



University of Idaho

College of Engineering

NEED 4 SPEED

**ANDY HOANG, BRADEN
CONNOLLY, NASSER
ALDAWSARI, NATHAN
MILLER**

OBJECTIVE

Our objective for this project is to supercharge a KTM 540 SXS motorcycle engine with an Eaton M24 Supercharger and redesigning it to package inside a snowmobile chassis to achieve more power and better fuel efficiency.





CLIENT INSTRUCTION ITEMS

- Find out how much space is available for us in the engine bay
- Evaluate the best layout of the supercharged engine for optimal snowmobile packaging
- Calculate engine/supercharger performance
- Remove stock transmission to accommodate the CVT
- Add electric start
- Achieve 80 hp
- Design virtual and physical proof of concept for engine kinematics and packaging
- Devise bill of materials and budget for functional prototype
- Develop manufacturing plans for functional prototype

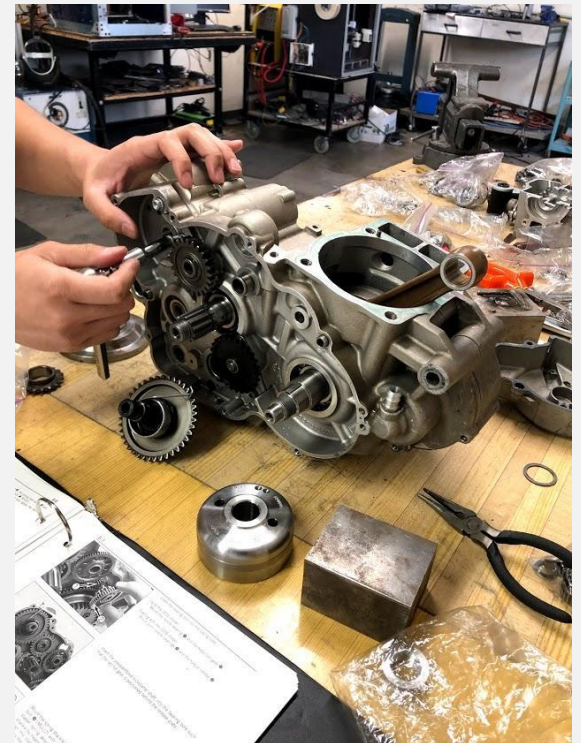


KTM ENGINE VS SUPERCHARGED ENGINE SPECS

KTM 540 SXS Engine			
	Stock Engine	With Eaton Supercharger	
Horsepower	55 Hp	85 Hp	
Compression Ratio	11.5:1	8:1	
Displacement	538.5 ccm	525 ccm	
Boost Pressure	0 PSI	10 PSI	
Weight	60 lbs	70 lbs	

