

## MANUFACTURING OF MAGNETIC DIAGNOSTIC PROBES FOR DIII-D\*

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The magnetic diagnostics program at DIII-D adds to its in-vessel installations of induction-type loops and coils almost every year. The current design of toroidal and poloidal magnetic field coils (45-50 kHz,  $N \cdot A = 0.06 \text{ m}^2$ ) has been in existence since 1987. Many coils were installed in DIII-D during that year and are still operating and reliable today. Other magnetic devices, such as Mirnov probes, diamagnetic loops, Rogowski loops, and saddle loops, were included in the various magnetic installations over the years. The magnetics program has been enhanced with integrator performance advancements and improved calibration techniques. However, even a mature program such as this can still find room for improvement and growth. For example, recent coil fabrication using mineral-insulated cable (MIC) having just a slightly out-of-specification outer diameter (1.6%) led to a 20% reduction in coil bandwidth. Therefore, other manufacturing factors must have contributed to the bandwidth reduction, making this set of manufactured coils unusable. This paper describes how small changes in MIC product and changes in winding tooling and winding procedures affect the uniformity of the magnetic coils. With possible future magnetic diagnostics installations in ITER and other long-pulse machines requiring large numbers of coils and/or multiple layers per coil, the manufacturing scale-up, quality control, and the development of layered coils should all be investigated in addition to issues such as irradiation effects.

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