Winterthur Gas & Diesel

HERKULES-2

Work Package 3: Intermetallics and advanced materials for marine engines

Work package leader:
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WP3: Intermetallics and advanced materials for marine engines

WP Leader: Monika Damani
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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 tubine casing***

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

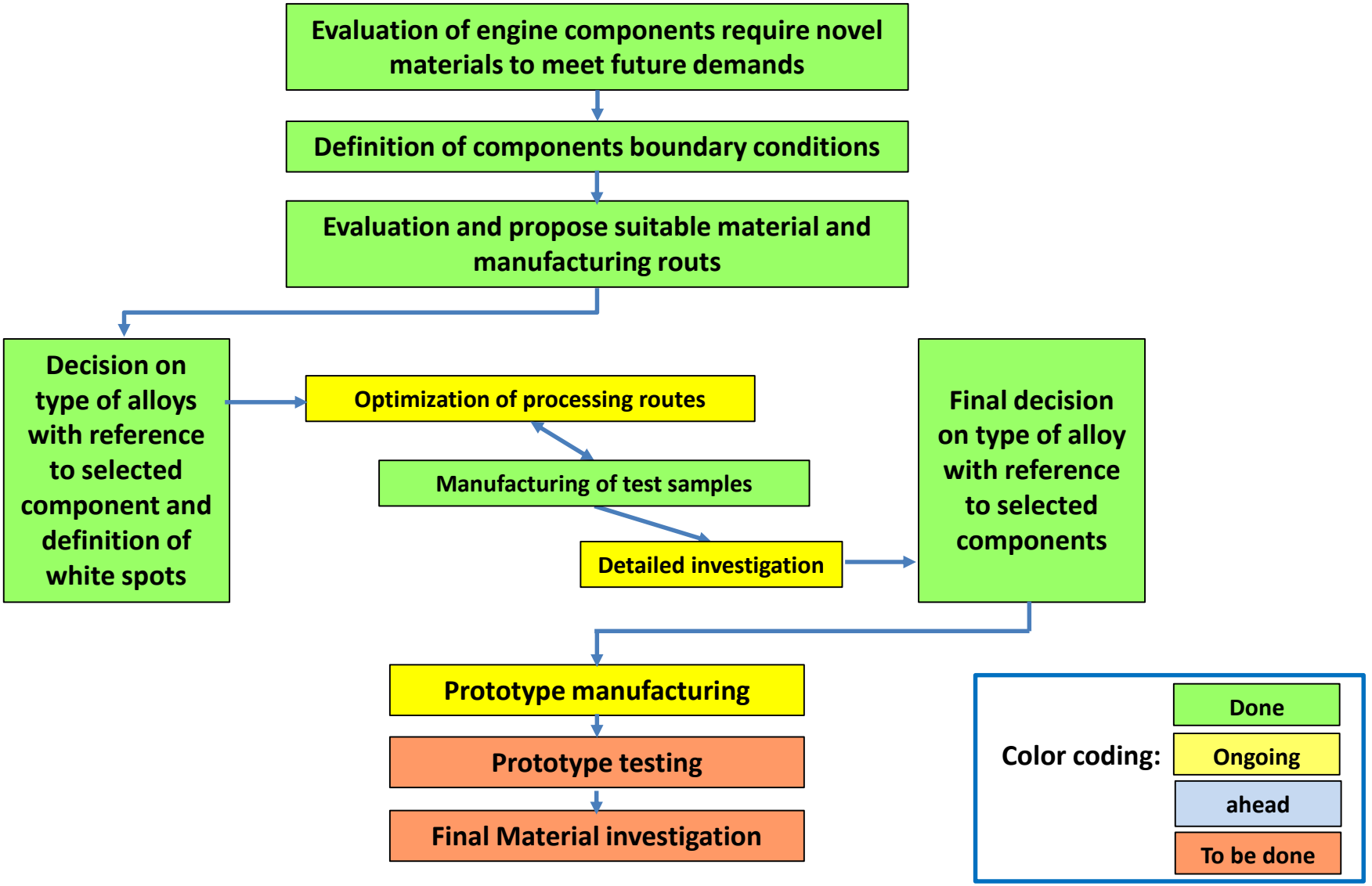
Expected outcome

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: Max-Planck-Institut für Eisenforschung GmbH, ABB, Deloro Wear Solutions, WÄRTSILÄ, WIN GD Winterthur Gas & Diesel

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:

Microstructure from different manufacturing routes & materials

Mechanical properties

Corrosion testing (cold & hot corrosion)

