

# Magnetostatic Analysis of Mild Steel Solenoid

**Author: EMWorks**

**Company: EMWorks**

**Date: November 30, 2011**

- [Materials](#)
- [Load & Restraint Information](#)
- [Coils Information](#)
- [Force and Torque Information](#)
- [Study Properties](#)
- [Results Table](#)
- [Magnetic Flux Density Results](#)
- [Magnetic Field Intensity Results](#)
- [Applied Current Density Results](#)
- [Force Density Results](#)
- [Temperature Results](#)
- [Temperature Gradient Results](#)
- [Heat Flux Results](#)

- [Appendix](#)

---

- **Materials**

**Note:** R.P. stands for Relative Permeability

<b>Nbr.</b>	<b>Part Name</b>	<b>Material Name</b>	<b>Permeability Type</b>
1	Center_pole-1-Body 1 (Boss-Extrude1)	<a href="#">Mild Steel</a>	Isotropic
2	Coil-1-Body 1 (Split1[1])	<a href="#">Copper</a>	Isotropic
3	Coil-1-Body 2 (Split1[2])	<a href="#">Copper</a>	Isotropic
4	Inner_air-1-Body 1 (Cavity1)	<a href="#">Air</a>	Isotropic
5	Outer_air-1-Body 1 (Cavity1)	<a href="#">Air</a>	Isotropic
6	Yoke_T-1-Body 1 (Boss-Extrude1)	<a href="#">Mild Steel</a>	Isotropic

---

- **Load & Restraint Information**

<b>Nbr.</b>	<b>Name</b>	<b>Selected Faces</b>	<b>Selected Components</b>
-------------	-------------	-----------------------	----------------------------

**Thermal Loads**

<b>Nbr.</b>	<b>Name</b>	<b>Convection Coefficient (W/(m<sup>2</sup>.K))</b>	<b>Ambient Temperature (Kelvin)</b>	<b>Selected Faces</b>	<b>Selected Components</b>
1	Convection - 1	1.000e+001	3.000e+002	19	None

---

- **Coils Information**

<b>Coils</b>					
<b>Nbr.</b>	<b>Name</b>	<b>Nbr.Of Turns</b>	<b>Magnitude</b>	<b>Phase</b>	<b>Components &amp; Bodies</b>
1	Wound Coil - 1	3000	1.000000e+00 0	0.0000e+000de g	Coil-1

---

- **Force and Torque Information**

<b>Nbr.</b>	<b>Name</b>	<b>Torque Center</b>	<b>Components &amp; Bodies</b>
1	Virtual Work - 1	At origin	Center_pole-1

---

- **Study Properties**

<b>Mesh Information</b>			
<b>Nbr.Of Nodes</b>	<b>Nbr.Of Elements</b>	<b>Element Size (m)</b>	<b>Tolerance (m)</b>
46465	274204	0.028915	0.000029

<b>Solver information</b>		
<b>Solver Type</b>	<b>Nbr. Current Increments</b>	<b>Compute Circuit Parameters</b>
Direct Solver	1	Yes

---

- **Results Table**

**Force Results**

	<b>Fx-axis (N)</b>	<b>Fy-axis (N)</b>	<b>Fz-axis (N)</b>
Virtual Work - 1	2.388274e-001	8.917278e-001	9.638898e+001

**Torque Results**

	<b>Tx-axis (N.m)</b>	<b>Ty-axis (N.m)</b>	<b>Tz-axis (N.m)</b>
Virtual Work - 1	1.889069e-001	-6.028587e-002	-3.353976e-003

