Thermal Analysis
Blendenansatz

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1. General information and goals

1.1. Project Information

Project description:	Durchführung eine Temperaturanalyse von der Baugruppe “Blendenansatz" in verschiedenen Konfigurationen und mit verschiedenen Temperaturen. (1) Konfiguration I: Existierende Baugruppe mit dem Blendenansatz als ein Teil. (2) Konfiguration II: Blendenansatz hat ein zusätzliche Kupfer Anlegeteil. (3) Konfiguration III: Die Sensoranlagefläche ist durch eine 15° Neigung optimiert Analysentyp: **Transient Thermal Analysis**. **(1)** In Zeit $\mathbf{t_0 = 0}$ **s** Kontaktfläche (im Model rotmarkiert) hat Temperatur: a) **60 ° C** b) **100 ° C** die Temperatur bleibt unverändert während des gesamten Testes. **(2)** In den Anfangszustand, alle Modellkomponenten haben Temperatur **22 ° C**. Umgebungstemperatur = 22 **° C**. **(3)** Getestet Modell befindet sich in einem gut belüfteten Bereich, wird daher als natürliche Konvektion, Wärmeleitung = **25W / m2 * K**.
Date:	20.07.2015 - 24.07.2015
Project Engineering Goals:	(1) Zur Untersuchen ist die Temperaturänderung des Models innerhalb ersten 20 sec. (2) Bestimmen wie lange braucht die Wärme um vor Kontaktfläche bis zur Fläche des Sensors "97301-137-P727__SWP_001" in verschiedenen Konfigurationen zu erreichen. Sensor Schalttemperatur = 50 ° C.

1.2. Units

Unit system:	SI (MKS)
Length	mm
Temperature	˚C
Stress	MPa (N/mm^2)
Mass	Gram

1.3. Study Properties

Thermal Analysis

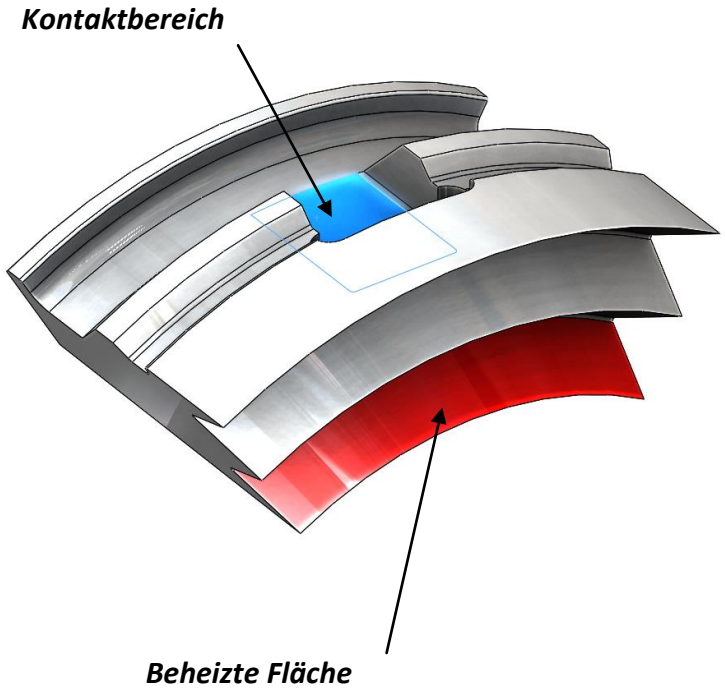
Analysis type	Thermal(Transient)
Mesh type	Solid Mesh
Solver type	Direct sparse solver
Solution type	Transient
Total time	10 Seconds (20 Seconds)
Time increment	0.25 Seconds
Contact resistance defined?	No