Thermal shock testing

Some additional mechanical properties to be determined

Additional corrosion tests under progress

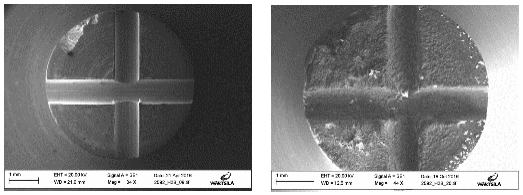
Tribo testing – samples ready / testing pending

MILESTONE 2:
Out of initally 5 canditates one material was chosen for prototype testing on test rig and/or engine

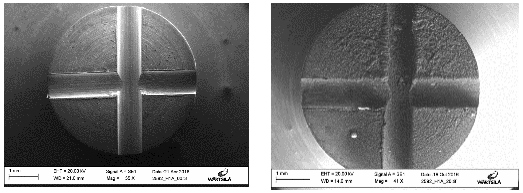
Status of Sub-project 3.1: Novel materials for engine application

Selected test results from material characterisation done:

Thermal shock tests

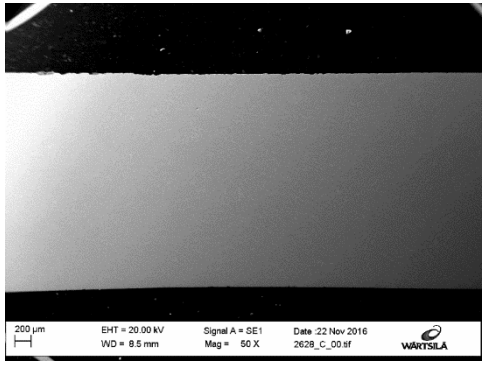


Mat 2: Before and after test
PASSED

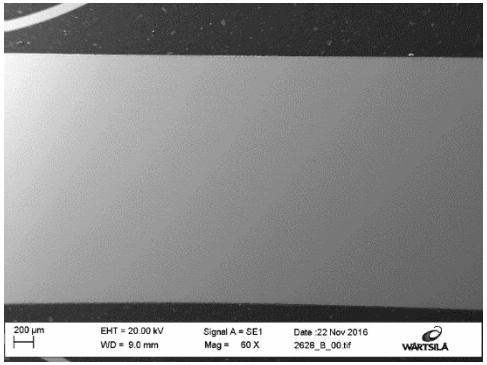


Mat 3: Before and after test
PASSED

Hot corrosion tests



Mat 2



Reference material

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

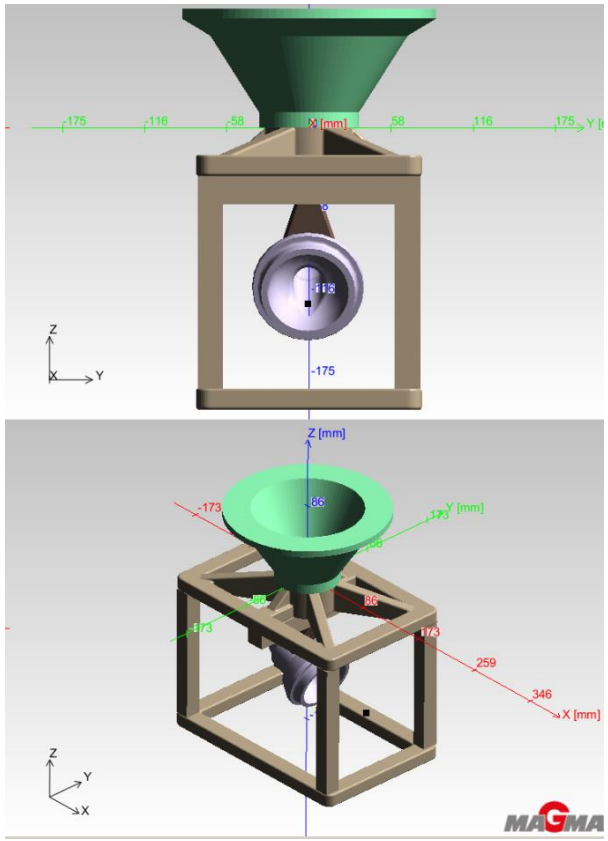
Test matrix and results for Milestone 2 decision:

Material	Condition	Corrosion resistance*	Mechanical properties*	Remark
Mat A	coating	+/-	+	Not suitable for chosen application
Mat B	coating	+/-	+	Not suitable for chosen application
Mat 1	Cast	++	--	Too brittle
Mat 1	HIP	++	-	Too brittle
Mat 2	Cast	+	+/-	Chosen for prototype test
Mat 2	HIP	pending	+/-	Chosen for prototype test
Mat 3	Cast	-	+/-	Corrosion resistance too low

