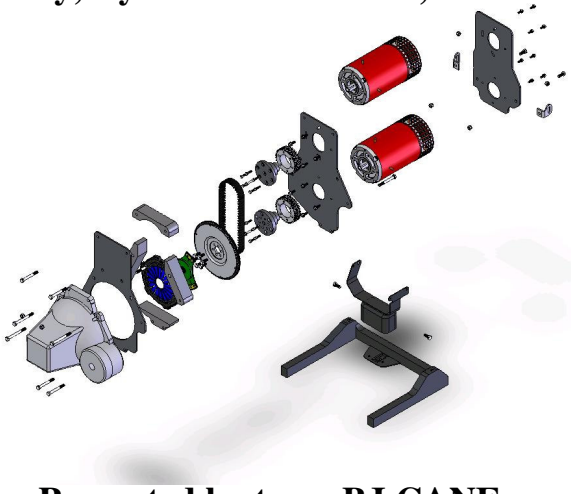
Electric Fiero:

Drive Train Assembly, Dynamic Simulation, and Driving Instructions



Presented by team BJ CANE:

Brett Joseph, John Jolly, Colin Bates, Alex Fabbiano, Nick Smith, and Eric Yost

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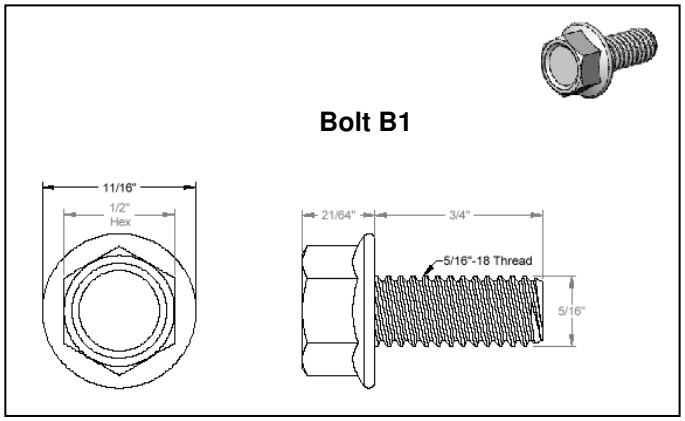
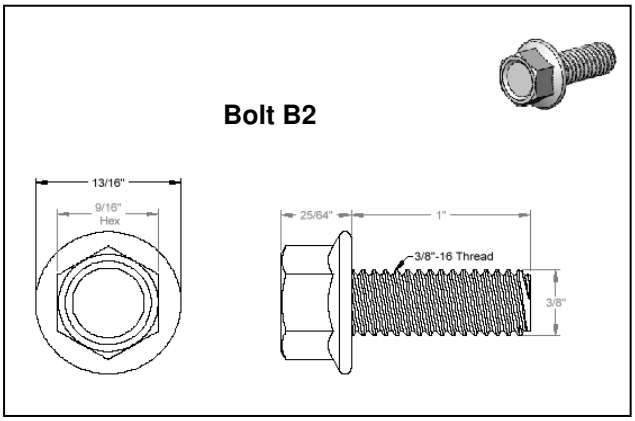
Parts List