**Inductance Results (H)**

<b>Coil Name</b>	<b>Wound Coil - 1</b>
Wound Coil - 1	2.010836e+000

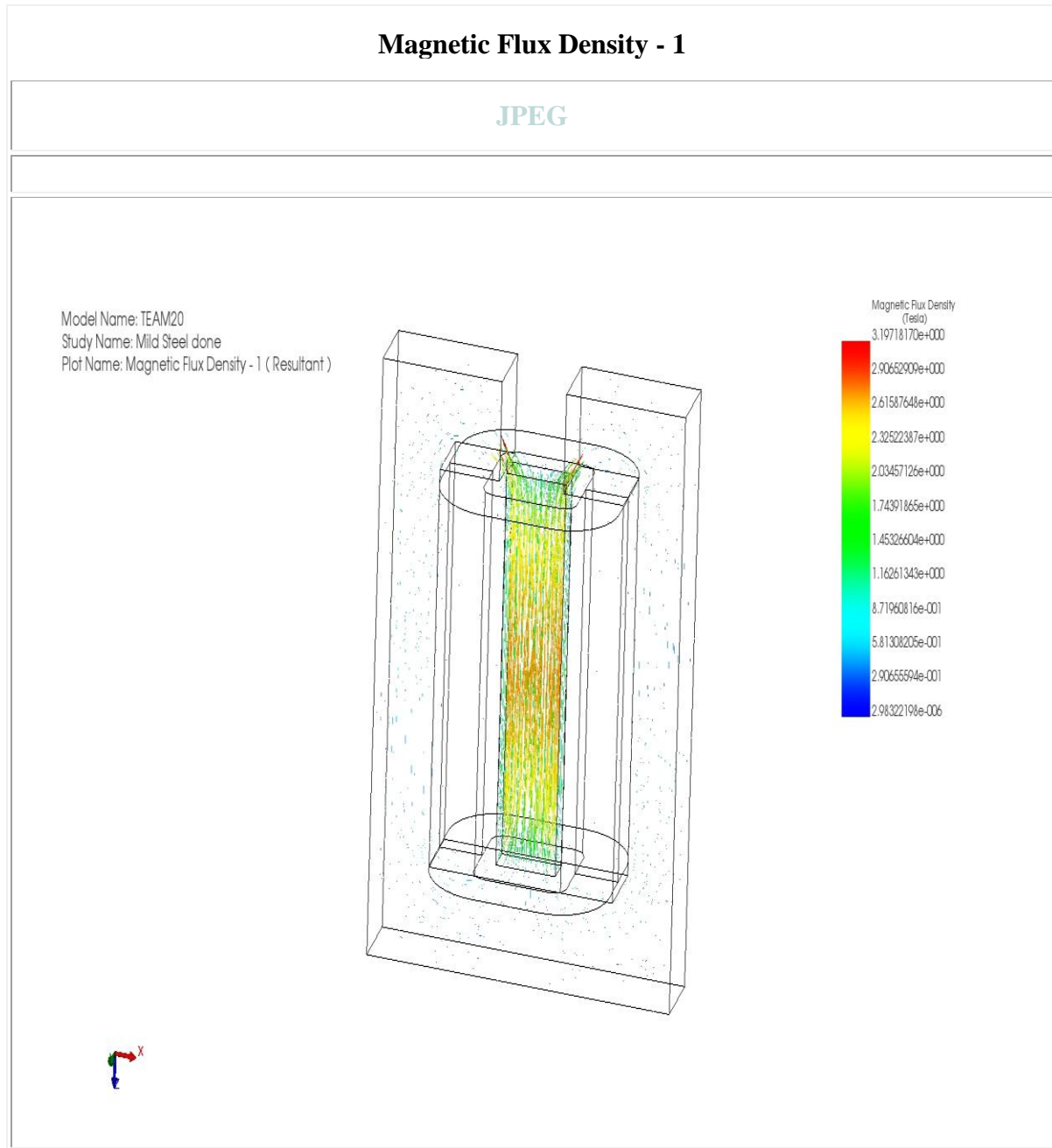
**Flux Linkage Results**

<b>Coil Name</b>	<b>Flux Linkage (Wb)</b>
Wound Coil - 1	2.010836e+000

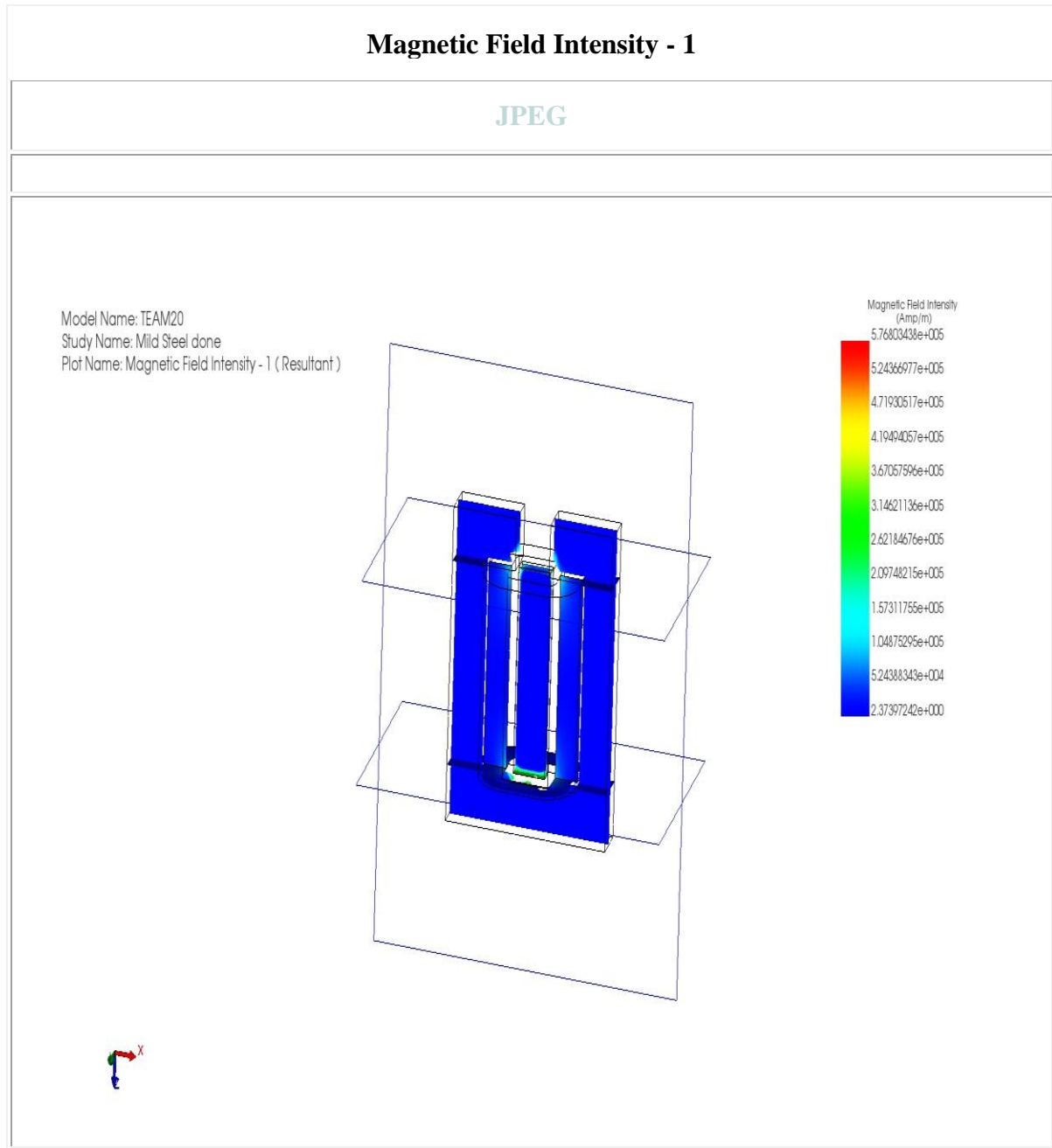
**Energy Results**

Energy (J)	Co-Energy (J)
1.005418e+000	1.005418e+000

