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Thermal Analysis of Combustion Outer Case for Turbo Engine

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ABSTRACT

A turbocharger or fast is a fuel compressor that makes utilization of the turbine pushed constrained enlistment gadget that will expand a motor's effectiveness and vitality through compelling more noteworthy air into the ignition chamber. A turbocharger has the compressor fueled through a turbine. The turbine is driven by means of the fumes fuel from the motor. It does never again utilize a direct mechanical weight. This permits enhance the execution of the turbocharger.

The imperative issues with the quicker charger are oil spillage, mischief of sharp edges, shrieking, steady, and external case pressure issue to beat this issue the different people groups work at the issue and they arrived out with new responses to it.

The objective of this undertaking is to be plan the external instance of a turbocharger for a diesel motor to blast its energy and effectiveness, and demonstrating the upside of planning of a turbocharger. The endeavor keeps an eye on utilization of most recent materials is required. In the present work impeller end up plainly composed with 3 distinct substances. The examination can be done by utilizing Creo-2 and ANSYS programming. The Creo-2 is utilized for demonstrating the impeller and assessment is done in .ANSYS is dedicated limited detail bundle utilized for deciding the variety of stresses, follows and disfigurement all through profile of the impeller.

INTRODUCTION

The internal burning motor is the powerhouse of a consequence of machines and contraption going from little grass gear to extensive plane or vessels. Given the purpose of enthusiasm of this paper, the most extreme basic framework fueled through an inward burning motor is the auto. The motor really offers the main impetus of the auto even as additionally immediately or in a roundabout way driving pretty much every other mechanical and electric gadget in the front line car. While there are various sorts of inner burning motors that cowl the previously mentioned enormous scope of projects, every one of them basically do a similar factor. They all change over the substance control spared in a fuel or something to that affect into mechanical power, that would then be able to be changed over into electrical vitality. The 3 greatest typical types of internal burning are the 4-stroke gas motor [1], [2], the two-stroke fuel motor, and the diesel motor. A short portrayal of each the basic sorts of internal burning motor are provided underneath.

The four-stroke gas motor is the most extreme frequently utilized motor in autos and light vehicles and also in huge water crafts and little flying machine. The transcendent added substances of the chamber of a four-stroke fuel motor are demonstrated in Fig. 1.1. While the game plan and scope of the chambers in a motor has a tendency to shift, the parts that make up an individual barrel stay truly consistent. The most broad thing is the cylinder that is associated with the crankshaft through an interfacing pole [3]. The movements of the cylinder and crankshaft are typically related, with one continually constraining the other to move.

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The two valves, utilization and fumes, at the zenith of the chamber are opened and shut with the guide of particular camshafts that precisely control the planning of each valve's movement.

The spark plug on the top of the cylinder is powered with the aid of the engine battery and activated by the engine pc at the ideal time. Finally, the whole cylinder is surrounded with the aid of coolant channels that run via the engine block to dispose of the massive quantity of warmth generated by way of the running engine.

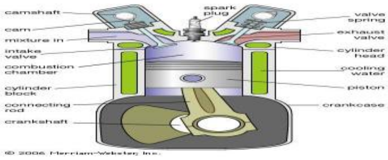

Figure 1.1 Components of a four-stroke gasoline engine cylinder.

The 4 strokes of a 4-stroke fuel motor, represented in Fig. 1.2, are utilization, pressure, power and fumes. Amid the admission stroke, the camshaft opens the admission valve in light of the fact that the crankshaft brings down the cylinder, which lets in the chamber to be stuffed with a particular total of air and fuel. Once the cylinder achieves the base of the chamber, the camshaft shuts the utilization valve. The cylinder is currently at what is known as posterior dead focus, and the chamber is totally loaded with the air/fuel total.

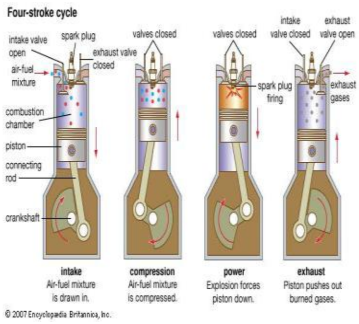

Figure 1.2 Engine cycle of a four-stroke gas engine.

LITERATURE REVIEW

This period of the paper incorporates the aftereffects of the history ponders led by method for the gathering. These discoveries comprise of famous insights around interior burning motors, influenced enlistment and turbochargers. A rundown of FSAE rules relevant to turbo charging is additionally included for the reason that turbocharged framework being progressed ought to be intended to consent to all FSAE controls so it can be gone into the FSAE resistance.

