

The background of the slide is a deep blue space scene. On the left, a large portion of the Earth is visible, showing continents and oceans. In the upper center, a bright sun or star is partially obscured by a red, glowing ring, creating a lens flare effect. The overall atmosphere is futuristic and high-tech.

NORTHROP GRUMMAN

DEFINING THE FUTURE

Induction Brazing for Shipboard Pipe Applications

Fall 08 SP-7 Meeting
Ketchikan, Alaska

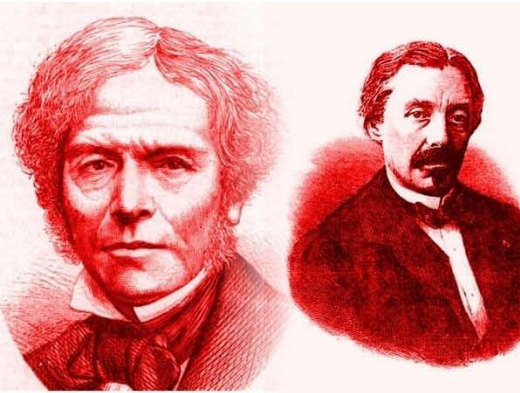
Patrick M Hoyt

Chief Welding Engineer
Northrop Grumman Shipbuilding
New Orleans

Why Bother? What's wrong with my torch?

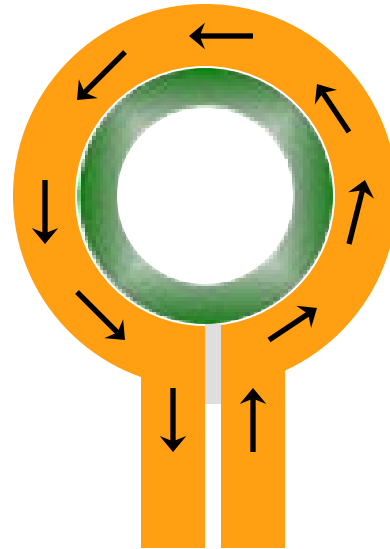
- Induction Brazing allows us to reduce the hazards of hot work, no open flame, no shipboard fires
- Reduced cycle time. 2 minutes for induction brazing vs. 6 minutes for torch brazing
- Operator skill level less critical. Will allow the use of less experienced brazers on shipboard joints with difficult access
- The heating cycle is consistent and repeatable, no variation between brazers. Consistent braze joint quality

What is Induction Heating?



When an alternating current flows through an induction coil a magnetic field is generated

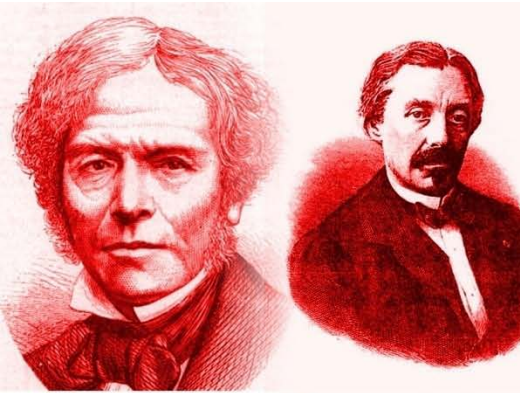
$$\varphi = \iint_S \vec{B} \cdot d\vec{S}$$



Induction Heating Coil

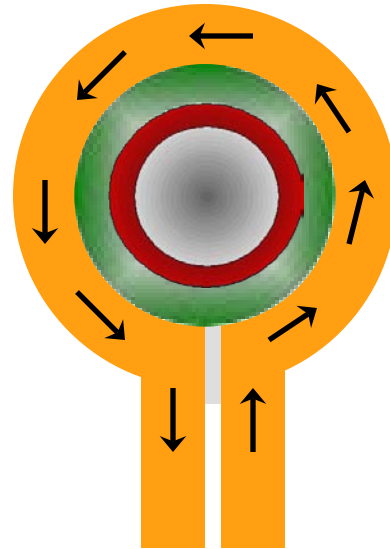
This field is concentrated on the inside of the coil and its magnitude depends on the strength of the current and the number of turns in the coil

