Preliminary Study of SiD Barrel Yoke

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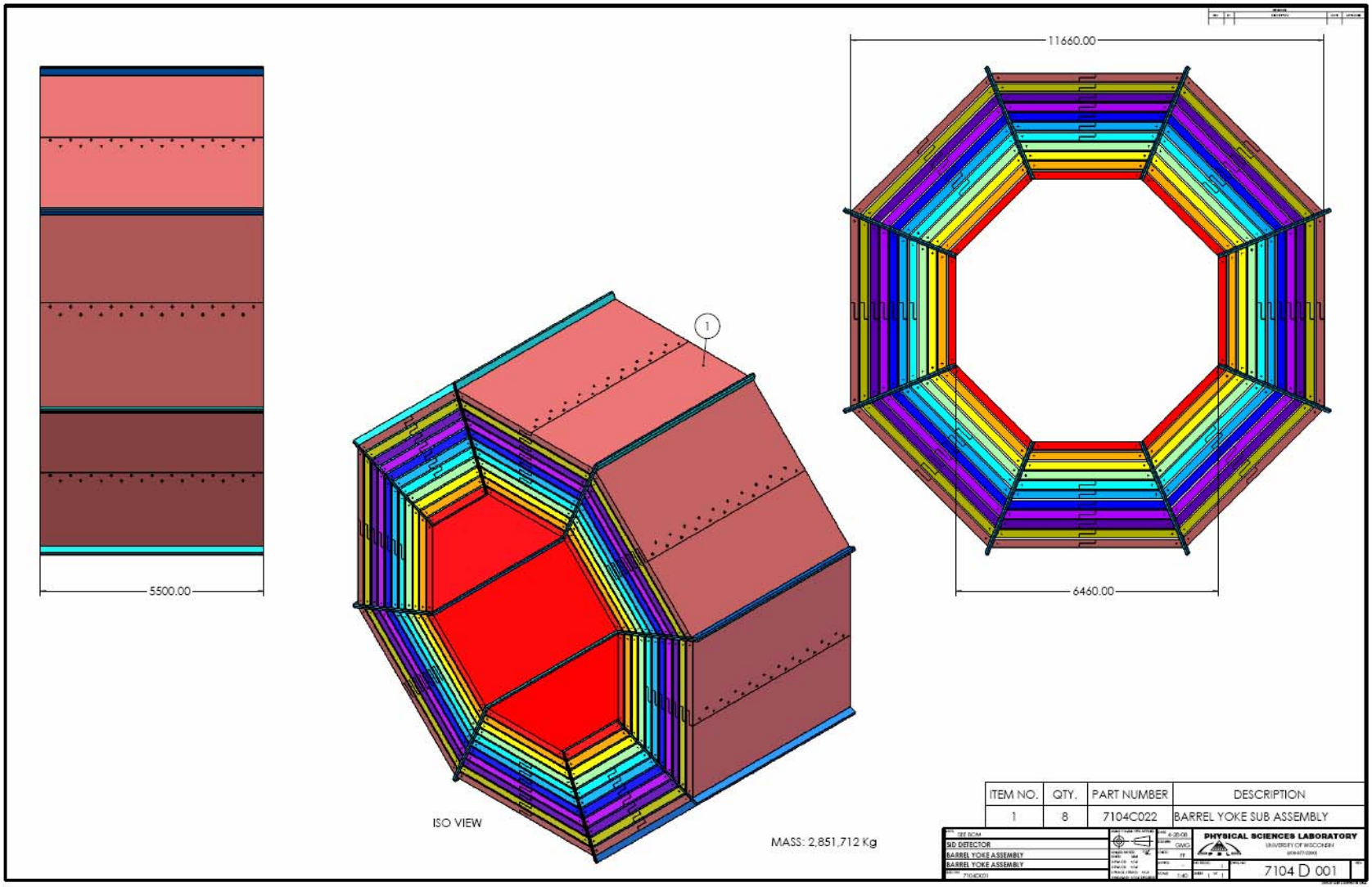
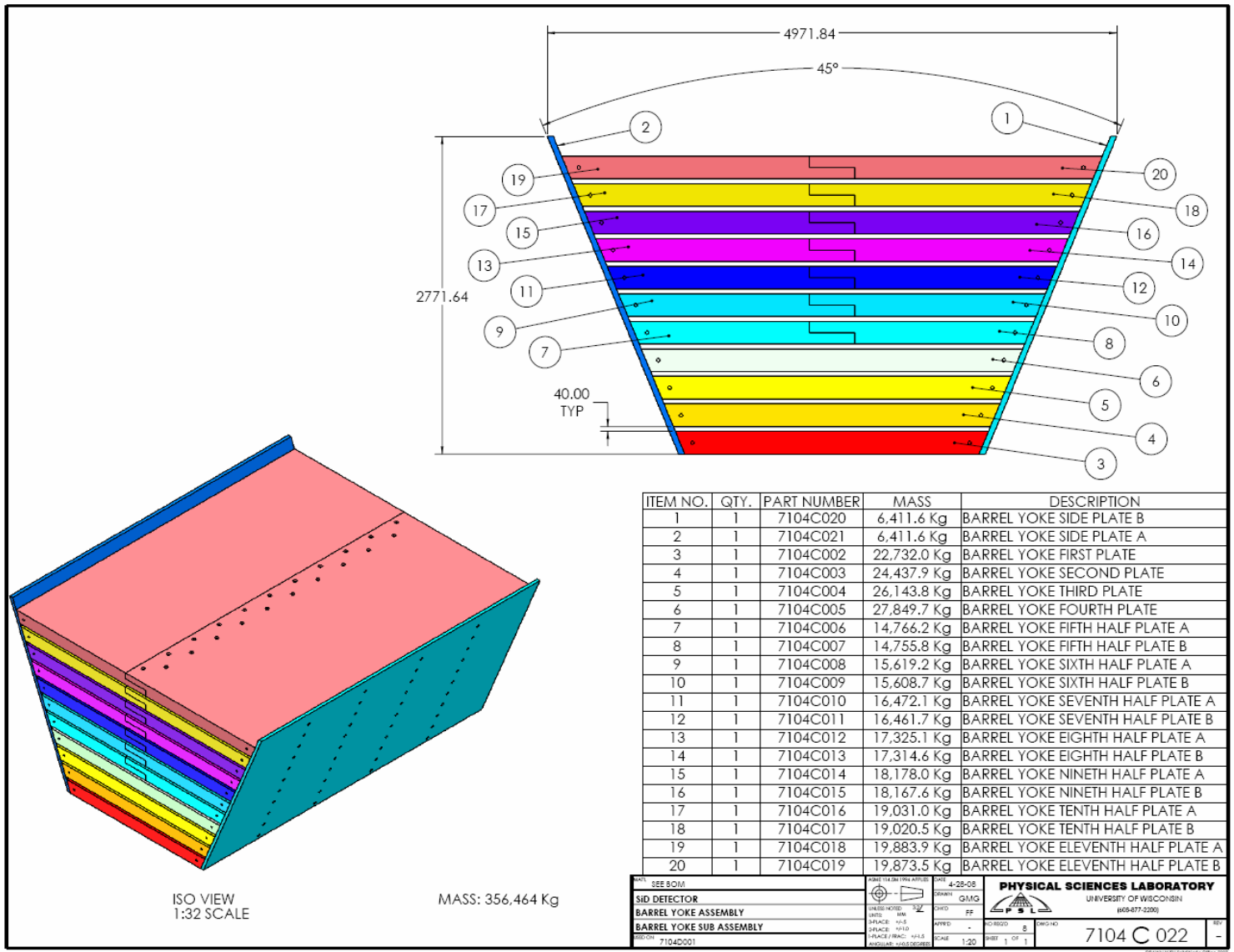
Physical Sciences Laboratory
University of Wisconsin-Madison



