Manufacturing of Dipole Chambers and Bellow Flat Absorber Vessels for the ESRF Storage Ring

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Abstract

For the ESRF storage ring in Grenoble/France a series of 67 UHV dipole and 65 UHV bellow flat absorber chambers was built by Siemens/KWU. Beside precise machining of the individual components, electron beam welding was the most important process. In case of the bellow flat absorber chambers vacuum brasing for the Cu absorbers was applied. Due to special cleaning and vacuum firing procedures leak rates < 10^{-10}mbar l/s and ultimate pressures <10^{-10} mbar were achieved.

1. INTRODUCTION

For the 3rd generation of synchrotron radiation sources with high brightness and brilliance significant lower emittances are required. The performance of the new machines have thus to exceed that of existing ones by 1 to 2 orders of magnitude. [1],[2] This results also in higher requirements for the vacuum chambers for the 6 GeV high intensity synchrotron radiation source ESRF.

A series of 67 UHV dipole and 65 UHV bellow flat absorber chambers were required for the ESRF storage ring. The dipole vacuum chambers had to be manufactured with a curved beam aperture and a divergent slot for the X-ray beam. The bellow flat absorber chambers compensate axial thermal expansion and lateral misalignment of the ring vacuum system.They included a water cooled Cu absorber.

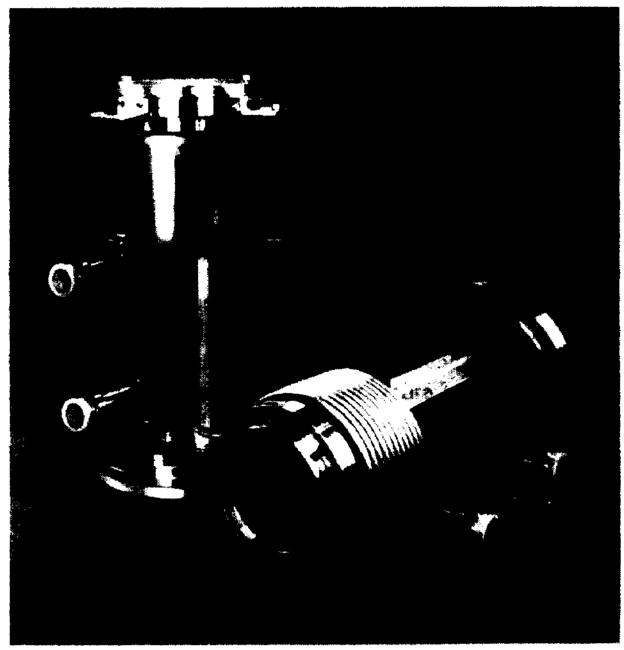

Figure 2: Bellow flat absorber chambers

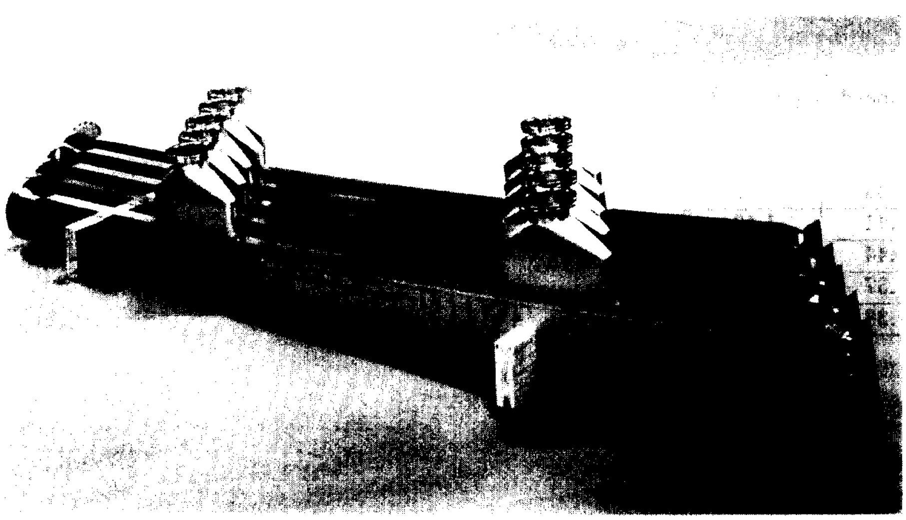

Figure 1: Dipole chambers

2. GENERAL REQUIREMENTS

The general requirements are listed in Table 1.