WHAT WE ACCOMPLISHED SO FAR

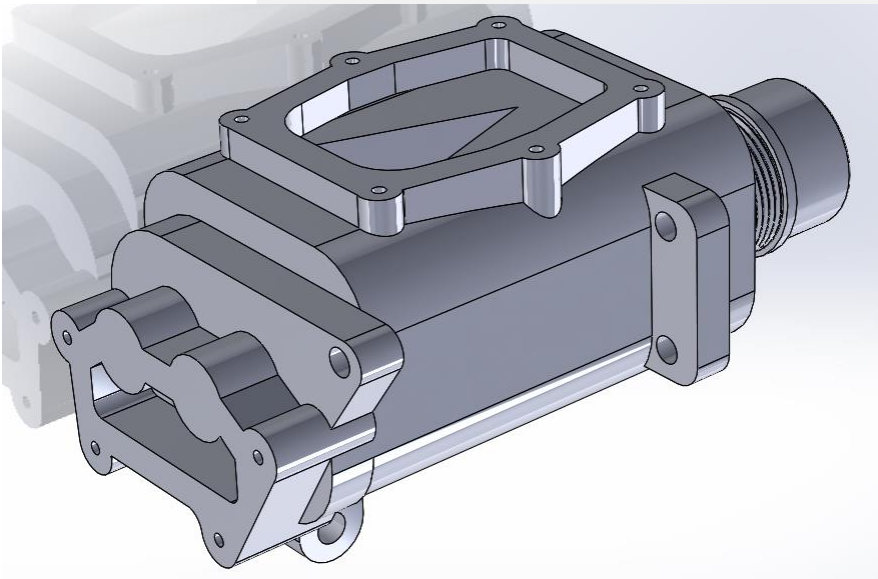
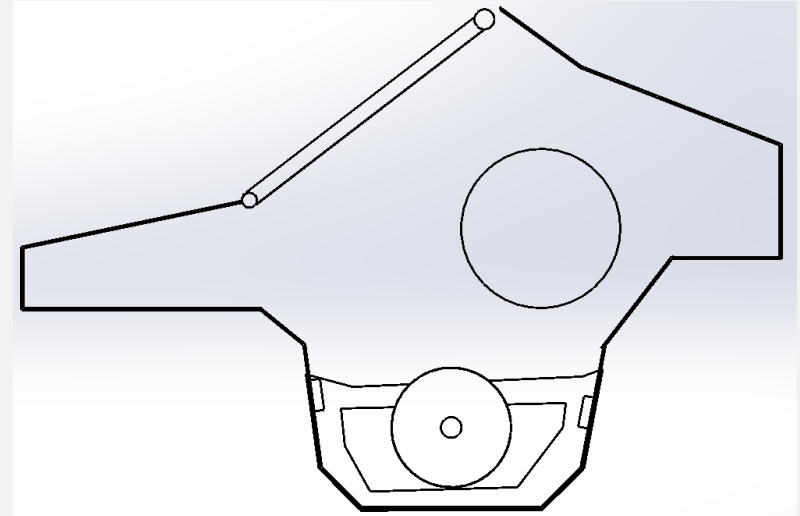
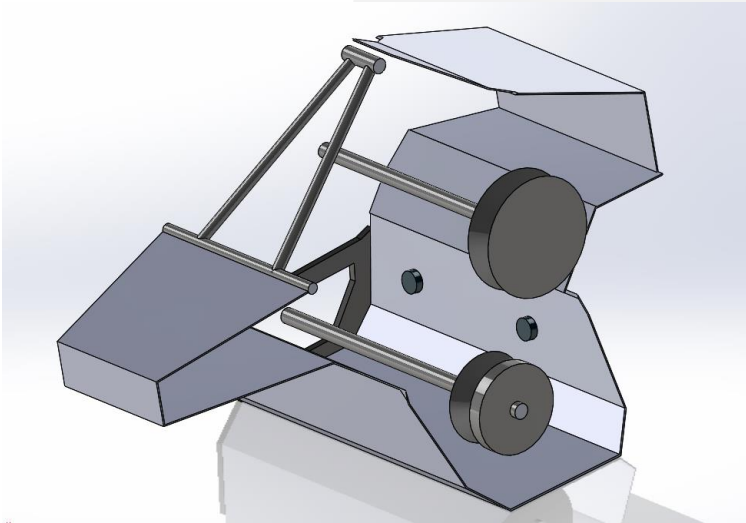
- Reassembled KTM engine and found what parts we needed
- Decompression Plate - reduce compression ratio from 11.5:1 to 8:1
- Engine bay solid-modeling
- Orientation of the supercharged engine
- Supercharger and plenum solid-modeling
- Decompression Plate



