



Research Fund for Coal and Steel



**Gears with top in-service performance
developed for
hybrid and electric vehicles**

Deliverable D7 (D4.2)

Evaluation of the performance of the surface hardened steels in fatigue and tribological tests

Deliverable D4.2

Deliverable No.	D4.2
Related WP	WP4
Deliverable Title	Evaluation of the performance of the surface hardened steels in fatigue and tribological tests
Deliverable Date	31.01.2024
Deliverable Type	Report
Dissemination level	Confidential – only for members of the consortium
Status	Final

Legal Disclaimer

Copyright ©, all rights reserved. No part of this report may be used, reproduced and or/disclosed, in any form or by any means without the prior written permission of TOPGEAR and the TOPGEAR Consortium. Persons wishing to use the contents of this study (in whole or in part) for purposes other than their personal use are invited to submit a written request to the project coordinator.

The authors of this document have taken any available measure in order for its content to be accurate, consistent and lawful. However, neither the project consortium as a whole nor the individual partners that implicitly or explicitly participated in the creation and publication of this document shall be liable or responsible, in negligence or otherwise, for any loss, damage or expense whatever sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error therein contained.



This project has received funding from the Research Fund for Coal and Steel under grant agreement No 101033989.

PUBLISHABLE SUMMARY

The project aims to improve the fatigue and tribological performance of automotive components tailored for Hybrid or Electric Vehicles by optimizing and innovate the heat treatment process according to specific component steel. In particular, the TOPGEAR project is focused on the main rotating transmission parts as gears since more than 25% of the component failures in vehicles are related to these components.

WP4, which deals with the assessment of tribological and fatigue behavior for gears, is central. It is related to the application of different heat treatments to the tribological and fatigue specimens, and the selection of the best condition.

This deliverable reports the work done in WP4 and summarizes the tribological and fatigue behavior of specimens produced with the various configurations. The analyzed configuration are investigated to lead to an improved resistance to the wear and an improved fatigue life.

From the fatigue point of view, the tests are carried out in a RUMUL CRACKTRONIC fatigue resonant machine. In this equipment, an electromagnetic driven resonator, built as a rotary oscillator, creates an appropriate bending moment that reproduces the stresses supported by the gear teeth during their in-service functioning.

A specimen with a proper notch sensitive factor ($kt = 1.21$), specifically designed to evaluate the fatigue performance of surface hardened steels is employed.

The tests are carried out following the STELLANTIS CEP00033 standard which combines finite life and endurance limit testing to generate the Wöhler curve of each steel. The endurance limit is evaluated through the staircase method (according to the standard ISO 12107:2012).

From a tribological point of view, the critical aspects to evaluate for the gear teeth performance is the scuffing risks. To evaluate the tribological scuffing behavior for the representative region of gear, an internal standard specimen geometry generally used for TNO tribometer at CRF, was chosen.

For the gear application: the scuffing risks are evaluated thanks to a block-on-ring test reproducing a pure sliding condition to assess the different heat treatments contribution to the surface in term of surface scuffing. The conventional route and the different configuration in term of heat treatment and steels are compared.