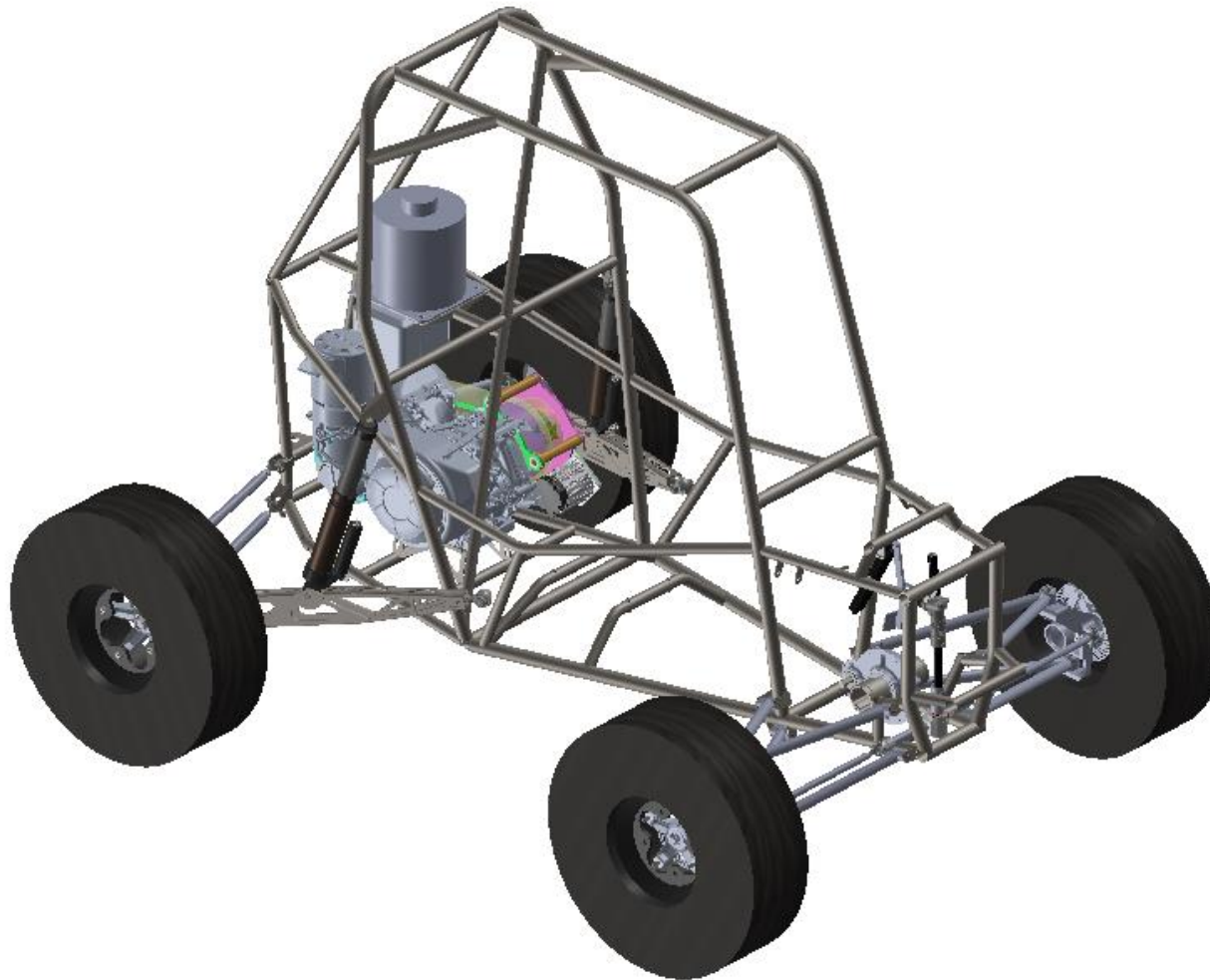


SAE Baja '24 Drivetrain

67+% Hardware Check

Henry Van Zuyle, Ryan Fitzpatrick, Jarett Berger, Donovan Parker

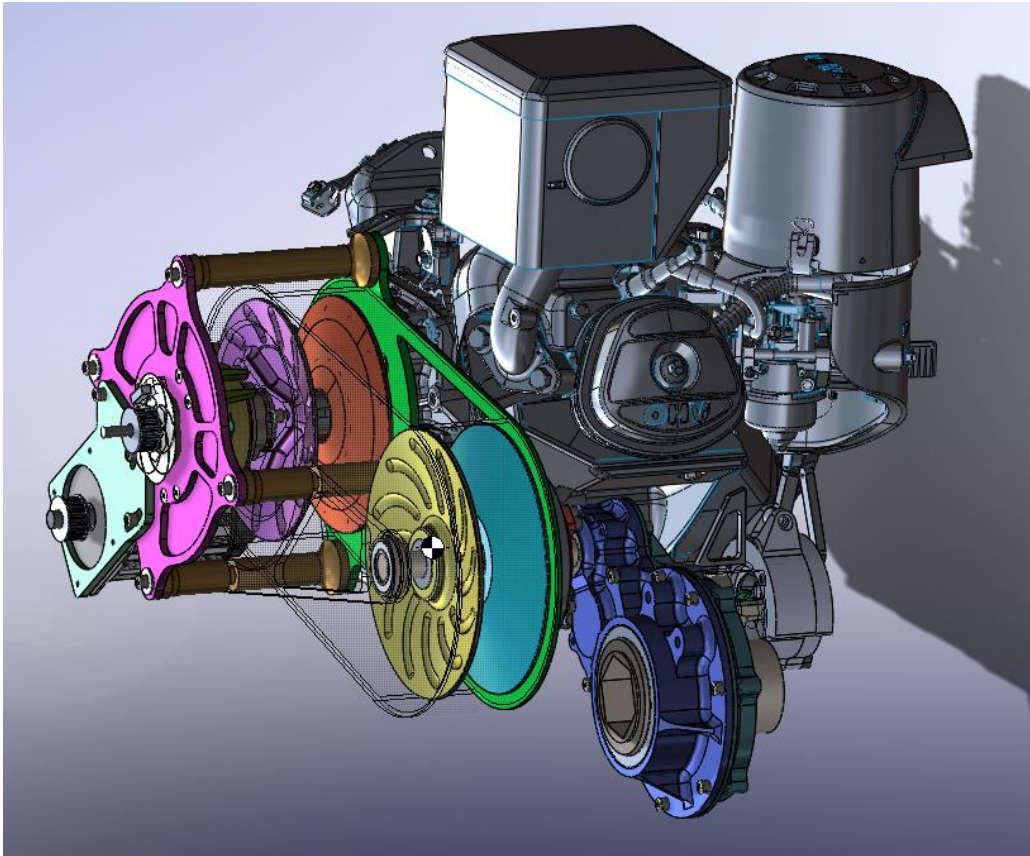
Design Efforts – Drivetrain CAD



