XML Description of Magnet Geometry

Version 1.1

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1 Introduction

The XML description of the magnet geometry is based on the recent update of the engineering drawings of magnet [1, 2]. Some simplification of the real design is done.

2 Magnet Design

The LHCb magnet consists of two bended trapezoidal coils arranged inside a magnet yoke (Figure 1a). The yoke is designed as window-frame type with small cut-outs for the coils. The yoke is assembled from two mirror symmetrical with respect to **yz** plane vertical parts and two mirror symmetrical with respect to **xz** plane horizontal parts. The parts of yoke are constructed from low carbon steel plates of 100 mm thickness.

A coil is an assembly of 5 sub-coils (triplets). Sub-coils are constructed from identical (before bending) mono-layer pancakes. Each pancake is wound from a hollow aluminum conductor of $\sim$ 310 m length. The conductor has square cross section of $50 * 50$ mm^2 with 25 mm diameter bore for water cooling. Lateral sides of pancakes are bended at the same angle 45°, but with different setting of bending line (Figure 1b).

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3 Magnet in XML

3.1 Yoke

In XML description the yoke parts are monolithic. In the current version a stepped shape of inner cut-outs for coil is smoothed out. The shape of vertical part with cut-outs for installation of horizontal parts of the yoke and coils is a result of subtraction[1] of three properly rotated and positioned boxes from initial box (Figure 2a).

The shape of the horizontal parts of the yoke are trapezoidal. Small cut-outs for the coils installation are provided by subtraction of two small rotated trapezoids[2] from the main trapezoid (Figure 2b).

3.2 Coil

The coil is defined as one monolithic bended trapezoidal pancake. The shape of coil is a result of sequential subtractions of numerous properly rotated and positioned trapezoids, boxes and cylinders from the initial trapezoid (Figure 3). Material "CoilAl" is defined as a proper mixture of aluminum and water.

3.3 Magnet

The magnet is defined as *logical volume* **without shape and material**. The center of "Magnet" is 5.3 m downstream of the interaction point.

The vertical parts of yoke are installed into "Magnet" *logical volume* symmetrically with respect to **z** axis.

Sequential rotations of the horizontal parts of yoke[3] (with respect to **y** axis through 90° and then with respect to **x** axis) provide amount of tilt corresponding to magnet aperture (Figure 2c).

Two identical coils are mounted mirror symmetrically to each other inside the magnet yoke. General view of Magnet is shown in Figure 4a.

4 XML File Structure

The XML description of magnet can be found in the
$LHCBSOFT/Det/XmlDDDB/v*/DDDB/Magnet directory.

Detector element "Magnet" is defined in structure.xml file.

geometry.xml file includes:

[1] <subtraction> in XML

[2] <trap> in XML

[3] In geometry DTD the trapezium faces of general trapezoid are perpendicular to the **z** axis.

- catalog of *references to logical volumes* of "Magnet", "YokeHor", "YokeVert" (horizontal and vertical parts of yoke) and "Coil";

- definition of basic geometry parameters of whole magnet, yoke and coils.

Names of parameters are mnemonic and start with "Mag∗", "Yoke∗" or "Coil∗". A full list of parameters can be found in the Appendix.