2. Model preparation for simulation

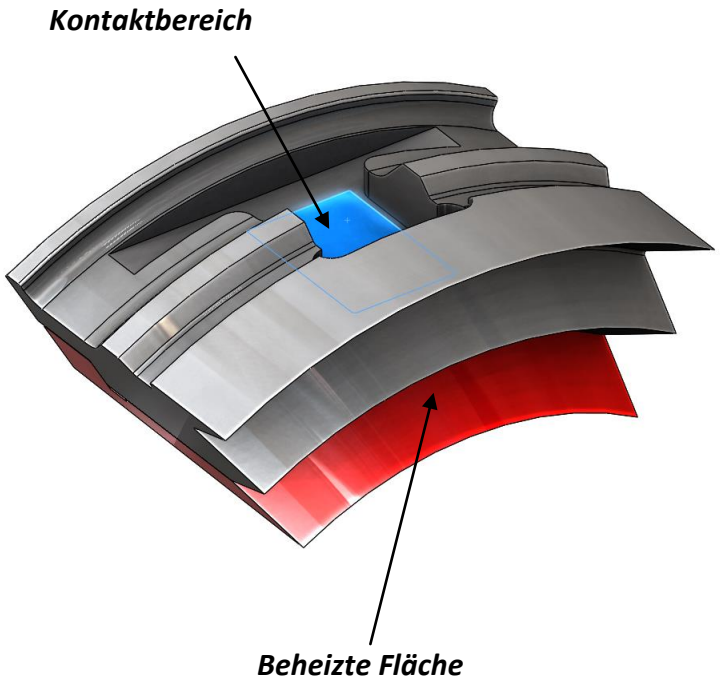
2.1. Model simplification

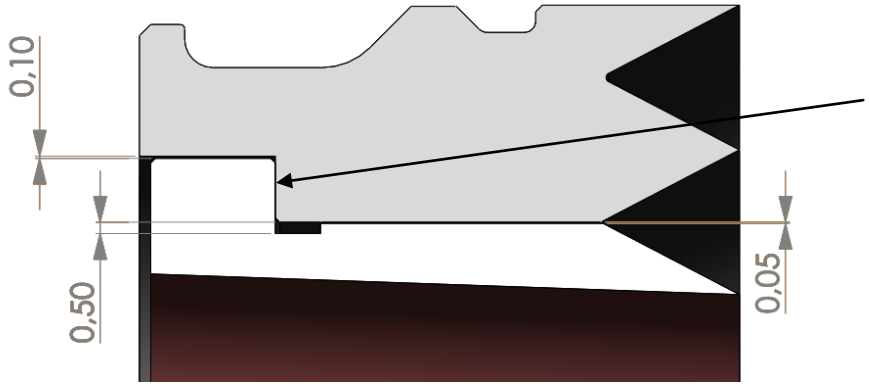
- Zur Vermessen ist die Kontaktfläche zwischen des TMC Sensor und Blendenansatz genommen.
- Im Temperaturtest 2 bekommt das innere Kupferteil zusätzlich eine Nickelbeschichtung
- In Konfiguration: Temperaturtest_2-1 wird bei Simulation der Wärmeübertragung zwischen Körpers nur Wärmewiderstand von Nickelschicht berücksichtigt.
- In Konfiguration: Temperaturtest_2-2 wird Wärmewiderstand von Nickelschicht und Luft in der Zwischenräumen plus zusätzlich die Wärmeübertragung durch Strahlung berücksichtigt

Temperaturtest_1



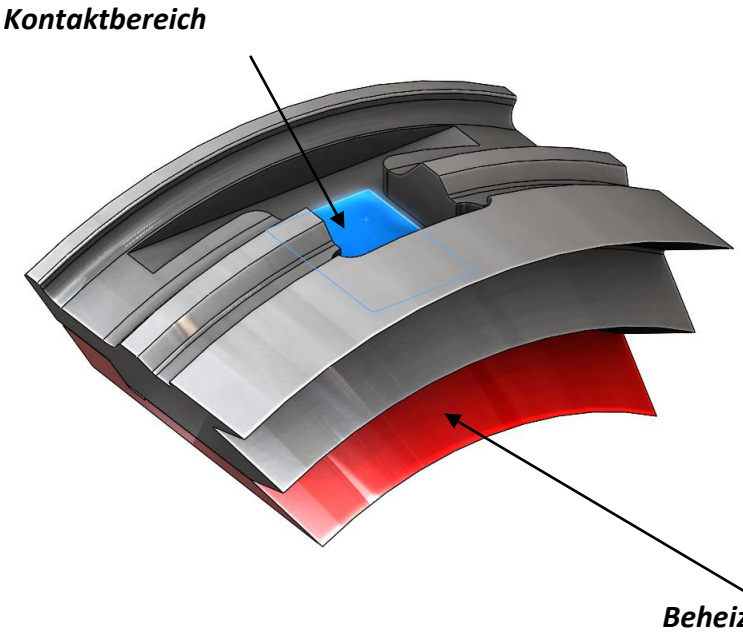
Temperaturtest_2-1

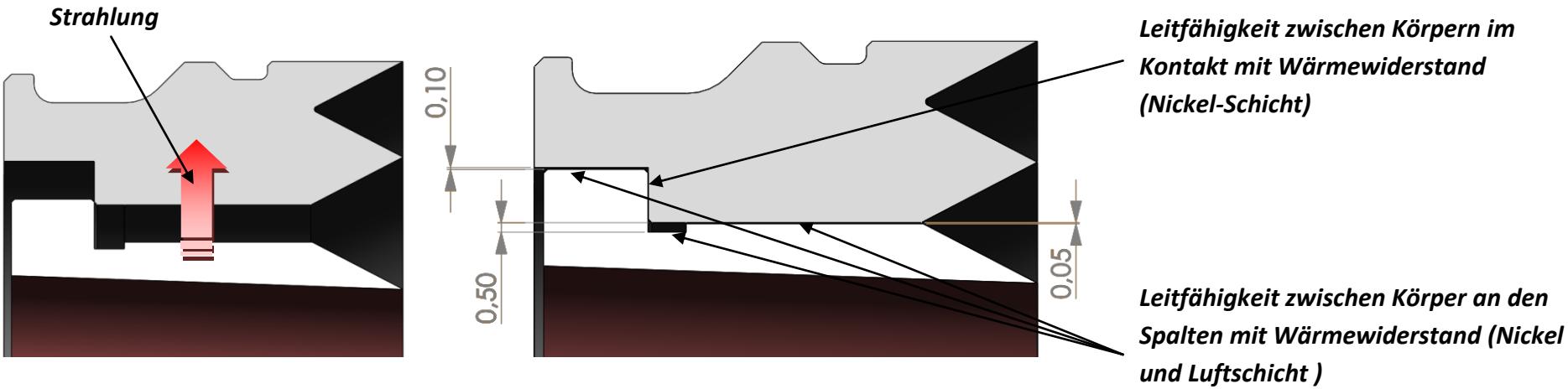




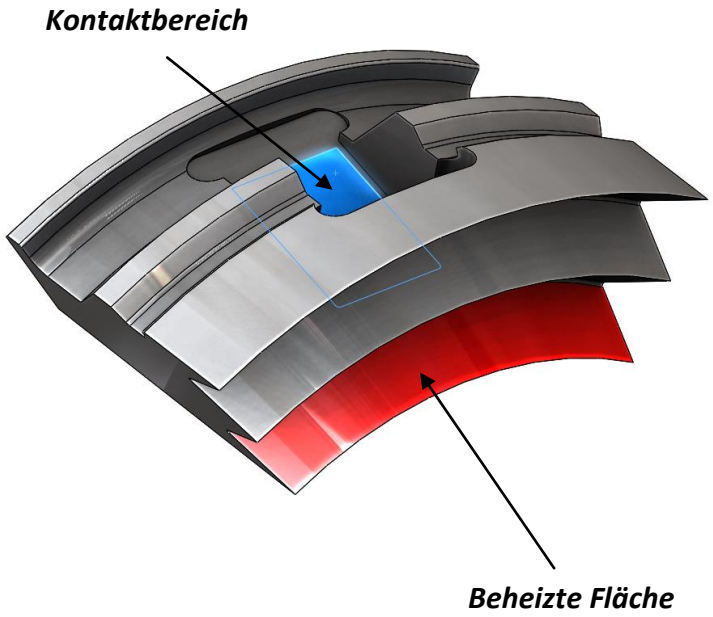
Leitfähigkeit zwischen Körpern im Kontakt mit Wärmewiderstand (Nickel-Schicht)