Drivetrain “Zones”

1. ECVT
2. Rear Gearbox
3. 4WD System
4. Front Gearbox

Design Efforts – Drivetrain CAD



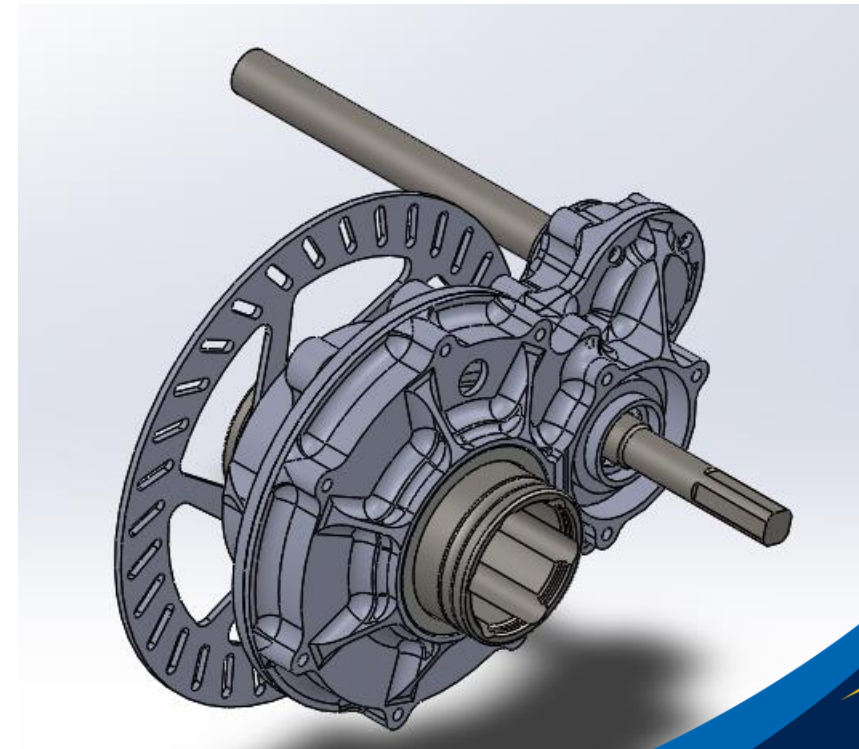
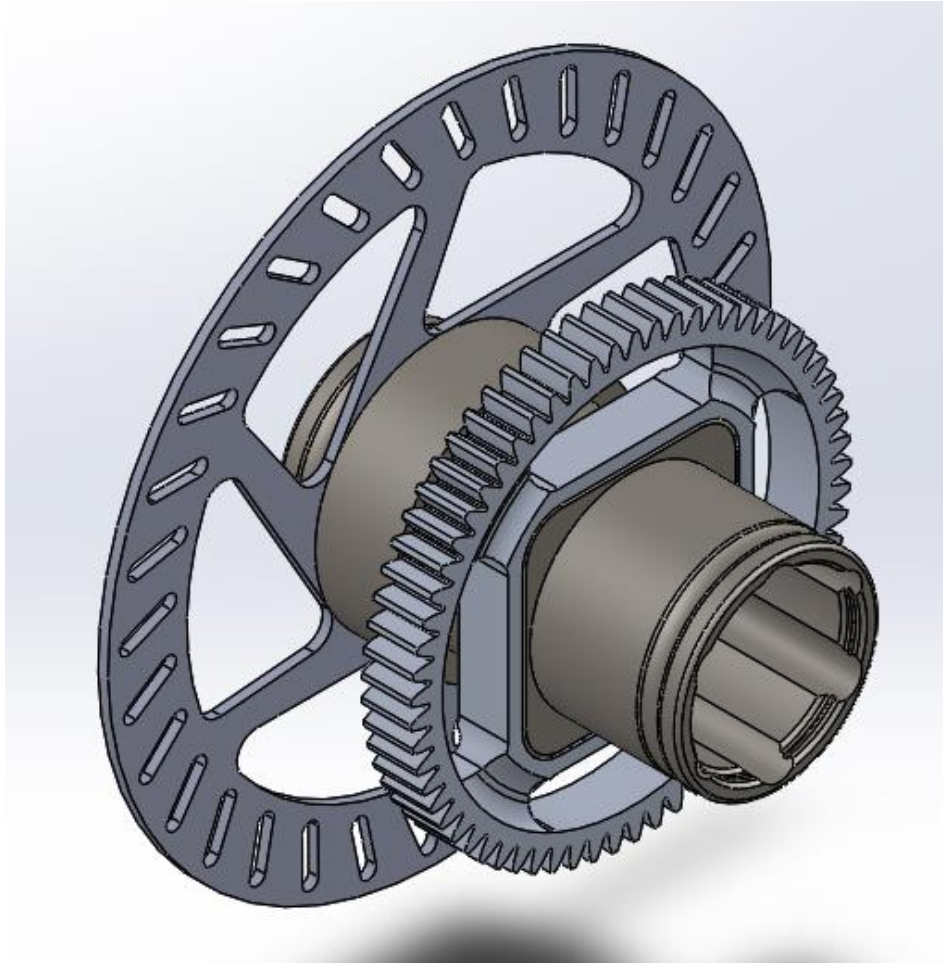
CVT Changes:

- Changed the secondary response spring from a simple compression spring to a compression and torsion spring.

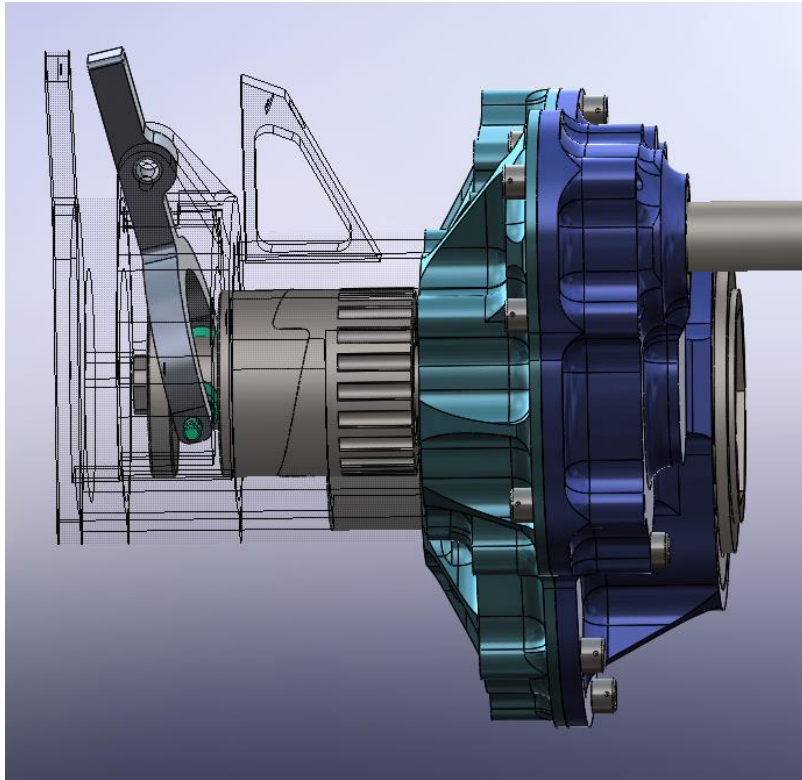
Design Efforts – Drivetrain CAD

Rear Gearbox Changes:

- Added in expansion bladder per Rule B.9.4.
- Split output gear with integrated CV cups into a separate gear and shaft.



