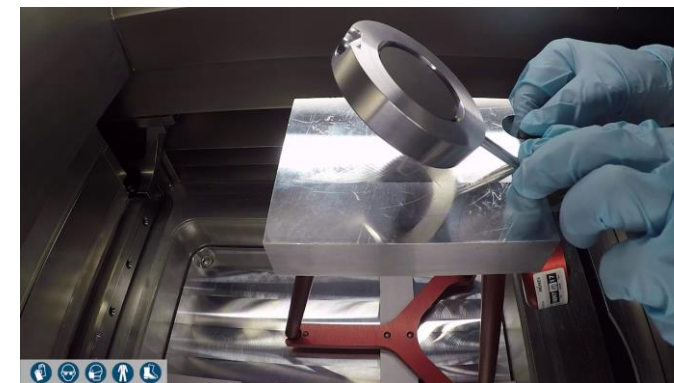
Step 8 – Mount the Measuring Device on the Holder



Measuring Device



Measuring Device Holder



Measuring Device Holder



Laser Power Measurement

Step 9 – Activation of the Measuring Device



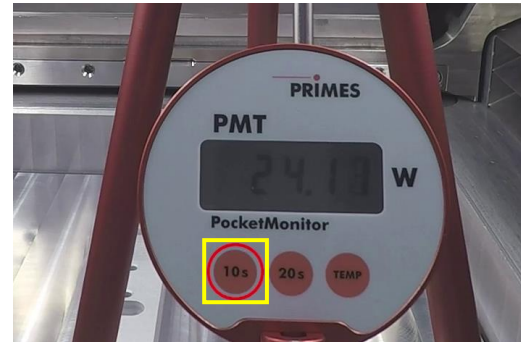
A measuring time is set on the laser power measuring device. In this specific case “10s”. The process chamber is then closed. This specific device will be ready for doing a measure during the next 15 minutes (auto switch off time).

1. Set the measuring time on the measuring device

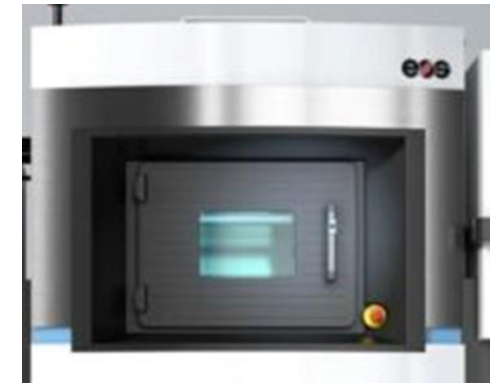
2. Close the process chamber



Measuring Device on the Holder



Timer on the Measuring Device



Closed Process Chamber

Laser Power Measurement

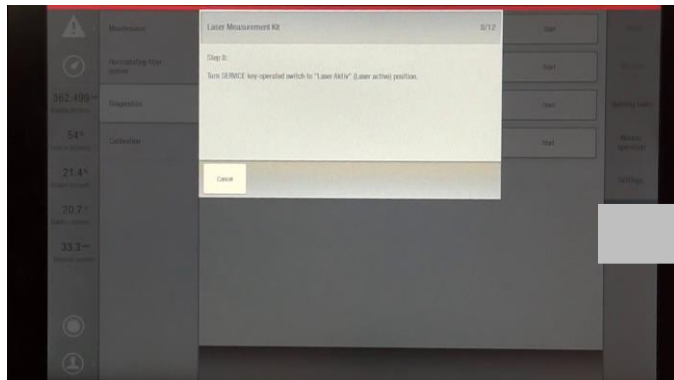
Step 10 – Turn Service Key to “On” Position



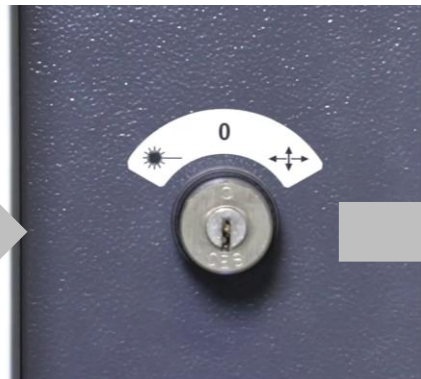
In order for the machine to trigger a laser shot, service key has to be inserted on the machine, and on turned to “Laser Active” position.