## • Magnetic Flux Density Results



- **Magnetic Field Intensity Results**

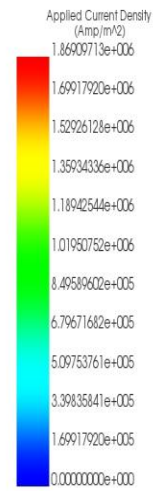
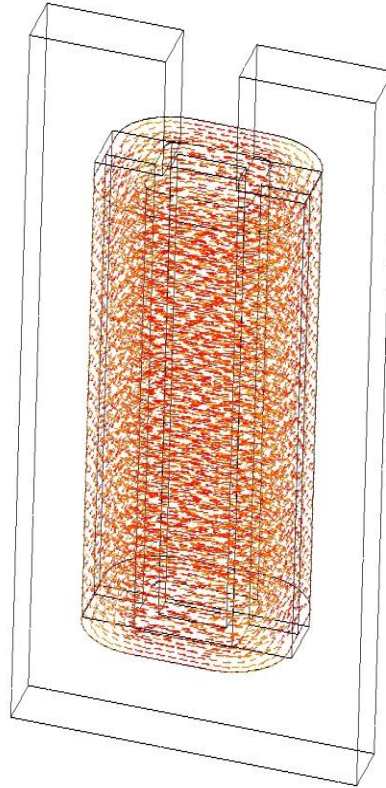


- **Applied Current Density Results**

## Applied Current Density - 1

JPEG

Model Name: TEAM20  
Study Name: Mild Steel done  
Plot Name: Applied Current Density - 1 (Resultant)