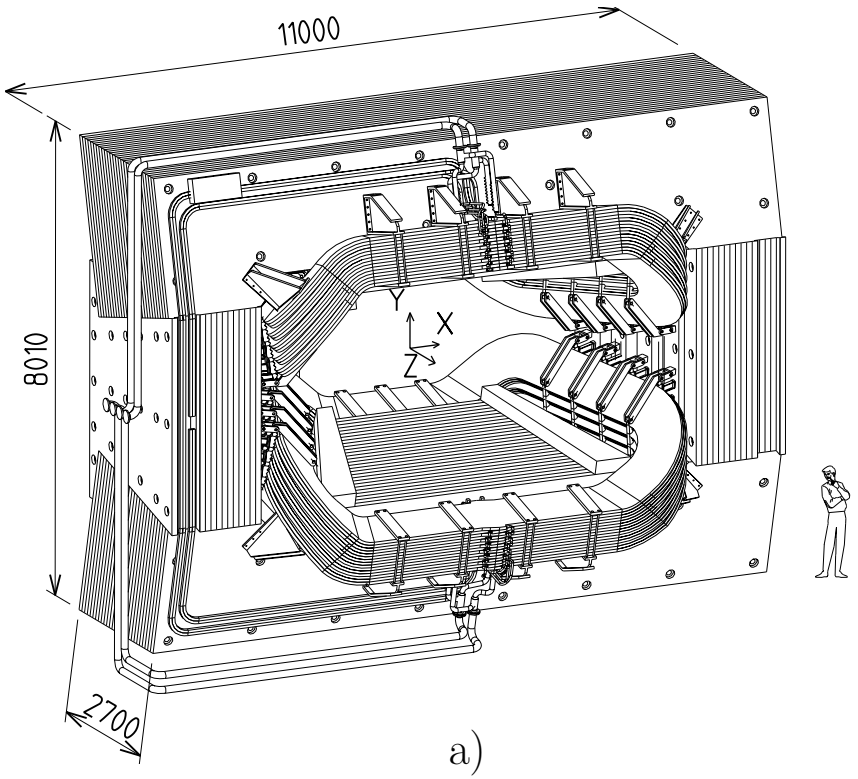
Yoke.xml file contains description of the horizontal and vertical parts of the yoke. Coil is defined in Coil.xml file. Installation of yoke parts and coils into "Magnet" *logical volume* is described in Magnet.xml file.

Catalog "/dd/Materials/Magnet" of specific magnet materials can be found in $LHCBSOFT/Det/XmlDDDB/v∗/DDDB/materials/MagnetMaterials.xml. The names of materials start with "Yoke∗" or "Coil∗".

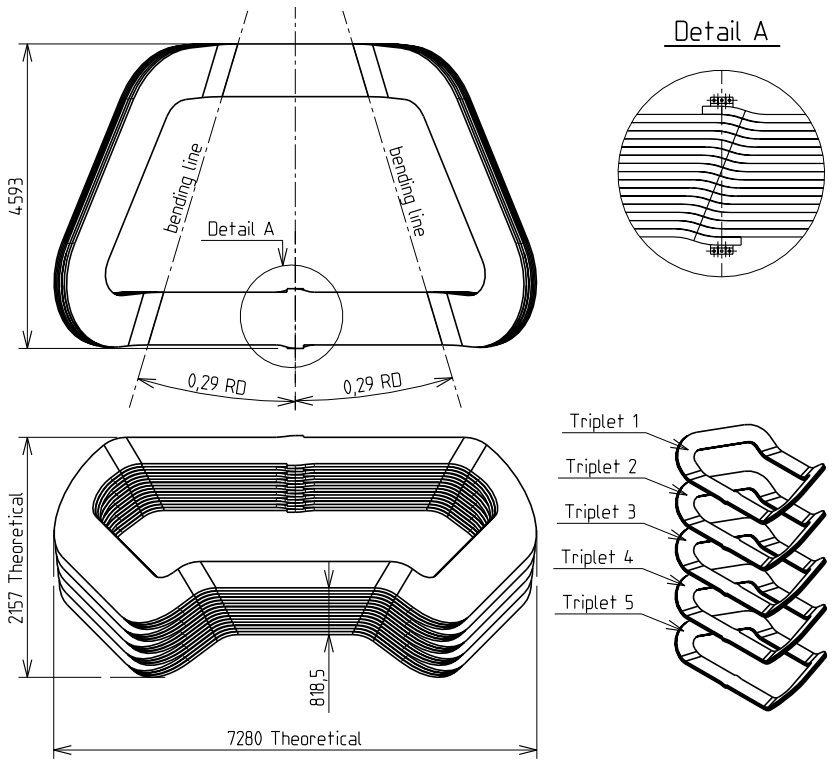
References

[1] LHCb Magnet: Technical Design Report, **CERN-LHCC-2000-007**; LHCb-TDR-1, 19 Dec. 1999.