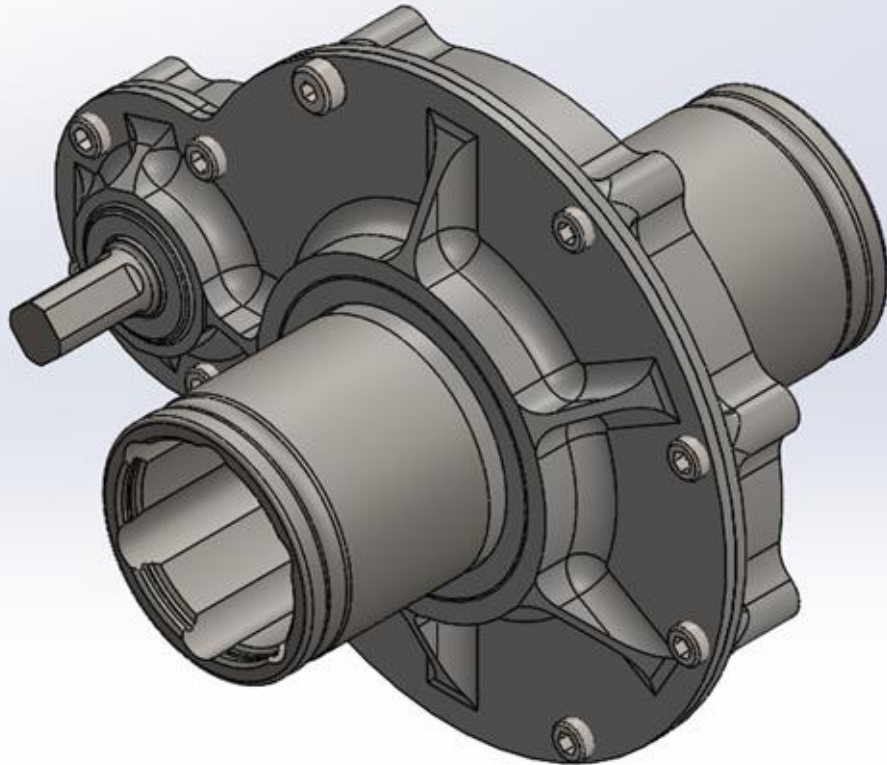
Design Efforts – Drivetrain CAD



4WD Changes:

- **Tooth Pitch Changes**

Design Efforts – Drivetrain CAD



Front Gearbox Changes:

- Updated CV Cup Geometry

Purchasing Plan - ECVT

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
CVT			CVT control belt	1	6	6	Rubber	Purchase	Beidlers Belts	160x1037
CVT			CVT power belt	1	50	50	Rubber	Purchase	Xcaliber Motorsports	21g3353
CVT			Cam followers	8	4	32	Steel	Purchase	Amazon	CF4 cam follower
CVT			Oil-Embedded Bronze Sleeve Bearing	3	6.56	19.68	Bronze	Purchase	McMaster-Carr	6391K768
CVT			One-Piece Thrust Ball Bearing	1	48.72	48.72	Steel	Purchase	McMaster-Carr	60715K111
CVT			Ultra-Thin Ball Bearing	1	63.69	63.69	Steel	Purchase	McMaster-Carr	6656K236
CVT			Ball Bearing	1	7.72	7.72	Steel	Purchase	McMaster-Carr	60355K336
CVT			Ball Bearing	1	12.62	12.62	Steel	Purchase	McMaster-Carr	60355K983
CVT			Cast Iron Acme Round Nut	1	39.91	39.91	Cast Iron	Purchase	McMaster-Carr	97014A595
CVT			316 Stainless Steel Acme Lead Screw	1	33.52	33.52	Steel	Purchase	McMaster-Carr	95080A103
CVT			Limit switch	1	5	5	N/A	Purchase	N/A	N/A
CVT			Hall effect	1	13	13	N/A	Purchase	N/A	N/A
CVT			Magnet	2	0.25	0.5	N/A	Purchase	N/A	N/A
CVT			Hudson 343x	1	500	500	N/A	Purchase	N/A	N/A
CVT			Odrive pro	1	300	300	N/A	Purchase	N/A	N/A
CVT			Arduino portena h7 lite	1	80	80	N/A	Purchase	N/A	N/A
CVT			Primary mobile sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Primary fixed sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary mobile sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary fixed sheave	1	0	0	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT standoffs	2	15	30	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT outside partial standoff	2	7	14	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			CVT inside partial standoff	2	7	14	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Control motor pulley	2	20	40	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Primary shaft	1	20	20	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary shaft	1	20	20	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary cam	1	40	40	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Secondary cam mount plate	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Backplate	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Frontplate	1	25	25	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Motor mount plate	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Square bush	1	15	15	Bronze	Purchase	McMaster-Carr	N/A
CVT			Gearbox shaft support	1	10	10	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Anti-rotation forks	3	2	6	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
CVT			Lead screw nut flange	1	45	45	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A