A literature review is conducted on various areas if IC engines and turbochargers and following findings are made;

Powell et al. [1] discuss the application of linear observer theory to engine control with a specific focus on observers based on exhaust measurements. The interesting aspects of the application of observed based control to engine air fuel ratio control are twofold 1) there is pure delay between the plant and the sensor due to the engine cycle and exhaust transport time and 2) the primary disturbance is the throttle which can be measured if a drive by wire throttle incorporated.

Muske et al. [2] presents an adaptive state space model predictive controller for SI engine air fuel ratio control is developed. The time varying delays inherent in this system are accounted for by adapting the time delay of the model based on the engine speed and load. This feature allows the controller to be aggressively tuned at all engine operating conditions.

Rahman et al.[3] investigates the effects of Air-fuel ratio and engine speed on engine performance of Hydrogen fueled, port fueled, port Injection internal combustion engine.GT-power is utilized to develop the model for port injection engine. One dimensional gas dynamics represented the flow and heat transfer in the components of engine model. Air-fuel ratio was varied from stoichiometric limit to lean limit and the rotational speed varied from 2500to4500 rpm while the injector location was fixed in the midway of intake port.

Geok et al. [4] investigates the performance and emission of a sequential port injection natural gas engine. The engine was converted to computer integrated CNG-gasoline bi-fuel operations by installing a sequential port injection CNG conversion system.

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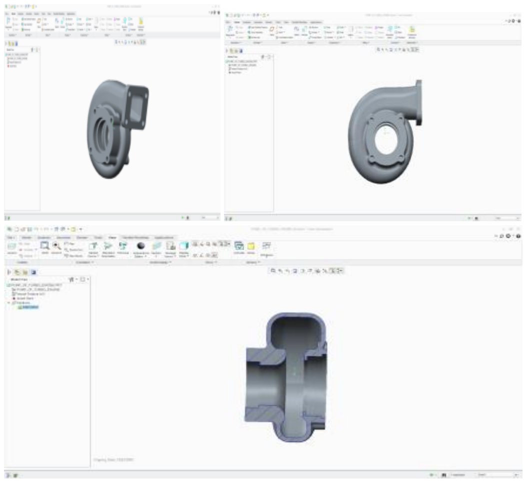
Engine control unit and exhaust gas analyzers were used for controlling engine operations and recording engine performance and emission data.

Naser et al., [5] concluded that efficient way which was used that time was to reduce the fuel consumption wasbased in reduction cylinder volume of internal combustion engine and power to be same or higher. Key componentwas turbocharged diesel internal combustion engine. Increased compressor outlet air pressure can result in anexcessively hot intake charge, significantly reducing the performance gains of turbo charging due to decreaseddensity. Passing charge through an intercooler reduced its temperature, allowing a greater volume of air to beadmitted to an engine, intercoolers have a key role in controlling the cylinder combustion temperature in aturbocharged engine [5]. The author, through his worked out programmed code in MATLAB presented effect ofintercooler (as a heat exchange device air-to-liquid with three different size and over

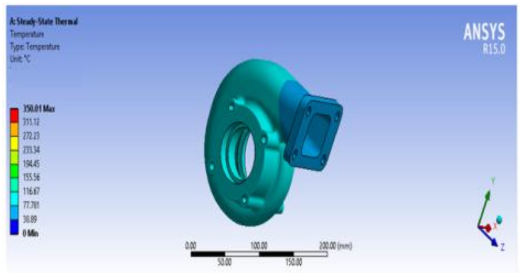
3-D MODELING OF TURBO CASING

Creo is a hover of relatives or suite of outline programming program supporting item plan for discrete makers and is progressed through PTC. PTC Creo is an adaptable, interoperable suite of item outline programming program that provisions quick time to cost. It encourages groups make, look at, view and use item plans downstream using 2D CAD, 3-D CAD, parametric and coordinate displaying [4].

PTC Creo Parametric gives the broadest scope of capable yet bendy 3D CAD abilities to help up the item improvement method. Via mechanizing undertakings including developing building illustrations, we can avoid mix-ups and shop sizeable time. The product program furthermore we might us be able to do examination, make renderings and activitys, and upgrade profitability over an entire scope of various mechanical plan obligations, including a check for the way legitimately our outline fits in with quality practices. PTC Creo Parametric grants us to design higher-top notch stock speedier and lets in us to impart additional accurately with creation, suppliers



4.9 THERMAL ANALYSIS OF TUBO CASING



Material Properties:

Stain less steel	HK30Nb stainless alloy
Density	7.81
Ductility	0.34
Elastic limit	207MPA
Thermal conductivity	15.23w/mk
Heat input	350°c