[2] J.Andre et al., Status of LHCb Magnet System, **LHCb-2001-148**; 11 Dec. 2001.



a)



b)

Figure 1: The engineering drawings: a) perspective view of the LHCb dipole magnet; b) assembly of coils from triplets.

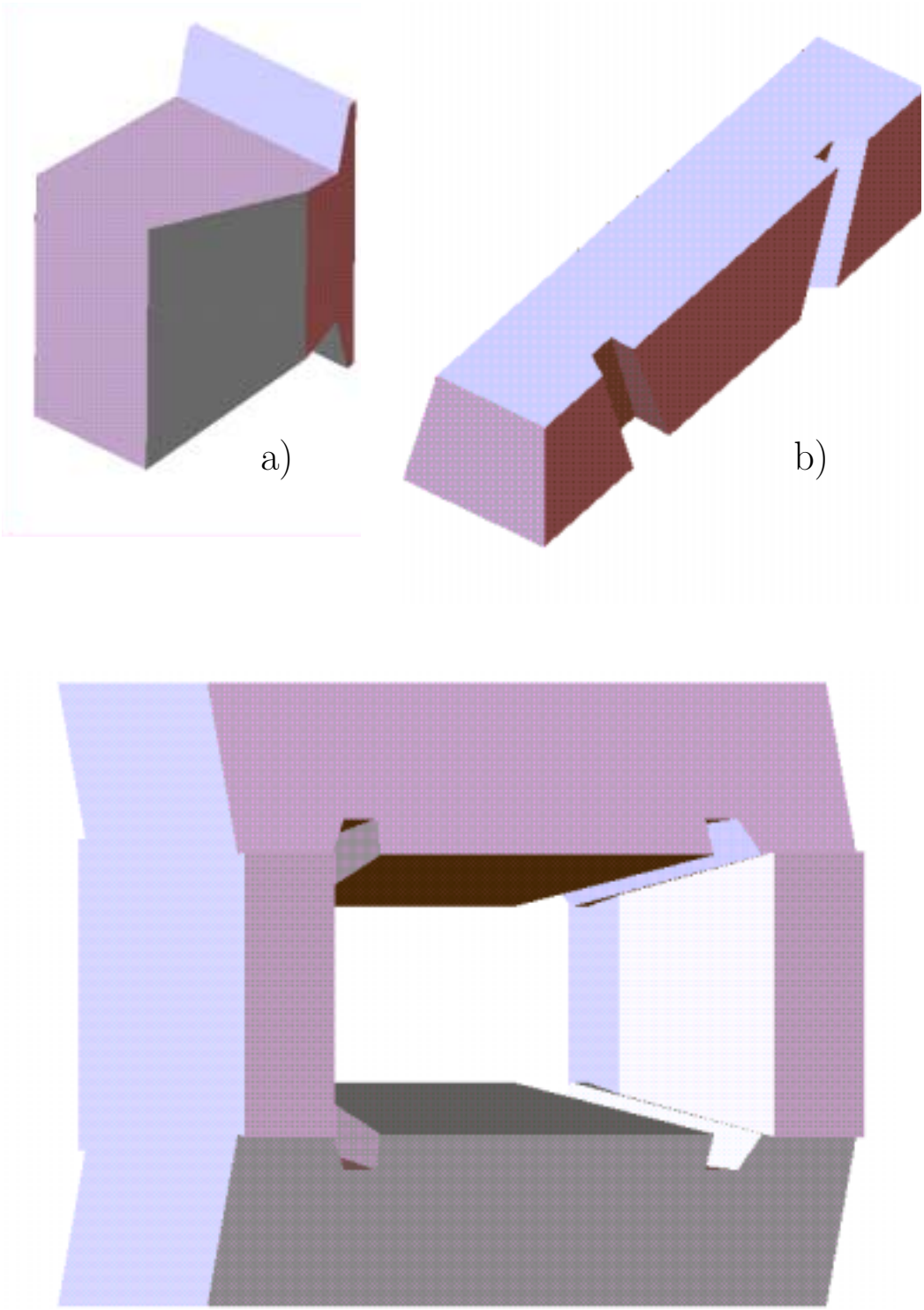


Figure 2: Panoramix: a) monolithic vertical yoke part with cut-outs for horizontal yoke parts and coil; b) monolithic horizontal yoke part with trapezoidal cut-outs for coil; c) window-frame type yoke.

