



INDUCTION TUBE WELDING

THE LATEST IN IMPROVING
SMALL TUBE WELDING SYSTEMS

Prinz & Co. GmbH Stahlrohre Case Study

Case setup

~400kHz 50-150kW power supply	15mm OD steel tube	1.2mm thick wall	8.5-9mm OD impeters		Line Speed (m/min)	Power (kW)
				9mm Ferrite	77	58
				8.5mm Fluxtrol 50	77	33

Energy savings for the same line speed was ~40%

Other Cost Benefit Analysis - 5000 hrs/yr

Material	Core Cost	Impeder Cost	Impeder Life	Changeovers/yr	Total Impeder Cost
Ferrite	\$5	\$55	4 hrs	1250	\$68,750
SMC	\$200	\$250	20 hrs	250	\$62,500

Material	Line Cost	Changeover Time	Impeder Life	Changeovers/yr	Changeover Time Cost
Ferrite	\$10/min	30 Minutes	4 hrs	1250	\$375,000
SMC	\$10/min	30 Minutes	20 hrs	250	\$75,000

Material	Scrap Cost	Restart Time	LbsScrap/Change-over	Impeder Life	Changeovers/yr	Changeover Scrap Cost
Ferrite	\$2/lb	1 Minute	69	4 hrs	1250	\$173,600
SMC	\$2/lb	1 Minute	69	20 hrs	250	\$34,700

Total annual savings

\$455,000

or \$90/hr

Lowers line cost by

15%

Gunther, D., Kroll, M., Goldstein, R., Kunke, A., UIE 2024. Geometry Optimization and Efficiency Increase of HFI Welding Process While Using SMC-impeters

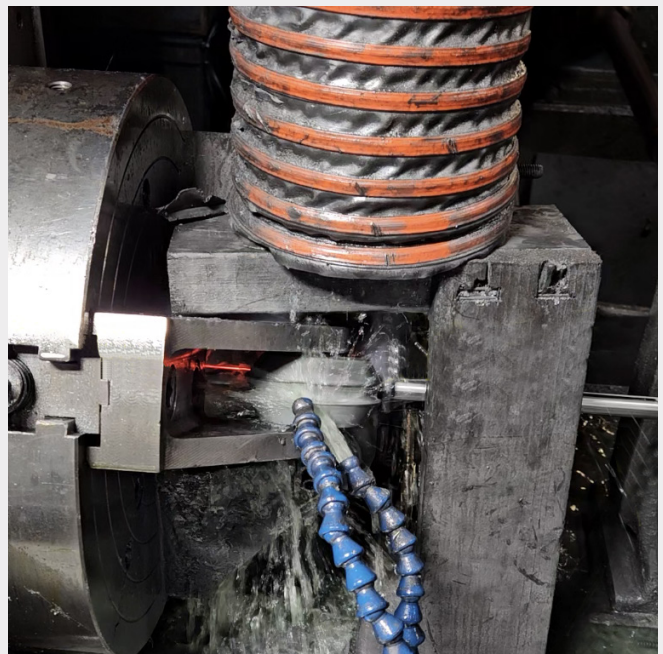
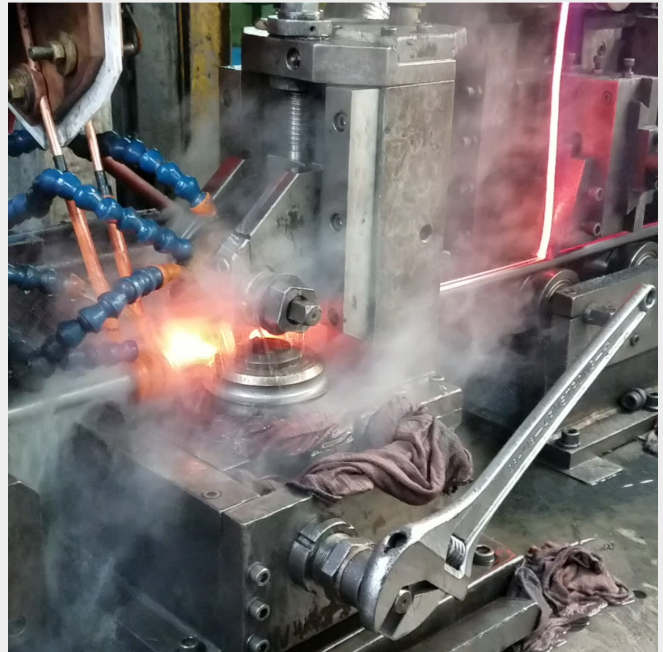


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Fluxtrol's **Soft Magnetic Composite (SMC)** impellers offer improved performance and cost savings where traditional ferrite impellers are unable to operate effectively.