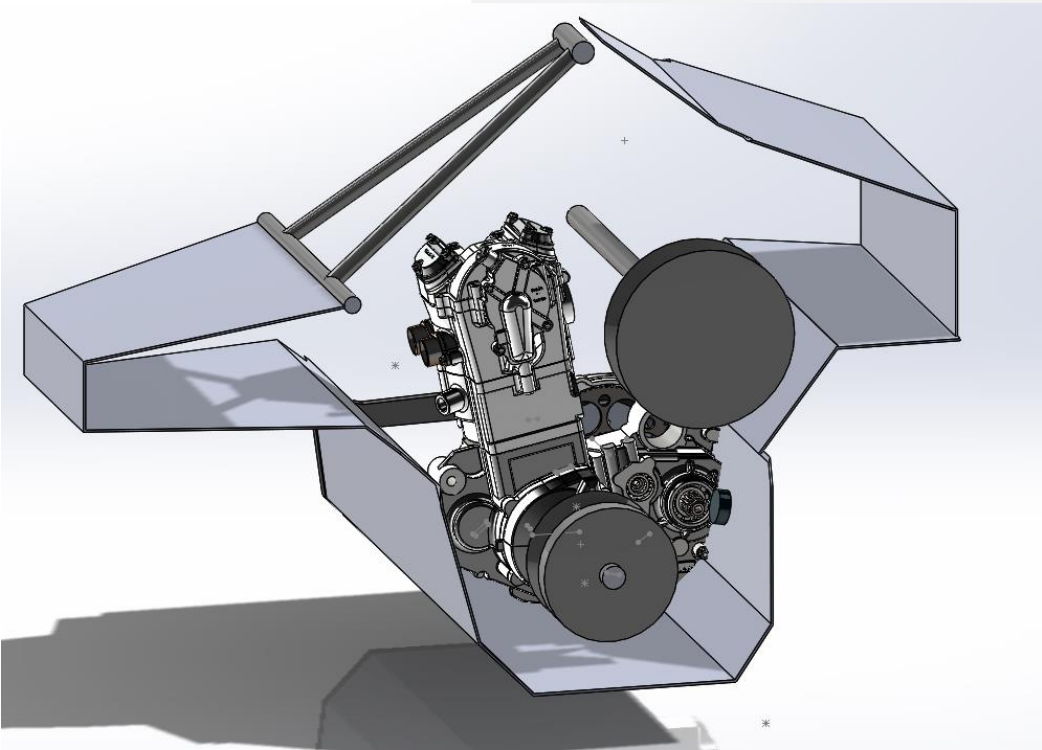
SOLID-MODELING



Engine bay volumetric capacity is 5014 cubic inches

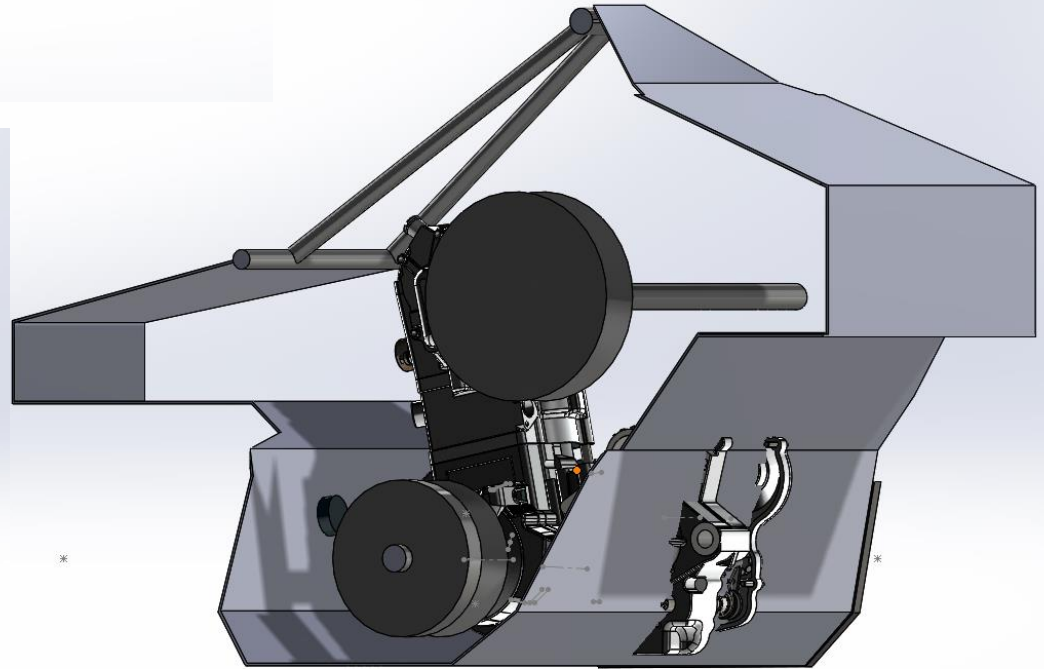
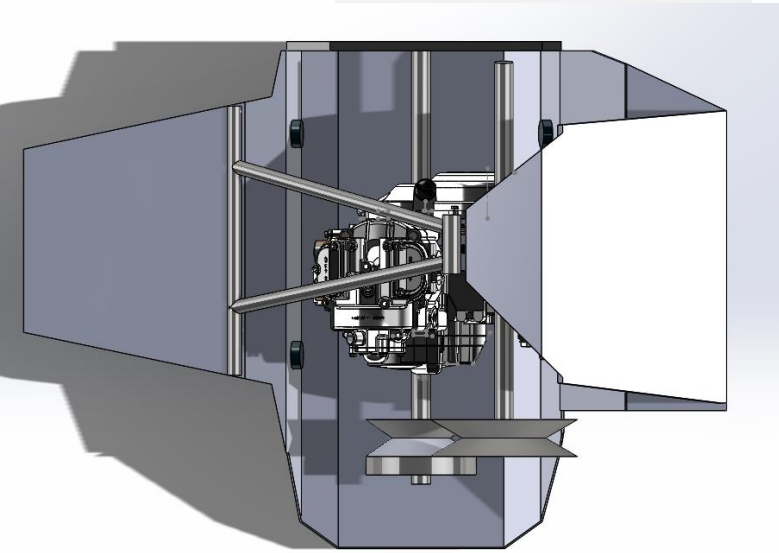