* Compared to reference material

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

Prototype manufacturing ongoing:



Mould for casting ready
Mat 2 to be cast within next few weeks

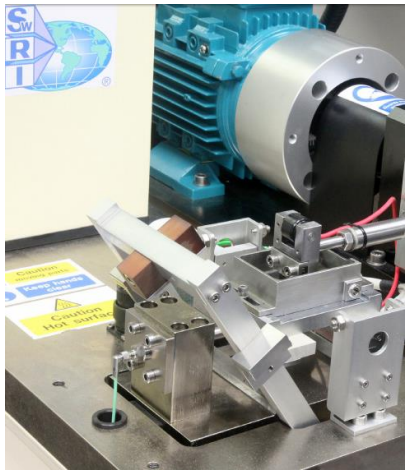
Part installation in test engine planned
Early Q3 2017

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

Planned next activities:

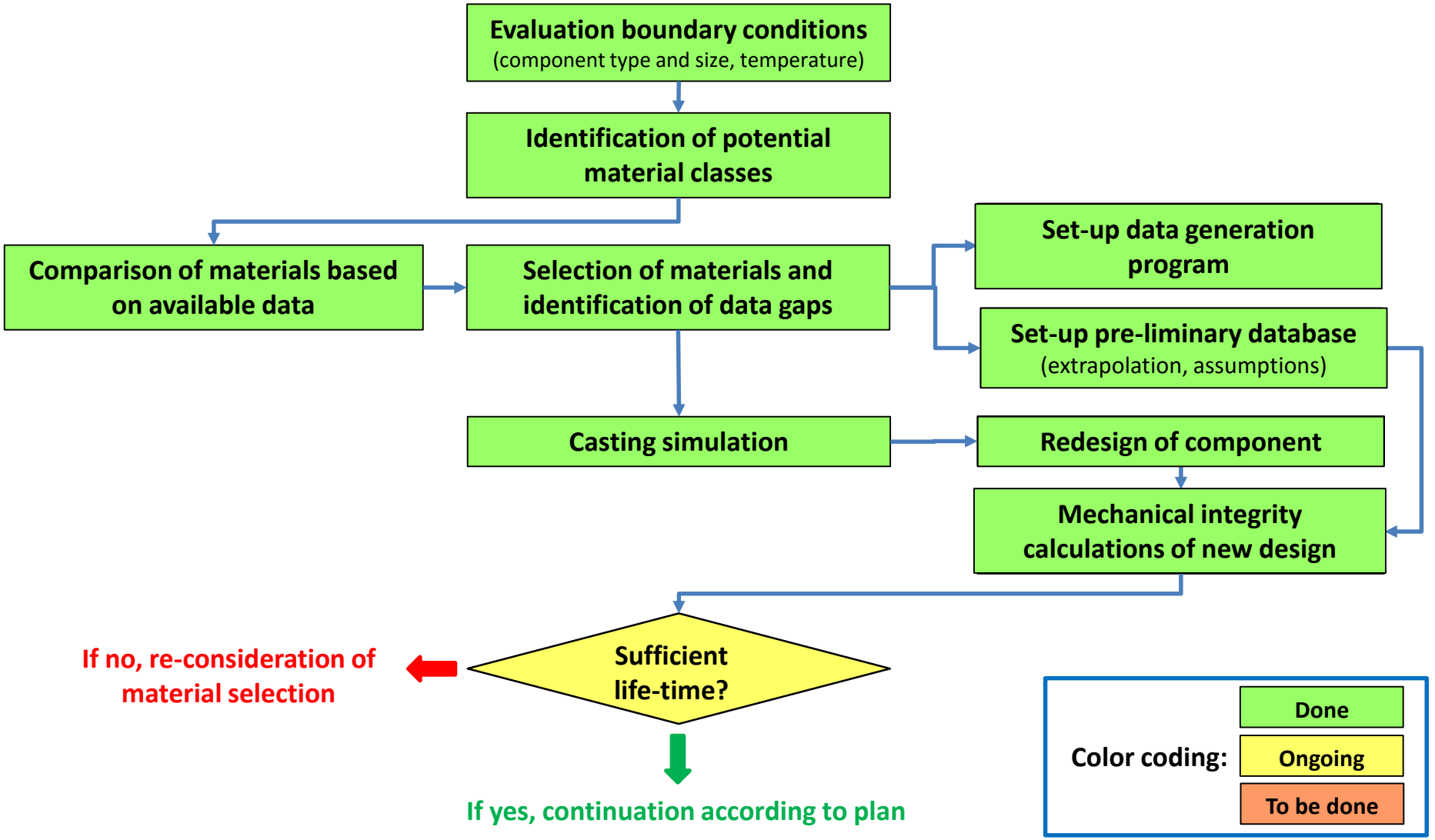
- ❑ Manufacturing of prototypes (3 different components)
- ❑ Additonal mechanical and corrosion testing to close gaps
- ❑ Tribo testing & sample evaluation