SiD Barrel Iron-Alternate 1



ITEM NO.	QTY.	PART NUMBER	MASS	DESCRIPTION
1	1	7104C020	6,411.6 Kg	BARREL YOKE SIDE PLATE B
2	1	7104C021	6,411.6 Kg	BARREL YOKE SIDE PLATE A
3	1	7104C002	22,732.0 Kg	BARREL YOKE FIRST PLATE
4	1	7104C003	24,437.9 Kg	BARREL YOKE SECOND PLATE
5	1	7104C004	26,143.8 Kg	BARREL YOKE THIRD PLATE
6	1	7104C005	27,849.7 Kg	BARREL YOKE FOURTH PLATE
7	1	7104C006	14,766.2 Kg	BARREL YOKE FIFTH HALF PLATE A
8	1	7104C007	14,755.8 Kg	BARREL YOKE FIFTH HALF PLATE B
9	1	7104C008	15,619.2 Kg	BARREL YOKE SIXTH HALF PLATE A
10	1	7104C009	15,608.7 Kg	BARREL YOKE SIXTH HALF PLATE B
11	1	7104C010	16,472.1 Kg	BARREL YOKE SEVENTH HALF PLATE A
12	1	7104C011	16,461.7 Kg	BARREL YOKE SEVENTH HALF PLATE B
13	1	7104C012	17,325.1 Kg	BARREL YOKE EIGHTH HALF PLATE A
14	1	7104C013	17,314.6 Kg	BARREL YOKE EIGHTH HALF PLATE B
15	1	7104C014	18,178.0 Kg	BARREL YOKE NINETH HALF PLATE A
16	1	7104C015	18,167.6 Kg	BARREL YOKE NINETH HALF PLATE B
17	1	7104C016	19,031.0 Kg	BARREL YOKE TENTH HALF PLATE A
18	1	7104C017	19,020.5 Kg	BARREL YOKE TENTH HALF PLATE B
19	1	7104C018	19,883.9 Kg	BARREL YOKE ELEVENTH HALF PLATE A
20	1	7104C019	19,873.5 Kg	BARREL YOKE ELEVENTH HALF PLATE B