Eaton M24 Supercharger



Engine in

Chassis

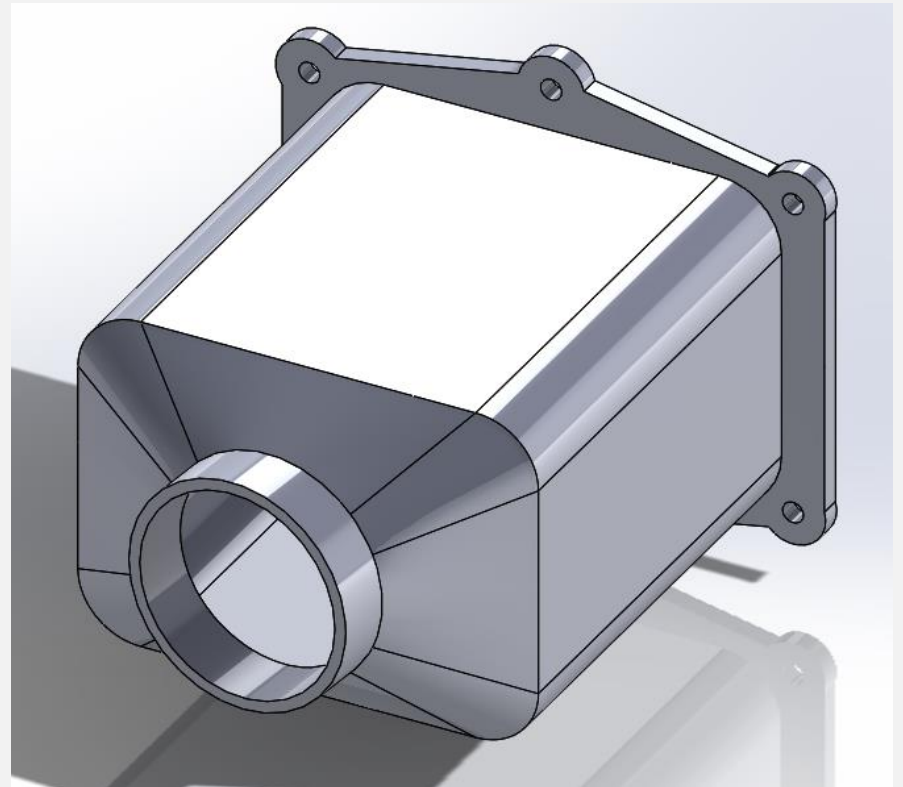


SOLID-MODELING



Decompression Plate

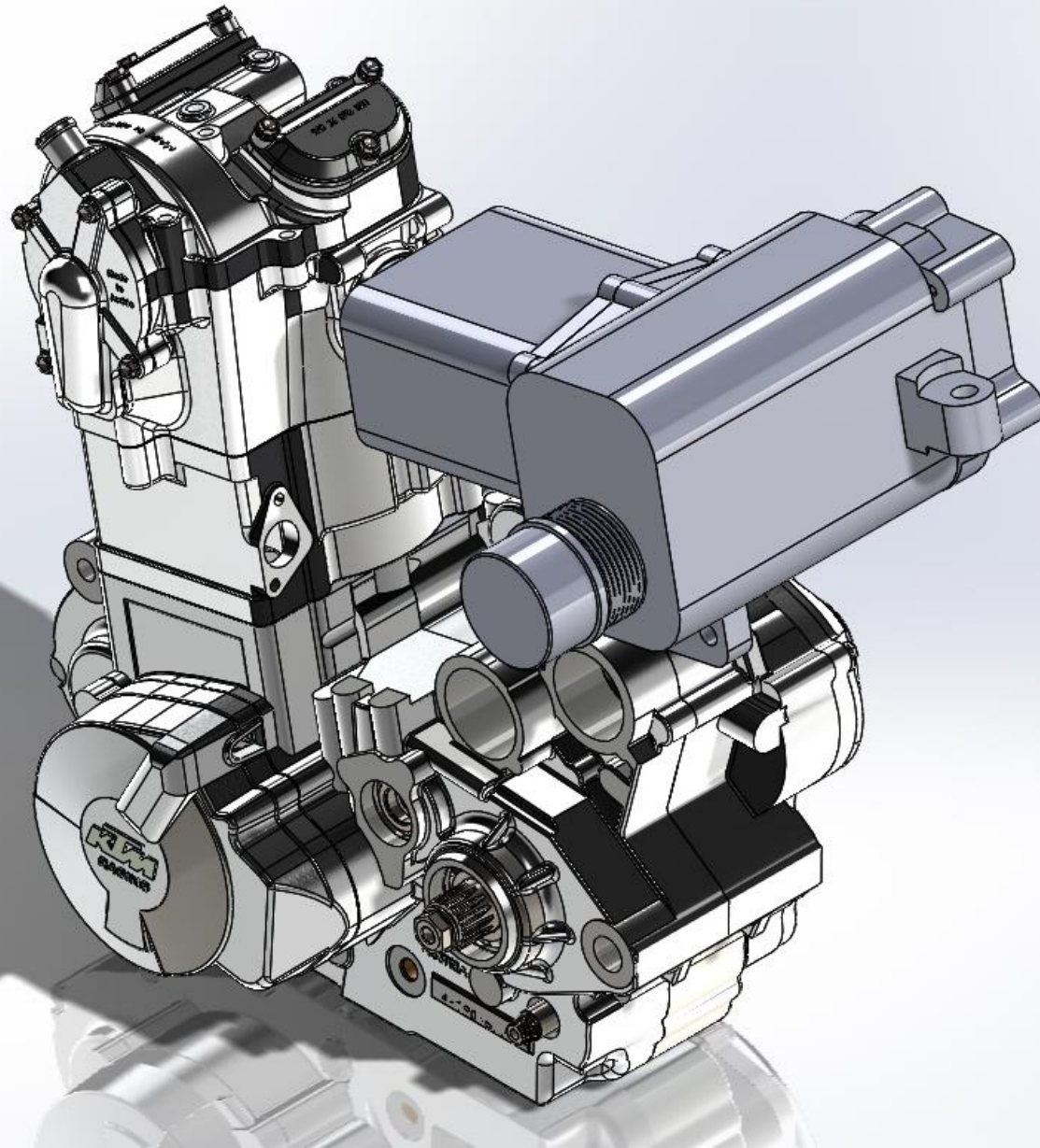
3.1mm Thickness



Intake Plenum

Volumetric Capacity: 1.06 L

Prototype Assembly





Stock Engine

"A 4-stroke, 1-cylinder IC engine modeled with the Otto Cycle,"

```
a$ = 'air_ha'
rpm = 7500[rev/min]
P[1] = 14.7[psia]
T[1] = 50[F] "Inlet Temp"
Vol_1 = 32.574[in^3]*convert(in^3,ft^3)
P[3] = 700[psia]
CR = 11.5
N_r = 2[rev] "4-stroke engine"
```