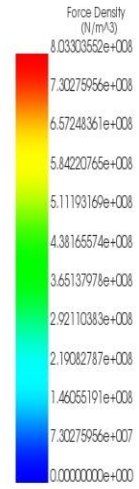
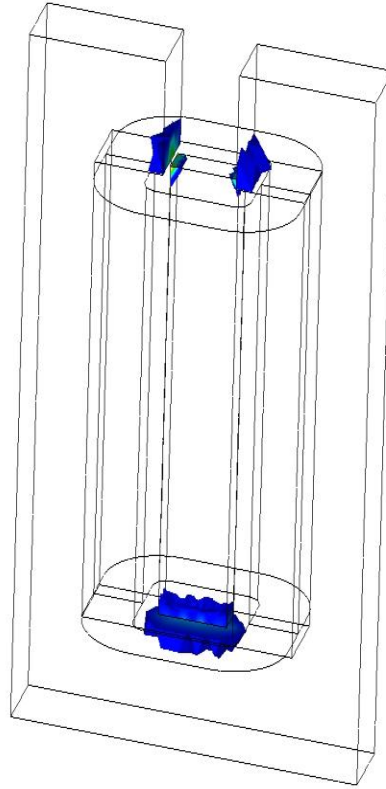


## • Force Density Results

### Force Density - 1

JPEG

Model Name: TEAM20  
Study Name: Mild Steel done  
Plot Name: Force Density - 1 (Resultant)  
Force Type: Virtual work



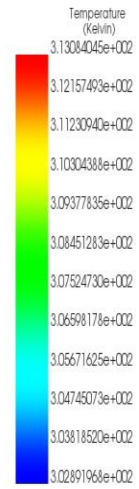
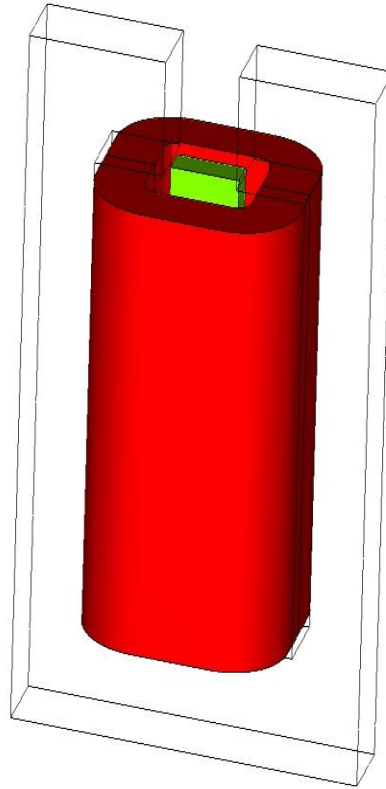
- **Temperature Results**

**Temperature - 1**

JPEG



Model Name: TEAM20  
Study Name: Mild Steel done  
Plot Name: Temperature - 1 ( Resultant )  
Global Range: 3.02891968e+002 to 3.13084045e+002

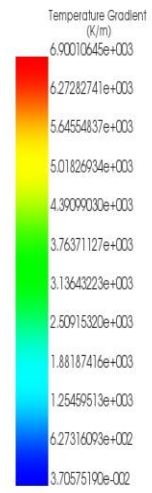
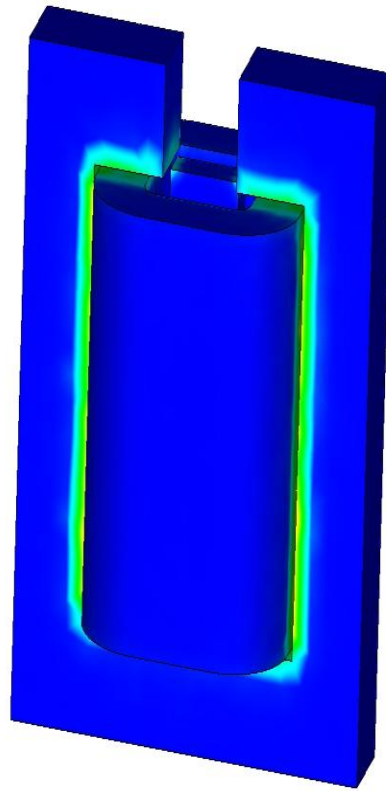