Total number of dipole chambers:	67
Length (B1):	2830 mm
Total number of bellow chambers:	65
Lenth:	389 mm
Material:	316 LN
Leak rate:	$<10^{-10}$ mbar l/s
End pressure:	$<10^{-10}$ mbar
Welding technique:	EB for longitudinal seams
Dimensional tolerances:	±0.05 mm and $\pm0.02°$ for key dimensions
Permeability:	<1.01

Table 1: General requirements for dipole and bellow flat absorber chambers

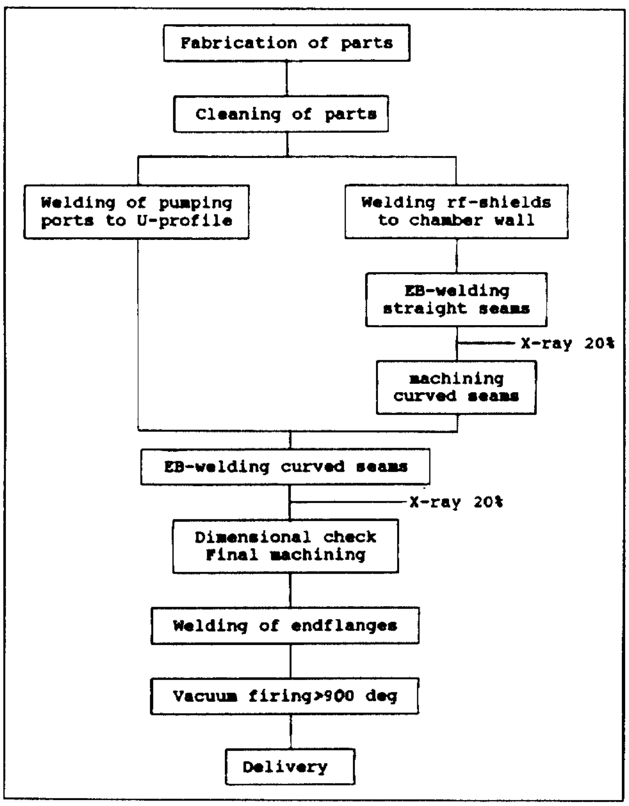

Table 2: Fabrication steps for dipole chambers

To meet the goal to store the beam in the storage ring for many hours the chambers had to be produced under a high level of cleanliness. Only smooth impedance variations were tolerated, therefore a high mechanical precision was required and steps and discontinuities in the electron beam path had to be minimized.

Virtually no colourisation inside the chambers was accepted to avoid a deterioration of the the vacuum by photon induced desorption. The absorbers for the bellow chambers had to be vacuum brazed and subsequently tested by 100% US scanning.

3. PRODUCTION

The fabrication procedure for the dipole chambers is shown in the flowshart in Table 2.

In a qualification program the design of the welding seams was optimised e. g. to avoid splashes occuring during the eb welding process. Especially at the dipole chambers these splashes could not be removed out of the long and small chamber volume containing deflector sheets and pumping grids.