Sort	1	2	3	4	5
	T_i	P_i	v_i	u_i	s_i
	[F]	[psia]	[ft ³ /lbm]	[Btu/lbm]	[Btu/lbm-F]
[1]	80	14.7	13.6	92.01	1.639
[2]	928.8	439.8	1.182	244.2	1.639
[3]	1745	700	1.182	410.5	1.733
[4]	466.4	25.25	13.6	159.3	1.733

$\dot{W}_{net} = 48.57$ [hp] (a) Power developed by the engine
 $\eta_{th} = 0.5956$ (b) Thermal Efficiency of the engine
 $mep = 43.12$ [psia] (c) mean effective pressure of the engine

Supercharged Engine

Input Parameters for Supercharged model include:

- Inlet Temp based on compression and intercooling
- Inlet pressure with 10 psi boost
- Combustion pressure due to thermodynamic and stoichiometric properties
- Compression Ratio reduced to 8:1



WHAT WE NEED TO ACCOMPLISH NEXT FALL

- Redesign crankcase
- Run supercharger off crankshaft with a belt
- Mount crankshaft to CVT from snowmobile
- Fuel Injection System - EFI
- Air to Liquid Intercooler mounted inside plenum
- Supercharger Bypass valve
- Electric starter



PROJECT SCHEDULE

Project: Supercharger		Last Updated: 7/24/19		2019																																																
Year		Month		June							July							Aug							Sept							Oct							Nov							Dec						
Task Description	Duration	Assign	6/10	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	9/30	10/7	10/14	10/21	10/28	11/4	11/11	11/18	11/25	12/2	12/9	12/16	12/23	12/30																				
PROJECT DOCUMENT																																																				
Summer																																																				
Project Bid Portfolio	1 day	Team																																																		
Team Contract	5 days	Andy																																																		
Client Interview Questions	5 days	Braden																																																		
Budget		Nathan																																																		
Product Requirements Document	5 days	Andy																																																		
Project Schedule		Andy																																																		
Portfolio		Andy																																																		
Wiki page		Andy																																																		
Logbook		Team																																																		
Design Validation Plan	1 day	Andy																																																		
Project Value Proposition		Nathan																																																		
Concept Design Review		TBD																																																		
Snapshot Storyboard		Nathan																																																		
Team Member Citizenship		Braden																																																		
Bill of Materials		Braden																																																		
Fall:																																																				
Engineering Release Review		Team																																																		
Logbook		Team																																																		
Team Member Citizenship Assessment		Team																																																		
Course Deliverables		Team																																																		
SUPERCHARGER																																																				
3D Scan Supercharger	1 day	Team																																																		
Supercharger Solid Modelling	3 days	Braden																																																		
Supercharger Plenum Design																																																				
Supercharger Plenum Solid Modelling		TBD																																																		
Supercharger Plenum Prototype																																																				
Supercharger Belt																																																				
KTM ENGINE																																																				
Reassemble KTM Engine	2 days	Team																																																		
Reduce Compression Rate																																																				
Spacer Solid Modelling																																																				
Spacer Prototype																																																				
Fuel Injectors or Carburetor																																																				
INTERCOOLER																																																				
Intercooler Design																																																				
Intercooler Solid Modelling																																																				
Intercooler Prototype																																																				
CRANKCASE																																																				
Crankcase Design																																																				
Crankcase Solid Modelling																																																				
Crankcase Prototype																																																				
TBD																																																				
Crankshaft																																																				
Connecting Rod																																																				
Cams/haft Regrind																																																				
Cams/haft Chain Drive																																																				
Oil Pump																																																				
Water Pump																																																				
Journal Bearings																																																				
Electric Starter																																																				
SNOWMOBILE																																																				
Layout of Engine Solid Modelling	2 days	Nathan																																																		
Scan Snowmobile Engine Bay Without Engine		TBD																																																		
Attach KTM Engine																																																				
Connect Engine to CVT																																																				

In Progress
 Complete
 Due
 No School