



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**PNRR 117 Research Field: INNOVATION IN THE STEELMAKING AND THE ROLLING  
PROCESSES TO IMPROVE THE QUALITY OF STEEL WIRE-ROD FOR ADVANCED  
MECHANICAL APPLICATIONS**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1400.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## Context of the research activity

### Motivation and objectives of the research in this field

The PNRR plan is an extraordinary and outstanding occasion to innovate the industrial tissue and increase the current and future competitiveness of Italian industry. Such goal can be obtained improving the competencies and the knowledge in all those fields that are nowadays fundamental for the efficiency and the sustainability. The present research aims at improving both the production processes (from the steelmaking to the hot rolling and the following controlled cooling) both the wire rod metallurgical properties to access those markets, where the compliance of the minimum requirements can be obtained only by products with high quality standards and very good overall performance. Moreover, the optimization of the whole manufacturing process does not mean an improvement of the material quality only, but also a reduced waste of resources and carbon footprint. For this reason, the enhancement of the product properties will be associated to the process sustainability and environmental impact.

### Methods and techniques that will be developed and used to carry out the research

The improvement of the product quality and performance will require a careful control of the material from the steel plant to the final user. The metallurgical and the mechanical properties, in fact, depend on the whole manufacturing cycle, i.e. the steelmaking procedures, the hot rolling parameters and the choice of the proper



|                               |   |
|-------------------------------|---|
|                               | <p>cooling strategy. For such a reason, the steel characteristics will be studied by mechanical tests and metallography after each production step. Moreover, the chemical composition of the continuous casting bar will be measured on different sections to investigate the element segregation phenomenon. This is particularly important on high carbon and alloyed steels, since a heterogeneous distribution of the chemical composition can affect the wire-rod final quality greatly and often cause defects or damages during the following plastic deformations. The presence of surface defects coming from the continuous casting bar or due to the hot rolling will be studied by an eddy-current instrument available on the rolling plant. Its tuning is particularly complicated and require time and many tests to investigate its capabilities in detecting surface defects. Nevertheless, the use of such instrument is considered fundamental to improve the wire-rod quality significantly. Finally, the modifications of the microstructural characteristics will be tested and evaluated with the support of some end-users from the cold deformability and from the response to heat treatments point of views. The feedback of the end-users will be considered for further modifications and/or fine tuning of the metallurgical features.</p> |
| <b>Educational objectives</b> | <p>The Ph.D. candidate will be involved in all the technical discussions and in the choice of the process parameters able to obtain the desired mechanical, metallurgical and surface properties. This will improve the candidate hard skills and contemporary its aptitude to the team working and to the project management. The attention to the whole production cycle will improve the candidate knowledge in the steelmaking process, the hot and cold plastic deformation and the understanding of the relation among the metallurgical characteristics and the wire-rod properties. The final aim is the development of a professional figure able to manage the different aspects of a real industrial process, from the raw material to the customer service.</p>   |
| <b>Job opportunities</b>      | <p>The skills, the knowledge and the experience that will be developed in the Ph.D. program, will make the candidate</p>  |



|  |  |
|--|--|
|  | <p>very interesting for all the companies working in the mechanical-metallurgical field.</p> <p>The research will be carried out in cooperation with Arlenico S.p.A., Caleotto S.p.A., Acciaierie di Calvisano, Feralpi Siderurgica, ESF Elbe-Stahlwerke Feralpi GmbH and the University of Brescia.</p> |
| <b>Composition of the research group</b> | 0 Full Professors<br>3 Associated Professors<br>0 Assistant Professors<br>1 PhD Students   |
| <b>Name of the research directors</b>    | Prof. Riccardo Gerosa, Prof. Barbara Rivolta   |

| <b>Contacts</b>   |
|---|
| <p>Phone: 0341-488776 E-mail: riccardo.gerosa@polimi.it, barbara.rivolta@polimi.it</p> <p>For questions about scholarship/support please contact phd-dmec@polimi.it</p> |

| <b>Additional support - Financial aid per PhD student per year (gross amount)</b> |    |
|---|----|
| <b>Housing - Foreign Students</b>   | -- |
| <b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>             | -- |

| <b>Scholarship Increase for a period abroad</b> |         |
|---|---------|
| <b>Amount monthly</b>                           | 700.0 € |
| <b>By number of months</b>                      | 6       |

| <b>National Operational Program for Research and Innovation</b>   |                                  |
|---|----------------------------------|
| <b>Company where the candidate will attend the stage (name and brief description)</b>                       | ARLENICO S.p.A.                  |
| <b>By number of months at the company</b>   | 6                                |
| <b>Institution or company where the candidate will spend the period abroad (name and brief description)</b> | ESF Elbe-Stahlwerke Feralpi GmbH |
| <b>By number of months abroad</b>   | 6                                |

| <b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>  |
|---|
| <p>Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of</p> |



euro 5.707,13.

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.