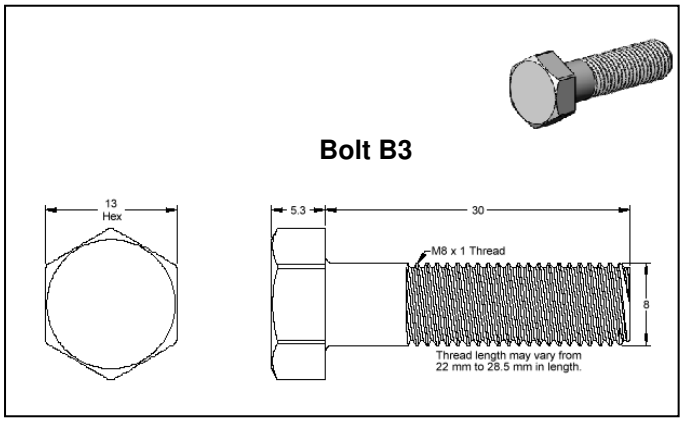
Part	Part Number	Item Call Out	Description	Quantity
Goodyear Eagle Pd Blue Belt	B-994	Belt	Coupling System Pd Belt	1
Goodyear Eagle Pd Blue Sprocket	B-30S-MPB	Sprocket	Coupling System Sprockets	2
Custom Lower Sprocket Bushing	Bush 1	Bush 1	Custom made to fit to motor shaft. Also acts as flywheel hub	1
Custom Upper Sprocket Bushing	Bush 2	Bush 2	Custom made to fit to motor shaft.	1
Warp 8" DC Motor	Warp 8	Motor	Dual Shaft, Advanced Timing DC motor	2
Custom Aluminum Adapter Plates	P1	P1	6061 Aluminum, 0.25" thickness, connects to transmission	1
Custom Aluminum Adapter Plates	P2	P2	6061 Aluminum, 0.25" thickness, connects to motors (belt side)	1
Custom Aluminum Adapter Plates	P3	P3	6061 Aluminum, 0.25" thickness, connects to motors (back)	1
Custom Plate Support Structures	S1, S2, S3, S4	S1, S2, S3, S4	6061 Aluminum block spacers between P1 & P2	4
McMaster 1/4" x 1/4" Key	98870A405	K1	Transmits torque from motor to Hub	2
Flywheel	1988 2.5L 5 Sp	Flywheel	Original Fiero Flywheel	1
ClutchNet "E-Z Lock Pro" clutch disk	65005	Clutch	8.5 in., 3-button, Sprung Hub	1
ClutchNet Pressure Plate		Pressure Plate	Double Diaphragm Pressure Plate	1
88 Pontiac Fiero Transmission	Getrag	Transmission	5-speed Getrag for 2.5L Fiero engine	1
Custom Alignment Pins	A1	A1	Alignment pins for adapter plates to transmission	2