Theory of Induction Heating



If a metal object is placed in the coil, eddy currents will be induced in the object

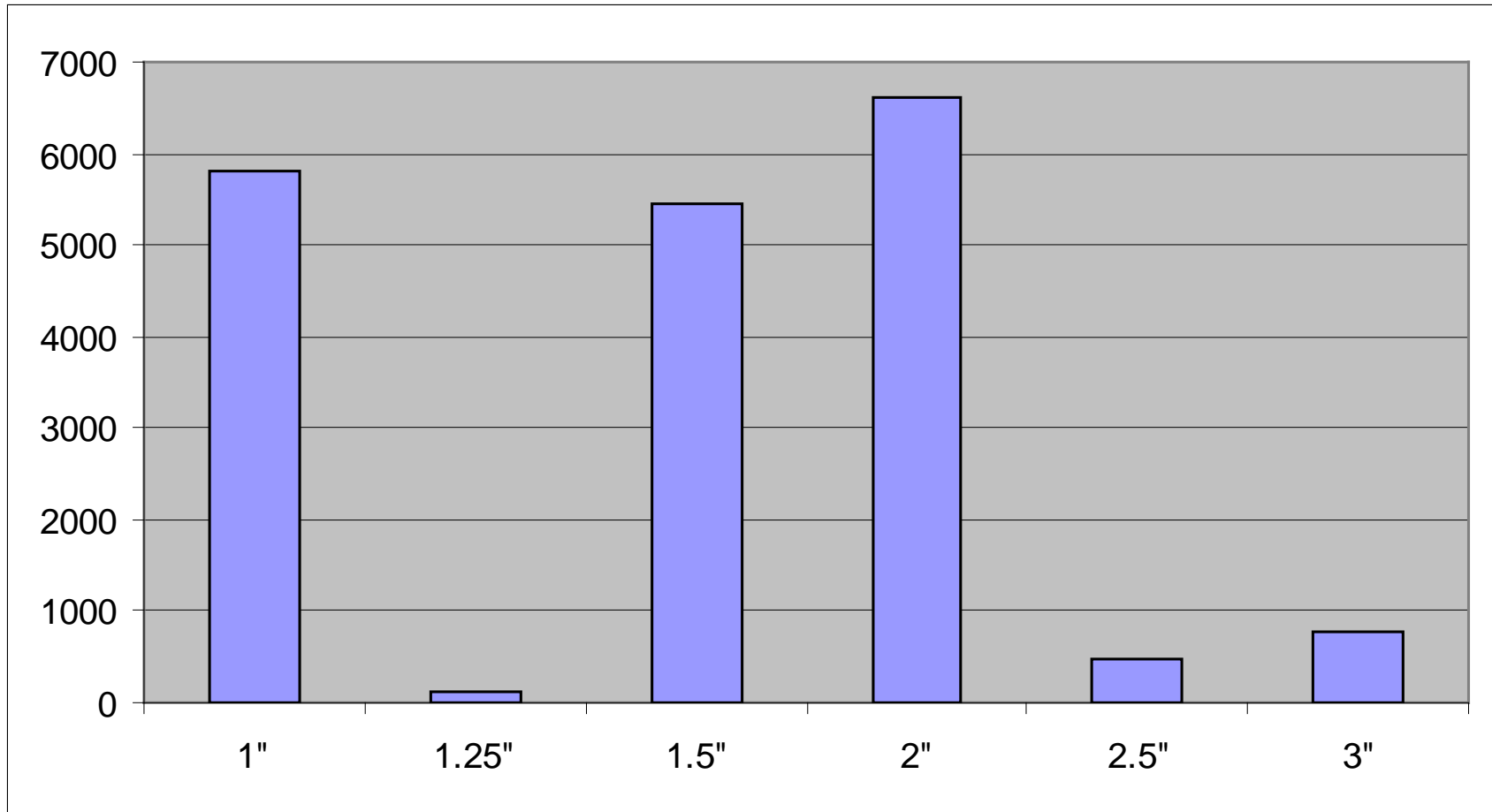
$$\varphi = \iint_S \vec{B} \cdot d\vec{S}$$



