

# Assembly Cycle

**Introduction to engine manufacturing**

**Manufacturing cycle**

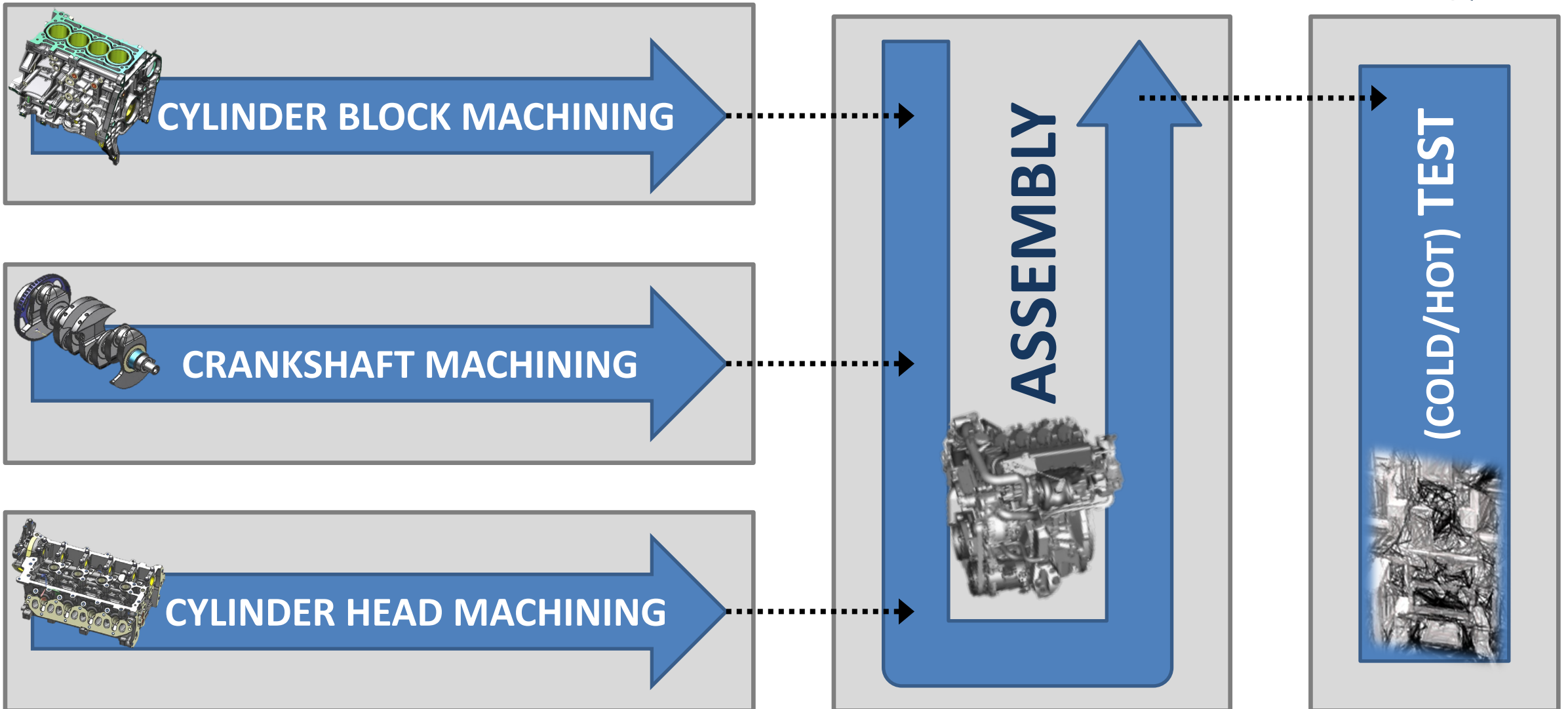
**Engine Assembly process**

**Piston - Connecting Rod sub-assembly**

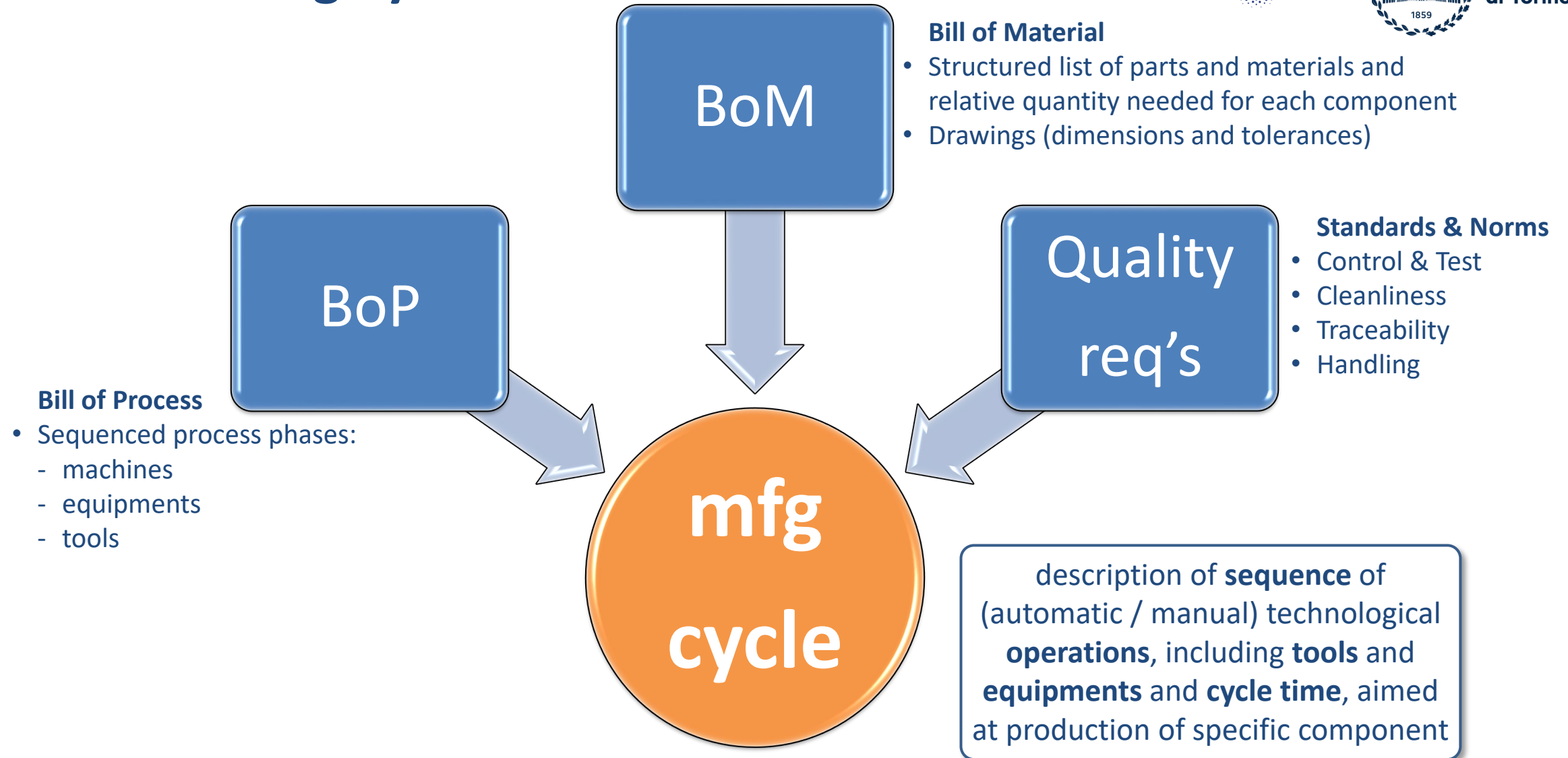
**Operation sheet**

**Examples of manual and automatic processes**

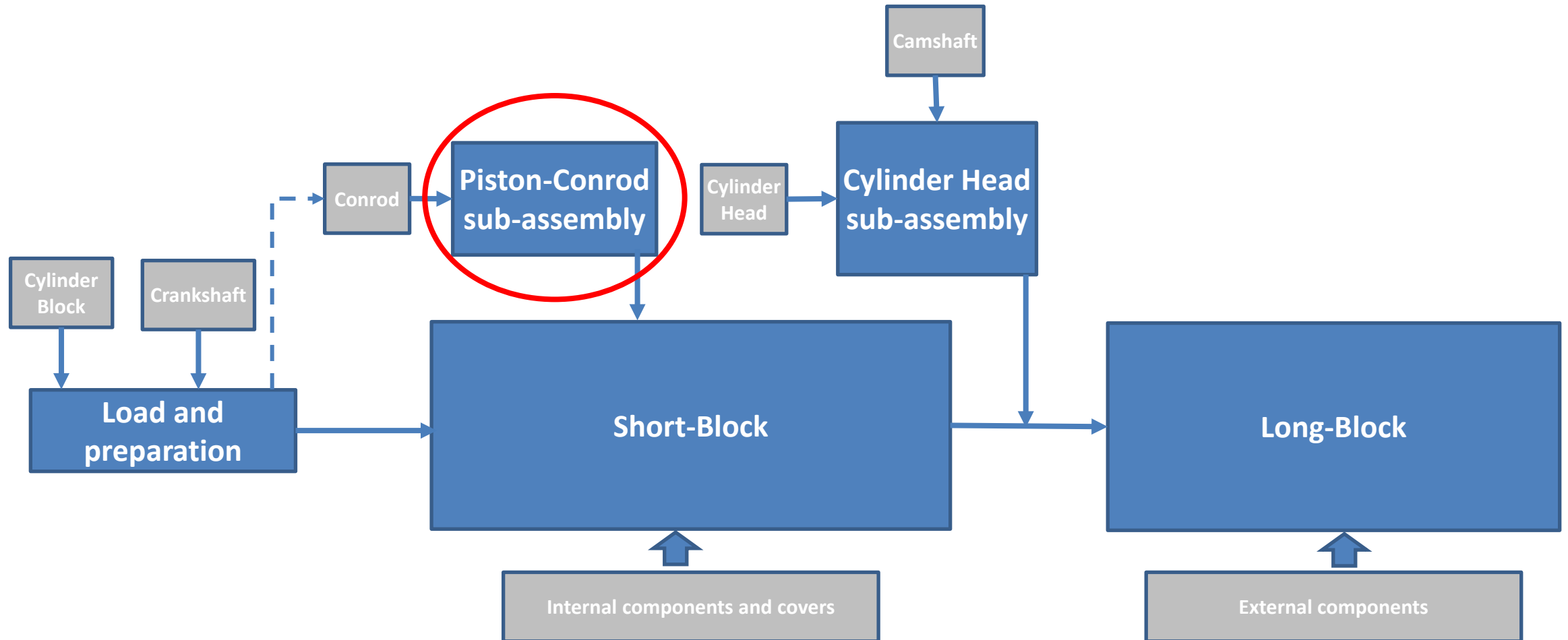
# Introduction to engine manufacturing



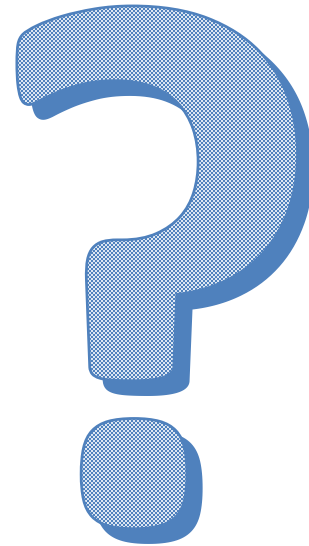