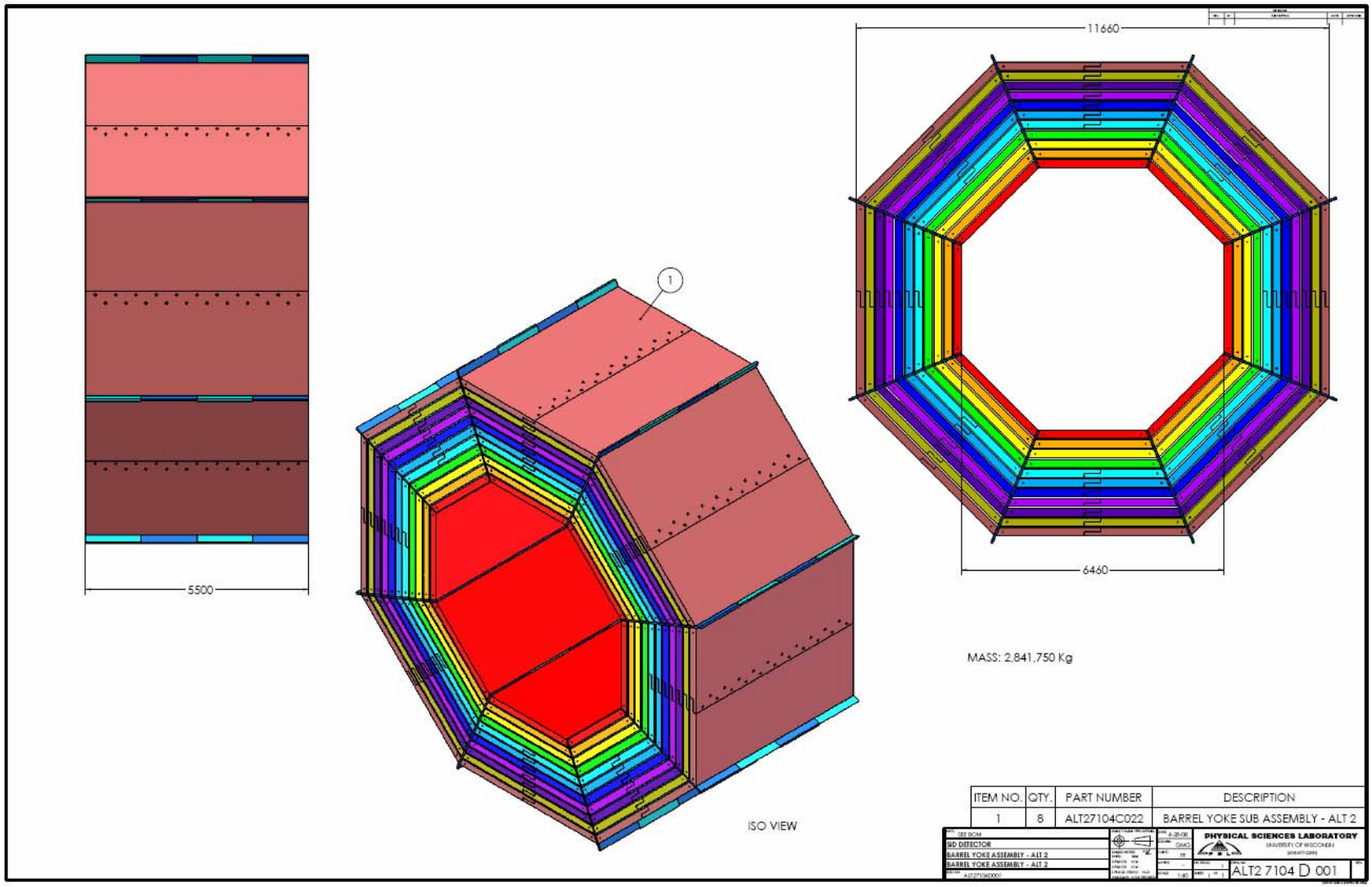
SEE BOM
SiD DETECTOR
BARREL YOKE ASSEMBLY
BARREL YOKE SUB ASSEMBLY
7104D001