1. Take the machine service Key

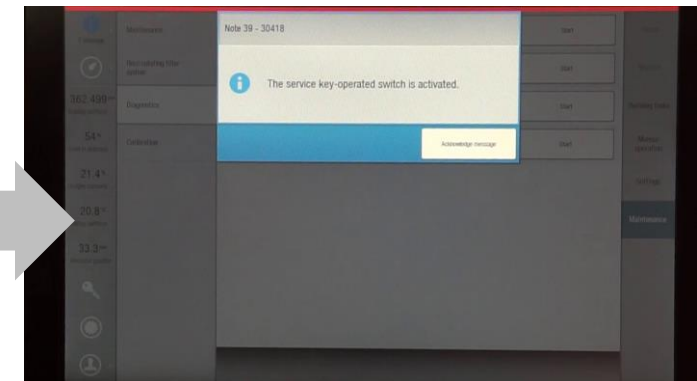
2. Turn it to the “Laser Active” position



EOS M400-4 HMI Instructions



Service Key Set to 'Laser Activate' Position



EOS M400-4 HMI Instructions

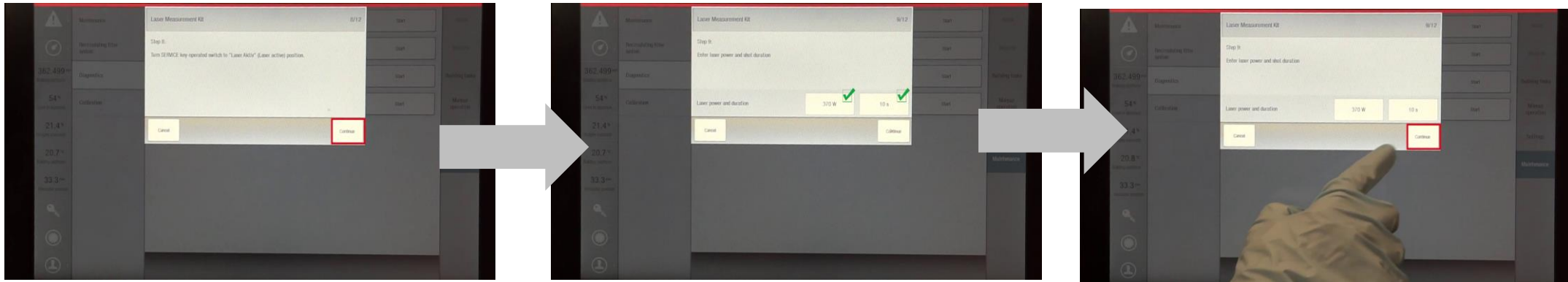
Laser Power Measurement

Step 11 – Software – Laser Power and Shot Duration



Then, the laser power and shot duration is selected.

1. Select laser power and shot duration



EOS M400-4 HMI Instructions

Laser Power Measurement

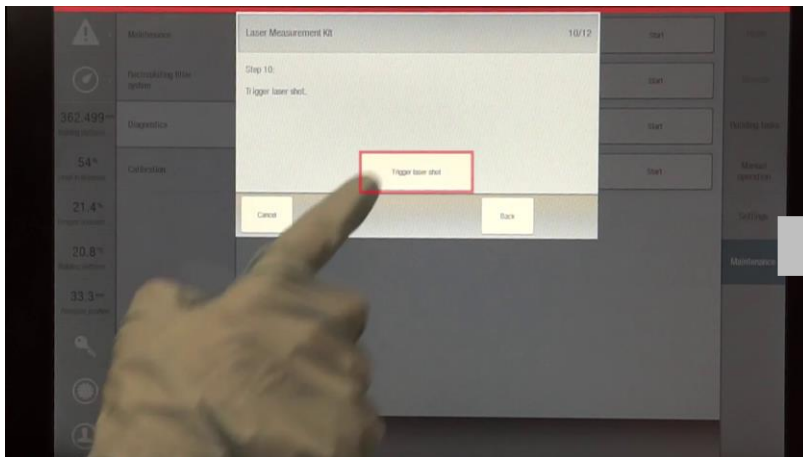
Step 12 – Trigger the Laser Shot



Then, the laser shot is triggered, and result can be recorded.