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

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TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\sanya\turbocasing thermalanalysi sinputdatasanyatechnologie\turbo housing\turbo housing\pump_of_turbo_engine3.stp
Type	Step
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	109. mm
Length Y	170.87 mm
Length Z	160.7 mm
Properties	
Volume	5.1095e+005 mm³
Mass	0. kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	25639
Elements	14257
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use	Yes

TABLE THREE
Model (A4) > Geometry > Parts

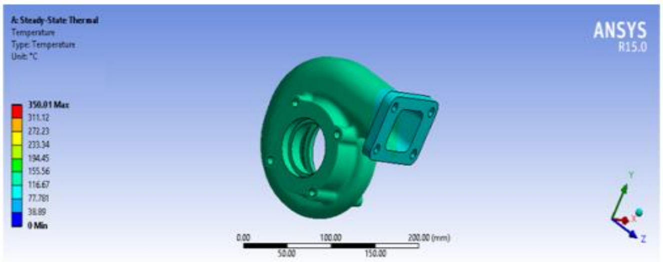
Object Name	PUMP_OF_TURBO_ENGINE
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	material 2
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	109. mm
Length Y	170.87 mm
Length Z	160.7 mm
Properties	
Volume	5.1095e+005 mm³
Mass	0. kg
Centroid X	-10.023 mm
Centroid Y	15.766 mm
Centroid Z	3.0438 mm
Moment of Inertia Ip1	0. kg·mm²
Moment of Inertia Ip2	0. kg·mm²
Moment of Inertia Ip3	0. kg·mm²
Statistics	
Nodes	25639
Elements	14257
Mesh Metric	None

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	Global Coordinate System
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

TABLE FIVE
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	2.9763e-002 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Meshed	Program Controlled
Patch Independent Options	
Topology Checking	Yes
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midsize Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	0
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	25639
Elements	14257
Mesh Metric	None



Steady State Thermal (A5)

TABLE 6
Model (A4) > Analysis

Object Name	Steady-State Thermal (A5)
State	Solved
Definition	
Physics Type	Thermal
Analysis Type	Steady-State
Solver Target	Mechanical APDL
Options	
Generate Input Only	No

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TABLE 7

Model (A4) > Steady-State Thermal (A5) > Initial Condition

Object Name	Initial Temperature
State	Fully Defined
Definition	
Initial Temperature	Uniform Temperature
Initial Temperature Value	22. °C

TABLE 8

Model (A4) > Steady-State Thermal (A5) > Analysis Settings

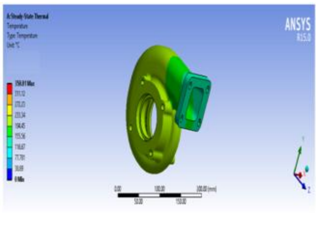
Object Name	Analysis Settings
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Radiosity Controls	
Radiosity Solver	Program Controlled
Flux Convergence	1.e-004
Maximum Iteration	1000.
Solver Tolerance	1.e-007 W/mm²
Over Relaxation	0.1
Hemicube Resolution	10.
Nonlinear Controls	
Heat Convergence	Program Controlled
Temperature Convergence	Program Controlled
Line Search	Program Controlled
Output Controls	
Calculate Thermal Flux	Yes
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\kishore\AppData\Local\Temp\WB_CHANDU_kishore_35752_2\unsaved_project_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	Yes
Solver Units	Active System
Solver Unit System	nmm

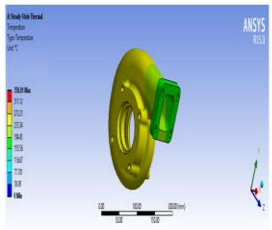
Object Name   Analysis Settings

TABLE NINE

Model (A4) > Steady-State Thermal (A5) > Loads

Object Name	*Temperature*	*Convection*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	41 Faces	1 Body
Definition		
Type	Temperature	Convection
Magnitude	350. °C (ramped)	
Suppressed	No	
Film Coefficient		Tabular Data
Coefficient Type		Average Film Temperature
Ambient Temperature		22. °C (ramped)
Convection Matrix		Program Controlled
Edit Data For		Film Coefficient
Tabular Data		
Independent Variable		Temperature
Graph Controls		
X-Axis		Temperature