# Manufacturing Cycle



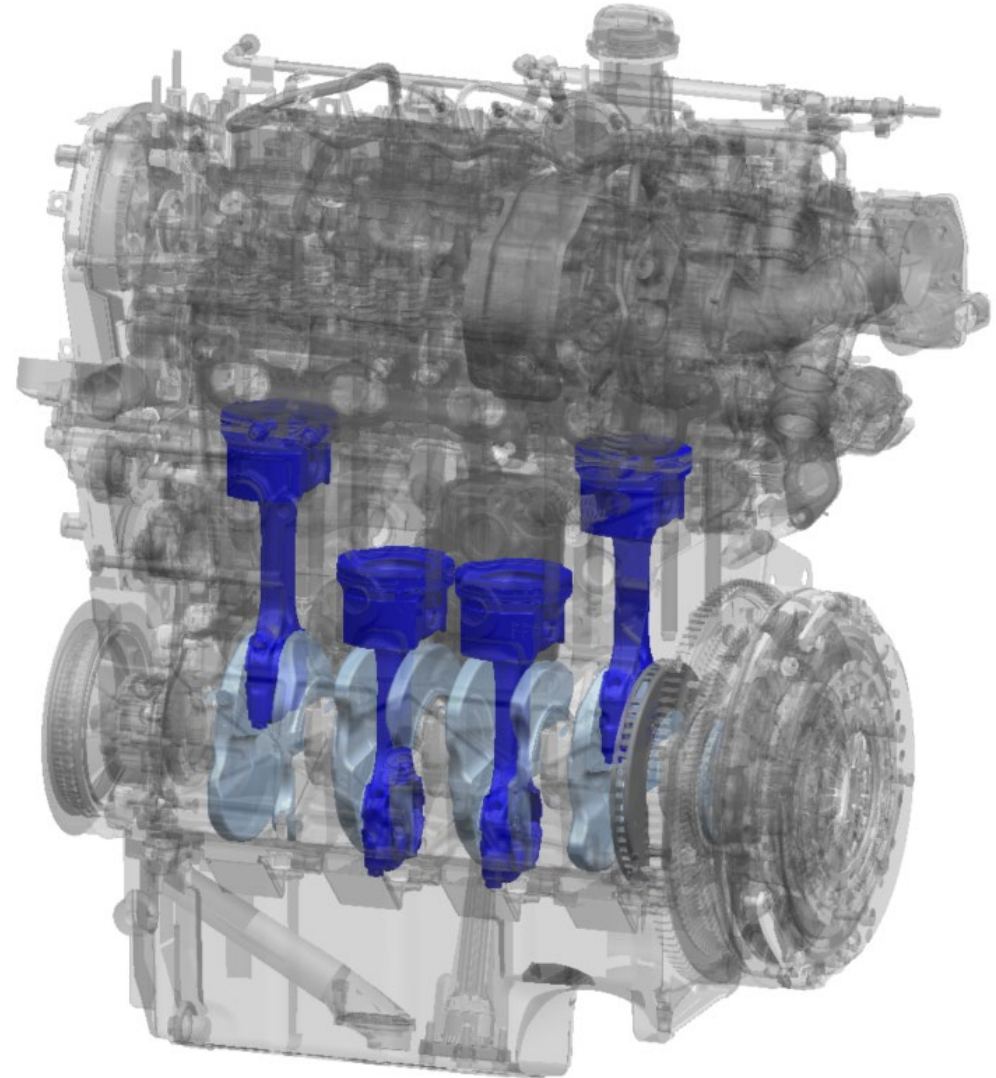
# Engine assembly



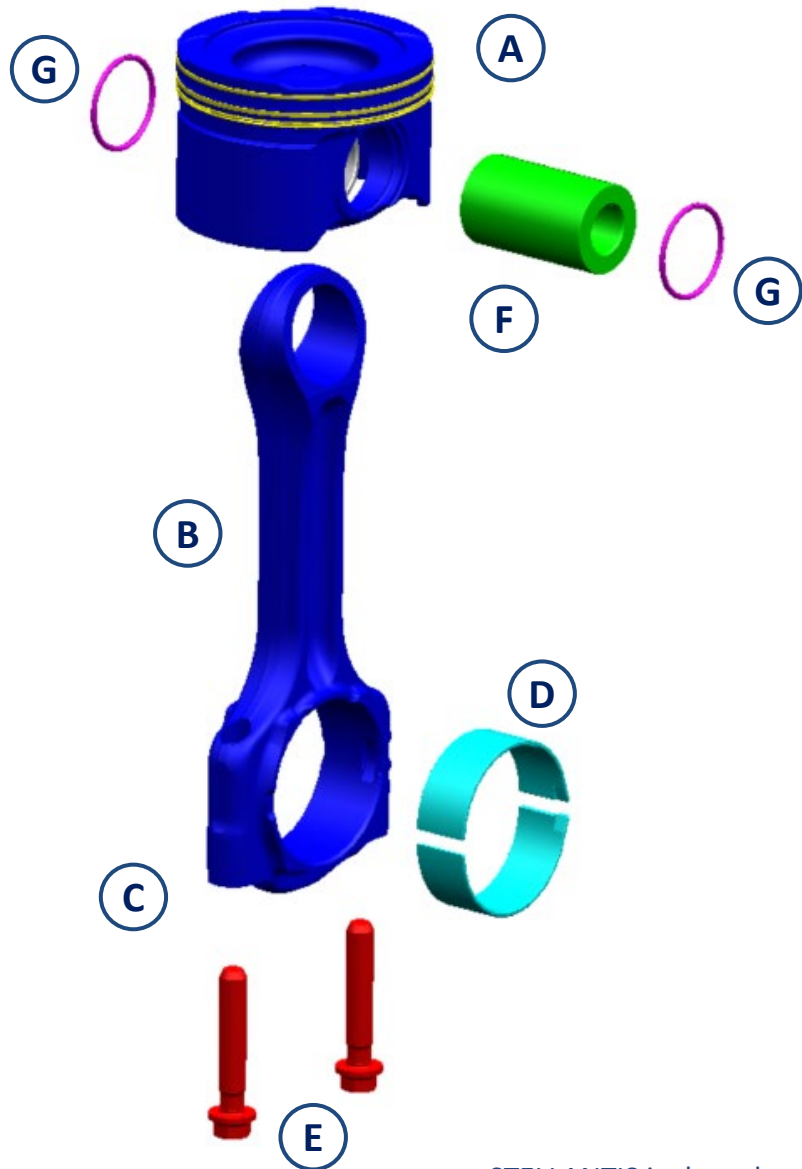
# What



# Where



# Piston and conrod Bill of Material (BoM)

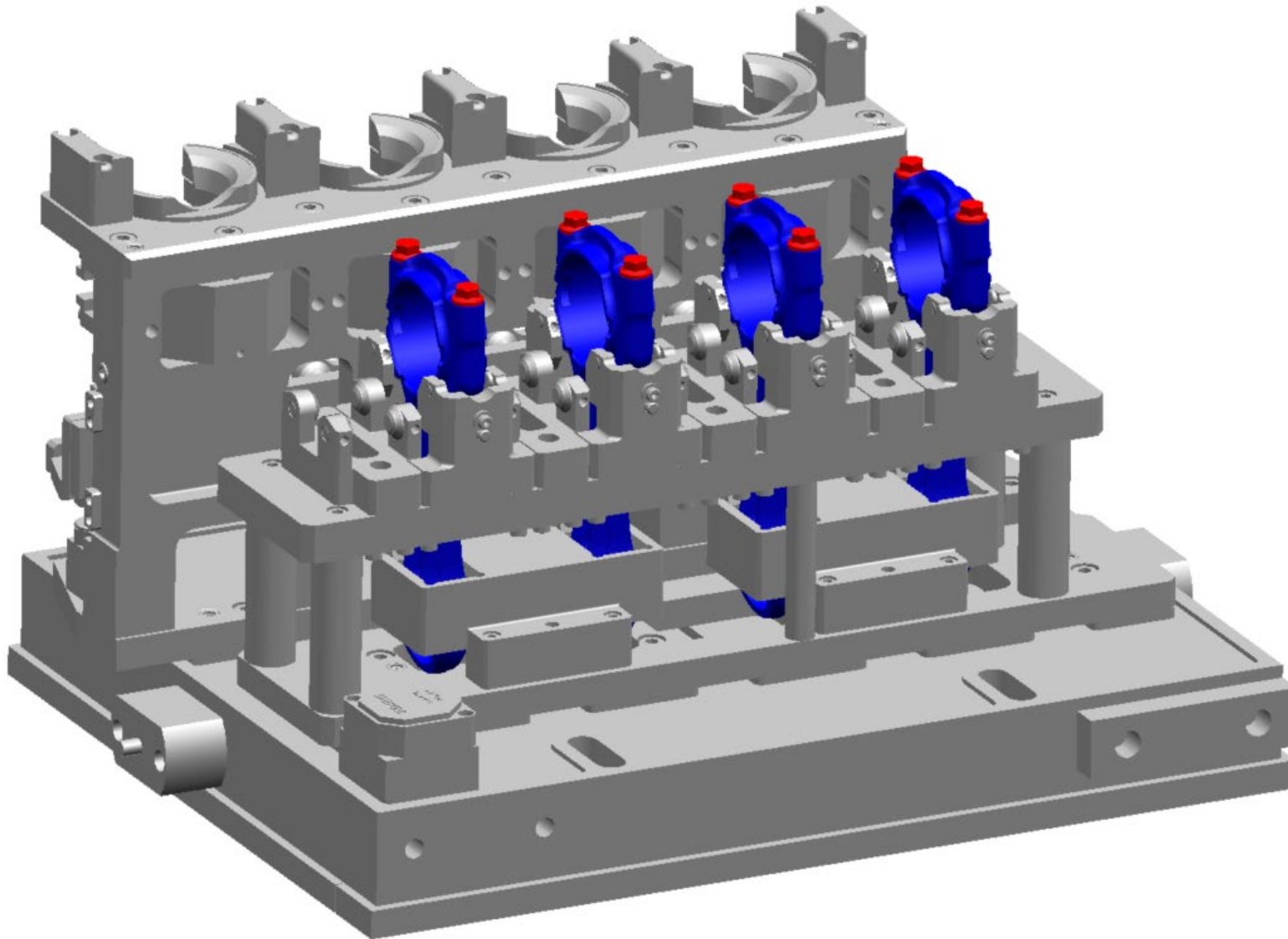


#	Components	Quantity
A	PISTON	1
B	CONROD	1
C	CONROD CAP	1
D	CONROD BEARING	2
E	SCREW	2
F	PISTON PIN	1
G	SNAP RING	2



# Conrod loading and datamatrix reading

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## Process description:

1. Conrod select (type and classes weight)
2. Conrod load onto the pallet
3. Check the correct orientation
4. Data matrix reading to control the correct type and classes

## Equipment:

1. Feeding system
2. Gripper unit to handle the conrod
3. Camera system
4. LVDT system (Linear Variable Displacement Transducer)
5. Data matrix reader