Purchasing Plan – Front & Rear Gearboxes

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
Gearboxes			60355K178 Ball Bearing -R10	2	7.55	15.1	Steel	Purchase	McMaster-Carr	60355K178
Gearboxes			6656K151 Ultra-Thin Ball Bearing -61813-2RS	3	14.77	44.31	Steel	Purchase	123Bearing	61813-2RS
Gearboxes			GMN FK6205-2RS Sprag	2	0	0	Steel	Own	NAU SAE Baja	N/A
Gearboxes			Circlip CV Cup	2	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			Front Input Gear	1	50	50	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Output Gear	1	100	100	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Input Shaft	1	75	75	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Output Shaft	1	75	75	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			CV Cup	2	50	100	4140 Steel	Made	OnlineMetals	N/A
Gearboxes			Front Drive Side Housing	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Front Passenger Side Housing	1	50	50	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			SKF 65X80X8 CRW1 R Seal	3	19.30	57.90	Nitrile Rubber	Purchase	Motion Industries	85311027328
Gearboxes			SKF_80X100X10 CRW1 R Seal	1	19.94	19.94	Nitrile Rubber	Purchase	Motion Industries	85311030847
Gearboxes			SKF 7438 Seal	3	11.36	34.08	Nitrile Rubber	Purchase	Motion Industries	85311005562
Gearboxes			Socket Head Cap Screw	8	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			Socket Head Shoulder Screw	2	0	0	Aluminum	Own	NAU SAE Baja	N/A
Gearboxes			60355K185 Ball Bearing - R12	6	8.99	53.94	Steel	Purchase	McMaster-Carr	60355K185
Gearboxes			6656K245 Ball Bearing -61816-2RS	1	21.89	21.89	Steel	Purchase	123Bearing	61816-2RS
Gearboxes			Rear Gearbox Input Shaft	1	35	35	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gearbox Intermediate Shaft	1	40	40	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 2	1	15	15	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 3	1	15	15	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 4	1	50	50	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gear 5	1	400	400	4340 Steel	Made	OnlineMetals	N/A
Gearboxes			Rear Gearbox Driverside Case	1	125	125	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Rear Gearbox Passengerside Case	1	125	125	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
Gearboxes			Rear Gearbox Expansion Chamber	1	36.30	36.30	Plastic	Purchase	Summit Racing	TGI-140207-1-KIT
Gearboxes			Rear Brake Rotor	1	0.00	0.00	A6 Steel	Made	Vroom	N/A
Gearboxes			Bolts 3/8"-16 (Brake Caliper Mounting)	2		0.00				
Gearboxes			Bolts #8-32 (Brake Rotor Mounting)	6		0.00				
Gearboxes			Bolts 1/4-20 (Gearbox Assembly)	22		0.00				

Purchasing Plan – 4WD System

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vendor	Vendor Part Number
4WD			Driving Side Clutch	1	59	59.00	4140 Steel	Made	OnlineMetals	N/A
4WD			Driven Side Clutch + Pulley	1	59	59.00	4140 Steel	Made	OnlineMetals	N/A
4WD			Front End Pulley	1	10.92	10.92	4140 Steel	Made	OnlineMetals	N/A
4WD			Shifter Lever	1	25.24	25.24	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shifter Lever Housing	1	75	75.00	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shifter Fork	1	21.49	21.49	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Swivel Joint	1	8.21	8.21	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Gear Box Pulley Shield	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Shift Fork Mount Guard	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Dog Clutch Cap	1	19.67	19.67	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Engagement Cable Mount	1	5.35	5.35	Aluminum	Made	Ryan Kedrowskis aluminum vendor	N/A
4WD			Idler Pulleys	11	0	0.00	Delrin	Made	McMaster-Carr	8576K27
4WD			Ball Bearings R10-2RS	2	1.68	3.36	Aluminum	Purchase	Amazon (Maple Ace)	R10-2RS
4WD			Idler Pulley Bearings	11	0.78	8.58	Aluminum	Purchase	Amazon (Maple Ace)	R8-2RS
4WD			Rollers	11	97.75	97.75	Delrin	Made	McMaster-Carr	8576K27
4WD			Linkage Cable	1	78.74	78.74	Steel, etc.	Purchase	N/A	N/A
4WD			1460T Threaded Black-Oxide Steel Track Roller	2	34	68.00	Steel	Purchase	McMaster-Carr	N/A
4WD			Circlips	2	2	4.00	Copper	Purchase	N/A	N/A
4WD			1/4-20 Screw	3	0		Aluminum	Purchase		
4WD			#10-24 Screw	2	0		Aluminum	Purchase		
4WD			4WD belt	1	76	76	Rubber	Purchase	Bolton	3280-8M-20 Optibelt OMEGA HTD Timing B