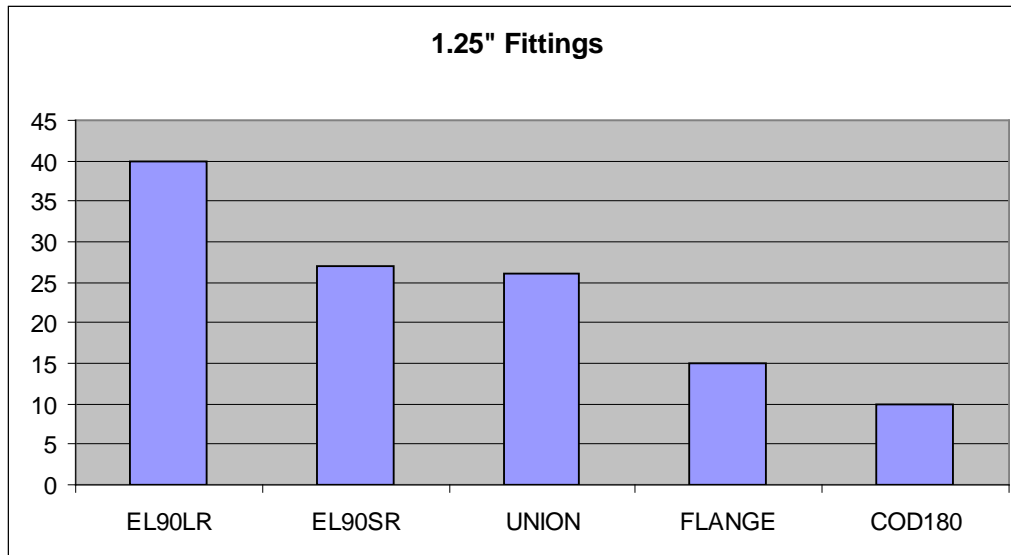
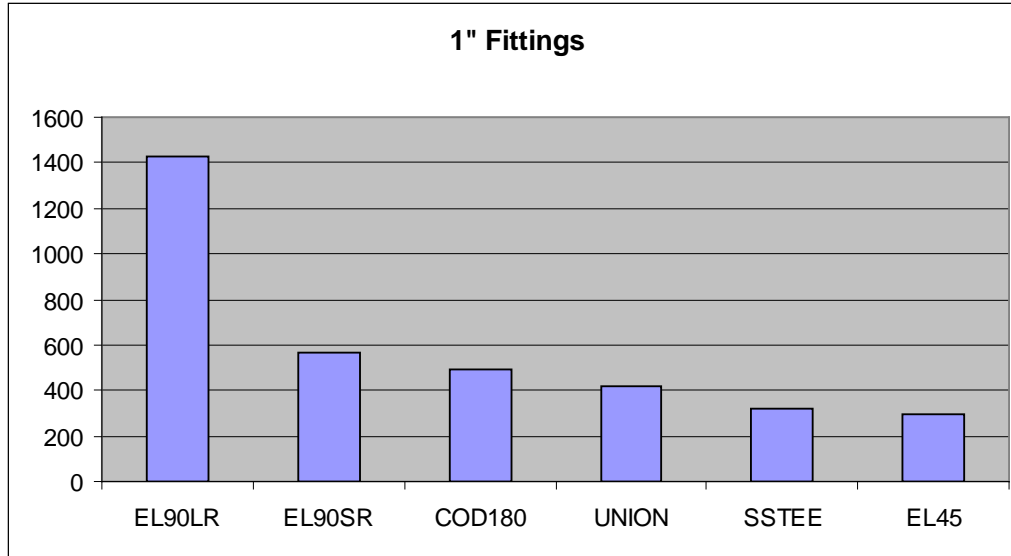
Induction Heating Coil

Due to the resistance of the material, heat is developed in the region through which the eddy currents flow