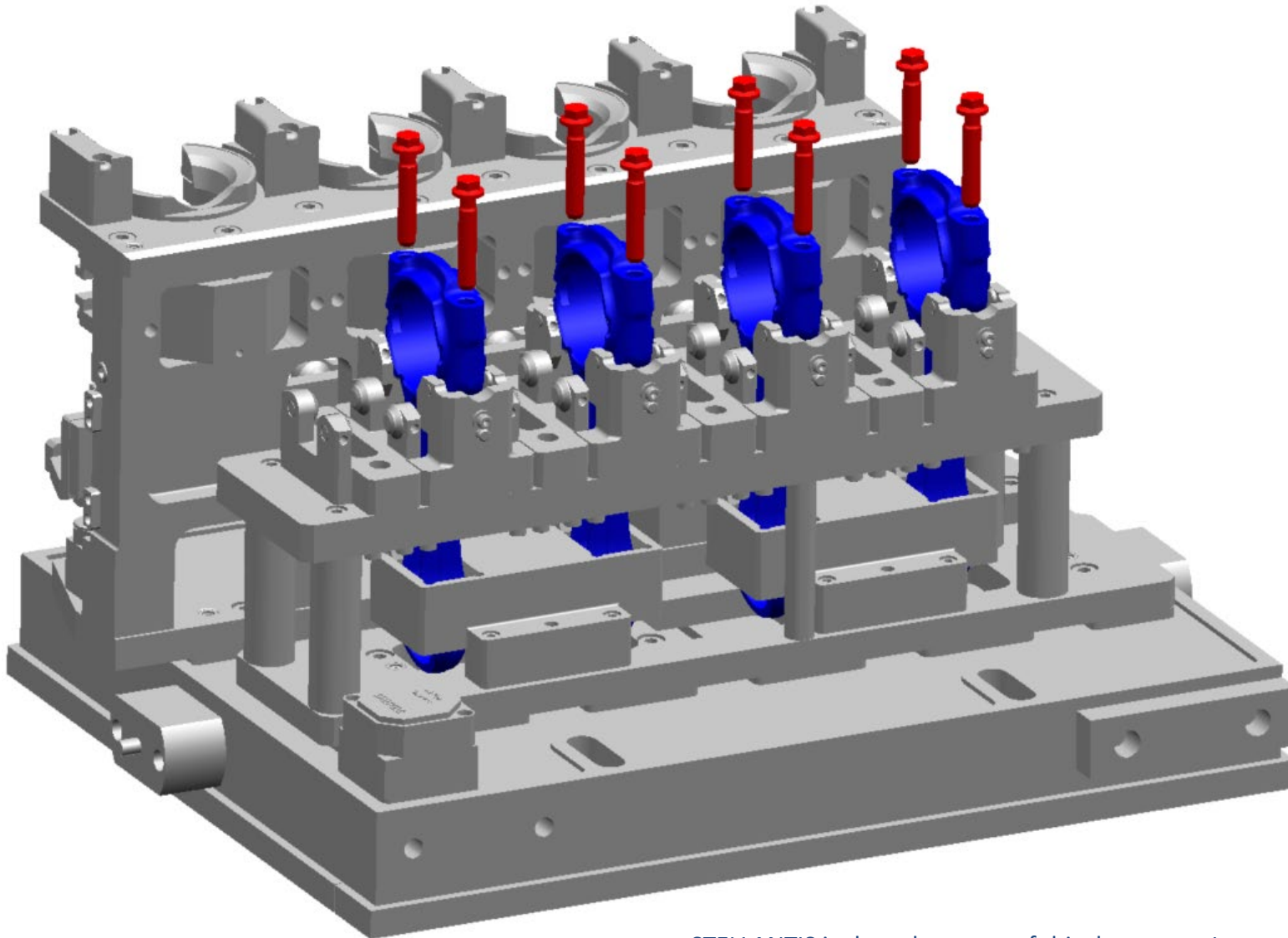
## Quality requirements:

1. Surfaces No-Touch policy
2. Traceability data

## Safety recommendation:

1. Gloves
2. Safety shoes

# Untightening conrod caps screws and marking



## Process description:

1. Conrod and conrod caps marking
2. Untightening conrod caps screws

## Equipment:

1. Nutrunner or manual wrench
2. Socket
3. Marking system
4. Camera system

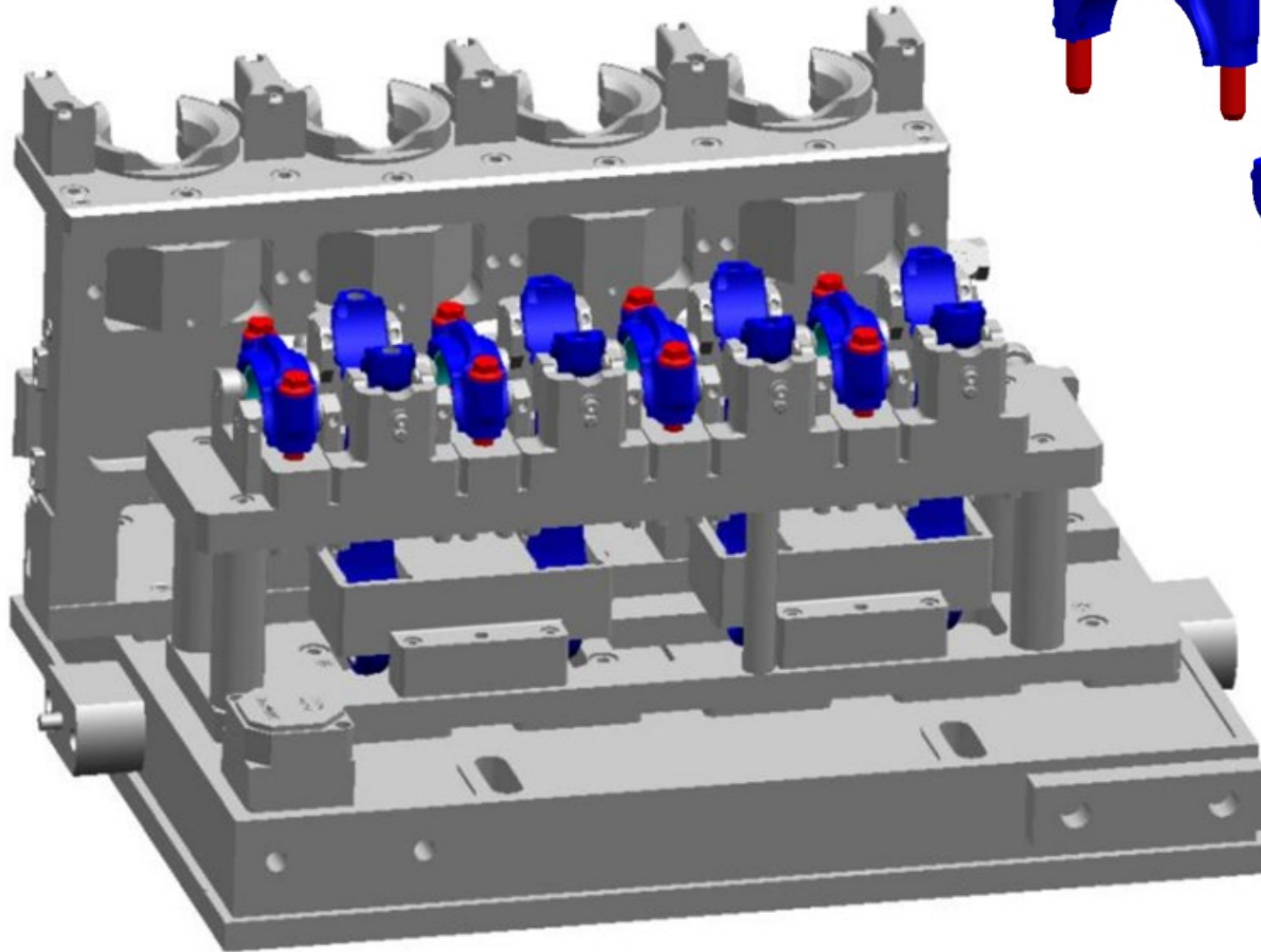
## Quality requirements:

