



*Winterthur Gas & Diesel*



**HERCULES-2**

# Work Package 3: Intermetallics and advanced materials for marine engines

Work package leader:

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**HERCULES-2**

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## Objectives

### **Subproject 3.1: *Novel materials for engine applications***

Examine possibilities of using novel materials in engines to facilitate the development of components that enable higher engine loads, hereby increasing efficiency and lower emissions. Ensure proper lifetime performance and durability.

### **Subproject 3.2: *Novel materials for turbine casing***

Material of turbine casing is reviewed in respect of material and design in order to meet requirements needed for higher exhaust gas temperatures.

## Expected outcome

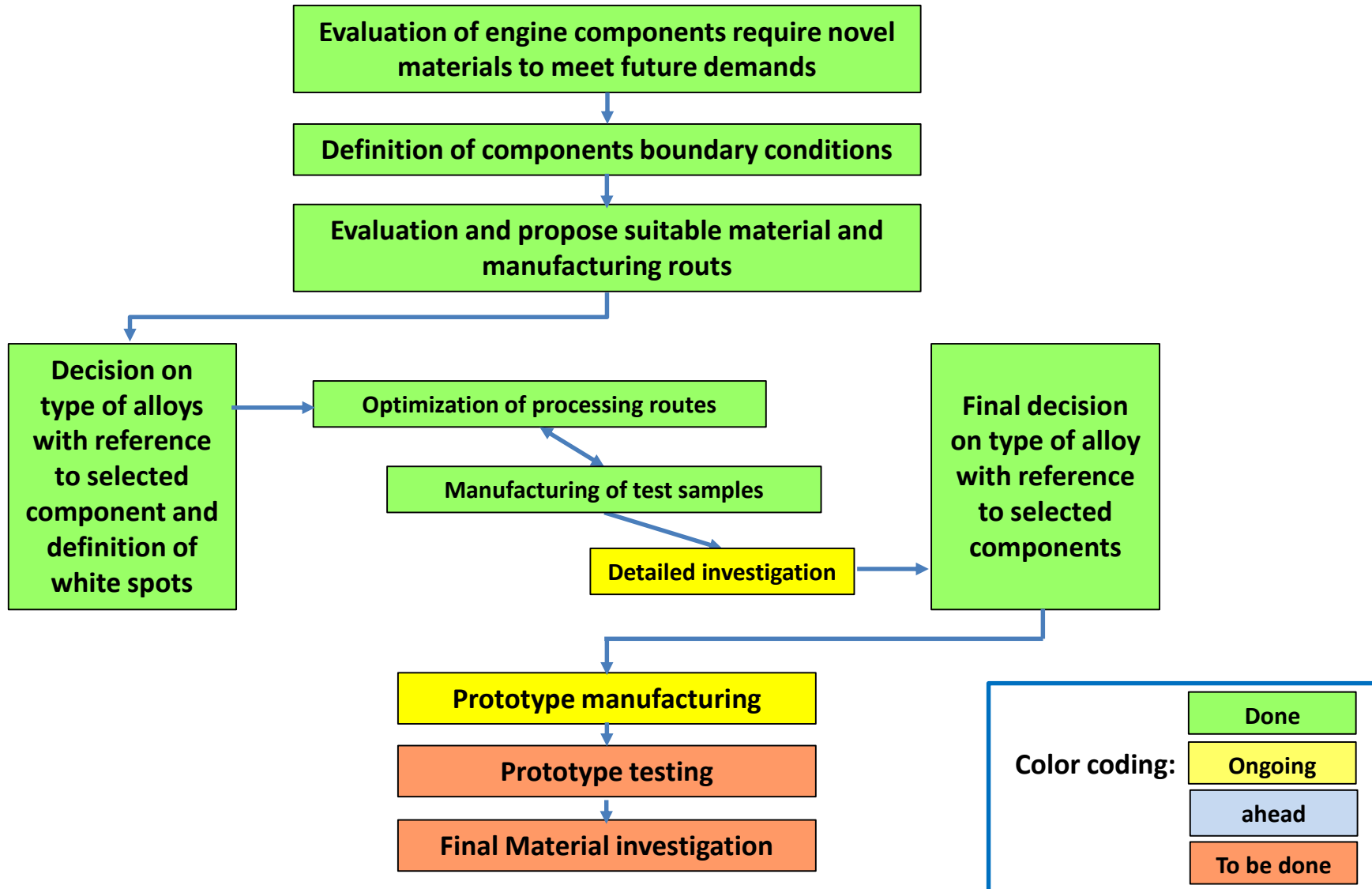
**Subproject 3.1:** Suitable new materials can be identified for at least two components for higher load operations and longer life time.