Temperaturtest_2-2





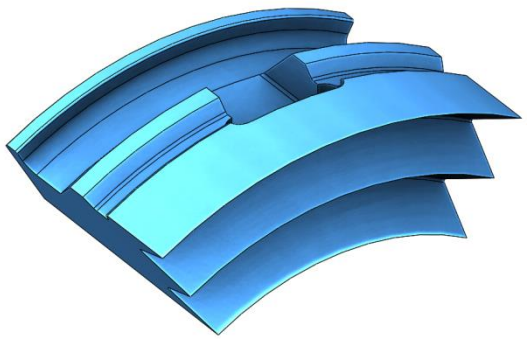
Temperaturtest_3



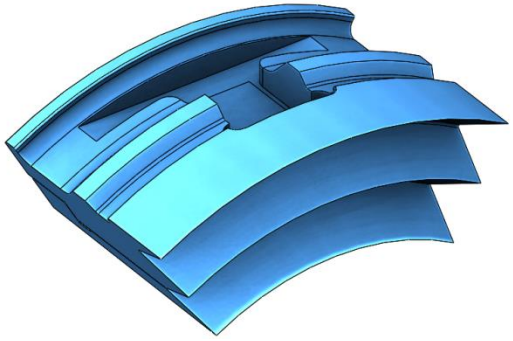
2.2. List parts and material data

Part Name	Material	Weight (gram)	Mass density (kg/m^3)	Elastic modulus N/mm^2(MPa)	Poisson's Ratio	Thermal conductivity W/(m*K)	Specific heat J/(kg*K)	Thermal expansion coefficient 1/K
97301-137-P674__SWP_temperaturtest	3.3547/EN AW-5083 (AlMg4,5Mn0,7)	20.19	2660	71000	0.33	117	899	2.40e-005
S157500-32-P75__SWP_temp_test	2.0040/CW009A (Cu-OFE)	21.14	8940	120000	0.34	393	385	1.73e-005
S157500-32-P75__SWP_temp_test	Nickel	-	8500	210000	0.31	43	460	1.7e-005
	Air	-	1.205			0.027	1005	3.43e-003

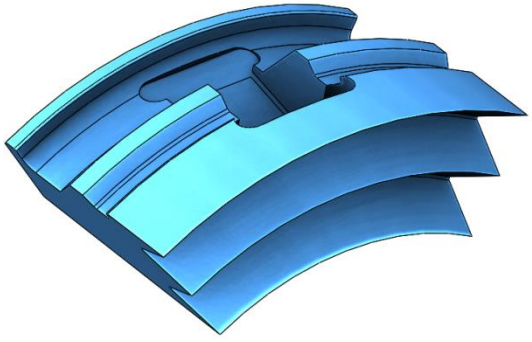
2.3. Definition of Loads



Temperaturtest_1

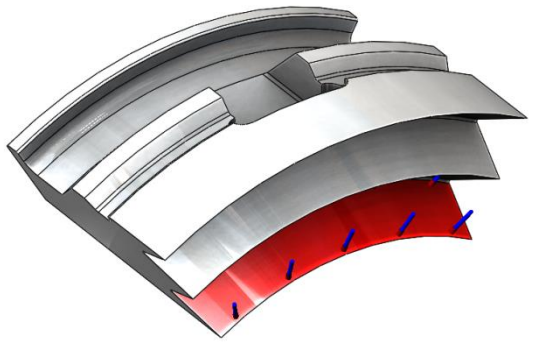


Temperaturtest_2-1, Temperaturtest_2-2

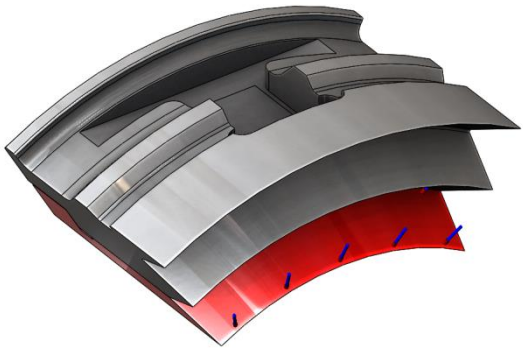


Temperaturtest_3

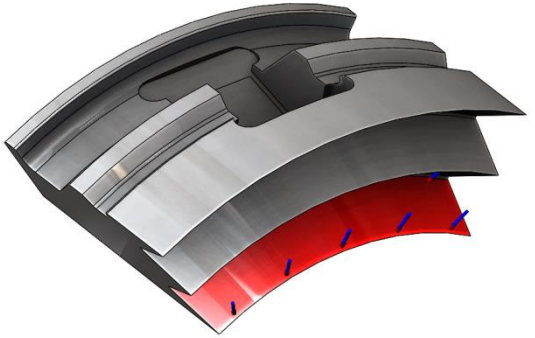
Initial temperature
Entities: all components
Value: 22 ˚C



Temperaturtest_1

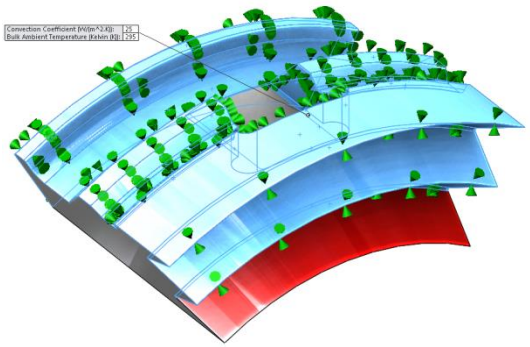


Temperaturtest_2-1, Temperaturtest_2-2

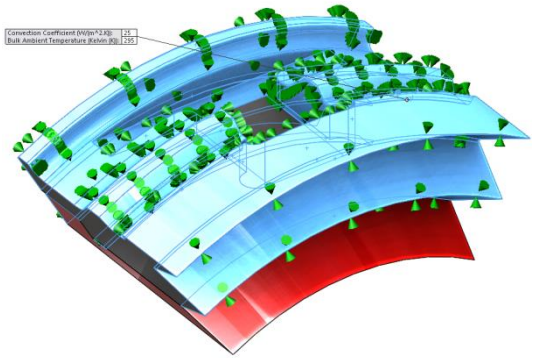


Temperaturtest_3

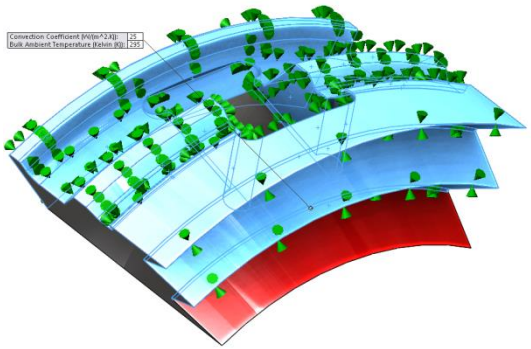
Temperature
Entities: face (Contact area)
Temperature = constant 60˚C and 100 ˚C



