

(graphical header skipped)

. (Poster only/Topic G Vessel / In-Vessel Engineering and Remote Handling.): , –

On the applicability of dye penetrant tests on vacuum components - allowed or forbidden?

Michael Schröder, Christoph Biedermann, and Reinhard Vilbrandt

Max-Planck-Institute for Plasma Physics, Wendelsteinstraße 1, 17491 Greifswald, Germany

Beside the visual examination (VT) the penetrant testing (PT) is often the only applicable non-destructive procedure for the testing of components and in particular of welds. With PT it is possible to detect surface imperfections (e.g. cracks) which have a special potential to lead to the failure of the component or of the weld. Therefore, PT is substantially more sensitive than a purely visual examination. Because the complicated geometries of fusion experiments make the accessibility for repairs during the operation extremely difficult, an assembly with as few imperfections as possible is necessary. This requires very high efforts on testing with sensitive procedures, for instance with dye penetrant testing. In contrast to this desire for widespread penetrant testing, however, is the general fear that dye penetrant tested components or welds, which are used in the cryo-vacuum and particularly in the ultra-high vacuum, are contaminated by the dye in such a way that they do not fulfill the cleanliness requirements for vacuum components. This fear is mainly based on the high penetrating property of the dye, which is even the property required for the test procedure. After the penetration test, however, the penetrant dye remaining in cavities like porosities or in cracks in the vacuum could create virtual leaks because of the outgassing. As the penetrant dye primarily consists of hydrocarbons, which are considered critical for outgassing in fusion devices, a dye penetrant test of such vacuum components is usually considered problematic. This study aims to clarify the applicability of dye penetrant tests on components exposed to high- vacuum. To examine the behaviour of penetrant tested areas, samples with different surface properties are tested. For this purpose plate samples with machined surfaces, rolled surfaces and with real welds are used. These samples are exposed to the penetrant dye and afterwards cleaned with different procedures (cloth and cleaner, cryo-blasting, bake out). The vacuum properties of these samples are then investigated in a vacuum chamber with a mass spectrometer. As a result of these studies, recommendations are formulated concerning the PT procedure of vacuum components and the cleaning procedures for penetrant tested areas under vacuum necessary after a dye penetrant test.