**Subproject 3.2:** Performance is improved through material / design optimization.

Partners:



## Status of Sub-project 3.1: Novel materials for engine application



## Status of Sub-project 3.1: Novel materials for engine application

### *Status of different tests:*



Mechanical properties of differently processed material and from cast engine parts  
Oxidation behaviour  
Aqueous corrosion testing



Hot corrosion tests under progress  
Tribo testing – outcome still pending

### *Status of Prototype manufacturing*



Investment casting (however, as-cast parts too porous)  
Castings of blocks

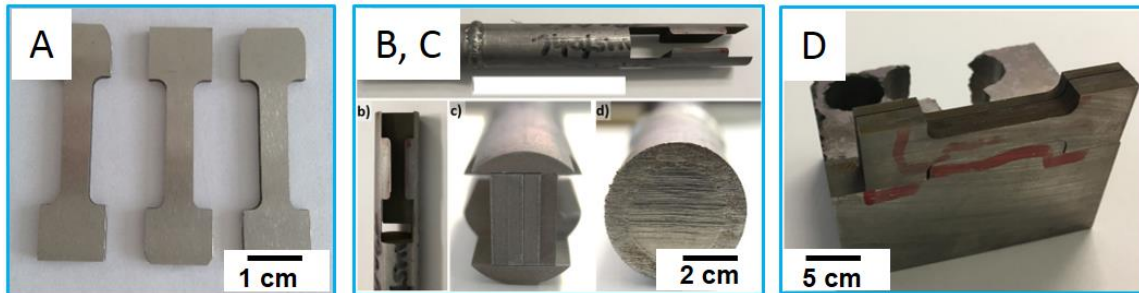


HIP of blanks  
Machining of blanks

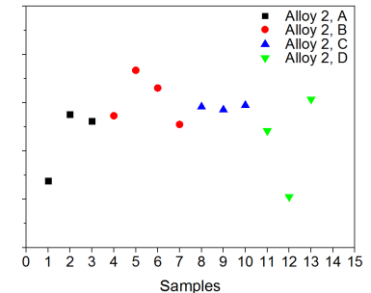
## Status of Sub-project 3.1: Novel materials for engine application

### Selected test results from material characterisation done:

#### Mechanical tests

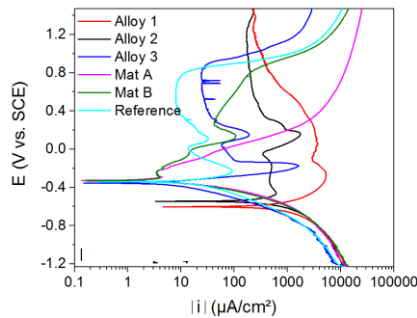


A: tensile samples from cast engine part; B, C: powder metallurgical processed; D: cast block

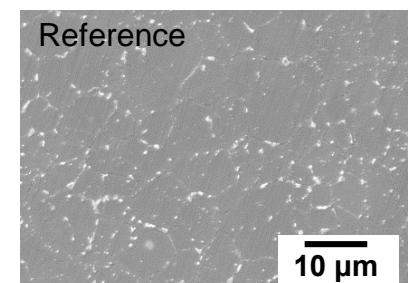
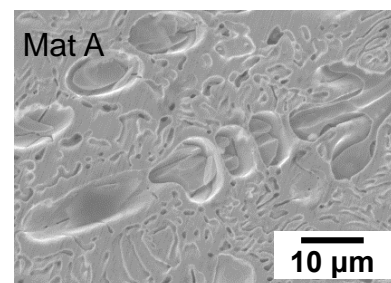
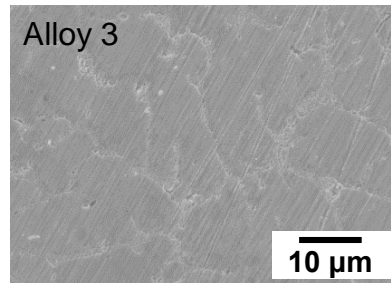


Tensile tests at 600 °C

#### Aqueous corrosion tests



Polarisation curves

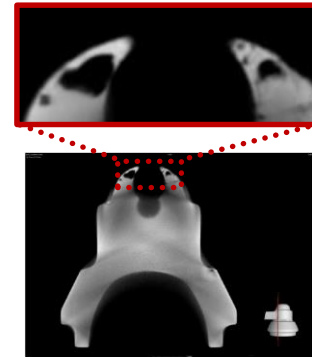


SEM micrographs of samples after wet corrosion

## Status of Sub-project 3.1: Novel materials for engine application

Prototype manufacturing ongoing:

Investment casting



Casting of blocks



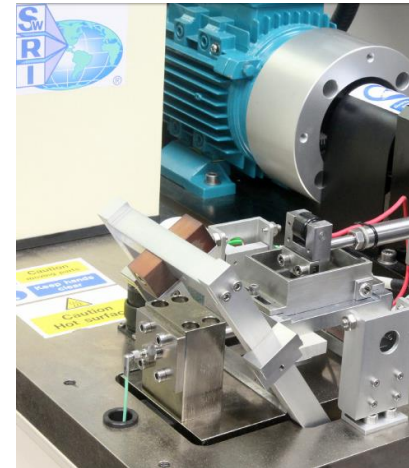
## Status of Sub-project 3.1: Novel materials for engine application