Temperaturtest_1



Temperaturtest_2-1, Temperaturtest_2-2

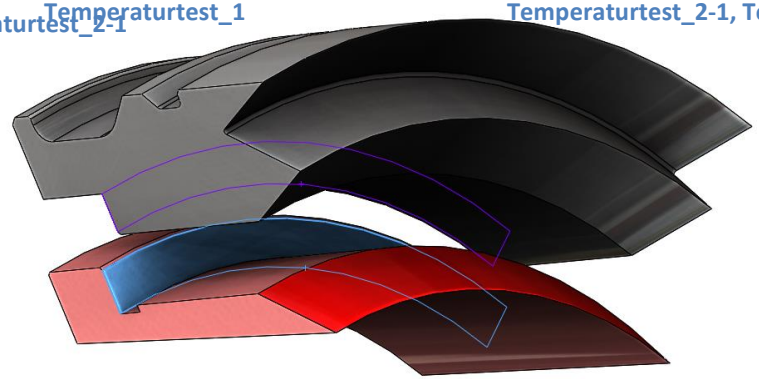


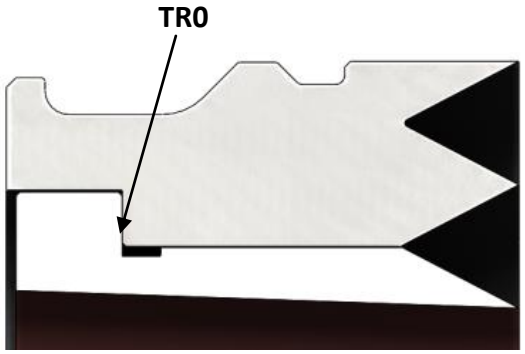
Temperaturtest_3

Convection
Entities: all faces
Value: **25 W/(m^{2}K)**
Time variation: Off
Temp. variation: Off

Bulk Ambient
Temperature: **22 ˚C**
Time variation: Off

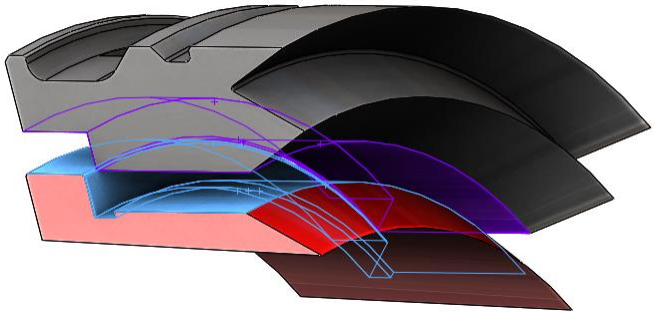
Temperaturtest_2-1



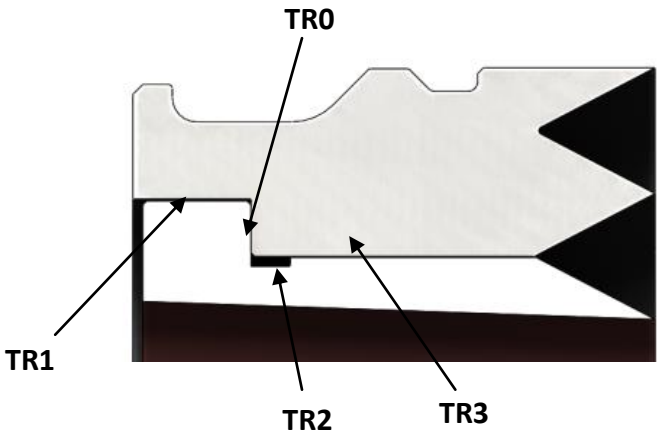


Thermal Resistance for Nickel layer

Entities: contact faces
TR0=2.36e-6(m^{2}K)/W



Temperaturtest_2-2

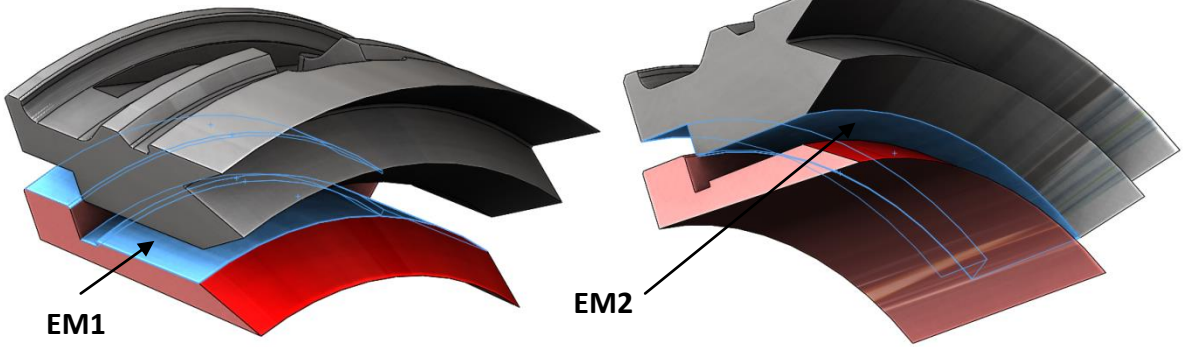


Thermal Resistance for Nickel and Air layer

Entities: contact **faces** for Nickel layer
TR0 = 2.36e-6(m^2K)/W

Entities: contact **faces** for Nickel and Air layers
TR1 = 0.00370602(m^2K)/W
TR2 = 0.01852083(m^2K)/W
TR3 = 0.00185417(m^2K)/W