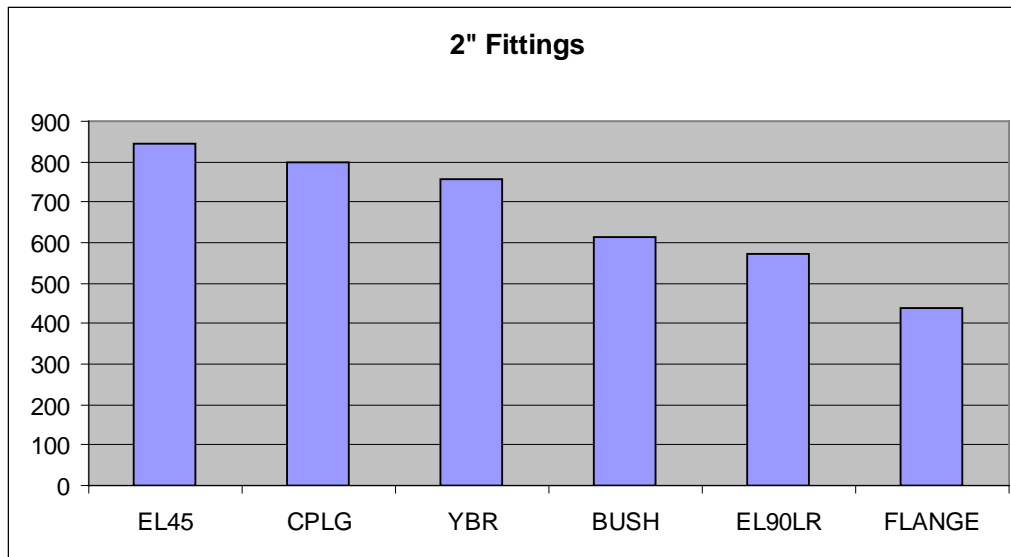
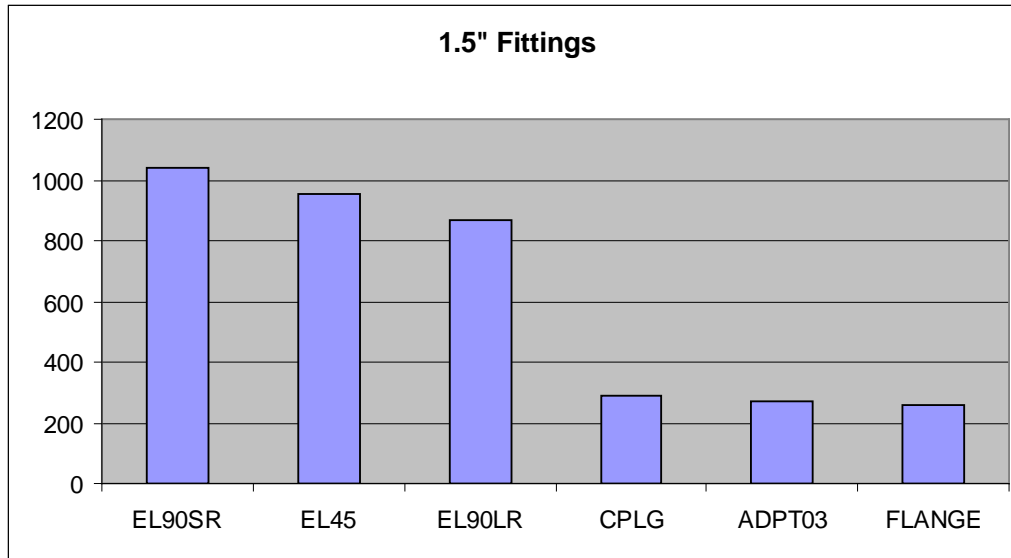
Fitting Quantity by Pipe Size