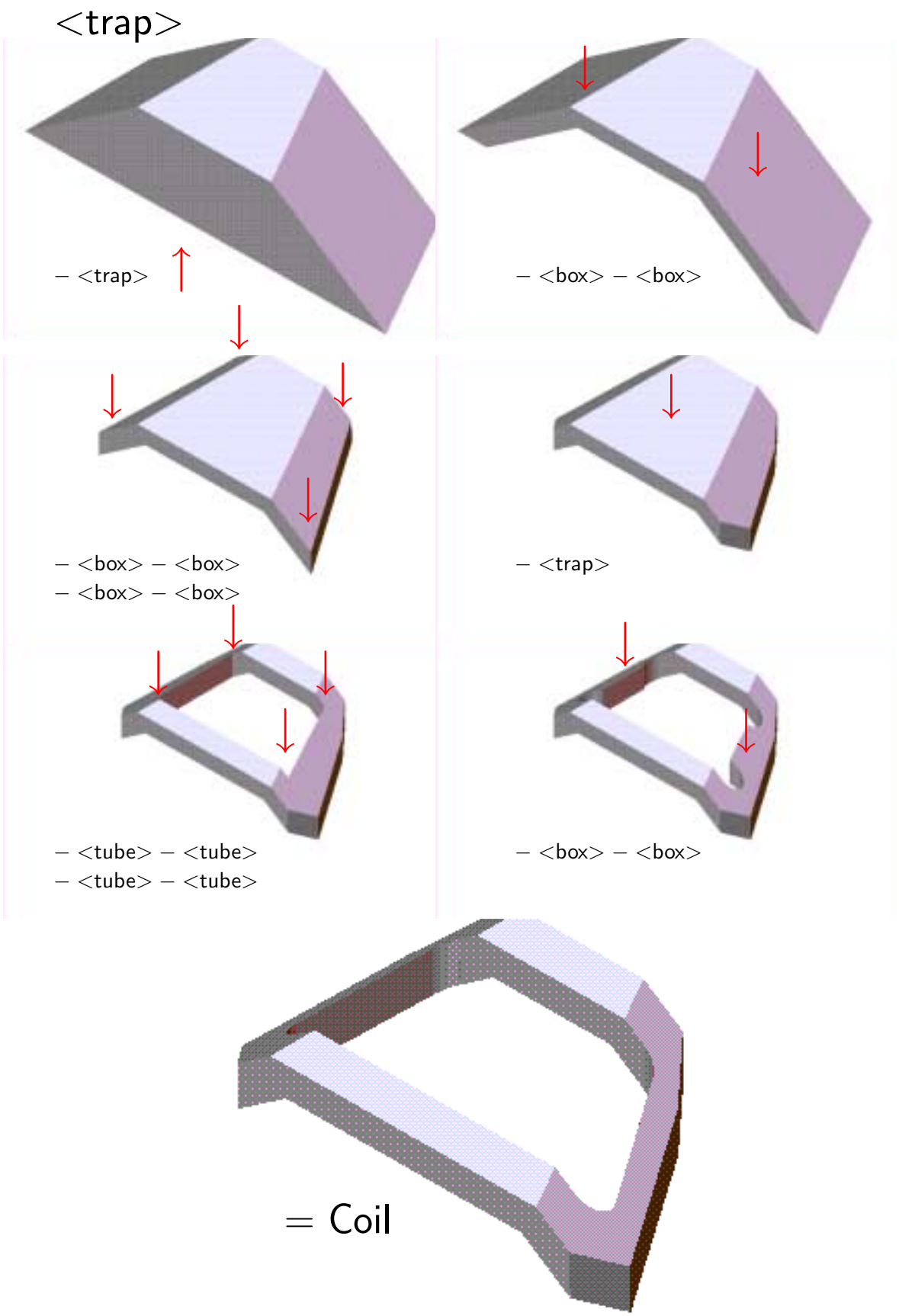
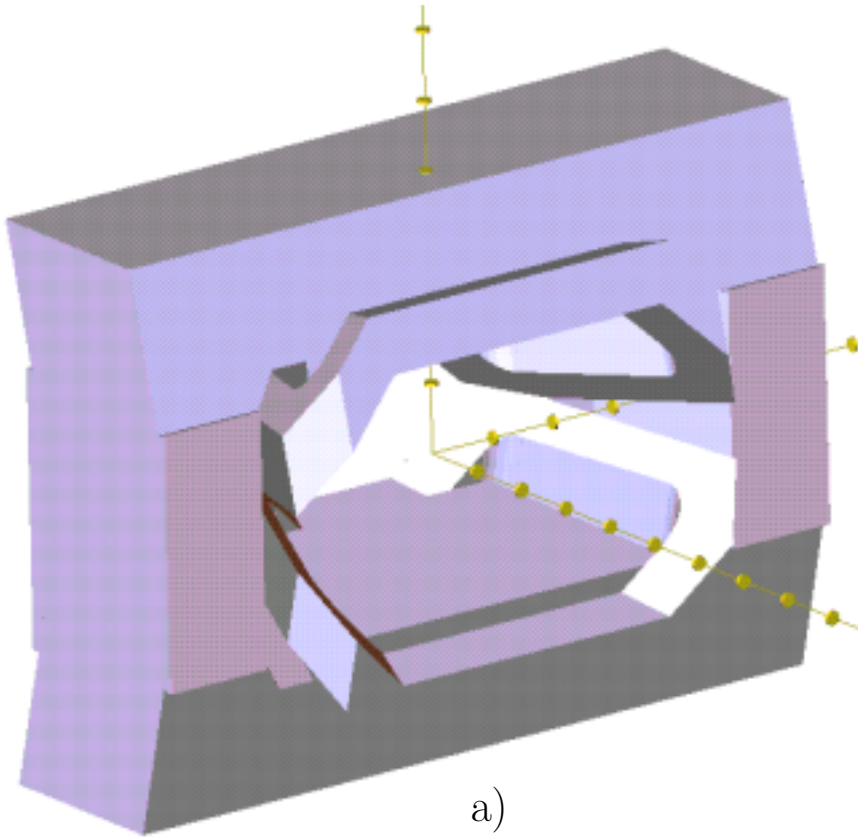