Purchasing Plan – Engine

Classification	Purchased	On Hand	Part Name	Quantity	Cost	Total Cost	Material	Purchase/Made	Vender	Vender Part Number
Engine			Motor	1	900	900	N/A	Purchase	Kholer	CH440-3302
Engine			Flywheel, Assembly Electric Start	1	157.12	157.12	N/A	Purchase	Kohler	17 025 44
Engine			Stator Assembly, 18 AMP	1	144.6	144.6	N/A	Purchase	Kohler	17 085 14
Engine			Screw, Stator Mounting	4	13.36	13.36	N/A	Purchase	Kohler	25 086 373
Engine			Bracket Stator Mounting	1	6.2	6.2	N/A	Purchase	Kohler	17 126 69
Engine			Screw Coil Bracket	1	3.26	3.26	N/A	Purchase	Kohler	25 086 301
Engine			Harness Regulator Wiring Assembly	1	19.44	19.44	N/A	Purchase	Kohler	17 176 03
Engine			Regulator 18 AMP	1	137.42	137.42	N/A	Purchase	Kohler	17 403 07
Engine			Bracket Assembly Control System	1	22.6	22.6	N/A	Purchase	Kohler	17 126 231
Engine			Lever Control Assembly	1	27.17	27.17	N/A	Purchase	Kohler	17 090 22
Engine			Linkage, Remote Control	1	4.92	4.92	N/A	Purchase	Kohler	17 079 29
Engine			Bushing, Linkage Retaining	1	6.11	6.11	N/A	Purchase	Kohler	25 158 11
Engine			Clamp, Cable	2	6.82	6.82	N/A	Purchase	Kohler	17 237 12
Engine			Screw	2	6.4	6.4	N/A	Purchase	Kohler	25 086 244
Engine			Optional High Speed Setting Bracket	1	13.27	13.27	N/A	Purchase	Kohler	17 126 157

Purchasing Plan Percentages

Purchased

$$\frac{209 \text{ items}}{209 \text{ items}} = 100\%$$

On-Hand

$$\frac{181 \text{ items}}{209 \text{ items}} = 86.6\%$$

Manufacturing Plan - Hours

CVT – 50 Hours Completed / 70 Hours Total

Gearboxes – 61 Hours Completed / 86 Hours Total

4WD System – 0 Hours Completed / 15 Hours Total

TOTAL: 131 Hours Completed / 171 Hours Total

76.6% Completed

Manufacturing Plan - ECVT

ECVT				
Primary mobile sheave	Henry	50%	2/12/24	3/11/24
Primary fixed sheave	Henry	100%	1/22/24	3/11/24
Secondary mobile sheave	Henry	95%	1/31/24	3/11/24
Secondary fixed sheave	Henry	100%	1/22/24	3/11/24
CVT standoffs	Henry	10%	2/5/24	3/11/24
CVT outside partial standoff	Henry	0%	2/6/24	3/11/24
CVT inside partial standoff	Henry	0%	2/6/24	3/11/24
Control motor pulley	Henry	90%	1/25/24	3/11/24
Primary shaft	Henry	10%	2/5/24	3/11/24
Secondary shaft	Henry	100%	1/22/24	3/11/24
Secondary cam	Henry	85%	1/28/24	3/11/24
Secondary cam mount plate	Henry	100%	1/22/24	3/11/24
Backplate	Henry	50%	1/30/24	3/11/24
Frontplate	Henry	50%	1/31/24	3/11/24
Motor mount plate	Henry	50%	1/29/24	3/11/24
Gearbox shaft support	Henry	100%	1/22/24	3/11/24
Anti-rotation forks	Henry	50%	1/30/24	3/11/24
Lead screw nut flange	Henry	100%	1/22/24	3/11/24

Henry | SAE Baja '24 | F23toSp24_09 | February 27th, 2024

Manufacturing Plan – Rear Gearbox

Rear Gearbox				
Casing (Passenger)	Henry	100%	1/30/24	3/8/24
Casing (Driver)	Ryan	0%	1/31/24	3/8/24
Gear 2	Donovan	95%	2/19/24	3/8/24
Gear 3	Donovan	95%	2/7/24	3/8/24
Gear 4	Donovan	95%	2/5/24	3/8/24
Gear 5	Donovan	25%	2/19/24	3/8/24
Input Shaft	Henry	95%	2/6/24	3/8/24
Intermediate Shaft	Henry	90%	1/23/24	3/8/24
Output Shaft	Henry	50%	2/22/24	3/8/24

