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# TECHNICAL SPECIFICATION OF FORMWORK AND SEGMENT HANDLING EQUIPMENT

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## SCOPE OF THE SUPPLY

The supply includes the manufacture of segments moulds.  
Precast segments are parts of the ring as tunnel lining excavated by TBM.

## SEGMENTS MOULDS: TECHNICAL SPECIFICATIONS

Technical description for the manufacture of SEGMENTS STEEL MOULDS for the production of Tunnel precast segments.

Segments moulds type	Stationary
Number of moulds / ring	Nr.
Number of sets	Nr.
Side opening	Manual
Vibration	External pneumatic vibrators
Warranty	The entire duration of the project



## SERVICES

Technical and commercial info with the Client  
Periodical check for the warranty of the quality of the segments moulds  
Segments moulds design  
Delivery Timetable  
Quality Control and Final Acceptance of the segments moulds  
Supply for Segments Moulds (EXWorks condition including packaging)

## QUALITY PROCESS

### DESIGN

Drawings processing and technical documents registration  
Design drawings processing and registration

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### COORDINATION

Periodical control for the supply  
Acceptance of incoming materials (quality and quantity)

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### MANUFACTURE

Reception of design drawings  
Manufacture of the segments moulds in according to design & drawings  
Cut and moulding processes  
Mechanical operations  
Welding process  
Assembly and final check and setting

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### CONTROL

Final check of the components and reports certified by the Coordinator  
Non-Compliance survey  
Final dimensional check of the segments moulds based on Acceptance protocol  
Commissioning protocol

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### QUALITY DEPT

Control based on technical requirements

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## MANUFACTURE FEATURES

### LOWER STRUCTURE

ASTM A36 steel grade : Korean Standard: KS D 3503 – SS400,SS490 – Posco Steel  
Laser cutting and calender by cold process and properly reinforced steel  
12 mm thick steel plate as final thickness  
Conical centering pin of high precision at both side walls  
Access to the lower structure of the mould for inspection of vibrators

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### SIDE and FRONT WALLS



Mobil machined side walls designed to ensure a robust structure to endure all conditions during the precast works (ASTM A36 steel grade - 33 mm thick as starting machined steel plate).



Mobil front walls (ASTM A36 steel grade)  
33 mm thick as starting machined steel plate  
Conical centering pin of high precision  
Special rubber seals between the side walls and front walls and bottom of the mould

Two fast closing taps on top with springs to keep them open while doing ceaning and preparing for concreting.

### WELDING

MIG welding processes

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### SURFACE PROTECTION OF SEGMENTS MOULDS

Layer of coating (painting) should be composed of two components, 80/120 µm.

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### ASTM A36 STEEL GRADE PROPERTIES

ASTM A36 is a construction carbon steel with ductility properties

ASTM A36 has min 250 MPa yield strength and 400-550 MPa ultimate tensile strength.

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## TOLERANCES

The segments moulds are engineered and designed in according to Client requirements and manufactured and tested in according to ISO 9001-2008.

Segment length	$\pm 0.5$ mm
Circumferential length	$\pm 0.6$ mm
Thickness	0 -3 mm
Diagonal chord	$\pm 1.0$ mm
Longitudinal and radial face planarity	$\pm 0.5$ mm
Allowable bend into the lower structure	$\pm 1.5$ mm
Groove dimensions (gaskets)	$\pm 0.3$ mm
Tolerance into the lower groove due to rotation or faces deformation	$\pm 0.3$ mm
Inserts position	$\pm 1.0$ mm

## OPENING/CLOSE/CENTERING SYSTEMS



The side walls are connected to the mould structure by a tube-shaped bar.

A tailored hinge regulates the opening.

Onto the side walls are fitted bushings where will be placed the centering cones.

The side walls are blocked by screws.

The screws determine the contact between side wall and plate (cone location).

The front walls are centering and blocked to the mould structure with the same solution as per the side walls.

Onto the front walls will be fitted other centering cones that shall be coupled with the bushings inserted onto the side walls.

This solution defines precisely the position of the side walls and the front walls into the space assuring that the precast segments shall be poured in according to the design requirements in terms of tolerances.



Onto the side walls and front walls are visible the matching signs (the perfect alignment of these signs gives a fast reply about the closure of the segment mould).

## PNEUMATIC VIBRATORS

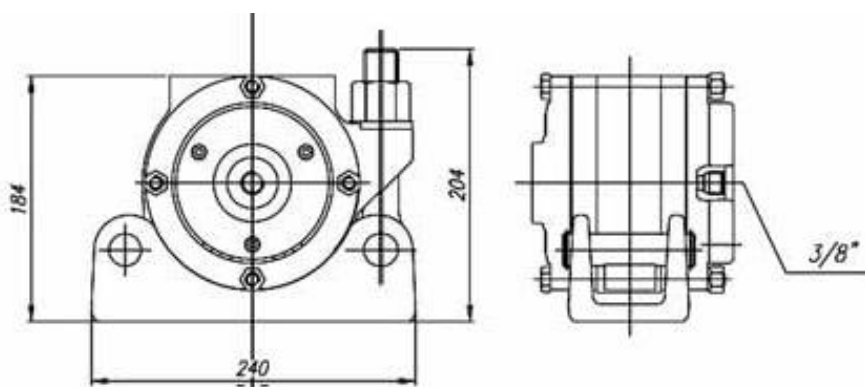
Each segment mould is equipped with external pneumatic vibrators in order to guarantee a correct spread and filling of the poured concrete on the full surface of the mould.

The vibration force resonates with the lower surface of the mould and has been specially designed so as not to influence the dimensional quality of the perimeter facades (whose tolerances is in the order of tenth of a millimetre) creating neither distortions nor tensions to the structure of the segment mould.

The external vibrators are fixed to the frames of the lower structure of the mould on vibratio diffusion bars.

Each vibrator should be supplied by a separate distribution line of compressed air provided with a quick-closing ball valve.

Air compressor and air storage tank are not included in the scope of supply.



<b>Frequency</b>	<b>14.500 vpm</b>
<b>Centrifugal force</b>	<b>61,18 kN</b>
<b>Air consumption</b>	<b>1.800 l/min</b>
<b>Working pressure</b>	<b>6 Bar</b>
<b>Assembly of vibrators</b>	<b>The support of the pneumatic vibrators is designed to guarantee the highest number of cycles without any failure and crack</b>

## SEGMENT HANDLING EQUIPMENT: TECHNICAL SPECIFICATIONS

### Vacuum Lifting Device



- Demoulding the segment and transport of the segments to the tilting station.
- Individual remote controller
- Crane hook type

### Segment tilting device



- Control Pannels
- Hydraulic sytem and control unit included

### Vacuum demould and tilting device – extrados surface of segment



- Demoulding the segment and 180 degree tilting
- Individual remote controller
- Crane hook type