SMC impellers will operate steadily beyond where ferrites show signs of degradation (sparking, increased current demand, etc.). This is because SMC impellers do not reach the same magnetic flux saturation that ferrites experience in typical welding environments.

These improvements translate to reduced shutdown and scrap costs, increased line speeds, improved mechanical clearance, and lower power demand.



Breakdown of Benefits

Reduced Shutdown & Scrap Costs

The thermal stability and durability of SMC's in continuous weld conditions allows for less frequent line shutdowns for impeder changeout. Fluxtrol SMC impeders are designed to operate 5x longer than ferrite, making replacement predictable and cost-effective vs ferrites that are prone to unscheduled failure.

Increased Line Speed

Ferrite impeder cores are the typical limiting factor in determining the maximum line speed for continuous tube welding operations. Removing the magnetic flux saturation obstacle allows the welder to operate at higher speeds while maintaining the same power usage.

Improved Mechanical Clearance

Fluxtrol SMCs' increased efficacy over ferrites allows for reduction in core area for the same performance. By shrinking the core, the overall size of the impeder is decreased and grants additional clearance from the pipe being welded. This additional clearance lowers the risk of a mechanical failure caused by the weld bead contacting the impeder. Most small tube setups can see 1.5-2x mechanical clearance over ferrite.

Lower Power Demand

Maintaining the same line speed as existing ferrite cores allows the welder to decrease power consumption when using SMC impeders. This also has the potential to extend the useful life of existing welders that are limited by diminished power output.

Opportunities for line improvement

- ✓ Small diameter, heavy-walled steel tubes
- ✓ Applications where impeder frequently fail due to mechanical impact with line
- ✓ Applications with very short impeder life
- ✓ Small tube applications where the welder is the bottleneck and the impeder is in saturation
- ✓ Applications with metallic components inside of the impeder such as scarfing or return flow fittings

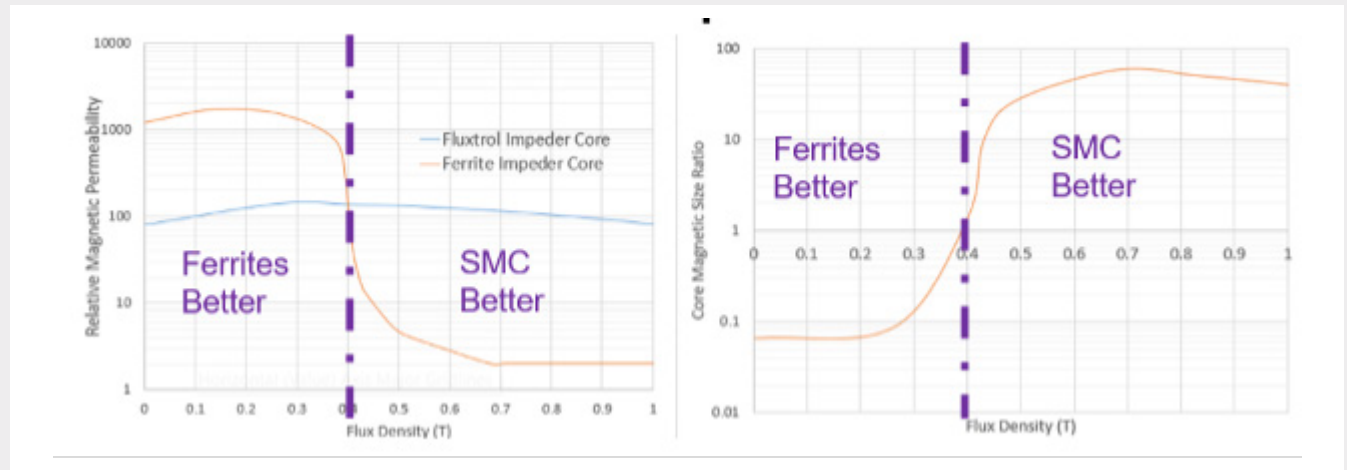
Core sizes offering greatest improvement

The best use cases for SMC cores are in tubes under 1.5" (38mm) OD. On the next page are some example impeder core sizes in which a switch from ferrite to SMC would be most beneficial.

Most hollow designs are compatible with return flow systems. Fluxtrol's design-to-production system allows for custom solutions if a specific size is not shown below.

Why it works

Impeders are used to limit the coil's magnetic field from inducing current around the inner diameter of the tube and instead focusses it toward the welding point. In small diameter tube systems, the relatively smaller ferrite impeder core experiences magnetic flux saturation and allows the field to induce internal diameter currents and dilutes the heat applied to the weld point. SMC impeders do not experience this saturation effect and can continue to perform beyond the previous saturation point.



