

Name of public contract: **Equipment for Development of Incremental Forming**

Substantiation of the business terms and conditions pursuant to section 156, ss. 1 par. c) PCA

Technical specification **Substantiation**

### KEY SPECIFICATIONS

The system shall be intended for flexible ...  
The Equipment should be capable of producing ...

This is required for achieving the desired sizes and shapes of rolled products for the purpose of planned research and development tasks.

### HEATING EQUIPMENT SPECIFICATIONS

The Contracting Authority requires induction heating (material to be heated: steel).

Advantages of induction heating include energy savings and high heating rates, as the material is heated directly. These are the reasons why it is required by the Contracting Authority.

The heating device shall allow the stock to be heated to the forming temperature in synchronism with the rolling equipment.

The stock has to be heated in a controlled manner. This means that an exactly defined heating schedule should be used for each material. The synchronism is required for the sake of accuracy of the thermomechanical treatment. In rapid processes, deformation must be applied within closely defined temperature intervals.

The heating temperature shall be controllable over the range of no less than 25-1250 °C.

This condition is required for achieving the necessary heating temperature (*austenitizing temperature*) prior to the actual thermomechanical treatment. It is needed for the planned research and development efforts. One of examples of these efforts involves exploring the effects of individual parameters of thermomechanical treatment on the resulting microstructure, for instance in TRIP steels (Transformation-Induced Plasticity), and finding optimum parameters for thermomechanical treatment.

Heated stock diameter range: 12 – 30 mm.  
Heated stock length range: 500 – 1500 mm.  
Minimum output...  
The position of the heating device shall be adjustable along the longitudinal axis of the equipment.

The requirements for heating (range of diameters, range of heated stock lengths, output capacity, power) are given by the Contracting Authority's need to achieve highly uniform heating combined with versatile configuration and high productivity of the equipment. The conditions are derived from the planned research and development tasks and the planned use of the equipment in the project. The parameters are interrelated and specified in terms of requirements for the power and functions of the equipment.

Temperature measurement shall be provided with two-colour pyrometers or other appropriate instruments.

During rolling, the surface temperature of the stock has to be measured using a contactless technique. Conventional radiation pyrometers would not deliver the required performance. The measurement could be distorted by multiple factors. For instance, the emissivity of the material may be unknown or changing rapidly, the measured object may fail to fill the entire field of view of the pyrometer, the measured surface may contain colder spots, the environment may be polluted with smoke or steam, dirt may accumulate on the lens of the pyrometer and other difficulties may arise. These issues precluding or complicating measurement with an ordinary radiation pyrometer can often be resolved by using a ratio pyrometer (two-colour pyrometer) or a multiwavelength pyrometer.

The permitted deviation from the reference temperature shall be no more than +/- 5 °C along the longitudinal axis of the stock at the point of entry between rolls...

The required temperature of the stock at the entry between rolls must be achieved. It is needed for the planned research and development tasks. This parameter is required for exploration of effects of individual thermomechanical treatment factors on the resulting microstructure.

### **INCREMENTAL ROLLING STAND SPECIFICATIONS**

•Rolling mill with three adjustable rolls at temperatures ranging from the room temperature to 1250 °C...  
The rolling speed (axial) shall be adjustable in the range of 25-250 mm/s.

The technical specifications were formulated by the Contracting Authority through requirements for the equipment's performance and function. They are based on the Contracting Authority's need to achieve high quality of rolled products combined with a versatile configuration and high productivity of the equipment. The specifications were drafted upon preliminary consultation with potential suppliers and based on the planned use of the equipment in the project and the envisaged research and development tasks. The requirement is necessary for experiments exploring the effects of individual parameters of thermomechanical treatment, namely the rolling speed and temperature, on the resulting microstructure of the rolled product.

The rolling mill shall be designed to sustain an operational load of no less than 10 tonnes of force per roll.

For effective rolling and the intended research and development tasks, the mentioned working load per roll is the minimum level.

The radial setting speed of each roll...

The equipment should be capable of producing cylindrical, conical and other pre-defined rotation-symmetric shapes with a straight longitudinal axis. This requirement dictates the need for the radial adjustment capacity for all rolls. The speed was determined with reference to the required shapes and the required rolling speed.

Capacity for rolling all metals and alloys.

There shall be capable of rolling all metals and their alloys, as required by the research objective of the project.

The ovality of final products...

The requirement for minimal ovality of final products is derived from the need for accurate thermomechanical treatment in experiments exploring the effects of individual parameters of thermomechanical treatment on the resulting microstructure

of the rolled product.

## COOLING EQUIPMENT

The system shall offer controlled and...  
The cooling nozzles shall be installed...  
The location of the fourth section...  
The minimum cooling rate shall be 30 K/s.  
The cooling medium shall be water...

The requirement for the cooling device results from the experience gathered by the Contracting Authority to date and from the planned research and development tasks, i.e. the planned use of the equipment in the RTI project. Furthermore, maximum versatility of the equipment should be maintained for future research, e.g. for new structures of rolled products.

## SPECIFICATIONS FOR DATA ACQUISITION

All control parameters of the equipment shall be logged and stored...

This requirement is essential for subsequent analysis of the rolling process and the impact of actual process parameters on the rolled product.

Synchronized data streams shall be available for other external measuring sensors or for synchronizing other inputs and outputs...

Synchronized data streams are essential for subsequent synchronized measurement, which is a prerequisite of the research.

The measured data for each rolled product shall be stored in a database.