Rig and engine testing to commence in Q3/2017



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

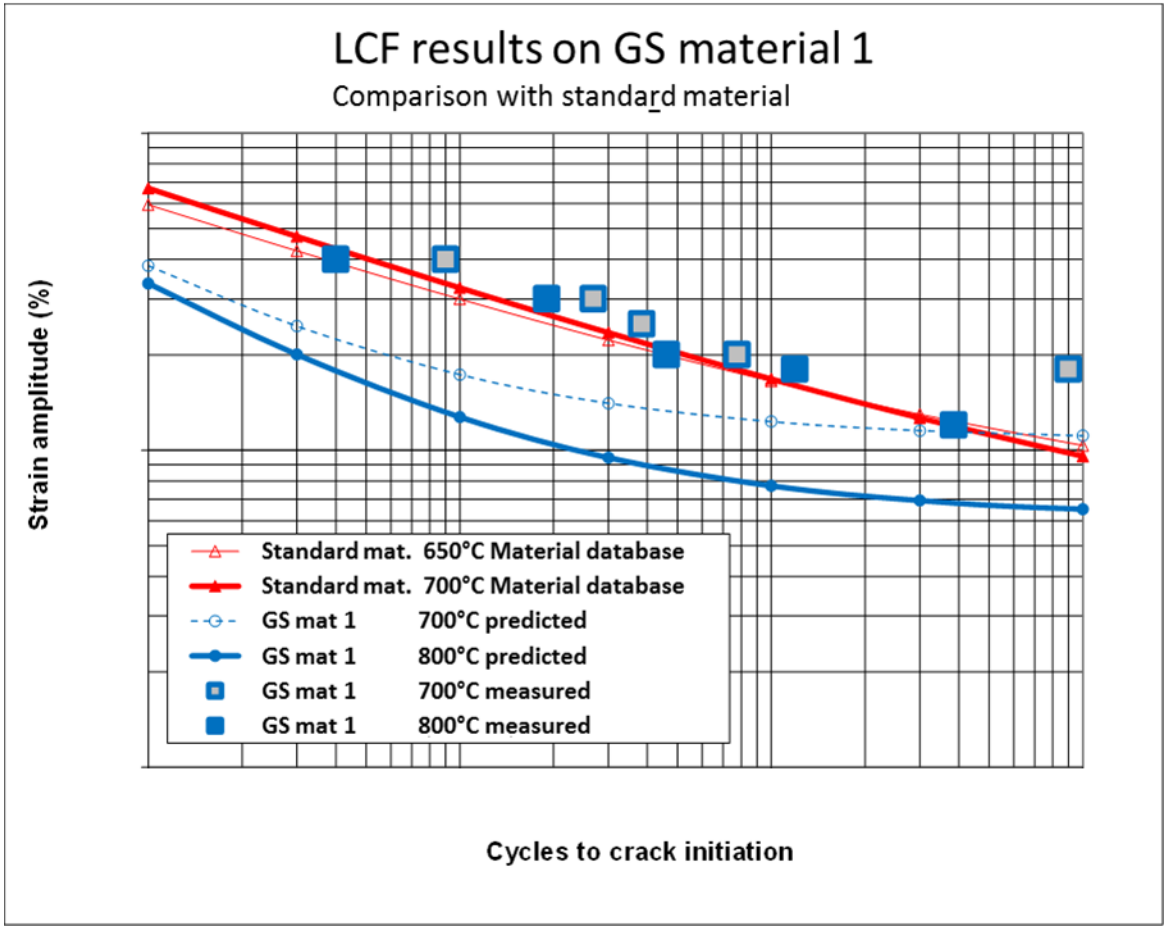
Work already done:

- Decision on casting type and manufacturing method
- Review of availability of required material data
- Preliminary material database setup
- Casting simulation
- Parametrisation of CAD-model
- Defintion of load profile
- Elimination of stress hot-spots
- Experimental material characterisation

Next planned activities:

- Production of prototype casings
- Qualification tests

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



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

Next steps:

- **Production of prototype castings by local foundry**
- **Non-destructive and destructive quality assurance testing**
- **Confirmation LCF- and creep tests on samples taken from the cast components**
- **Set-up and carry out of proper component tests**