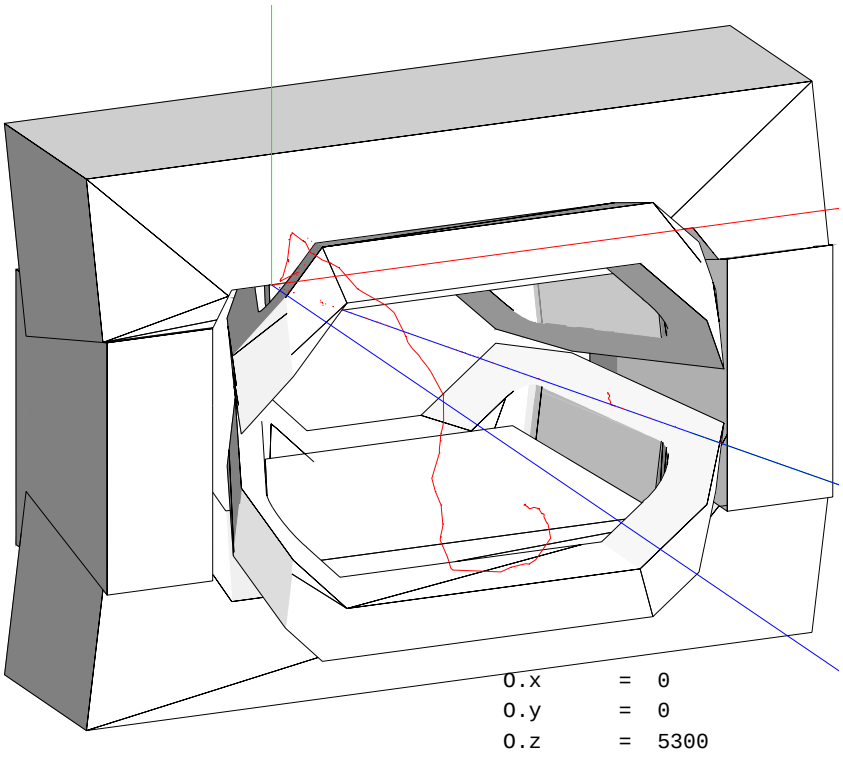