1. Surfaces No-Touch policy
2. Marking specification

## Safety recommendation:

1. Gloves
2. Safety shoes

# Conrod caps remove



## Process description:

1. Conrod caps remove from the conrod
2. Conrod caps seated properly on the pallet seats

## Equipment:

1. Gripper unit to handle the conrod caps
2. Vacuum system

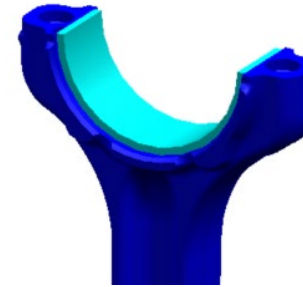
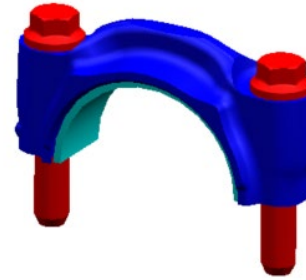
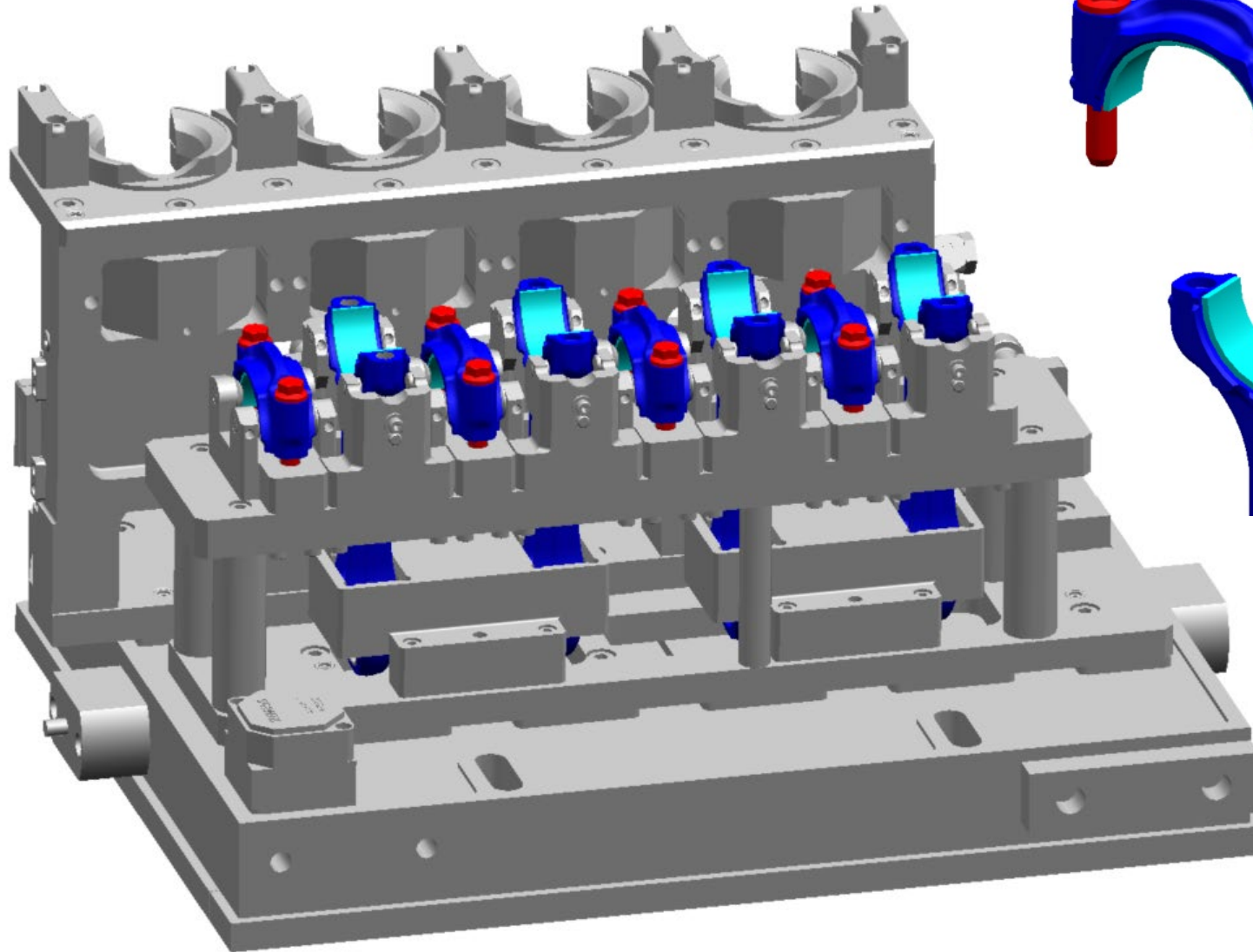
## Quality requirements:

1. Surfaces No-Touch policy
2. Cleanliness policy components

## Safety recommendation:

1. Gloves
2. Safety shoes

# Conrod and conrod caps bearing assembly



## Process description:

1. Half bearing selection
2. Half bearing assemble on the conrod and conrod caps
3. Conrod and conrod caps seated properly on the pallet seats

## Equipment:

1. Feeding system
2. Gripper unit to handle the bearing

## Quality requirements:

1. Surfaces No-Touch policy
2. Cleanliness policy components

## Safety recommendation:

1. Gloves
2. Safety shoes



# Conrod positioning for piston assembly

## Process description:

1. Pick the conrod from the pallet seats
2. 180° turnover conrod and 90° rotate conrod
3. Conrod properly seated on the pallet