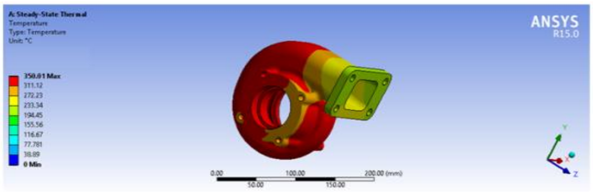


TABLE 10

Model (A4) > Steady-State Thermal (A5) > Convection

Temperature [°C]	Convection Coefficient [W/mm²·°C]
1.	9.5e-007
10.	2.05e-006
100.	4.41e-006
200.	5.56e-006
300.	6.36e-006
500.	7.54e-006
700.	8.43e-006
1000.	9.5e-006

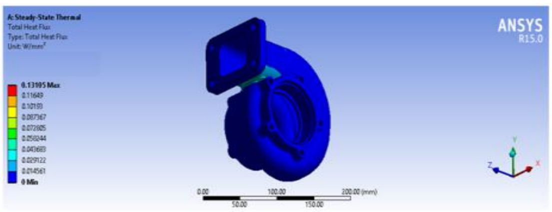


TABLE 11

Model (A4) > Steady-State Thermal (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done

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TABLE 12

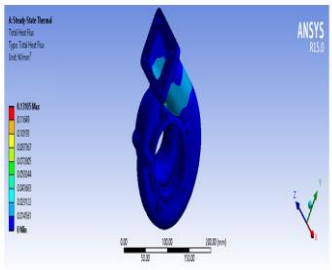
Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Solution Information

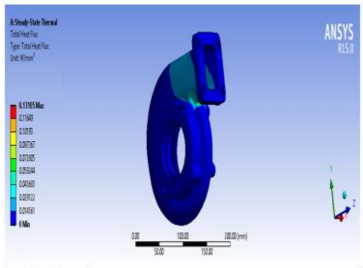
Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 13

Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Results

Object Name	*Temperature*	*Total Heat Flux*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Temperature	Total Heat Flux
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	350.01 °C	0.13105 W/mm²
Minimum Value Over Time		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	235.63 °C	2.2085e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.13105 W/mm²
Maximum	350.01 °C	0.13105 W/mm²
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	3	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No





Material Data

Material 1

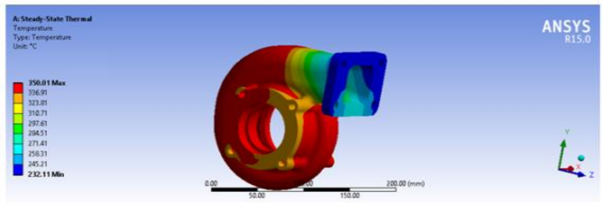
TABLE 14

Material 1 > Constants

Thermal Conductivity	1.523e-002 W mm^-1 C^-1

THERMAL ANALYSIS OF TUBO CASING

Material -2



Material Properties

Stain less steel	CF8C plus cast stain less steel
Density	7.96
Ductility	0.32
Elastic limit	209MPA
Thermal conductivity	14.54w/mk
Heat input	350°c

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

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TABLE 2

Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\sanya\turbocasingthermalanalysisinputdatasanyatechnologie\turbo housing\turbo housing\pump_of_turbo_engine3.stp
Type	Step
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	109. mm
Length Y	170.87 mm
Length Z	160.7 mm
Properties	
Volume	5.1095e+005 mm³
Mass	0. kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	25639
Elements	14257
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\kishore\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes

TABLE THREE

Model (A4) > Geometry > Parts

Object Name	PUMP_OF_TURBO_ENGINE
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	material 1
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	109. mm
Length Y	170.87 mm
Length Z	160.7 mm
Properties	
Volume	5.1095e+005 mm³
Mass	0. kg
Centroid X	-10.023 mm
Centroid Y	15.766 mm
Centroid Z	3.0438 mm
Moment of Inertia Ip1	0. kg·mm²
Moment of Inertia Ip2	0. kg·mm²
Moment of Inertia Ip3	0. kg·mm²
Statistics	
Nodes	25639
Elements	14257
Mesh Metric	None

Coordinate Systems:

TABLE 4

Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

TABLE FIVE

Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	2.9763e-002 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	Yes
Advanced	

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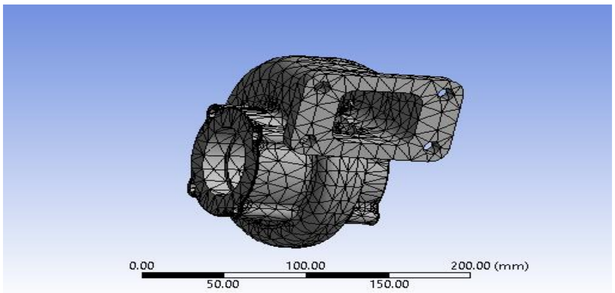
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midsize Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	0
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	25639
Elements	14257
Mesh Metric	None