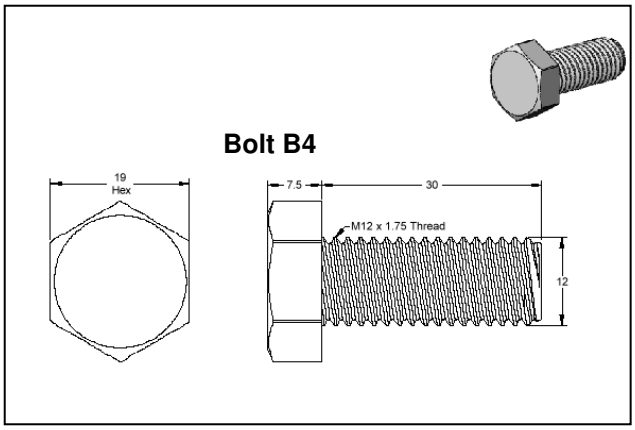
Parts List

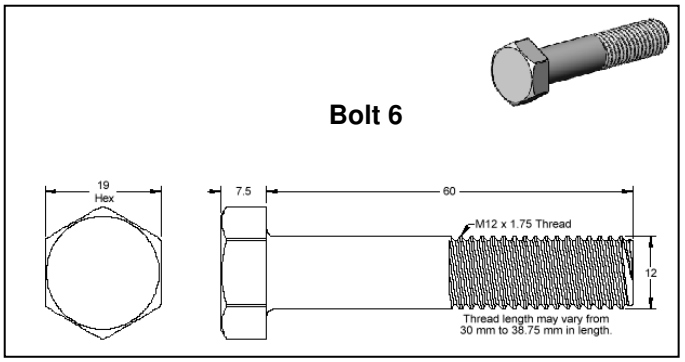
Part	Part Number	Item Call Out	Description	Quantity
McMaster-Carr Nut	90685A110	M12 Nut	Black Finish M12 nut	11
McMaster-Carr Split-ring Lock Washer	91190A570	M12 Washer	Black Steel M12 Split-ring Lock washer	11
McMaster-Carr Bolt	92316A581	B1	Grade 8, 3/4 inch, 5/16"-18, fully threaded	8
McMaster-Carr Bolt	92316A624	B2	Grade 8, 1 inch, 3/8"-16, fully threaded	8
McMaster-Carr Bolt	91310A538	B3	Class 10.9, 30mm, M8, partially threaded	12
McMaster-Carr Bolt	91310A712	B4	Class 10.9, 30mm, M12, fully threaded	6
Pontiac Pressure Plate Bolt	O98	B6	Pressure plate to flywheel bolts (already posses)	6
McMaster-Carr Bolt	91310A728	B6	Class 10.9, 60mm, M12, partially threaded	6
McMaster-Carr Bolt	91310A742	B7	Class 10.9, 100mm, M12, partially threaded	5
McMaster-Carr Bolt	91310A750	B8	Class 10.9, 120mm, M12, partially threaded	3
McMaster-Carr Bolt	92316A595	B9	Grade 8, 2.5", 5/16"-18, partially threaded	2

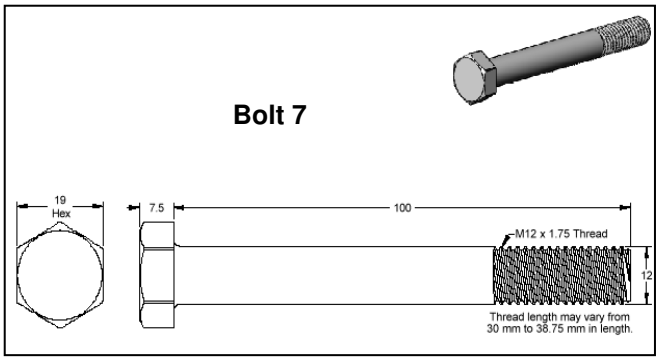

Bolt B1
11/16"
1/2"
Hex
21/64"
3/4"
5/16"-18 Thread
5/16"

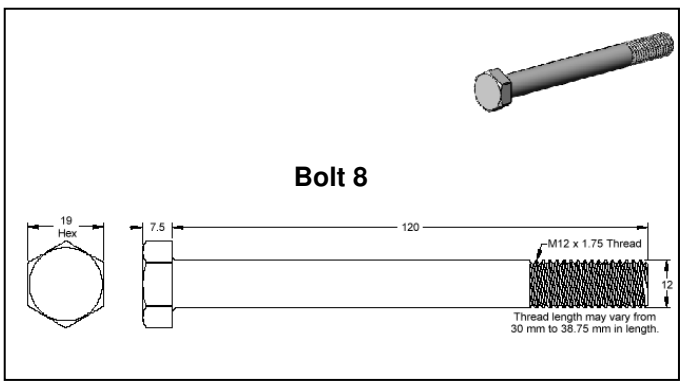

Bolt B2
13/16"
9/16"
Hex
25/64"
1"
3/8"-16 Thread
3/8"

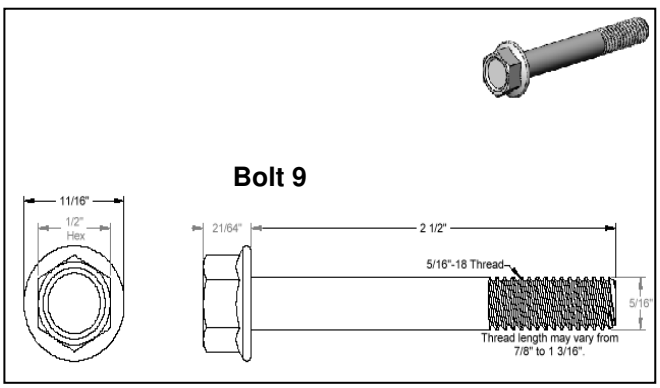

Bolt B3
13
Hex
5.3
30
M8 x 1 Thread
8
Thread length may vary from
22 mm to 28.5 mm in length.