## Equipment:

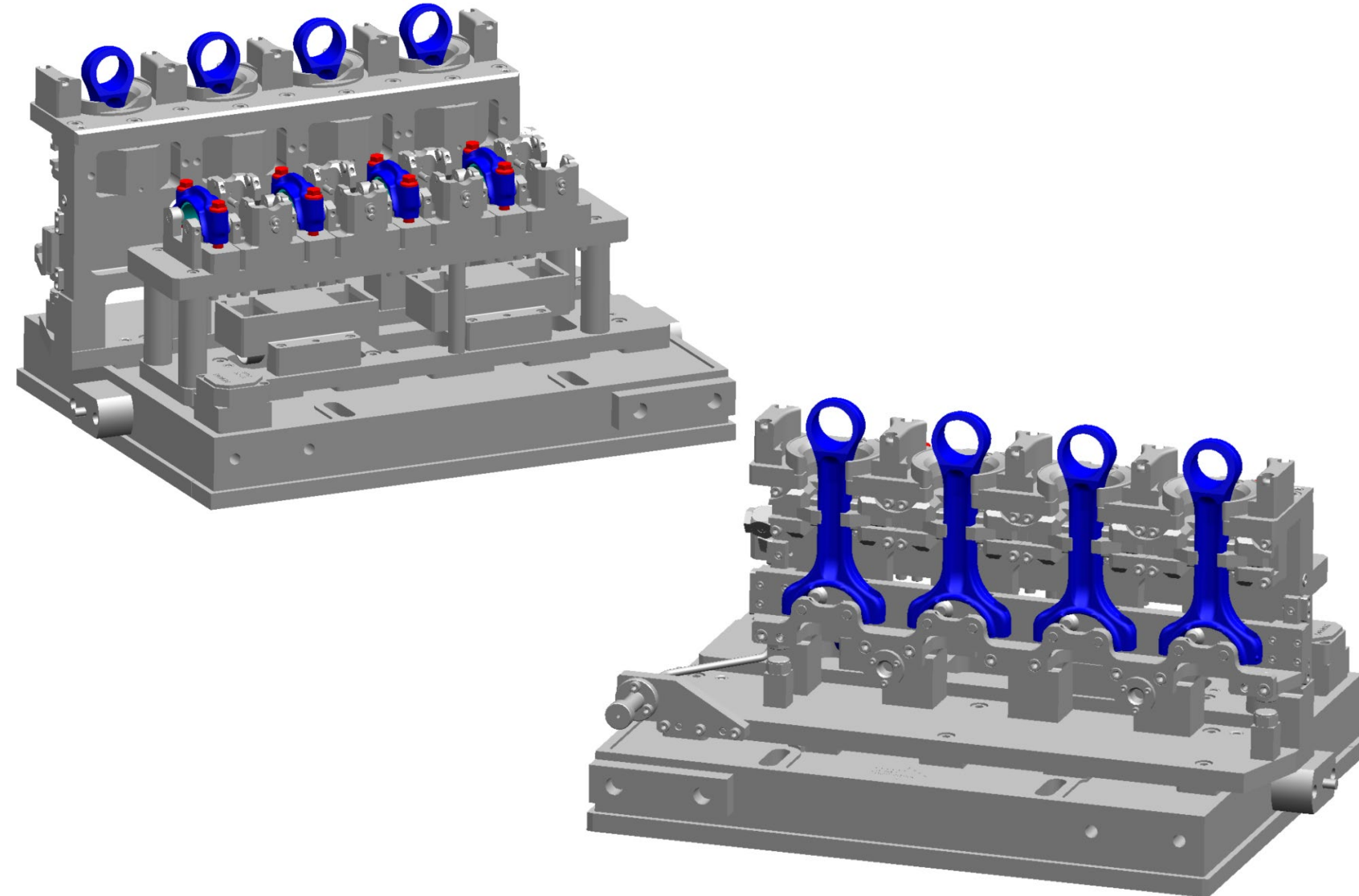
1. Gripper unit to handle the conrod

## Quality requirements:

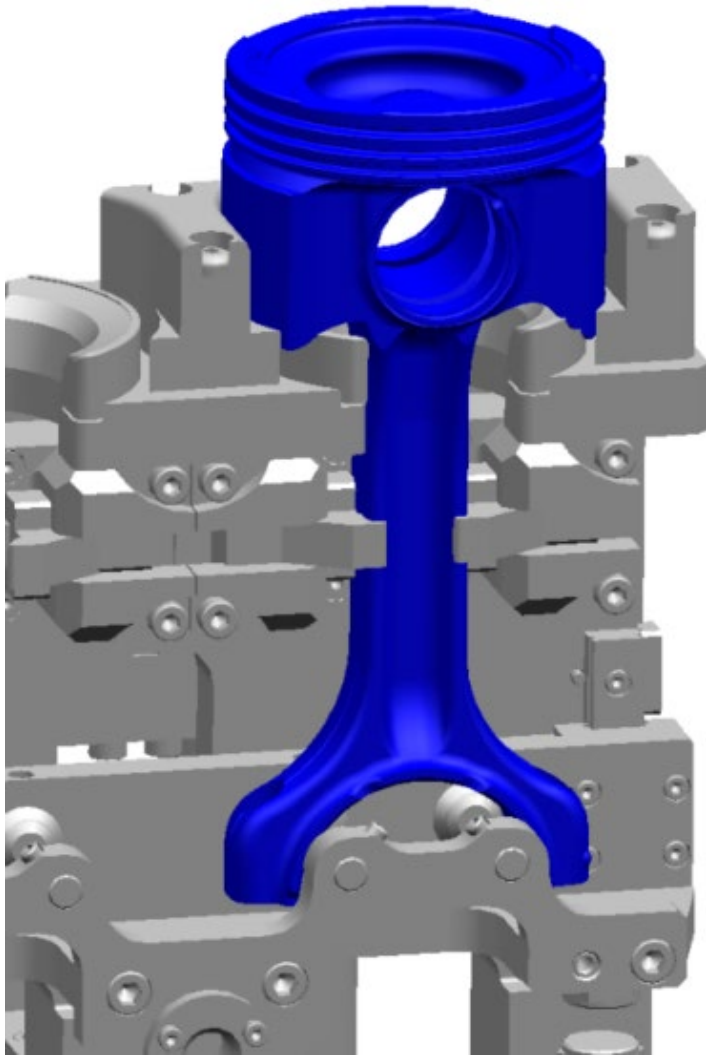
1. Surfaces No-Touch policy

## Safety recommendation:

1. Gloves
2. Safety shoes



# Piston placed on the conrod



## Process description:

1. Piston selection
2. Piston pick and place on the conrod seated on the pallet

## Equipment:

1. Piston feeding system
2. Gripper unit to handle piston
3. Data matrix reader
4. Camera system

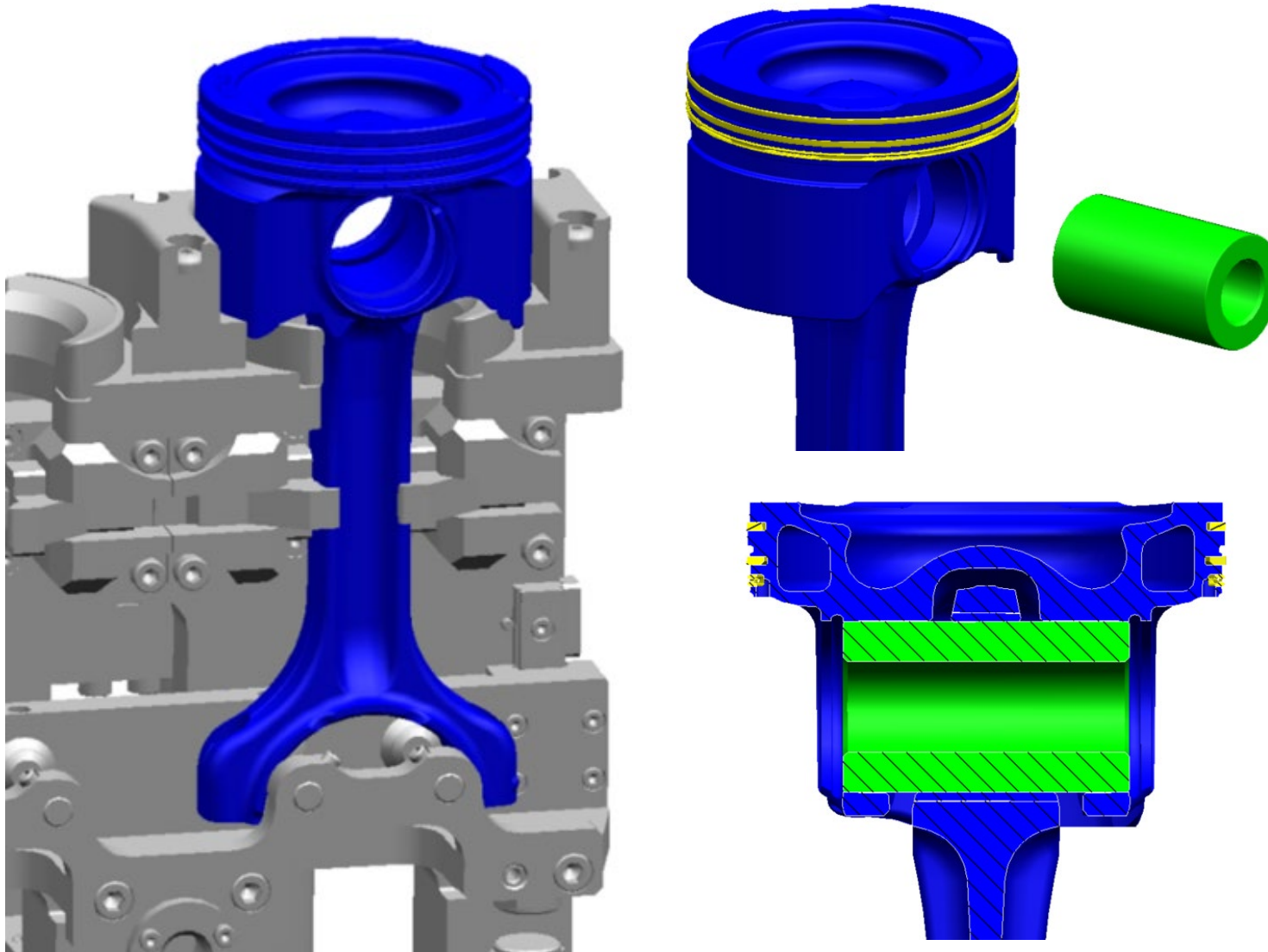
## Quality requirements:

1. Surfaces No-Touch policy

## Safety recommendation:

1. Gloves
2. Safety shoes

# Piston pin assembly



## Process description:

1. Piston pin feeding
2. Piston and conrod alignment
3. Oiling piston pin diameter
4. Piston pin insertion

## Equipment:

1. Feeding system
2. Gripper unit to handle piston pin
3. Fixture to align conrod piston pin diameter
4. Oiling system
5. Insertion unit