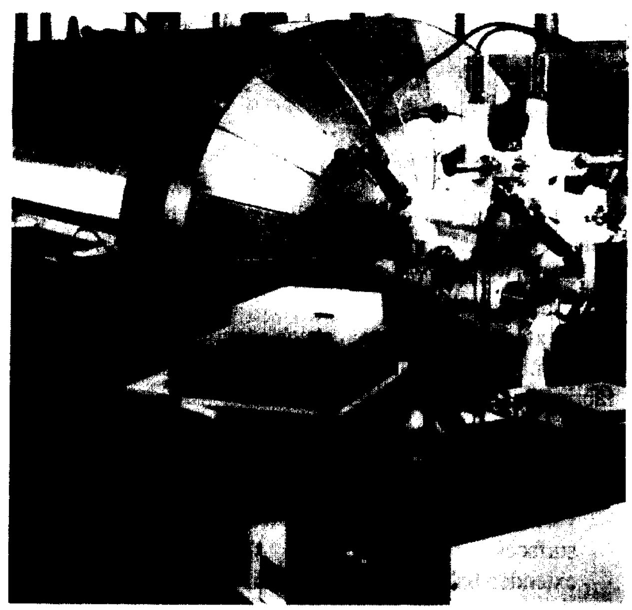

Figure 3: Baking out facility

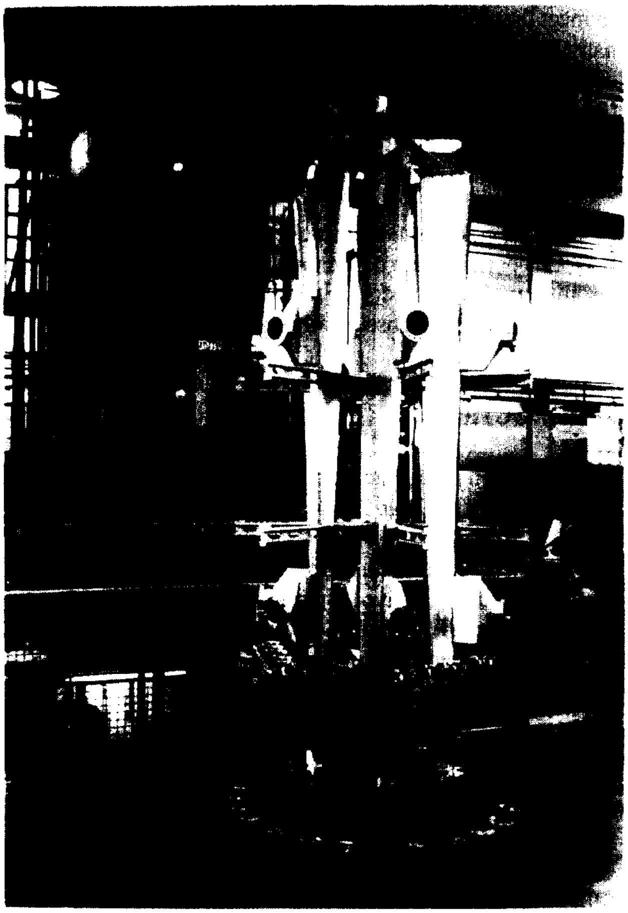

Figure 4: Dipole chambers in front of the vacuum furnace

The shringkage during the welding process had to be counterbalanced with sophisticated fixtures and procedures to cope with the high precision requirements.

In an extended dimensional check program the precision of all chambers was confirmed. Other features of the mechanical fabrication program are listed below:

- dedicated team for the production
- assembling in a clean area
- vacuum firing to get virtually oxide and colourfree surfaces
- extended baking out and vacuum treatment procedure at room temperature and 250°C

5. CONCLUSION

In the meanwhile all chambers are installed in the storage ring. The impedance measurements on chamber assemblies and the vacuum tests after installation, where ultimate pressures below $5 \cdot 10^{-10}$ mbar have been reached, demonstrate that the requirements according to the specification are fulfilled. [3] ,[4]

6. REFERENCES

[1] K. Witte, ESRF: A Progress Report SRN 4(1990)6

[2] H. Winick, G.P. Williams General Review SRN 4(91)26

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[4] J. Jacob et. al. Wireless Impedancé Measurements and Fault Locations on ESRF Vacuum Chambers Assemblies This conference