MPD Yoke production status

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JINR, Dubna
MPD Yoke (L=8970 mm, Ø6625 mm)

- **28 plates**: 16 t each
- **2 support rings**: 42.5 t each
- **2 poles**: 44 t each

**Total**: 621 t

**Material**: Steel 10 (AISI 1010) forging

*Lodgement (Yoke support)* – 74 tons, ordinary steel St.3 (Fe 360)

*2 Pole transport support* – 15 tons each, ordinary steel St.3 (Fe 360)
Global scenario:

December 2015 - signing contracts:

1 – JINR – SPETSMASH (St.Peterburg) – Forging production
2 – JINR – VHM (Vitkovice, Czech Republic) – Yoke and auxillary equipment production

June 2016 – forging production finishing (4 rings - Italy, 28 beams (plates) - Ukraine)

2016 – mid. 2017 – machining at VHM

2017 - the VHM plant went bankrupt (it was a very dramatic situation)

March 2018 – resumption of work

June-July 2018 – Yoke preassembly

July 2018 – Yoke test

2018 – MPD movement system production

December 2018 – Yoke finish of production at VHM

Feb – March 2019 – rings transportation (AET Trans, St.Peterburg)

June – July 2019 – total transportation (AET Trans, St.Peterburg)

July - August 2019 – MPD rails installation (Pelcom, Dubna)

April 2020 – start to assembly in Dubna
Rad line of MPD Yoke production is Quality.
Plates production on NKMZ (Kramatorsk, Ukraine)
Plates chemical composition

Mechanical properties:

**Sigma** 0.2 = 225 - 354 N/mm²
Average = 241 N/mm²
Technical Order = 210 N/mm²

Ultrasonic control: good

Carbon C
GOST on steel 10  0.07 - 0.14 %
Technical Order  0.08 - 0.10 %
Forging (really)  0.08 - 0.10 %
All other elements are inside tolerances

A.I. Kruykh  31.03.2016
Support rings (Forgiatura Morandini)
Poles

4 May 2016

14 June 2016
Rings chemical composition

Carbon C

GOST on steel 10 0.07 - 0.14 %
Technical Order 0.08 - 0.10 %
Forging (really) 0.08 - 0.09 %
All other elements are inside tolerances

Ultrasonic control: good

Mechanical properties:

Sigma $0.2 = 231$-$292$ N/mm$^2$
Average = 255 N/mm$^2$
Technical Order = 210 N/mm$^2$
Forging transportation from Italy to VHM (Vitkovice, Czech Republic)

1130 km
Forging transportation from NKMZ (Kramatorsk, Ukraine) to VHM (Vitkovice, Czech Republic) - 1700 km, 29 trucks

Summer 2016
VHM equipment checking

Milling machine for plates

Boring machine for rings

A simple
Control measurements scheme

QC documents were done for all plates, rings, lodgement contact surfaces.

All deviations from nominal dimensions (length, wide, shape) are less than 0.05 mm.
Yoke production status, March - 2018

Support rings: need to have holes machining, sandblasting, painting

Yoke plates: 25 from 28 are ready

Pole machining
Cradles parts:

6 cradle support

Spacer plates between bottom surface of cradle and Roller Skates
Predicted very useful tool!
Poles transport supports (2 ps)

Front stand

Back stand

Bottom base parts

Rings billets
Technological tool

- Top beam
- Lifting beams and Base plate for face surface
- Lifting beam for plugs inserting-removing in vertical plates
- Plugs
Preassembly experience at VHM

Floor flatness on area 7x7 m²

Common non-flatness is 0.3 mm
Status on 04 June 2018

Stands shape
Main deviations are "zero"!