Temperaturtest_2-2



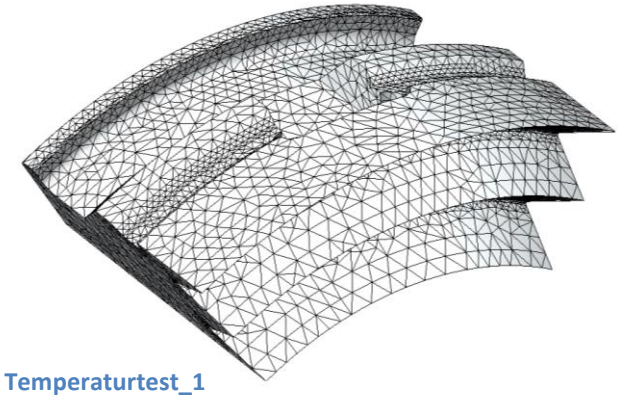
Radiation

Entities: contact faces
Emissivity Value:
EM1 = 0.5

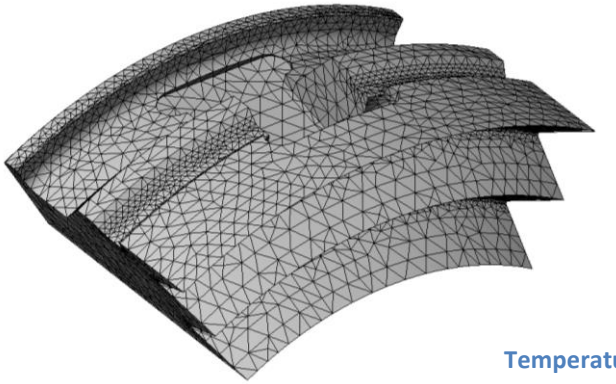
Emissivity Value: **EM1 = 0.97**

2.4. Meshing

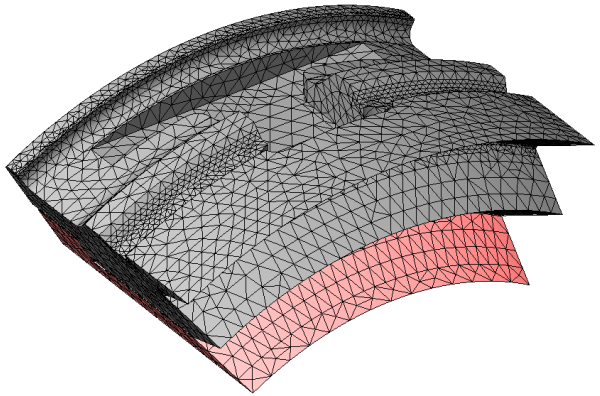
Mesh type	Solid Mesh			
Mesher Used:	Curvature based mesh			
Jacobian points	4 Points			
Maximum element size	1.5 mm			
Minimum element size	0.5 mm			
Mesh Quality	High			
	Temperaturtest_1	**Temperaturtest_2-1**	**Temperaturtest_2-2**	**Temperaturtest_3**
Total Nodes	81828	77073	78451	78451
Total Elements	55385	50528	52710	52710