1. Trigger the laser shot

2. The laser power measurement is done and shown after the settled time



EOS M400-4 HMI Instructions



Laser Power Measurement Results

Laser Power Measurement

Step 13 – Repeat the Process for Other Lasers



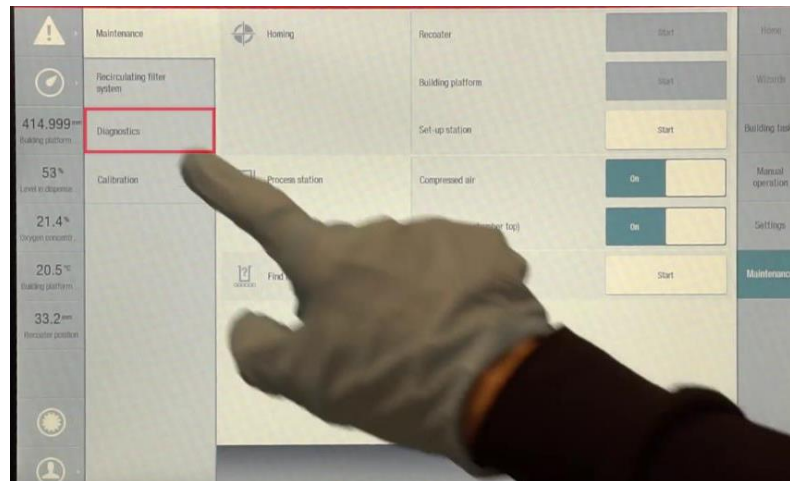
For a Multi-laser system the rest of the lasers will also need to be measured. The presented process will be repeated from Step 1, and by selecting another laser. The laser power measuring device must be cooled to ambient temperature before starting a repeat measurement.

1. On machine HMI select "diagnostics" option

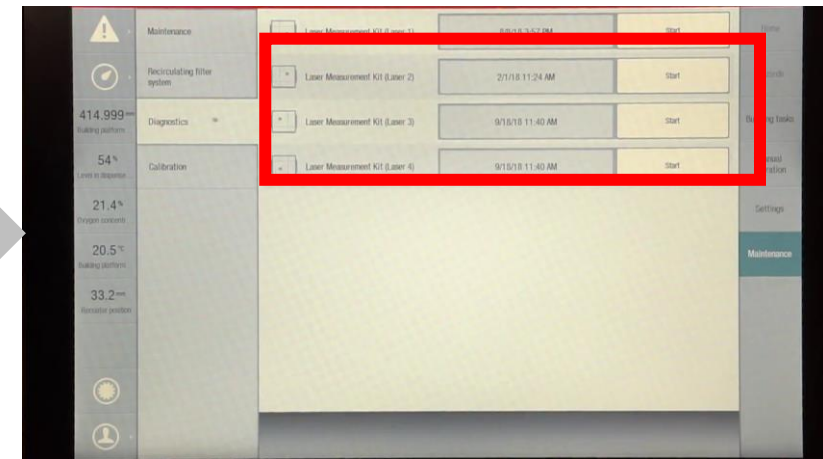
2. On HMI select "start" for Laser Measurement Kit (Laser X)



EOS M400-4 HMI



EOS M400-4 HMI - Diagnostics



EOS M400-4 HMI – Diagnostics - Start



Laser Power Measurement

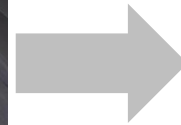
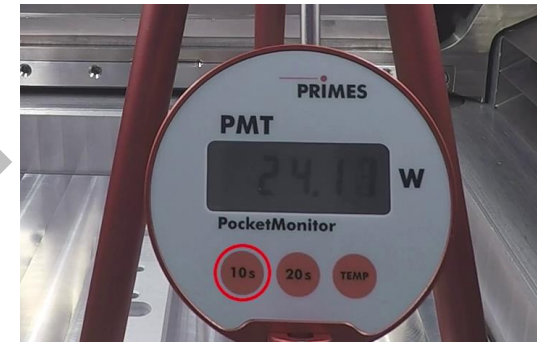
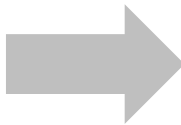
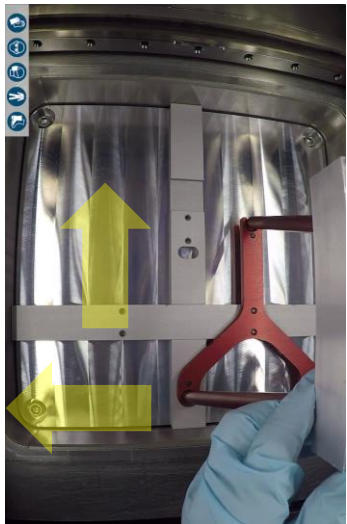
Step 13 – Repeat the Process for Other Lasers



When reaching Step 6 the pocket monitor will be switched to the specific position for the laser to be measured. Rest of steps will be repeated.

3. Switch pocket monitor position

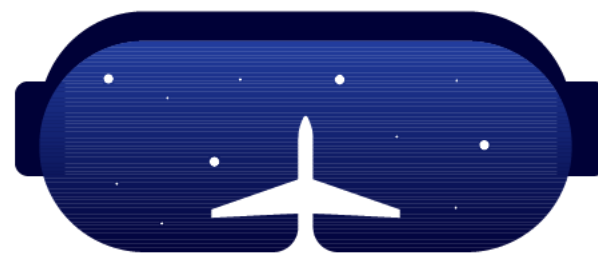
4. Repeat measuring steps



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Positioning measuring device to the laser specific location

Laser Power Measurement Results



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Any questions?

Thank you!

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