

FABRICATION AND INSTALLATION OF THE DIII-D RADIATIVE DIVERTOR STRUCTURES*

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Phase 1A of the Radiative Divertor Program is now installed in the DIII-D tokamak. This hardware was added to enhance both the Divertor and Advanced Tokamak research elements of the DIII-D program. This installation consists of a divertor baffle enveloping a cryocondensation pump at the upper outer divertor target of DIII-D. The divertor baffle consists of two toroidally continuous Inconel 625 water-cooled rings and a set of radiatively-cooled plates. The water-cooled rings are each comprised of four quadrants, mechanically formed, chem-milled, and resistance and TIG welded Inconel 625 panels. The supports attaching the panels to the vessel wall are designed to accommodate the differential thermal expansion between the rings and vessel during bake and to react the electromagnetic loads induced during disruptions. They are made from either Inconel 625 or Inconel 718 depending on the stress levels predicted in Finite Element Analysis (FEA). Gas seals are designed to limit the leakage from the baffle chamber back to the core plasma to 2,500 liters per second and incorporate plasma sprayed alumina to minimize currents flowing through them.

The bulk of the water-cooled ring fabrication was performed by a vendor, however, the final machining of 6.35 cm divertor penetrations in the conical ring for diagnostic access was performed in-house using a unique machining configuration. This configuration, and the machining of the diagnostic cutouts is described. Graphite tiles were machined from ATJ graphite to form a smooth plasma-facing surface.

The installation of all divertor components required only four weeks. This divertor installation included locating and electro-discharge welding studs, accurately locating the supports using a toroidally continuous tooling plate and local fixtures, and mounting the structures. Tooling was used during ex-vessel test assembly to greatly simplify the installation process.

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