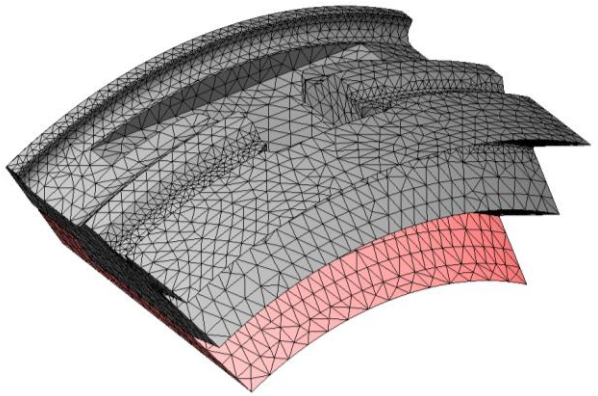
Temperaturtest_1



Temperaturtest_3



Temperaturtest_2-1



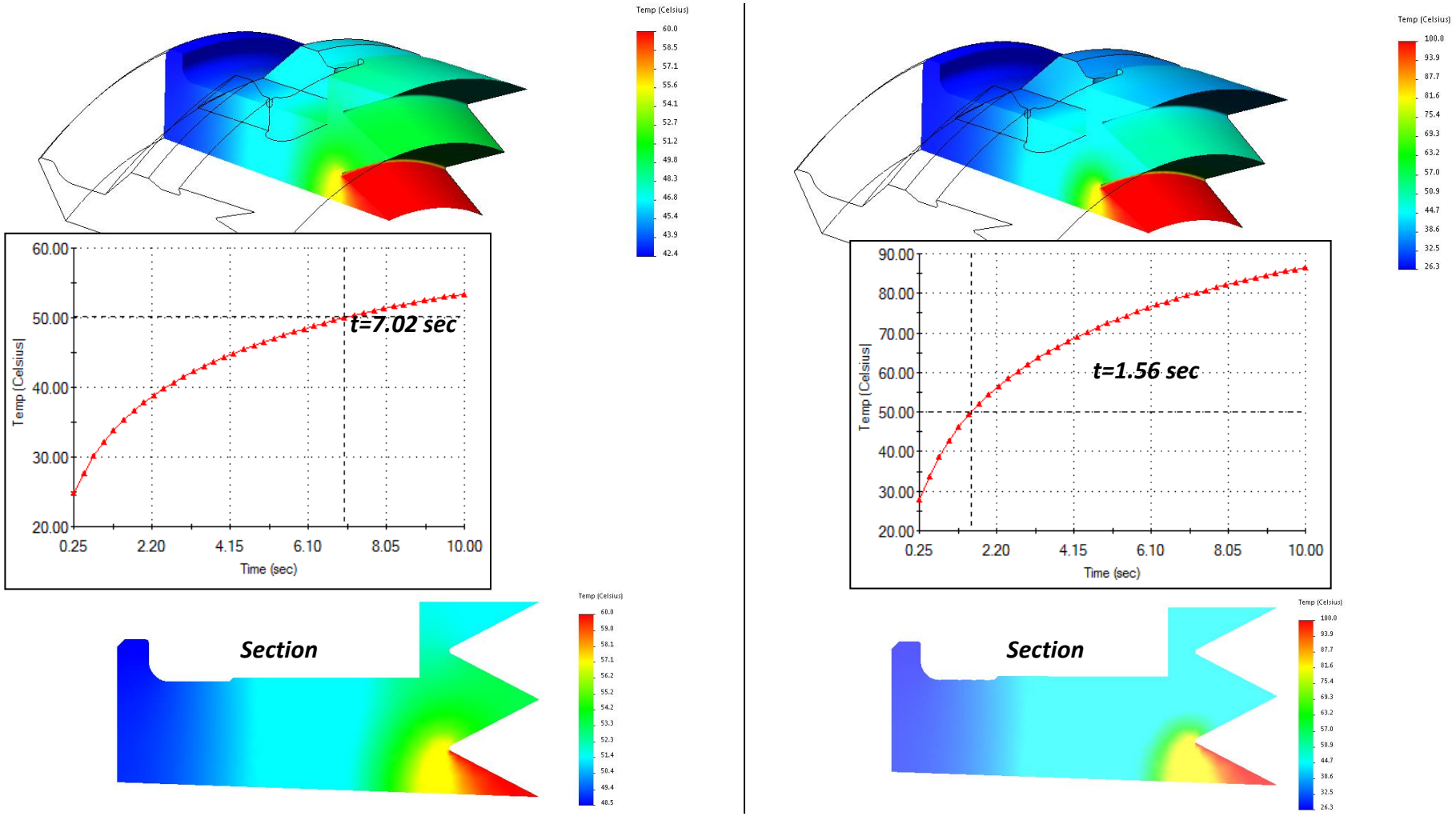
Temperaturtest_2-2

3. Simulation results

3.1. Thermal studies results

T=60˚C **T=100˚C**

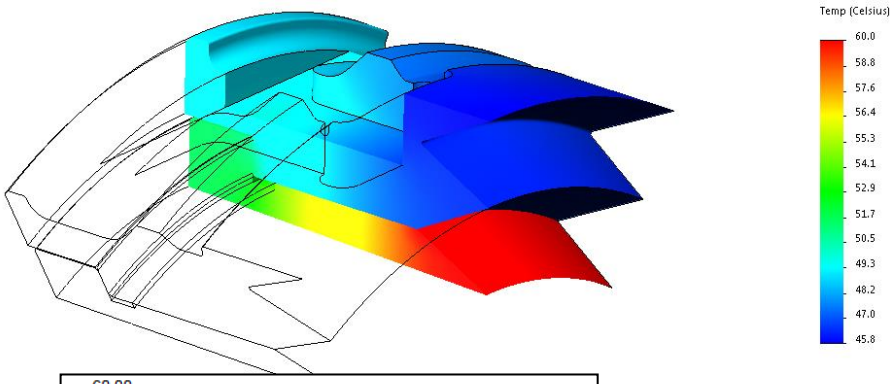
TEMPERATURTEST_1 (t=10 sec)

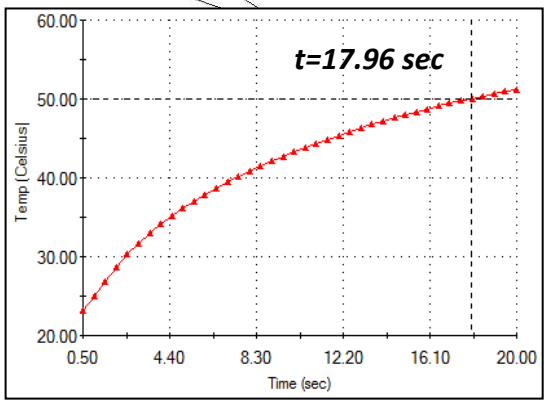


T=60˚C

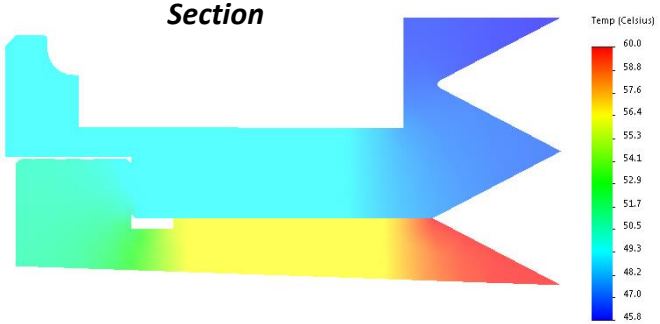
T=100˚C

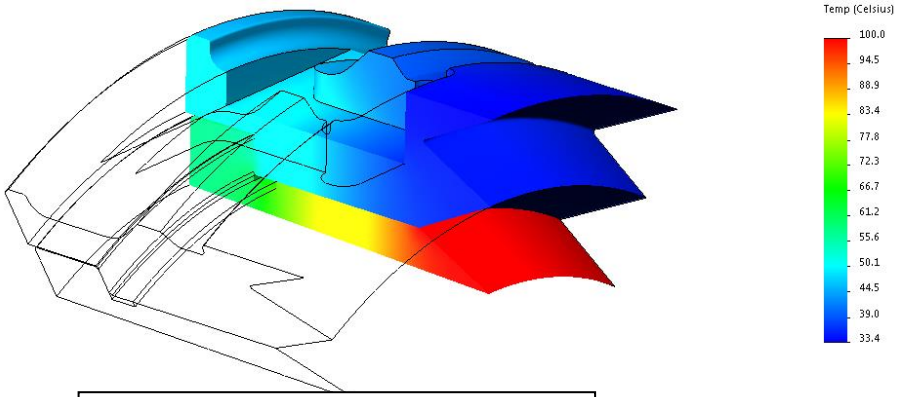
TEMPERATURTEST_2-1 (t=20 sec)