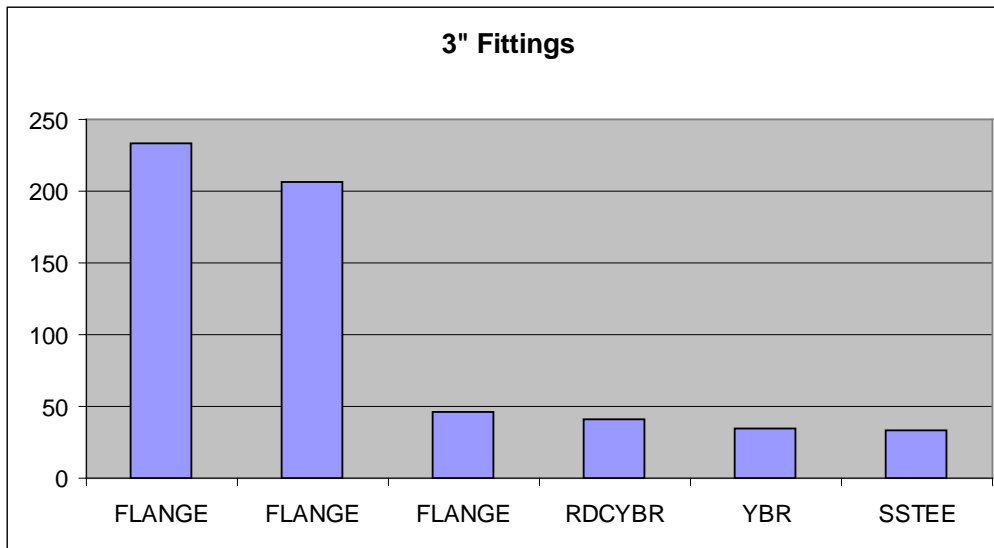
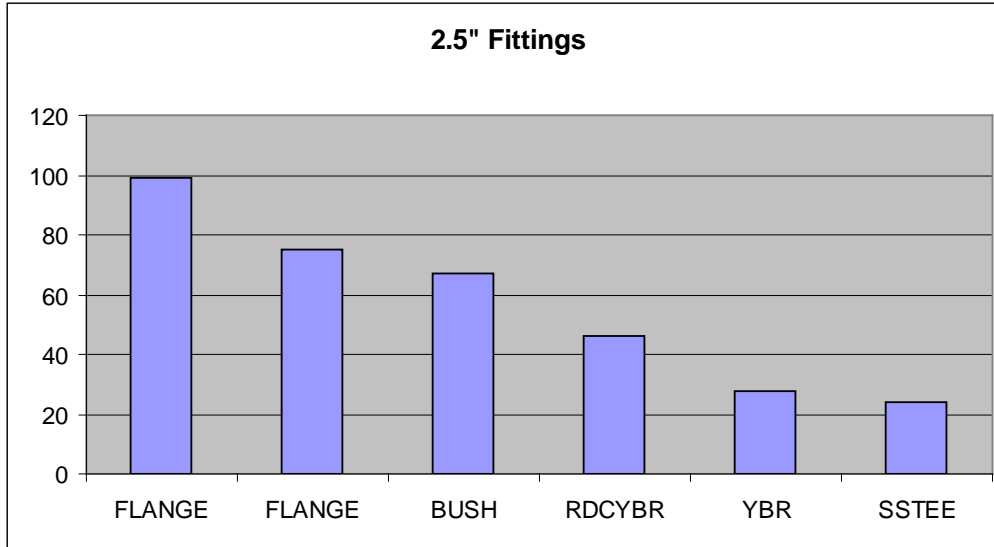
Fitting Types by Pipe Size