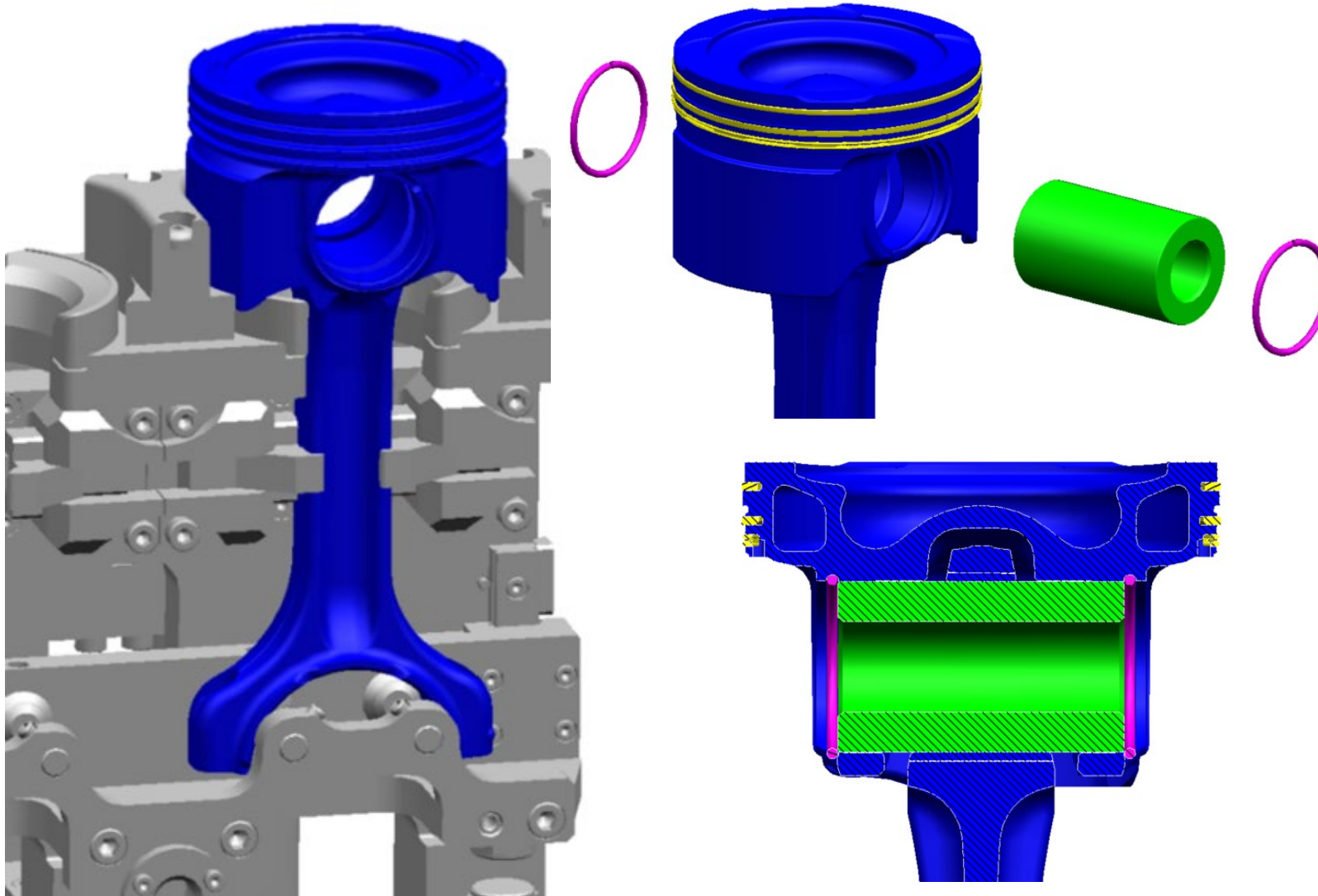
## Quality requirements:

1. Surfaces No-Touch policy
2. Press and stroke monitoring

## Safety recommendation:

1. Gloves
2. Safety shoes

# C-clip piston pin assembly



## Process description:

1. Piston pin C-clip feeding
2. C-clip assembly properly into the piston groove

## Equipment:

1. Feeding system
2. Insertion c-clip unit

## Quality requirements:

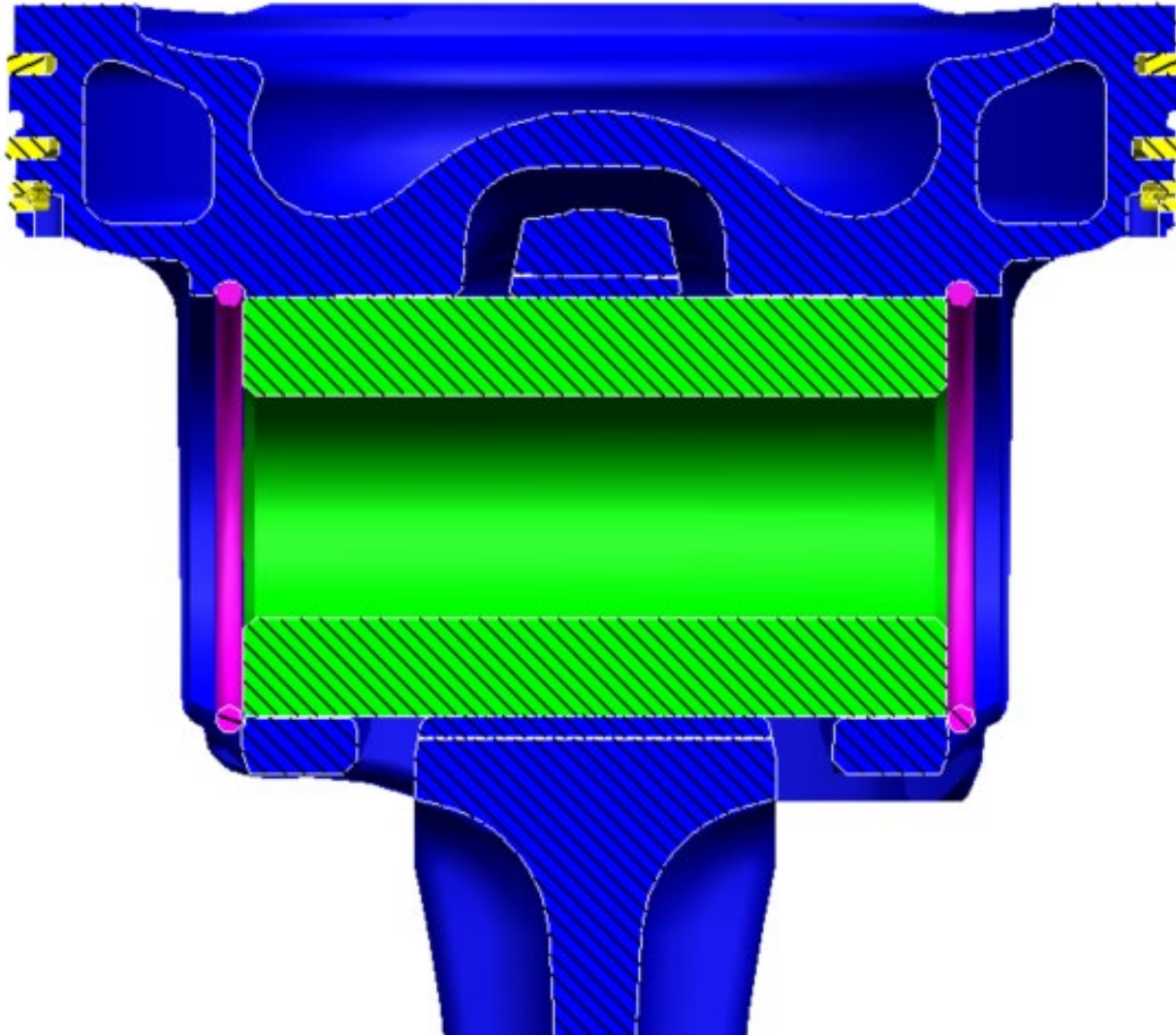
1. Surfaces No-Touch policy
2. Press and stroke monitoring