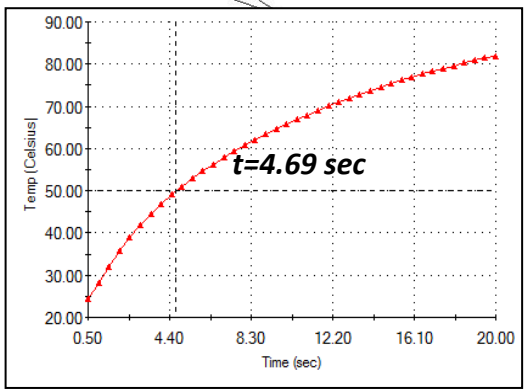




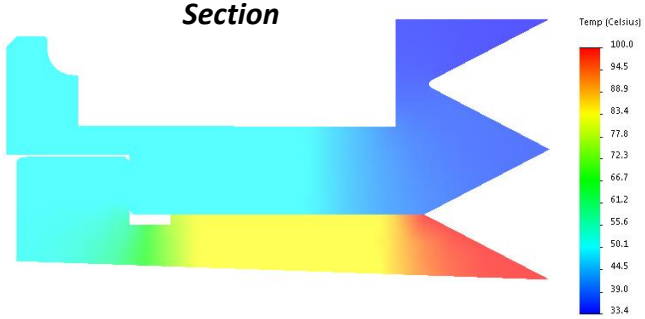
Section







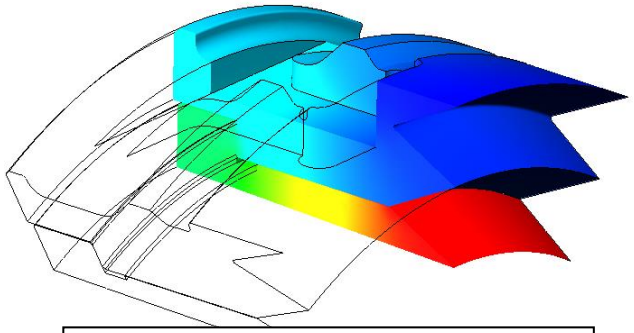
Section

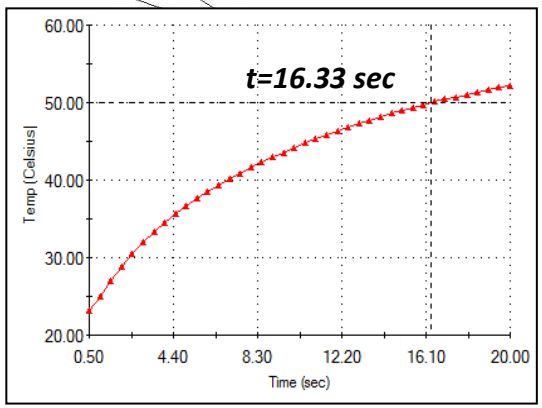


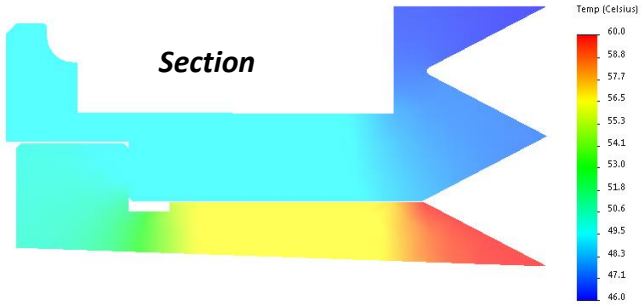
T=60˚C

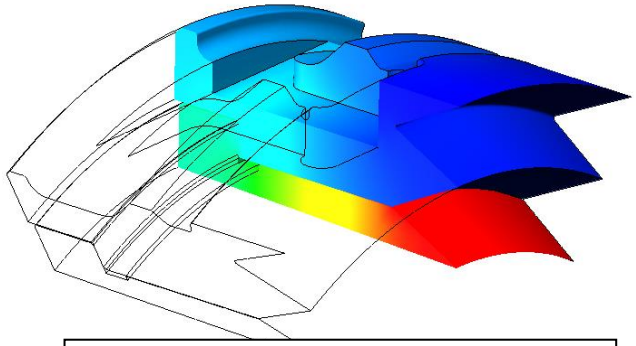
T=100˚C

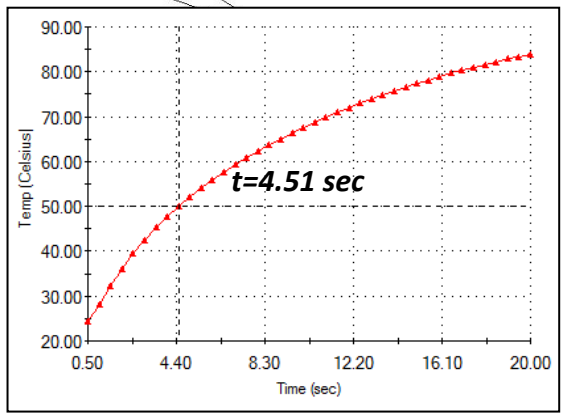
TEMPERATURTEST_2-2 (t=20 sec)