4-28-08 GMG FF - 1:20

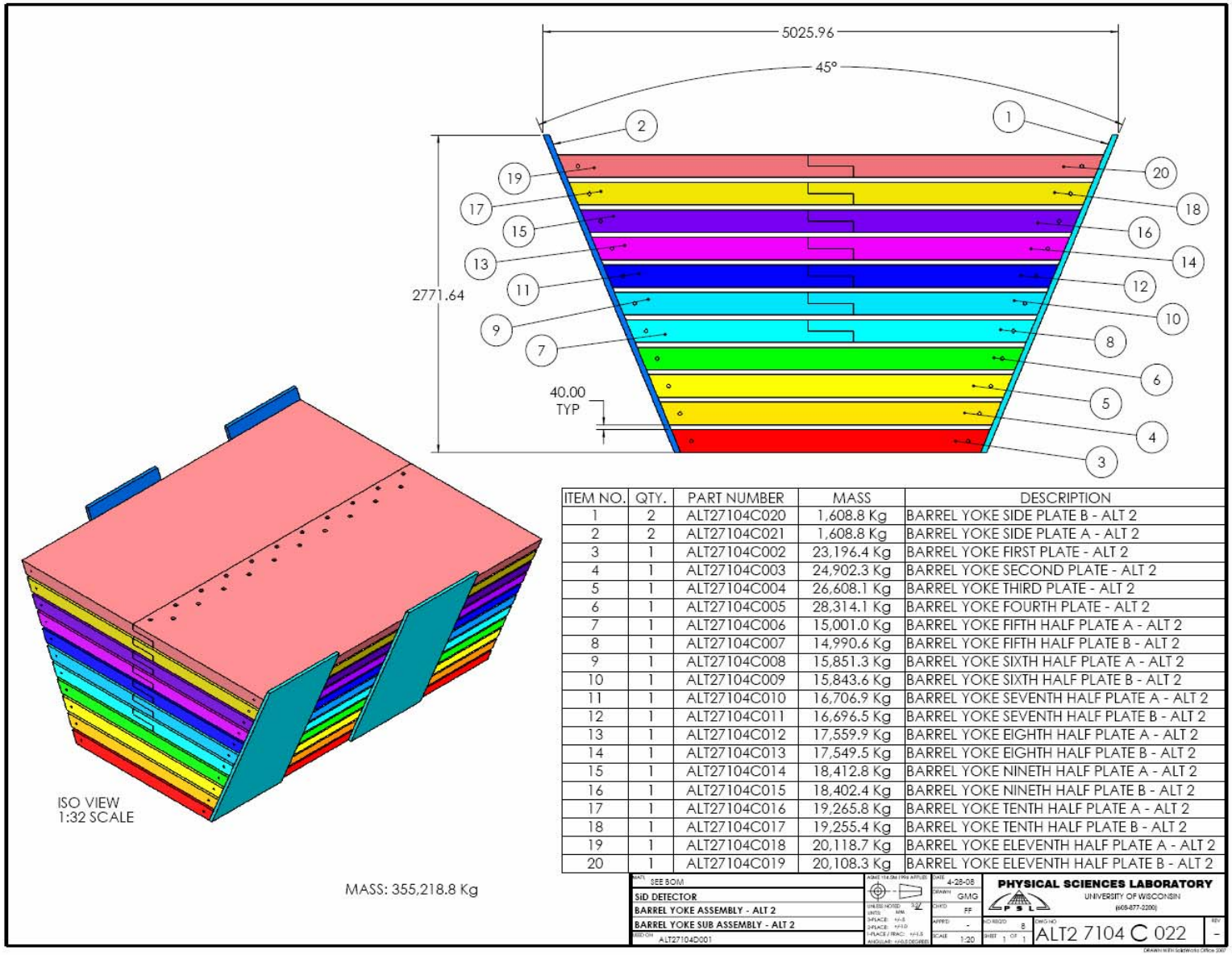
PHYSICAL SCIENCES LABORATORY
UNIVERSITY OF WISCONSIN
(608-877-2200)