Bolt B4
19
Hex
7.5
30
M12 x 1.75 Thread
12

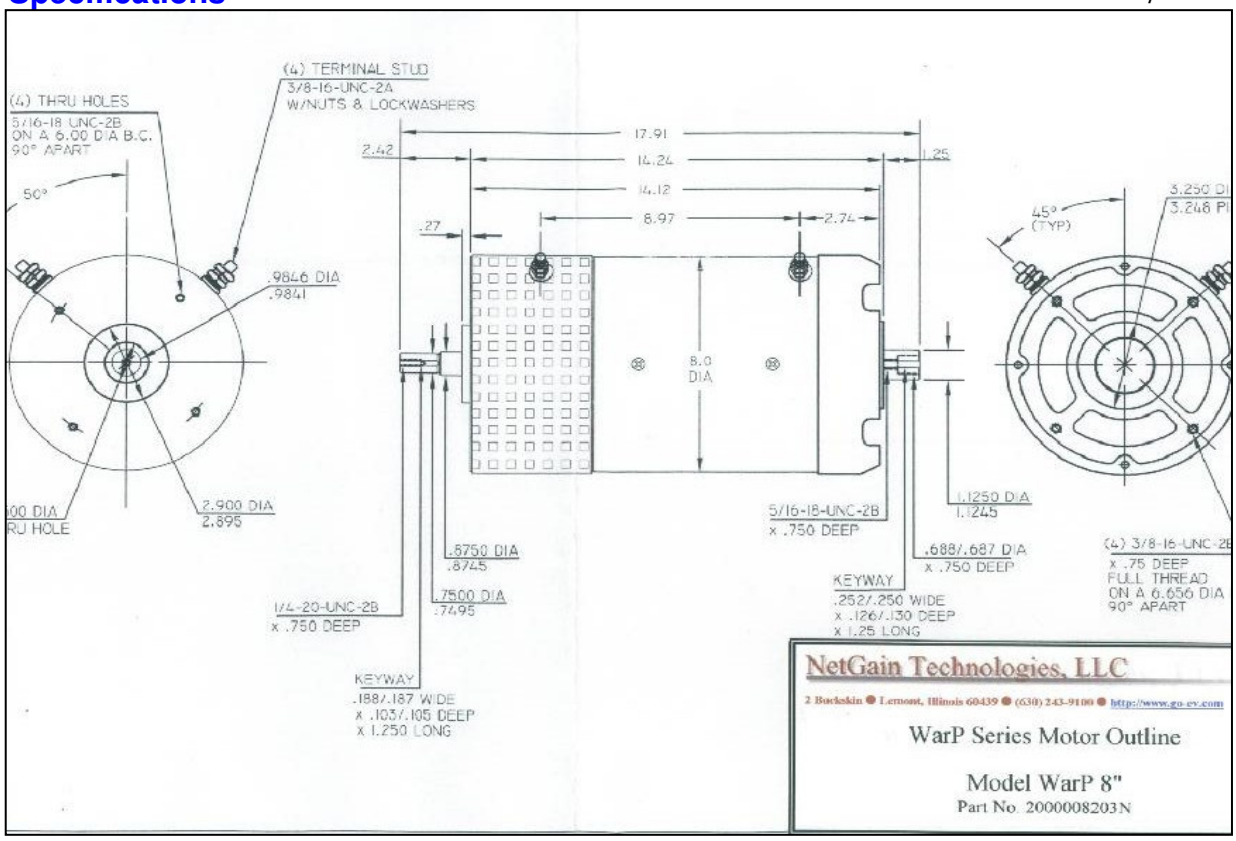

Bolt 6
19
Hex
7.5
60
M12 x 1.75 Thread
12
Thread length may vary from
30 mm to 38.75 mm in length.