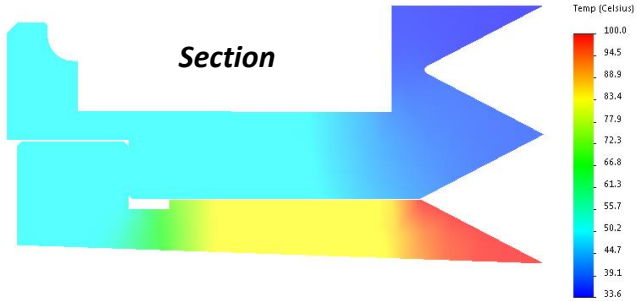






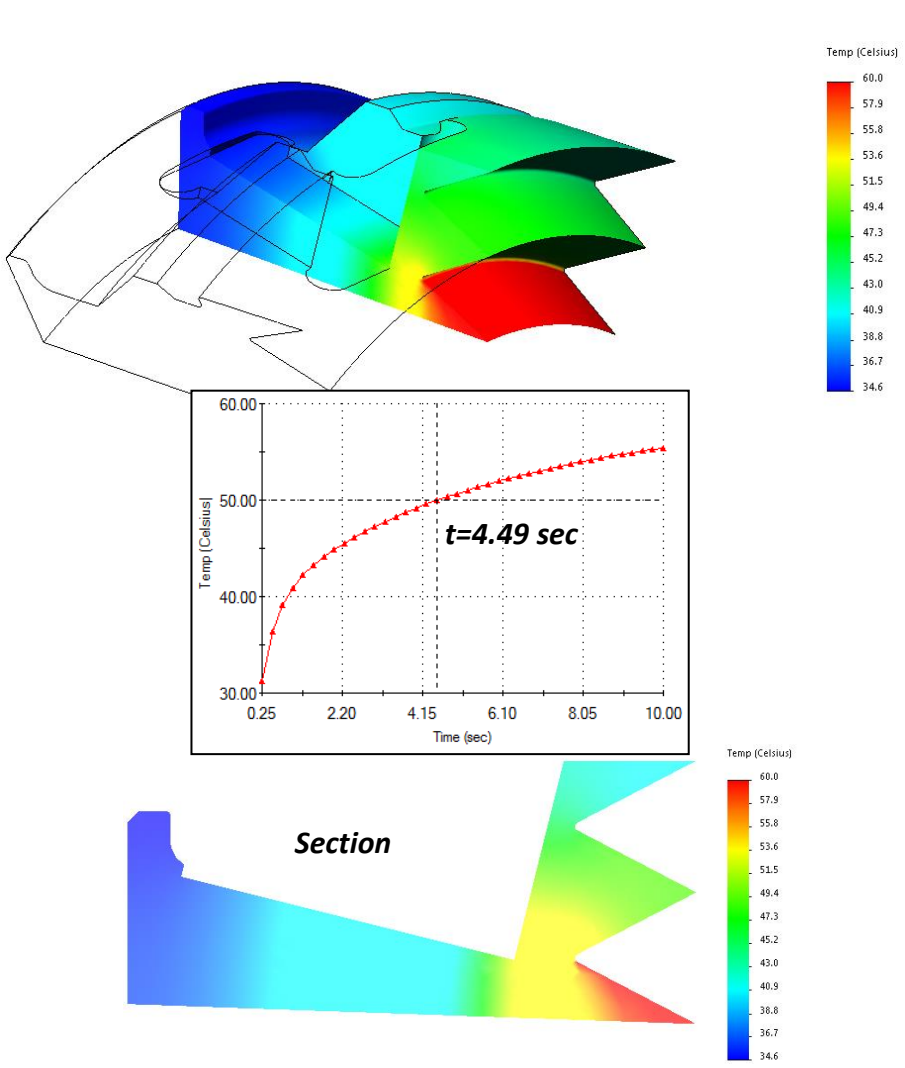


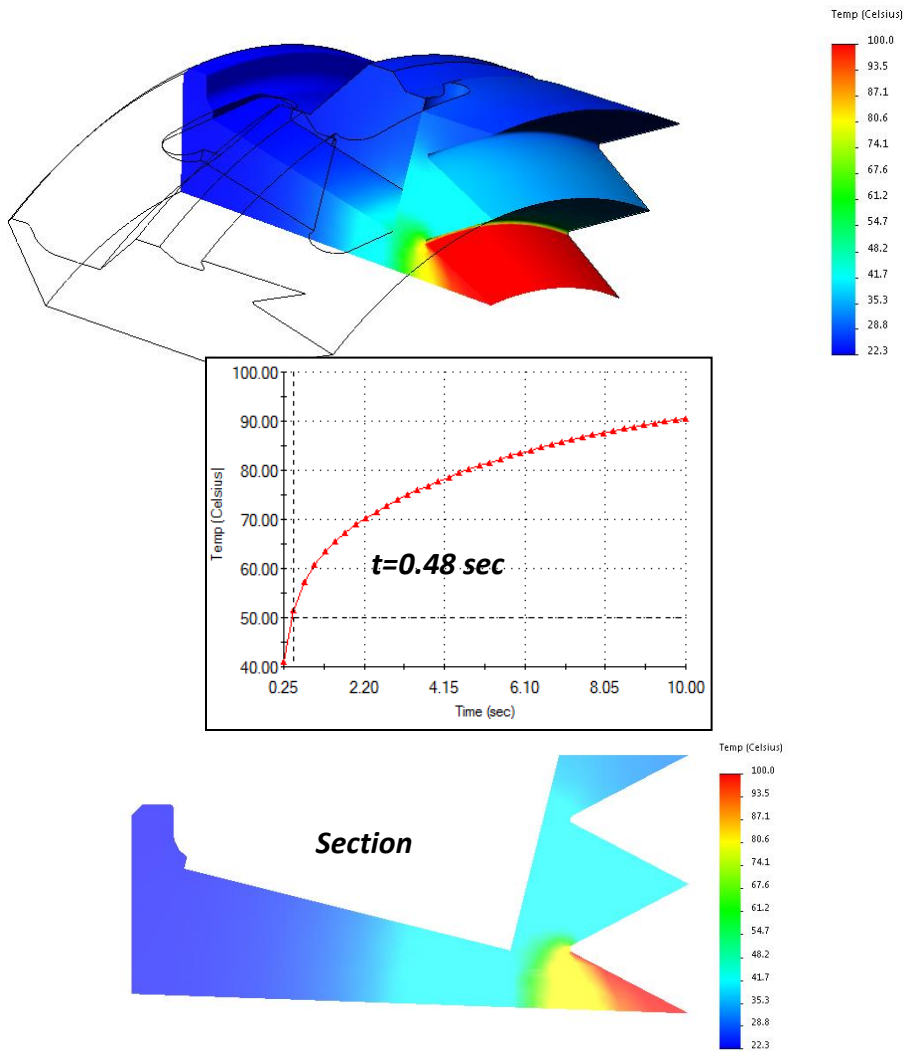




T=60˚C **T=100˚C**

TEMPERATURTEST_3 (t=10 sec)





4. Conclusion and suggestions

1) Verwendung eines Kupferansatzes bring wegen Nickelschicht und schwache Kontaktierung mit dem Außenteil keine Vorteile.
2) Durch Sensorposition Optimierung, z.B. mit 15° Neigung kann man die Übertragungsgeschwindigkeit verdoppeln.