7104 C 022 -

SiD Barrel Iron sector-Alternate 1



SiD Barrel Iron-Alternate 2



ITEM NO.	QTY.	PART NUMBER	MASS	DESCRIPTION
1	2	ALT27104C020	1,608.8 Kg	BARREL YOKE SIDE PLATE B - ALT 2
2	2	ALT27104C021	1,608.8 Kg	BARREL YOKE SIDE PLATE A - ALT 2
3	1	ALT27104C002	23,196.4 Kg	BARREL YOKE FIRST PLATE - ALT 2
4	1	ALT27104C003	24,902.3 Kg	BARREL YOKE SECOND PLATE - ALT 2
5	1	ALT27104C004	26,608.1 Kg	BARREL YOKE THIRD PLATE - ALT 2
6	1	ALT27104C005	28,314.1 Kg	BARREL YOKE FOURTH PLATE - ALT 2
7	1	ALT27104C006	15,001.0 Kg	BARREL YOKE FIFTH HALF PLATE A - ALT 2
8	1	ALT27104C007	14,990.6 Kg	BARREL YOKE FIFTH HALF PLATE B - ALT 2
9	1	ALT27104C008	15,851.3 Kg	BARREL YOKE SIXTH HALF PLATE A - ALT 2
10	1	ALT27104C009	15,843.6 Kg	BARREL YOKE SIXTH HALF PLATE B - ALT 2
11	1	ALT27104C010	16,706.9 Kg	BARREL YOKE SEVENTH HALF PLATE A - ALT 2
12	1	ALT27104C011	16,696.5 Kg	BARREL YOKE SEVENTH HALF PLATE B - ALT 2
13	1	ALT27104C012	17,559.9 Kg	BARREL YOKE EIGHTH HALF PLATE A - ALT 2
14	1	ALT27104C013	17,549.5 Kg	BARREL YOKE EIGHTH HALF PLATE B - ALT 2
15	1	ALT27104C014	18,412.8 Kg	BARREL YOKE NINETH HALF PLATE A - ALT 2
16	1	ALT27104C015	18,402.4 Kg	BARREL YOKE NINETH HALF PLATE B - ALT 2
17	1	ALT27104C016	19,265.8 Kg	BARREL YOKE TENTH HALF PLATE A - ALT 2
18	1	ALT27104C017	19,255.4 Kg	BARREL YOKE TENTH HALF PLATE B - ALT 2
19	1	ALT27104C018	20,118.7 Kg	BARREL YOKE ELEVENTH HALF PLATE A - ALT 2
20	1	ALT27104C019	20,108.3 Kg	BARREL YOKE ELEVENTH HALF PLATE B - ALT 2