Drawing tolerances are +/- 0.05 mm on the R=3655 mm and others.
Plate #1 installation (5 June 2018)
Plate #1 installation (5 June 2018)

Position pins Ø 50 mm
Plate #2 installation (5 June 2018)

Manipulator from Tile Calorimeter (ATLAS, CERN)
It was used in 2002-2006

Second life in 2018-2019 (NICA-MPD, VHM-JINR)
Plate #2 installation

Surface control tool
2 plates in place
Shims calculation

\[ S = 1.73 + \frac{(\Delta_1 + \Delta_2)}{2} \]

\( \Delta_1, \Delta_2 \) – plate passport data

\[ S = 1.8 \text{ mm as usual} \]
Shims preparing
Plates preparing for assembly
Plates preparing for assembly
Plate #5 installation (7 June 2018)
Top points flatness measurement of 7 plates
7 plates in assembly
Assembly step
Plate #13 installation (9 June 2018)
13 plates in place
13 plates in assembly

L = 5888 (+1 mm)
Scaffolding erection

Complementary supports from both sides
Support ring manipulation
Support ring #1 on side W

- Gap 0.4 mm
- Gap 0.6 mm
- Non-symmetry 0.1 mm
Support ring #2 installation (13 June 2018)

- Gap for plate #12 – 0.1 mm
- Gap for plate #13 – 0.1 mm
- Non symmetry 0 mm
- Full contact on all bottom 11 plates
<table>
<thead>
<tr>
<th>Dimension acc. testing</th>
<th>Measured dimension</th>
<th>Calculated value</th>
<th>Deviation from calculated value</th>
<th>Real deviation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
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<td>5886.95</td>
<td>5886.90</td>
<td>0.05</td>
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5887 \(-0.1\), really it is < 0.05 mm
Support rings on both sides
Technology beam (8470 mm) installation
Plate installation
2 support ring in assembly

0.53 mm out

0.66 mm out

Limit 0.5 mm
Plates position on support rings (the similar situation for all bottom ones)

9 mm gaps for 8.5 mm shims
Plates position on support rings (the similar situation for all bottom ones)
Plate #26 installation
27 plates in place (20 June 2018)
“Final” measurements report
(27 plates in assembly)

Side W – 0.55 mm out
Side E – 0.66 mm out
Top plates positions

Gap is zero

Gap is 0.2 mm

Gap between #27 and @28 is 0.5 mm (fixed by steel shims)

Diameters have nominal dimensions 6583 mm in vertical and horizontal directions on both sides
It is half way of preassembly. Next step is drilling of 544 holes 33H7 for pins 33p6.
712 Holes drilling (in 5 steps):

1 – drill 28 mm
2 – mill 30 mm, $h = 90$ mm
3 – mill 32 mm, $h = 90$ mm
4 – mill 32.6 mm, $h = 90$ mm
5 – rimmer 33H7 (0+0.025), $h = 80$-$85$ mm

279 from 712 are ready (on 23 June)
TEST on 24 July 2018 at VHM

<table>
<thead>
<tr>
<th>Shrinking calculation estimation, mm</th>
<th>Test result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neva-Magnit</td>
<td>Progresstech-Dubna</td>
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<tr>
<td>10,2</td>
<td>9,0</td>
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<td></td>
<td>VHM</td>
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<tr>
<td></td>
<td>10,4</td>
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</table>
What does that mean? (Conclusions)

* We are on the right way:

  1. there is no mechanical hysteresis
  2. All 4 support trolleys accept half of the standard load
  3. Local load on the concrete is 50% of the design: increases the durability of the foundation and reduces the chance of subsidence of rail tracks in the process of exploitation.

(локальные нагрузки на бетон составляют 50% от расчетных: повышается долговечность фундамента и уменьшается шанс просадки рельсовых путей в процессе эксплуатации)
Many thanks to “AET Trans”

All rings were delivered in time without any extra tax on the roads.
Plans for nearest future

October 2019 – April 2020 - installation of sandwich panels on the walls of the pavilion, creation of main and finishing floors, installation of gates, provision of heat and electricity in the pavilion

January – March 2020 – Top platform production

April – June 2020 – Yoke preassembly, movement system installation and test

May-July 2020 – Cryostat transportation

August 2020 – Cryostat installation

November 2020 – Magnetic field measurements

AOB
Thank you for your attention