

# **30kJoule Electromagnetic Welding/Forming Machine**

## **System Specifications**

<b>Parameters</b>	<b>Specifications</b>
Maximum Energy	30kJ
Capacitance	270 $\mu$ F
Proof voltage	15kV
No. of sub-banks	1
Short-Circuit current	750kA@15kV
Short Circuit Freq.	~30kHz
Controls	PLC & HMI
Trigger generator	IGBT & Fiber Optic
Current Sensing	Rogowski coil
Charging Supply	RC Charging Power Supply

## **Applications**

15kV, 30kJ Electromagnetic Manufacturing Equipment is developed to generate pulsed magnetic fields in the range of 20-50 T for various applications like crimping, welding, forming, etc. This bank is capable of delivering short circuit currents in the range of 750 kA, with 30 kHz as short circuit discharge frequency.



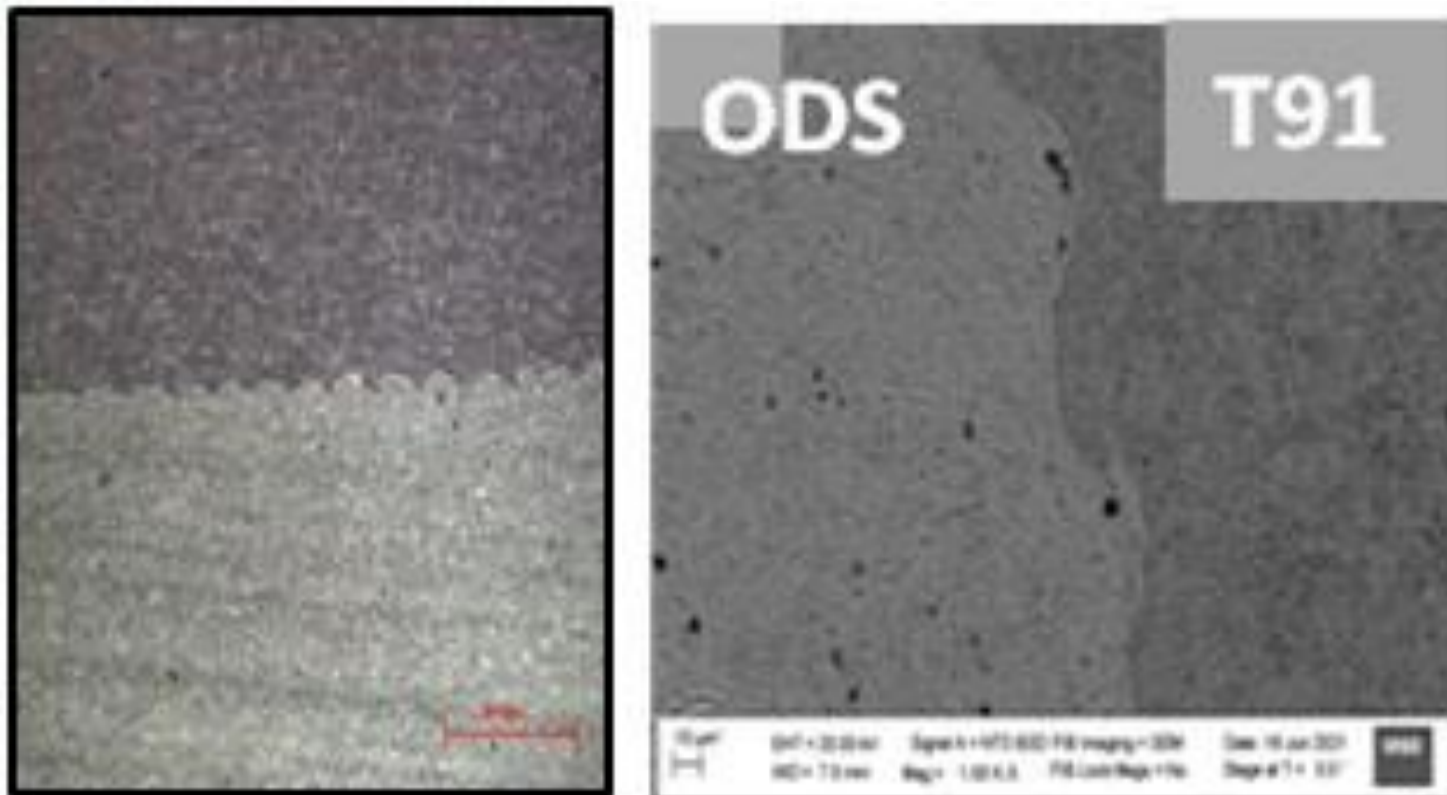
**30kJoule EMM System**



Typical Coil Current Waveform 306kA @ 17.544kHz



ODS clad tube to T91 end plug job post weld trial



**Optical Micrograph & SEM of ODS clad tube to T91 end plug**

**MPW for 9Cr1Mo ODS clad to T91 End Plug for FBR programme**

Considering the relative merits of the non-fusion welding process, the magnetic pulse welding (MPW) method for the future clad tubes of the Fast Breeder Reactor (FBR) programme is under development. . All welded samples withstood helium leak less than  $1.5 \times 10^{-9}$  mbar.l/sec. The bond length confirmed was more than 4mm by UT. Accordingly, four samples MPW samples were subjected to high temperature pressure burst test. MPW ODS-based clad tube joints are tested at a temperature of 750°C and 10 MPa internal pressure. It is the first time the ODS-based clad tube samples are tested at 750°C temperature. The minimum experimentally observed creep rupture life of the ODS-based clad tube samples at this condition is 101 h.



**Magnetic Pulse Welding Technique for Joining Fuel Element Clad to Bottom End Plug for CLWR Programme**

MPW development of 6.3mm OD x 0.25mm thick special alloy clad to end plug developmental work has been initiated at APPD in collaboration with RPD & IF3. The welded samples qualified for HLD better than  $1.5 \times 10^{-9}$  mbar.l/sec and optical micrographs showed weld length ~1.5mm. Efforts are going on to improve the weld length by modifying the plug configuration and tuning the operating parameters. The weld samples and the micrographs are shown above.