Bolt 7
19
Hex
7.5
100
M12 x 1.75 Thread
12
Thread length may vary from
30 mm to 38.75 mm in length.


Bolt 8
19
Hex
7.5
120
M12 x 1.75 Thread
12
Thread length may vary from
30 mm to 38.75 mm in length.


Bolt 9
11/16"
1/2"
Hex
21/64"
2 1/2"
5/16"-18 Thread
5/16"
Thread length may vary from
7/8" to 1 3/16".

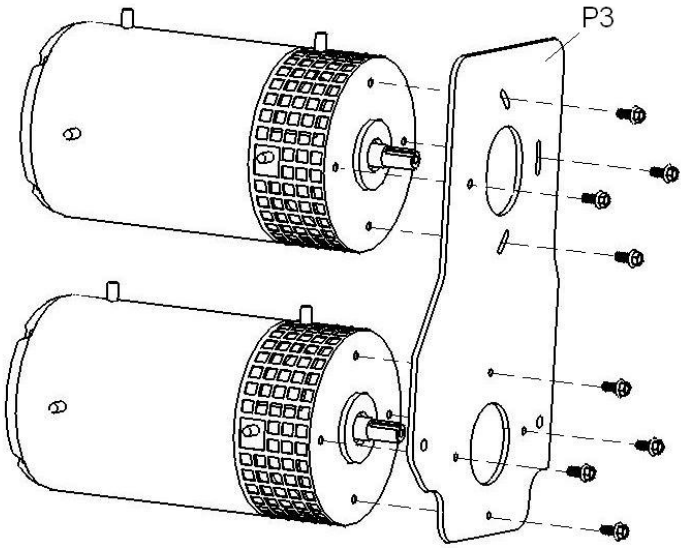
Motor Specifications



Motor Mounting to Adapter Plates

Step 1:

Mount a motor to the lower portion of **P3** (back plate) with **B1** bolts. Secure the bolts using a standard torquing pattern.



Step 2:

Mount the other motor to the upper portion of **P3** also using **B1** bolts. Only tighten these bolts finger tight.

DO NOT torque the upper motor bolts down yet. This motor must remain mobile until the belt has been tensioned.

Motor Mounting to Adapter Plates

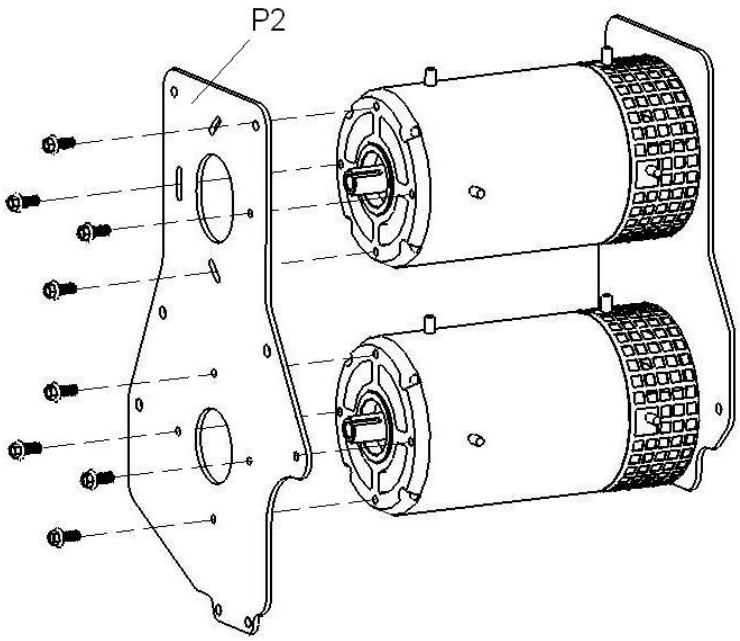
Step 3:

Attach **P2** to the lower motor using **B2** bolts. Secure the bolts with a standard torquing pattern.