The Contracting Authority requires this feature for subsequent analysis of the rolling process and the impact of actual process parameters on the rolled product.

## CONTROL SOFTWARE SPECIFICATIONS

The Contracting Authority requires full-scale software ...  
The control system shall include ...  
The entire equipment shall be operated using a central...

The required SW shall offer full compatibility and full performance with the computer hardware supplied in order to permit effective use of the entire equipment for the planned development and research tasks.  
The central control is essential for simple and comprehensible operation of the equipment.

Two data entry methods shall be available: via the

These features are required by the Contracting Authority in order to permit simple operation of the equipment, the preparation of programs outside the machine and to

equipment's operator interface and by uploading from...

achieve time savings.

The equipment shall allow the data entered...

These features are required by the Contracting Authority in order to permit simple operation of the equipment, storage of the program in the memory of the equipment and for time savings.

The control system shall permit ...

The characteristic is essential for the planned research and development tasks.

The language of the equipment communication interface and software shall be Czech or English.

The Contracting Authority requires either Czech or English language on the grounds of its language capabilities.

### **SPECIAL SPECIFICATIONS AND REQUIREMENTS**

Heating chamber...

This item is a prerequisite for thermomechanical treatment of final products.

Temperature measurement in no less than four locations (as described in the Specifications for Data Acquisition) shall be provided...

The surface temperature of the stock has to be measured using a contactless technique. However, conventional radiation pyrometers would not deliver the required performance. The measurement could be distorted by various causes. For instance, the emissivity of the material may be unknown or changing rapidly, the measured object may fail to fill the entire field of view of the pyrometer, the measured surface may contain colder spots, the environment may be polluted with smoke or steam, dirt may accumulate on the lens of the pyrometer and other difficulties may arise. These issues precluding or complicating measurement with an ordinary radiation pyrometer can often be resolved by using a ratio pyrometer (two-colour pyrometer) or a multiwavelength pyrometer.

The entry table with a minimum length of 2 m shall allow the stock to be fed...

The configuration shall enable simple handling of stock.

Handling table for removing final products with lengths of 6 m... This section of the equipment shall allow...

This item is required for simple handling and removal of rolled products. The cutting facility is important for subsequent simple handling of products.

Overload protection for the entire system...

The protection of the entire system from overload is important for preventing machine and tooling failures and the associated high costs.

The layout of the equipment shall permit...

This requirement is dictated by the constrained area available in the RTI/LET hall (Regional Technological Institute/Experimental Forming Laboratory).

## MISCELLANEOUS TERMS AND CONDITIONS

The Supplier shall provide warranty services for 24 months (the warranty period) following the acceptance of the equipment by the Contracting Authority. The scope and conditions of the warranty service shall be as follows: ...

The Contracting Authority has defined the warranty period as 24 months from the date of due acceptance of the Goods. In the domain of such specific research equipment, this duration of warranty period can be considered adequate and normal. The warranty service provided free of charge, the technical support for equipment commissioning and the subsequent phone support are required by the Contracting Authority to ensure the equipment is fully functional in accordance with the Contracting Authority's requirements set out in the tender documentation without requiring any additional investment throughout the warranty period.

Mandatory items of the warranty services shall include...

While providing the warranty service, the Supplier shall deliver spare parts...

Technical support for equipment commissioning...

The obligation to deliver spare parts and to provide technical support as part of warranty services is required by the Contracting Authority to ensure the equipment is fully functional in accordance with the Contracting Authority's requirements set out in the tender documentation without requiring any additional investment throughout the warranty period.

The scope of delivery of the equipment...

The SW upgrades are required, for instance, for the potential transition to newer software versions which typically offer new features. The software upgrades are prerequisite of effective use of the equipment. Also all necessary accessories and tools shall be included for effective work with equipment.

1) The Tenderer shall be required to deliver the Equipment...

As the delivery of the goods is part of the subject-matter of the public contract, the risk of damage transfers to the Contracting Authority with the title to the equipment, i.e. upon installation and demonstration of the equipment and upon authorization of the acceptance report. The conditions for equipment commissioning and utility connections are a precondition for correct use of the equipment delivered.

2) The Tenderer shall supply alongside the Equipment accompanying technical documentation...

The delivery of the full technical documentation and the user manual is required for ensuring the correct function of the entire equipment according to requirements set out by the Contracting Authority in the tender documentation. The Contracting Authority requires either Czech or English language to be used with respect to its language capabilities.

3) The accompanying technical documentation supplied by the Tenderer shall include an itemised list...

The delivery of the itemised list of spare parts with information on additional warranty service-related costs is required by the Contracting Authority for the purpose of estimating the equipment operation costs and for planning spare part ordering after the warranty period.

4) The scope of delivery shall include the installation of the control...

The installation of the control software and operator training are required for correct use of the equipment delivered.  
The trial run shall include advanced training of no-less than the minimum number of operators specified above, as a follow-up to the basic training, aimed at mastering specific measurements/tests and combining the knowledge acquired for advanced analyses and specific activities for the purpose of the envisaged research and development tasks.

5) During Equipment installation, the Tenderer shall be required to demonstrate all functions...

The demonstration of all requests achievement is necessary to overtaken equipment that will be according not only the contract but also useful for future planned work.

6) The Tenderer shall provide warranty for the Equipment supplied for a period of 24 months.

The Contracting Authority has defined the warranty period as 24 months from the date of due acceptance of the Goods. In the domain of such specific research equipment, this duration of warranty period can be considered adequate and normal.