MATL SEE BOM
SiD DETECTOR
BARREL YOKE ASSEMBLY - ALT 2
BARREL YOKE SUB ASSEMBLY - ALT 2
NEXT ASSY ALT27104D001
DATE 4-28-08
DRAWN GMG
CHK'D FF
APP'D -
SCALE 1:20
PHYSICAL SCIENCES LABORATORY
UNIVERSITY OF WISCONSIN
(608-877-2200)
DWG NO ALT2 7104 C 022
REV -

SiD Barrel Iron sector-Alternate 2 (Probably not strong enough)

4.3.1. Chemical Composition

The chemical composition of the material is not a strict requirement. However, the Contractor must determine a target range for carbon and all other elements. This range must be compatible with all other material requirements. The target range must be specified in the material specifications. Cobalt must be kept to less than 0.1%, Radioactivity must be at the safe level for routine shipping and handling.

4.3.2. Mechanical Properties

For YE1 and YE2 the mechanical properties of the plate used in the first layer (towards the I.P.) must meet those listed in Table 1.

Table 1: YE1, YE2 first plate properties

Yield Strength	250 MPa min
Ultimate Strength	350 MPa min
Elongation	25% min
Resilience	40 J min at 20 C

For all other plates the mechanical properties must meet those listed in Table 2.

Table 2: YE1, YE2 second and third plate properties

Yield Strength	230 MPa min
Ultimate Strength	350 MPa min
Elongation	25% min
Resilience	40 J min at 20 C

4.3.3. Magnetic Properties

The absolute value of relative permeability must be more than 130 at an induced field of 1.8 Tesla.

The uniformity of the relative permeability within any one disk must be less than 5 at an induced field of 1.8 Tesla.

4.3.4. Weldability

As ancillary elements (like gangways) will be attached to the Disks by welds to be done 'in situ', good weldability of the chosen steel for the sectors is important. The preheating necessary to suppress cold cracking must not exceed 100 C, thus the equivalent carbon C_{eq}, according to BS 5135, must not exceed 0.40%:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} < 0.40\%$$

To minimize risks of hot cracking, the ratio of manganese over sulfur must be sufficient:

$$\frac{Mn}{S} > 30$$

If welding is required for the manufacture of the sectors, the use of low hydrogen welding processes and welding materials is recommended to reduce the risk of cold cracking and to minimize the preheat temperature.

CMS Magnet

Specification Valid for Manufacture

CMS SY FS 0009
UW-98-0045

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UW-Madison
CERN/EP-CMI

Created:
9 October 1998
Last Revised:
16, December 1998

Abstract

This specification concerns the fabrication, machining, trial assembly, packaging, and transport to CERN of six endcap disk and six spacer rings of the magnet for the CMS experiment.

The six Endcap Disks, weighing 4000 tonnes in total, are mainly made from heavy plates of plain carbon steel.

These items shall be delivered to CERN site P5 at Cessy (after custom formalities at Prévessin, France), exonerated from all duties and taxes.