- **Temperature Gradient Results**

**Temperature Gradient - 1**

JPEG

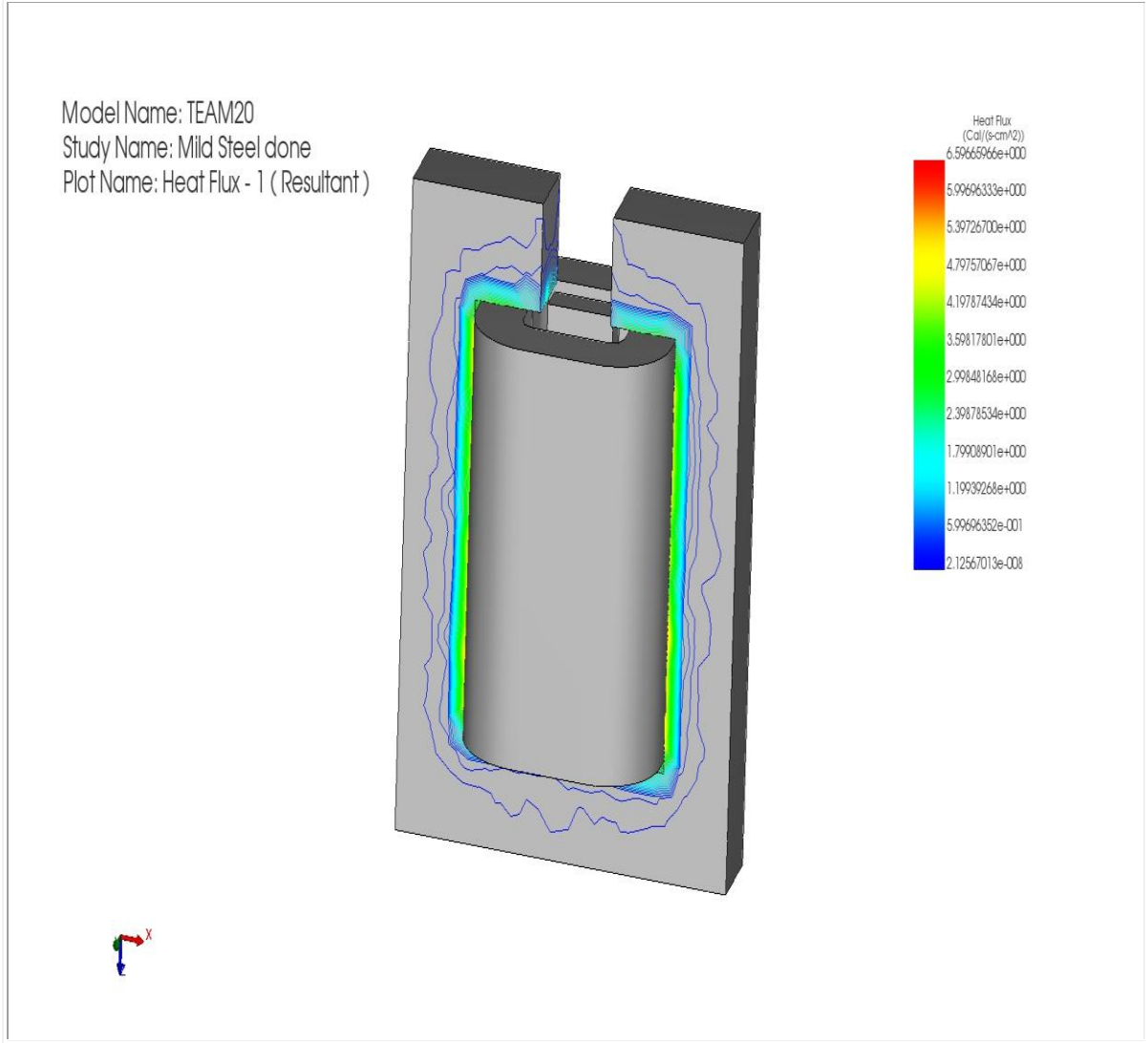
Model Name: TEAM20  
Study Name: Mild Steel done  
Plot Name: Temperature Gradient - 1 (Resultant)



## • Heat Flux Results

**Heat Flux - 1**

JPEG



• **Appendix**

**Material Name:** Mild Steel

**Permeability Type:** Isotropic

**Note:** R.P. stands for Relative Permeability

<b>R.P.</b>	<b>Permanent Magnet</b>	<b>Thermal Conductivity (W/m.K)</b>
-------------	-------------------------	---

2.000e+003	No	4.000e+001
------------	----	------------

**Material Name:** Copper

**Permeability Type:** Isotropic

**Note:** R.P. stands for Relative Permeability

<b>R.P.</b>	<b>Permanent Magnet</b>	<b>Thermal Conductivity (W/m.K)</b>
1.000e+000	No	4.010e+002

**Material Name:** Air

**Permeability Type:** Isotropic

**Note:** R.P. stands for Relative Permeability

<b>R.P.</b>	<b>Permanent Magnet</b>	<b>Thermal Conductivity (W/m.K)</b>
1.000e+000	No	2.400e-002