Step 4:

Secure the top half of **P2** to the upper motor using **B2** bolts. Only tighten these bolts finger tight.

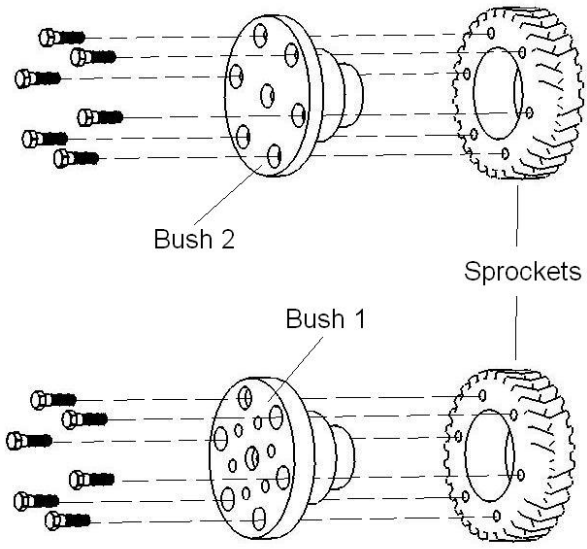
DO NOT torque the upper motor bolts down yet. This motor must remain mobile until the belt has been tensioned.



Motor Coupling System Installation

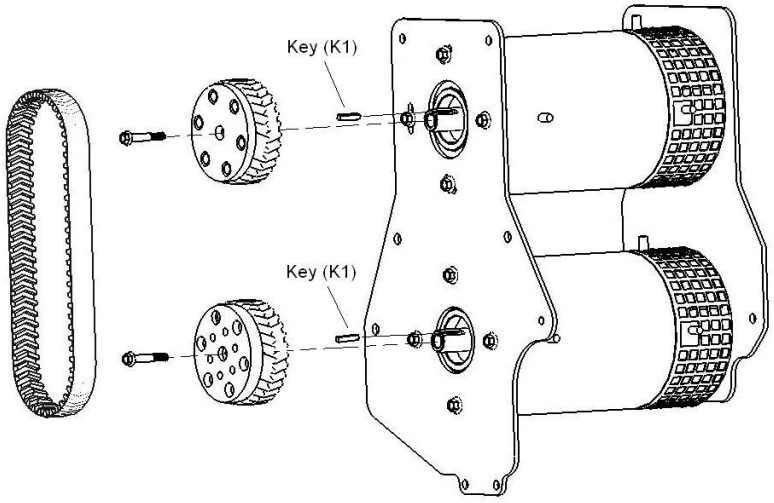
Step 5:

Attach the sprockets to the bushings using **B3** bolts. Secure with a standard torquing pattern. Make sure to mount the sprockets in the same orientation. It does not matter what orientation you choose.



Step 6:

Place a **K1** key in each of the motor shaft keyways. Line up the keyway of the bushings and firmly press the bushings onto the motor shafts. Make sure that **Bush 1** goes on the lower motor. Secure the bushings to the center of the motor shafts with **B9** bolts.



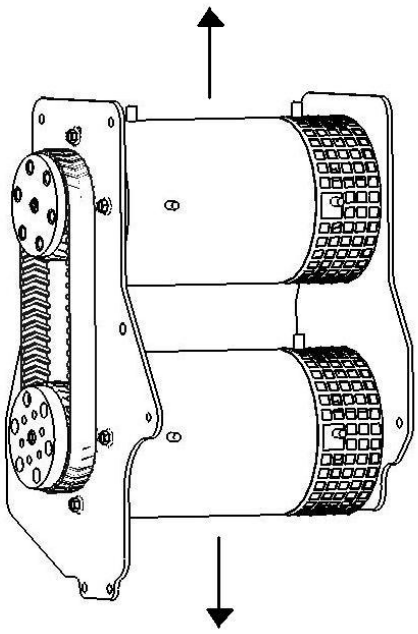
Step 7:

While the upper motor has not been torqued down and it is in its lowest position, slide the **Belt** onto the sprockets minding the orientation. The belt should not be taut at this time.