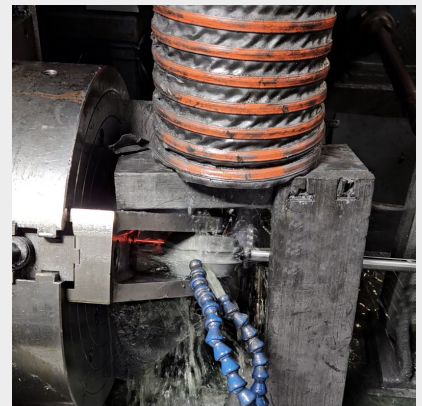
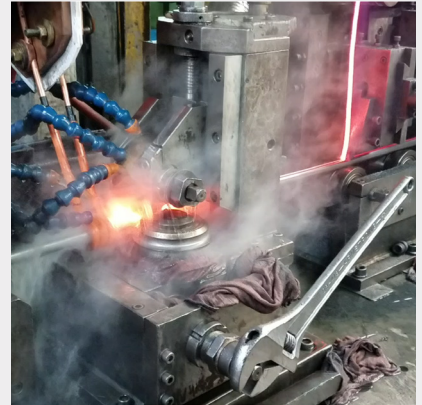
To the left of the line, typical ferrites used for impederes will outperform the Fluxtrol A material where saturation is not an issue.

To the right of the line, SMC will outperform ferrites.

At the level of 0.7 Tesla and above, Ferrite will only be approximately 2x better than air, while Fluxtrol's SMC remains approximately 100x better

Benefits of working with Fluxtrol

Fluxtrol has been an industry leader in magnetic flux concentrators for over 40 years. With this history comes expertise in modeling and developing products for use in induction applications. Additionally, Fluxtrol is the direct source of its SMC impeder core material and offers unrivaled flexibility in custom solutions for specific applications.



Check out our resources to learn more

Core Dimension		OD Characteristic	Minimum Casing ID (mm)
OD (mm)	ID (mm)		
3	0, Solid	Smooth	4
4	0, Solid	Smooth	5
4.5	0, Solid	Smooth	5.5
5	0, Solid	Smooth	6
5.5	0, Solid	Fluted	6.5
6	0, Solid	Fluted	7
6.5	0, Solid	Fluted	7.5
7	0, Solid 3	Fluted Smooth	8
7.5	0, Solid 3	Fluted Smooth	8.5
8	0, Solid 3 4	Fluted Fluted Smooth	9
8.5	0, Solid 3 4	Fluted Fluted Smooth	9.5
9	0, Solid 3 4 5	Fluted Fluted Fluted Smooth	10
9.5	0, Solid 3 4 5	Fluted Fluted Fluted Smooth	10.5
10	0, Solid 3 4 5 6	Fluted Fluted Fluted Smooth Smooth	11
11	0, Solid 4 5 6 7	Fluted Fluted Fluted Smooth Smooth	12
12	0, Solid 5 6 7 8	Fluted Fluted Fluted Smooth Smooth	13
13	0, Solid 6 7 8 9	Fluted Fluted Fluted Smooth Smooth	14
14	0, Solid 6 7 8 9	Fluted Fluted Fluted Smooth Smooth	15
15	0, Solid 7 8 9 10	Fluted Fluted Fluted Smooth Smooth	16

Core Dimension		OD Characteristic	Minimum Casing ID (mm)
OD (mm)	ID (mm)		
16	0, Solid 8 9 10 11	Fluted Fluted Fluted Smooth Smooth	17
17	0, Solid 9 10 11 12	Fluted Fluted Fluted Smooth Smooth	18
18	0, Solid 10 11 12 13	Fluted Fluted Fluted Smooth Smooth	19
19	0, Solid 11 12 13 14	Fluted Fluted Fluted Smooth Smooth	20
20	0, Solid 12 13 14 15	Fluted Fluted Fluted Smooth Smooth	21
21	Fluted 13 14 15 16	Fluted Fluted Fluted Smooth Smooth	22
22	0, Solid 14 15 16 17	Fluted Fluted Fluted Smooth Smooth	23
23	0, Solid 15 16 17 18	Fluted Fluted Fluted Smooth Smooth	24
24	0, Solid 16 17 18 19	Fluted Fluted Fluted Smooth Smooth	25
25	0, Solid 17 18 19 20	Fluted Fluted Fluted Smooth Smooth	26

*SMC cores have higher losses and require proper water cooling.
Not compatible with gas cooled systems.