### Planned next activities:

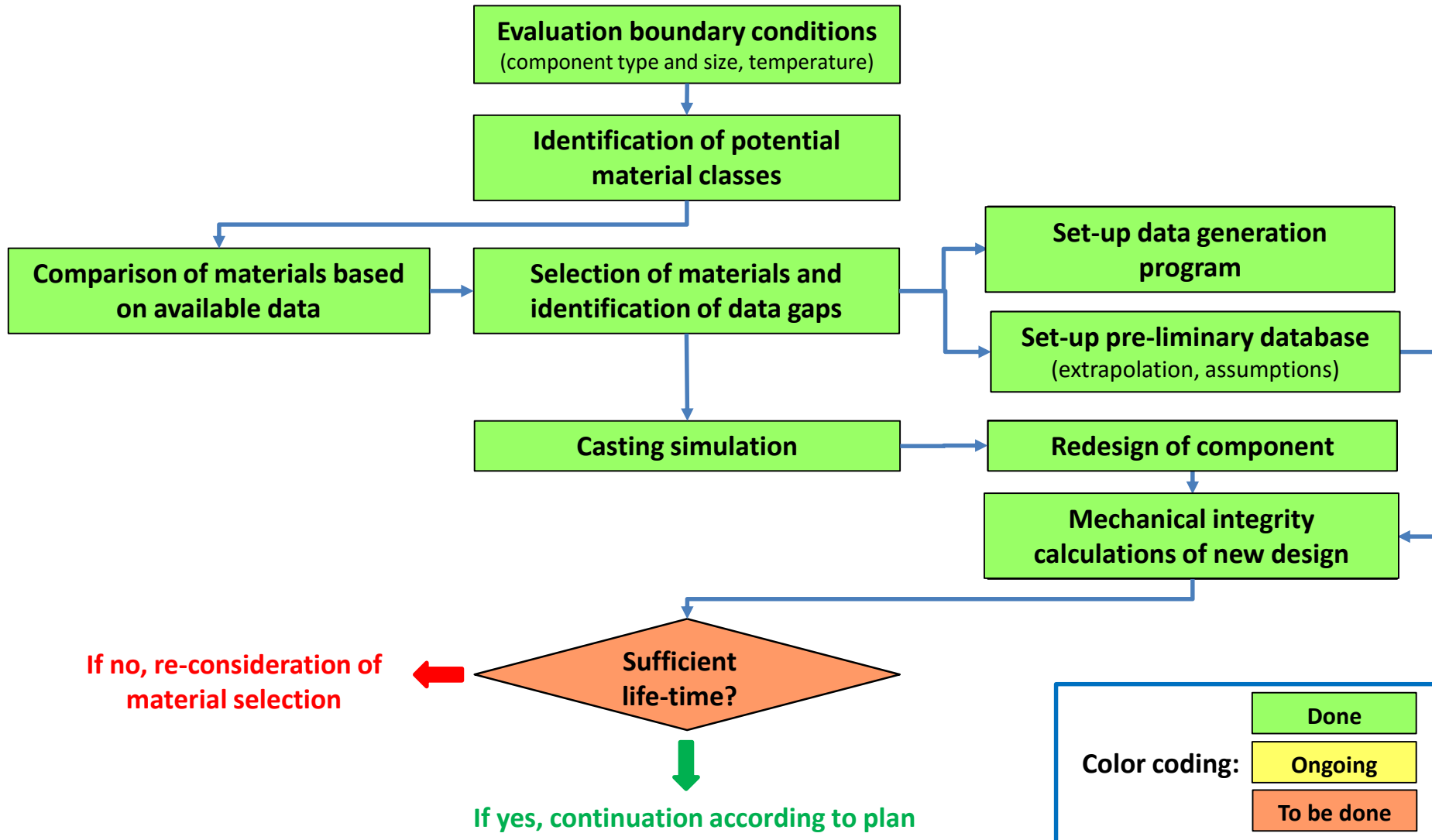
- Manufacturing of prototypes (2 different components)
- Finalize hot corrosion test evaluation
- Tribo testing & sample evaluation

Rig and engine testing to commence in Q1/2018



*Tribo tester: CPT*

## Status of Sub-project 3.2: Novel materials for turbine casing





### Status of Sub-project 3.2: Novel materials for turbine casing

#### Casting of prototypes:

- For the component qualification 3 parts are available
- One part in the as-cast condition
- Two parts in the fully machined condition
- Non-destructive testing was performed

#### Next planned activities:

- Destructive testing of prototypes such as microstructure, hardness, tensile test
- Machining of blanks for LCF and TMF tests
- Definition of TMF loading