Figure 3: Coil: subtraction procedure. Arrows show positions of the next subtraction, captions under pictures indicate which solids will be subtracted at the next step.



a)



b)

Figure 4: General view of magnet: a) Panoramix visualization; b) overlapping check test by GiGa+DAWN+DAVID indicates no overlapping volumes.

Appendix: Magnet Geometry Parameters	
Magnet Basic Parameters	
"MagSizeX"	"11000∗mm"
"MagSizeY"	"8010∗mm"
"MagSizeZ"	"6000∗mm"
"MagAperture"	"0.25∗rad"
Vertical parts of Yoke	
"YokeVertSizeX"	"2300∗mm"
"YokeVertSizeY"	"4000∗mm"
"YokeVertSizeZ"	"3100∗mm"
Vertical plates	
"YokeVertH1"	"1832.2∗mm"
"YokeVertL1"	"2758.0∗mm"
"YokeVertH20"	"1461.7∗mm"
"YokePlateThick"	"100∗mm"
"YokeCut"	"18.0∗degree"
Horizontal parts of Yoke (trapezoids)	
"YokeHorBase1"	"2969.8∗mm"
"YokeHorBase2"	"2280.4∗mm"
"YokeHorHeight"	"2700.0∗mm"
Cut-outs trapezoids	
"YokeHorA1"	"2785.0∗mm"
"YokeHorA27"	"1685.5∗mm"
"YokeHorC1"	"3352.0∗mm"
"YokeHorC27"	"2277.0∗mm"
"YokeHorD1"	"3836.5∗mm"
"YokeHorD27"	"3045.0∗mm"
"YokeHorE1"	"484.5∗mm"
"YokeHorE27"	"768.0∗mm"
Coil Parameters	
"CoilSizeX"	"7282∗mm"
"CoilSizeY"	"2134∗mm"
"CoilSizeZ"	"4549∗mm"
Parameters of unbended pancakes	
"CoilThick"	"815.5∗mm"
"CoilWidth"	"799.5∗mm"
"CoilInnRadius"	"400.0∗mm"
"CoilCylX1"	"1880.0∗mm"
"CoilCylX2"	"2857.3∗mm"
"CoilInnZ"	"2150.0∗mm"
"CoilLatLength"	"2361.7∗mm"
Bending line angle and basic sizes	
"CoilBendLine"	"0.29∗rad"
"CoilS1"	"1103.0∗mm"
"CoilS5"	"1386.4∗mm"
Coil installation offsets	
"CoilOffset1"	"200∗mm"
"CoilOffset2"	"100∗mm"