Step 8:

The belt now needs to be tensioned to a force of 560 lbs. The upper motor can be torqued to achieve this tension. Once the tension has been reached, torque down the **B1** and **B2** bolts in the upper motor in a standard torquing pattern.

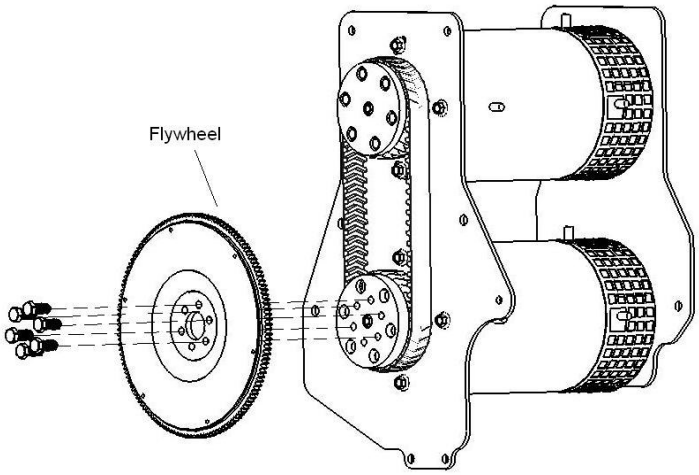
NOTE:
There are many ways to obtain the necessary tension in the belt. Suggestions include using a scissor jack between the motors, or suspending the system by the upper motor and applying additional weight. Special instrumentation may be needed.



Flywheel Installation

Step 9:

Attach the **Flywheel** to **Bush 1** using **B4** bolts. Secure the bolts in a standard torquing pattern.

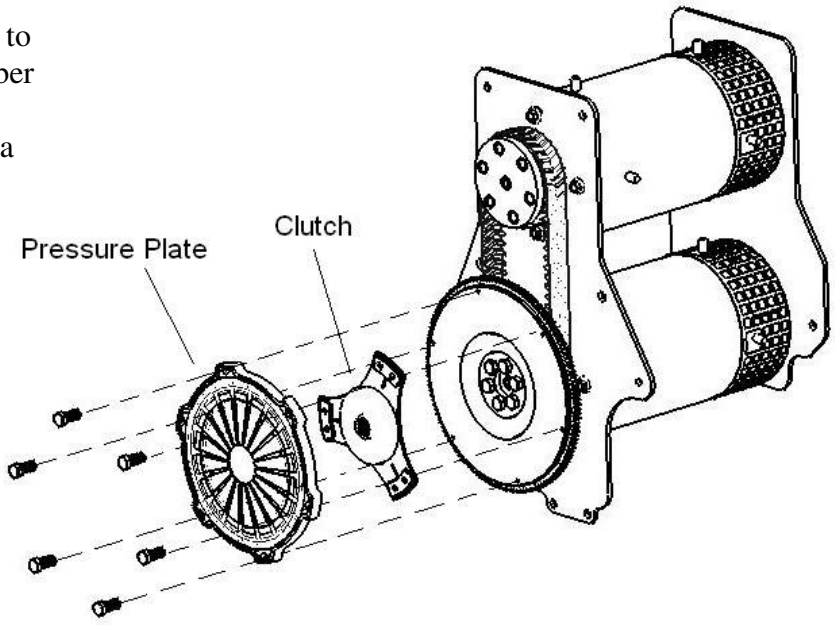


Clutch and Pressure Plate Installation

Step 10:

Attach the **Pressure Plate** and **Clutch** to the **Flywheel** using **B5** bolts. Remember that the clutch is free-floating between the pressure plate and flywheel so use a clutch alignment tool such as the one shown while tightening the bolts.