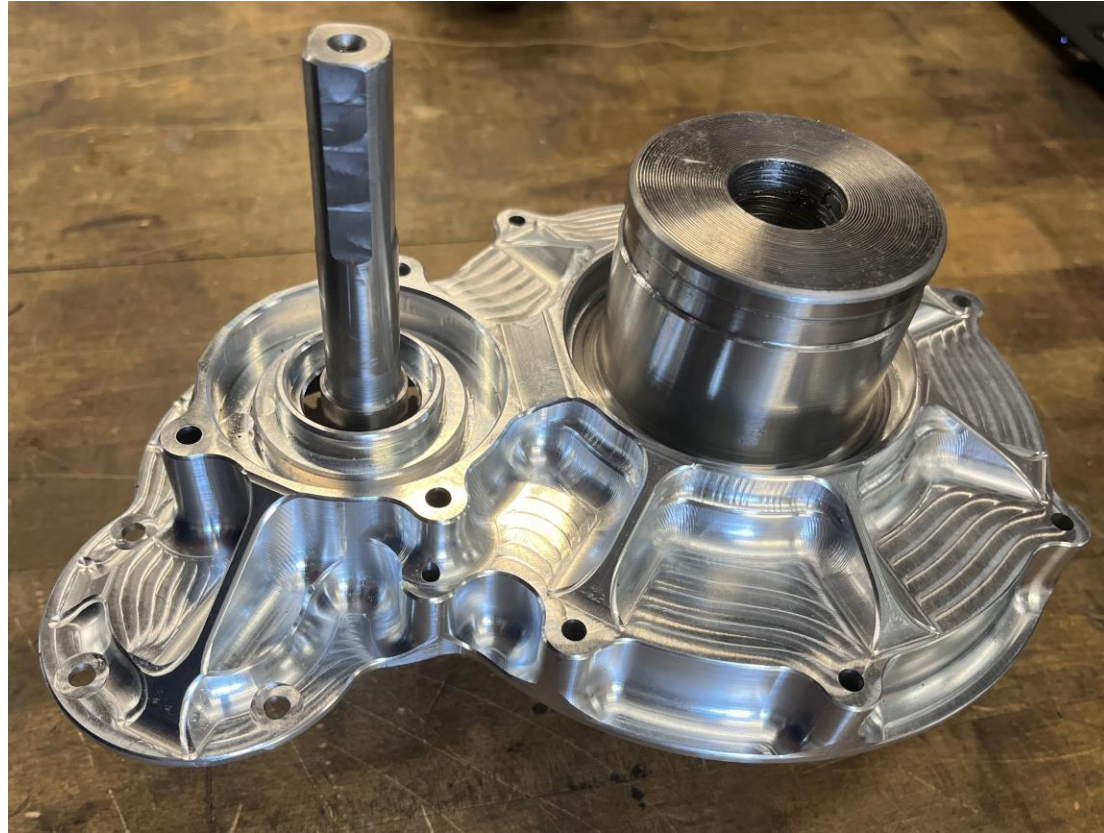
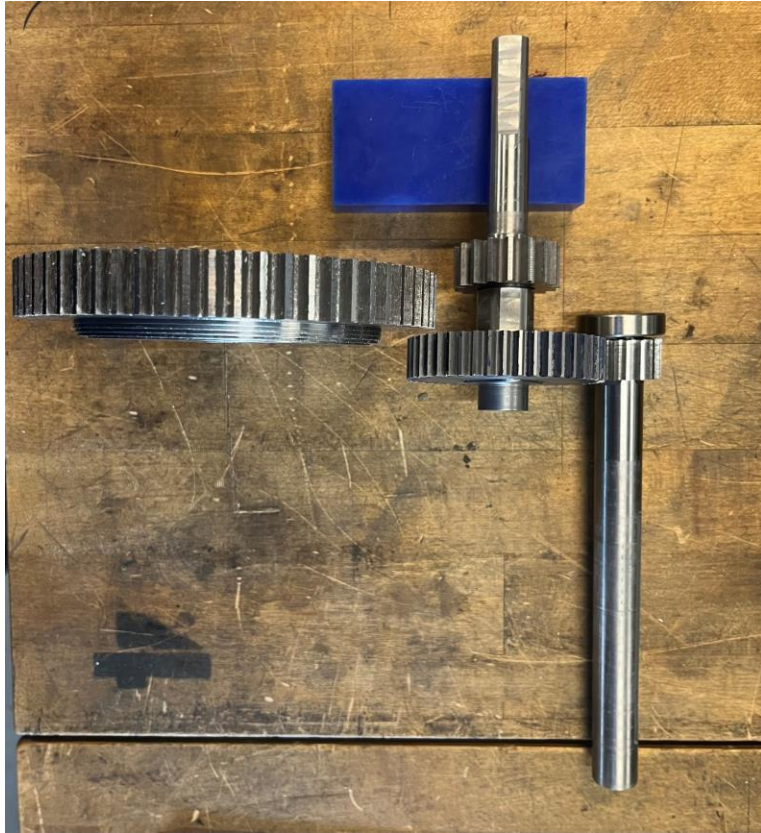
Manufacturing Plan – Front Gearbox

Front Gearbox				
Casing (Passanger)	Henry	0%	2/12/24	3/8/24
Casing (Driver)	Henry	0%	2/12/24	3/8/24
Gear 2	Donovan	95%	2/12/24	3/8/24
Gear 3	Donovan	50%	2/12/24	3/8/24
Input Shaft	Henry	95%	2/12/24	3/8/24
Output Shaft	Henry	50%	2/12/24	3/8/24
CV Cups	Henry	10%	2/12/24	3/8/24

Manufacturing Plan – 4WD System

4WD					
Clutch / Pulley	Donovan	0%	3/18/24	4/1/24	
Driven Clutch	Donovan	0%	3/18/24	4/1/24	
Front End Pulley	Donovan	0%	3/18/24	4/1/24	
Clutch Casing	Henry	0%	3/18/24	4/1/24	
Front End Casing	Henry	0%	3/18/24	4/1/24	