## Safety recommendation:

1. Gloves
2. Safety shoes
3. Safety glasses



# C-clip properly assembled check



## Process description:

1. C-clip assembly properly into the piston groove

## Equipment:

1. Slide unit
2. Camera system (2D or 3D)
3. LVDT system (Linear Variable Displacement Transducer)

## Quality requirements:

1. Surfaces No-Touch policy

## Safety recommendation:

1. Gloves
2. Safety shoes

# Operation Sheet

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				ASSEMBLY OPERATION		key characteristic:		1/6																																																						
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# Wrap-up

- The Assembly process is carried out through a series of operations of insertion, coupling, screwing, and so on, to compose the parts; operations which are largely reversible (while welding, press-fitting and others are not reversible)
  
- **Cycle time = Available time / Gross number of units to be produced**
  - Available time (i.e. meal break not included): 21 hours/day = 1260 min/day
  - Gross number of units (good + lost units): 2400 + 120 (5% losses) = 2520 units/day
  - Cycle time:  $1260/2520 = 0,5 \text{ min} = 30 \text{ sec}$
  
- **Level of automation (manual vs auto solution) is affected by internal and external factors, such as:**
  - Capacity requested
  - Part complexity
  - Manpower labor costs
  - Investments

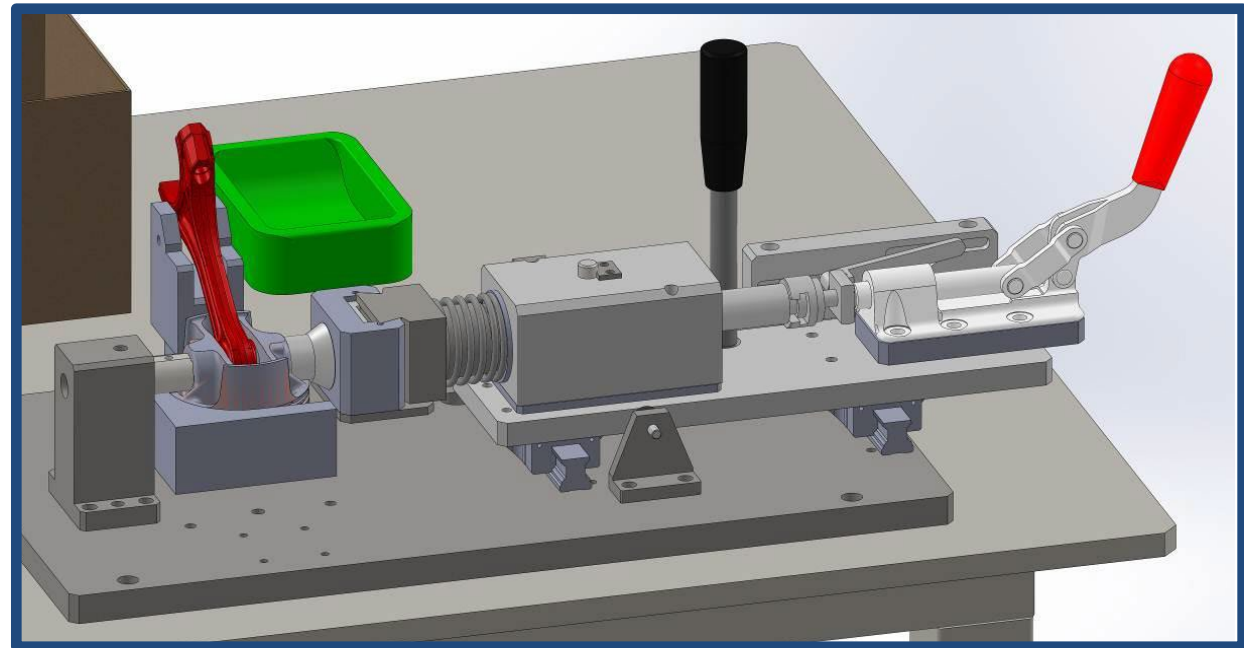
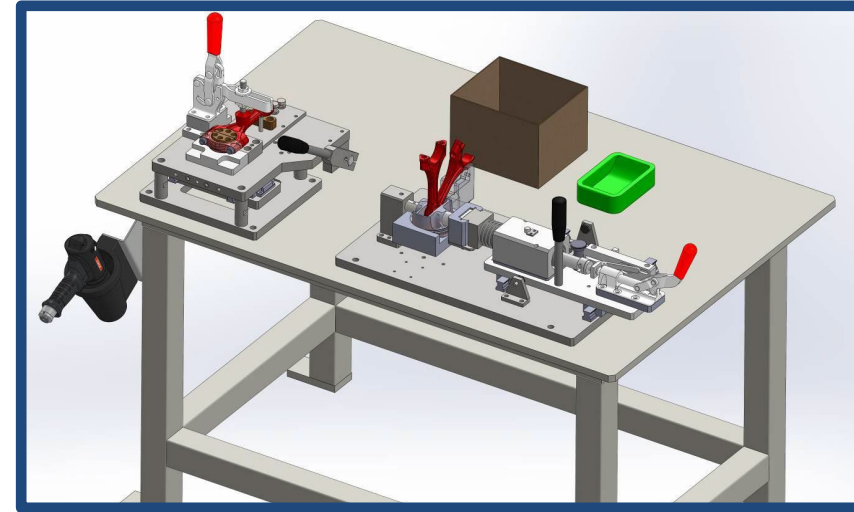
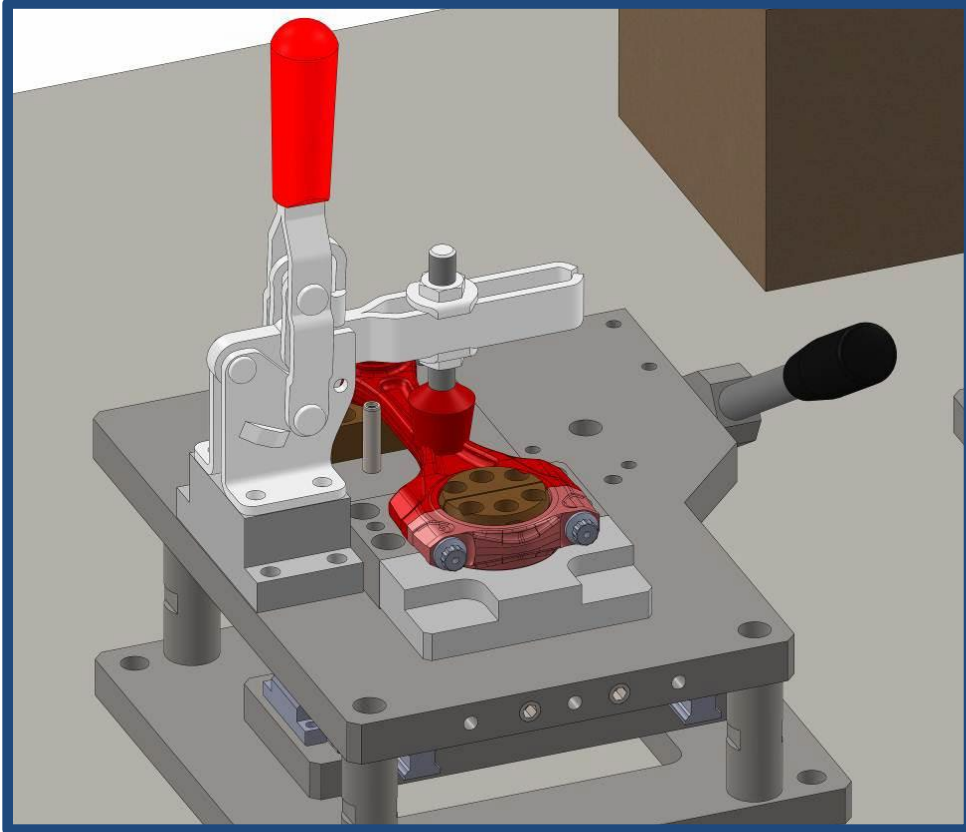
## Examples of manual and automatic processes

# Manual assembly process

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# Automatic assembly process