CMS Endcap steel specification

Use same for SiD Barrel

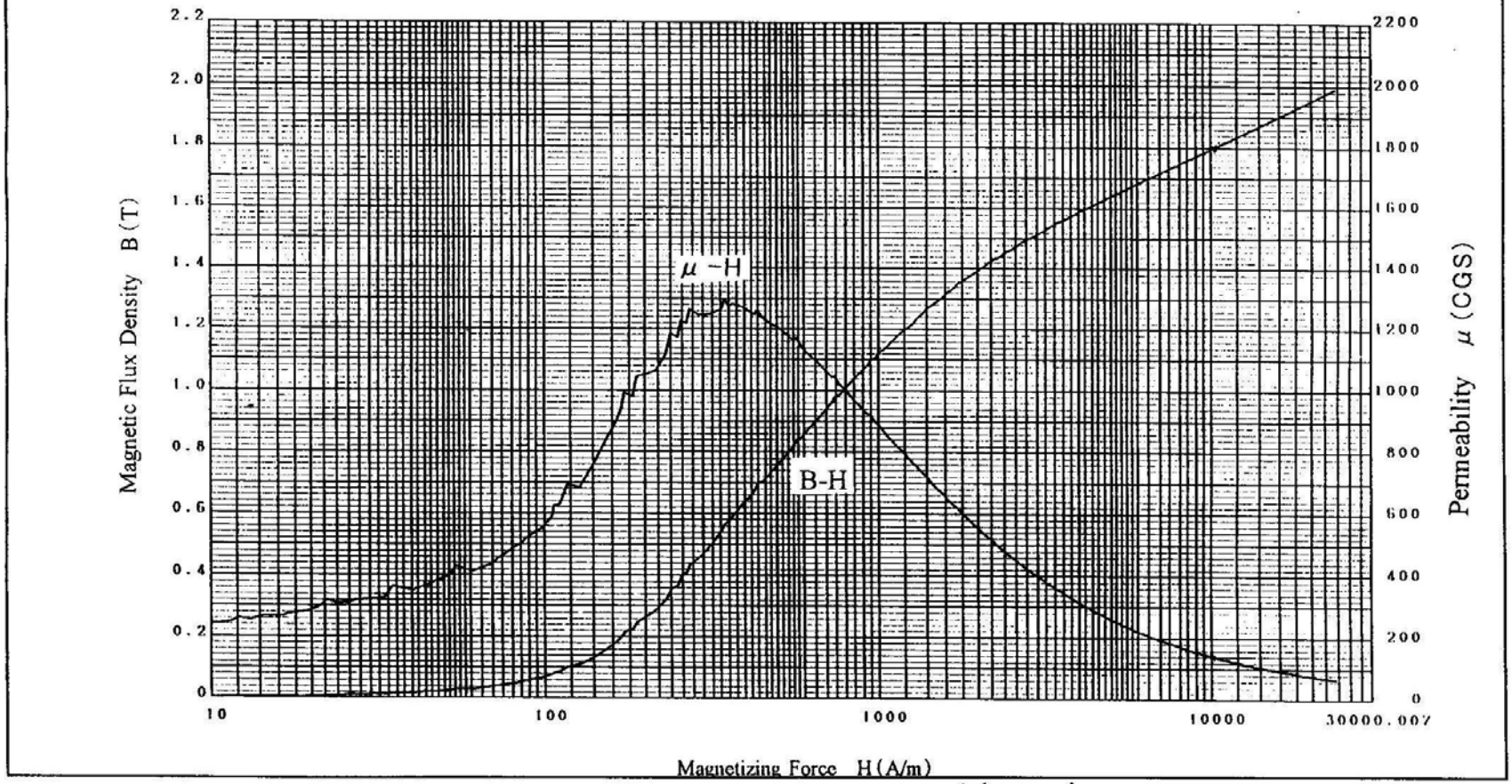
D.C.Magnetization Curves and D.C. Permeability Curves

Kawasaki Steel Techno-research Corporation
Technical Service Center
1,Kawasakicho Chuo-ku Chiba 260-0835 Japan
Phone 043-262-2676,Fax 043-262-2986

Date:January 4, 2000

O.D:Outside dia.,ID:Inside dia.,N1:Turn of primary coil,N2:Turn of secondary coil

Mark	Direction	Name of Article	Thick.	Weight	Making method of T.P.	Test piece dimensions			Density	N1	N2
A	Z	SS400-J3124	230mm	533.93g	Machining	O.D:114mm	I.D:76mm	Thick.:12mm	7.85g/cm^3	600	100



Manager,Steel and Welding Group/ Y. Hirai

Typical B-H curve of CMS endcap steel

Comments by Y. Chida of KHI on SiD Barrel Yoke

Some information for accounting the 40mm gap tolerance:

- 144 plates required, thickness variation: 2mm
- Plate thickness tolerance for each: 0.1mm
- Plate flatness: 4mm (in a plate)
- Fabrication (assembling & welding) tolerance: 2mm
- These numbers are not guaranteed but assumed by production results.

Capabilities at Harima Works of KHI

- Machining: capable
- Lifting: capable (by 500Ton over head crane 39Mspan, 21MLift)
- Turning: capable (but need to study)
- Full trial assembly: capable (but need to study)

Questions & Comments:

- Assumed fabrication year
- Assumed approximate budget
- Connection between side plate and 200mm thickness plates (Welding?)
- My information against the steel plate are given from mill maker in Japan. Please note if you use other countries mill maker, you better to investigate.