Project Demo (Cool Stuff)



Manufactured Drivetrain Components: Left (Gears, Intermediate & Input Shaft), Right Image (Rear Gearbox Passenger Casing with Intermediate and Output Shafts Visible)

Project Demo (Cool Stuff)



Manufactured CVT Components



Manufactured Front Gearbox Components

Project Demo (Cool Stuff)



Henry Operating the Lathe in the Machine Shop

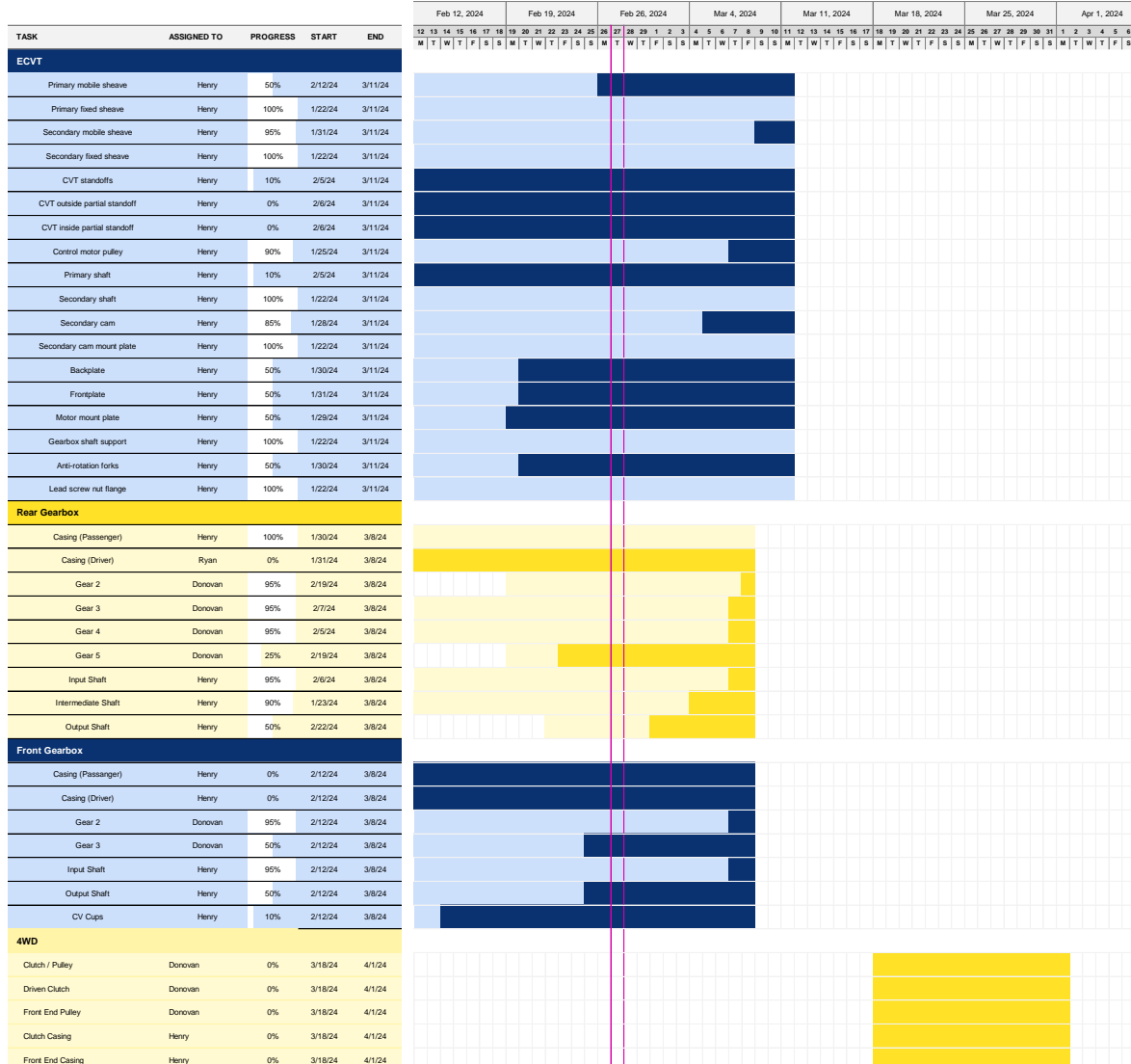
Gantt Chart Updates

SAE Baja

NAU Capstone Drivetrain

Project start: 2/12/24

Display week: 1



Updates:

- CVT Goal Date - 3/11/2024 (Start of Spring Break)
- Rear Gearbox Goal Date - 3/8/2024 (Back from Heat Treat)
- Front Gearbox Goal Date - 3/8/2024 (Back from Heat Treat)
- 4WD Goal Date – 4/1/2024 (ASAP)