Fitting Types by Pipe Size



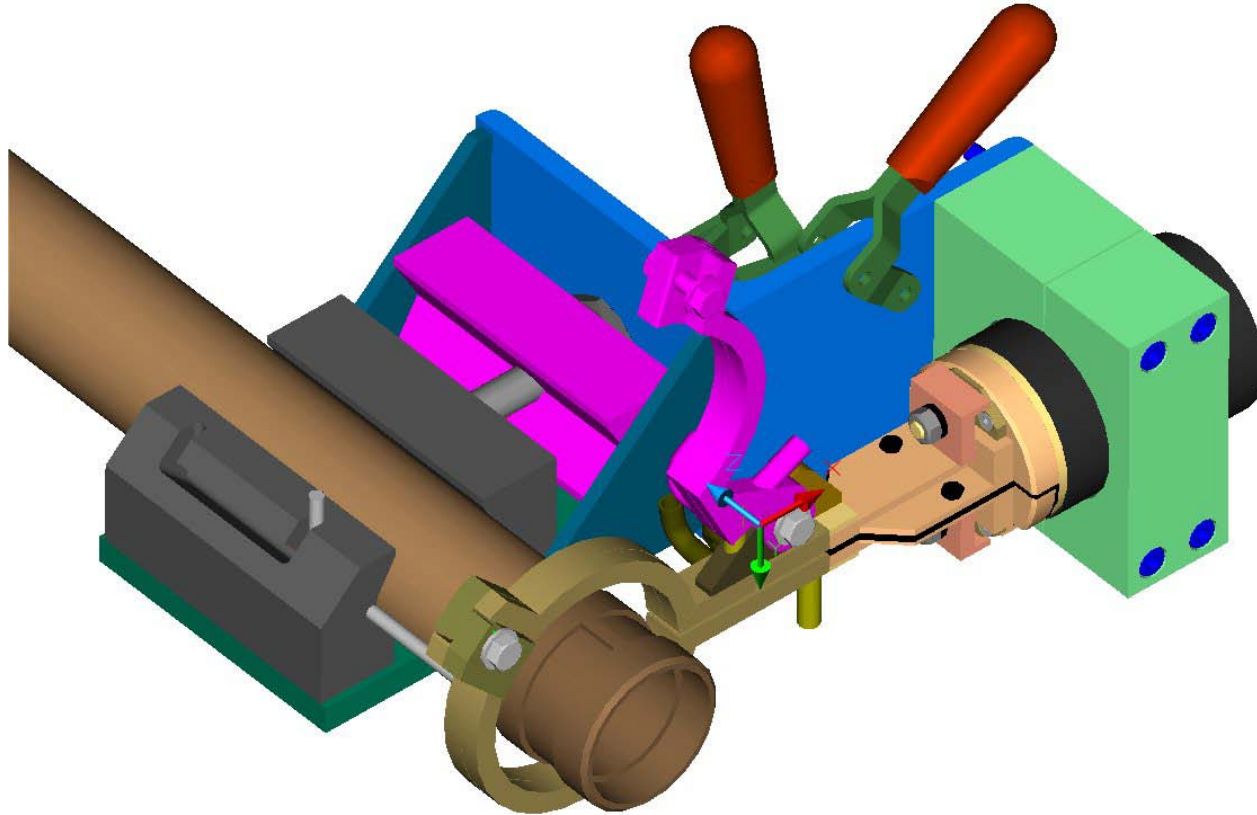
Fitting Types by Pipe Size



Induction Coil Design

- EFD has developed a prototype induction coil.
- It is reusable, not a consumable.
- It is a “clamshell” style coil.
- It clamps to the pipe to be brazed. The brazer does not have to support the induction coil.
- It will accommodate different sizes. For example the 2” pipe coil can be use to braze 1.5” pipe also.

Induction Coil Design



Schedule

| Quarter | Task | Description | Performed By | Due Date |
|---------|------|--|----------------|------------|
| 1 | 1 | Determine fitting types and pipe sizes most prevalent among the shipyard team members. | NGS, NGNN, BIW | 1/17/08 |
| 1 | 2 | Quarterly Status Report | EFD, NGS | 3/31/2008 |
| 2 | 3 | Develop reusable induction brazing coils based on shipyard requirements | EFD | 5/19/08 |
| 2 | 4 | NGSS utilizes reusable coils with brazing unit to determine conformance to Navy brazing requirements | NGS | 6/19/2008 |
| 2 | 5 | Quarterly Status Report | EFD, NGS | 6/30/2008 |
| 3 | 6 | EFD develops shipboard pipe brazing unit | EFD | 9/19/2008 |
| 3 | 7 | Quarterly Status Report | EFD, NGS | 9/30/2008 |
| 4 | 8 | NGS demonstrates shipboard pipe brazing system | NGS | 12/4/2008 |
| 4 | 9 | Final Report | EFD, NGS | 12/19/2008 |

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