Steady – State Thermal (A5):

TABLE 6

Model (A4) > Analysis

Object Name	*Steady-State Thermal (A5)*
State	Solved
Definition	
Physics Type	Thermal
Analysis Type	Steady-State
Solver Target	Mechanical APDL
Options	
Generate Input Only	No

TABLE 7

Model (A4) > Steady-State Thermal (A5) > Initial Condition

Object Name	*Initial Temperature*
State	Fully Defined
Definition	
Initial Temperature	Uniform Temperature
Initial Temperature Value	22. °C

TABLE NINE

Model (A4) > Steady-State Thermal (A5) > Loads

Object Name	*Temperature*	*Convection*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	41 Faces	1 Body
Definition		
Type	Temperature	Convection
Magnitude	350. °C (ramped)	
Suppressed	No	
Film Coefficient		Tabular Data
Coefficient Type		Average Film Temperature
Ambient Temperature		22. °C (ramped)
Convection Matrix		Program Controlled
Edit Data For		Film Coefficient
Tabular Data		
Independent Variable		Temperature
Graph Controls		
X-Axis		Temperature

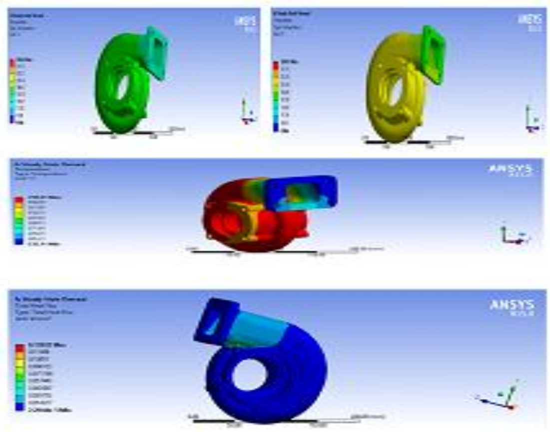


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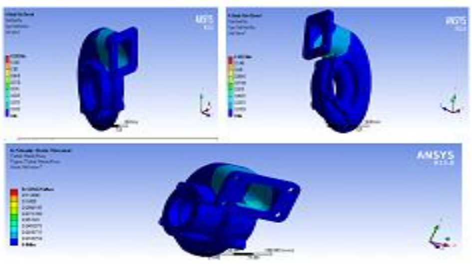
TABLE 13

Model (A4) > Steady-State Thermal (A5) > Solution (A6) > Results

Object Name	*Temperature*	*Total Heat Flux*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Temperature	Total Heat Flux
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Results		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	350.01 °C	0.12922 W/mm²
Minimum Value Over Time		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	232.11 °C	2.2044e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.12922 W/mm²
Maximum	350.01 °C	0.12922 W/mm²
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	3	
Integration Point Results		
Display Option		Averaged
Average Across Bodies		No



Material Data

Material 2

TABLE 14

fabric 1 > Constants

Thermal Conductivity	1.454e-002 W mm^-1 C^-1

CONCLUSION

In this venture we outlined the external instance of a turbocharger for a diesel motor to blast its quality and proficiency, and demonstrating the advantage of planning of a turbocharger. In this mission keeps an eye on utilization of new materials is required. In the current artistic creations impeller changed into composed with three unmistakable substances. The exploration might be accomplished by the utilization of Creo-2 and ANSYS programming. The Creo-2 is utilized for demonstrating the impeller and assessment is done in .ANSYS is dedicated limited component package utilized for making sense of the variant of stresses, follows and misshapening crosswise over profile of the impeller.

Material 1: HK30Nb stainless alloy

Results		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	350.01 °C	0.13105 W/mm²
Minimum Value Over Time		
Minimum	235.63 °C	2.2085e-005 W/mm²
Maximum	235.63 °C	2.2085e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.13105 W/mm²
Maximum	350.01 °C	0.13105 W/mm²

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Material 2: CF8C plus solid stain much less metal

Results		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	350.01 °C	0.12922 W/mm²
Minimum Value Over Time		
Minimum	232.11 °C	2.2044e-005 W/mm²
Maximum	232.11 °C	2.2044e-005 W/mm²
Maximum Value Over Time		
Minimum	350.01 °C	0.12922 W/mm²
Maximum	350.01 °C	0.12922 W/mm²

So, by this HK30Nb stainless alloy is nice material for the turbo casing layout It have the bypass to control the air flow in the device which it's going to via the intercooler or launch direct to the ambient.

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