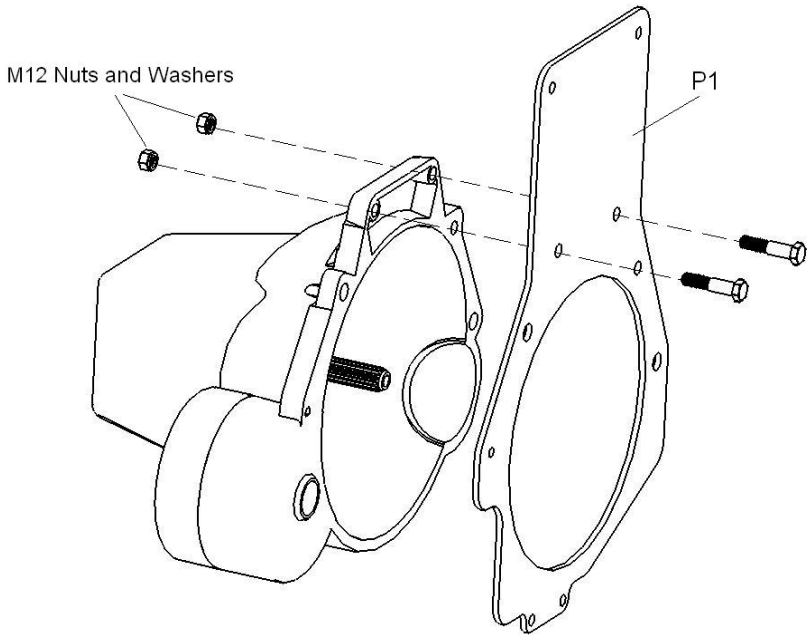
Clutch Alignment Tool



Transmission Mounting to Adapter Plate

Step 11:

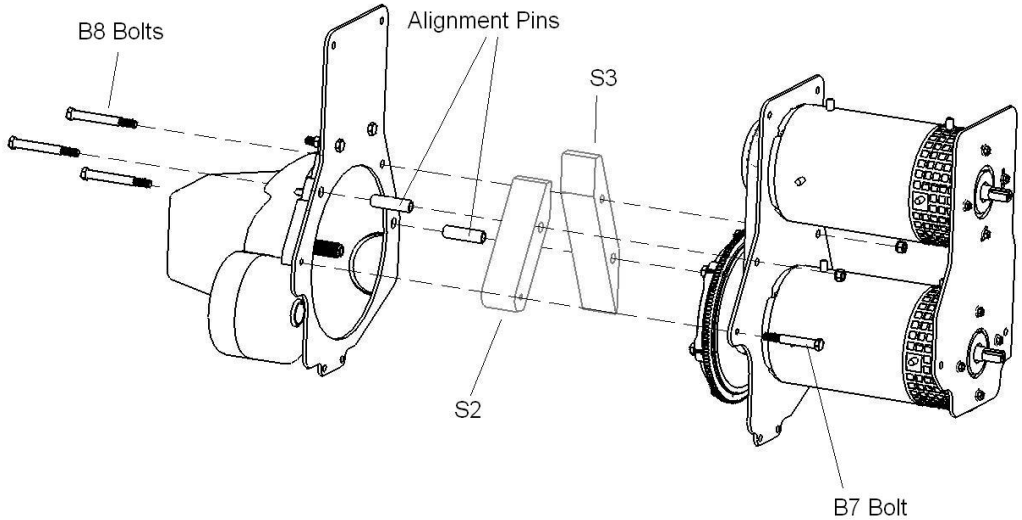
Attach the **P1** adapter plate to the transmission. Use two **B6** bolts through the front of the plate and out the back of the transmission. Secure the bolts with **M12 Nuts and Washers**.



Belt Housing and Adapter Plate Assembly

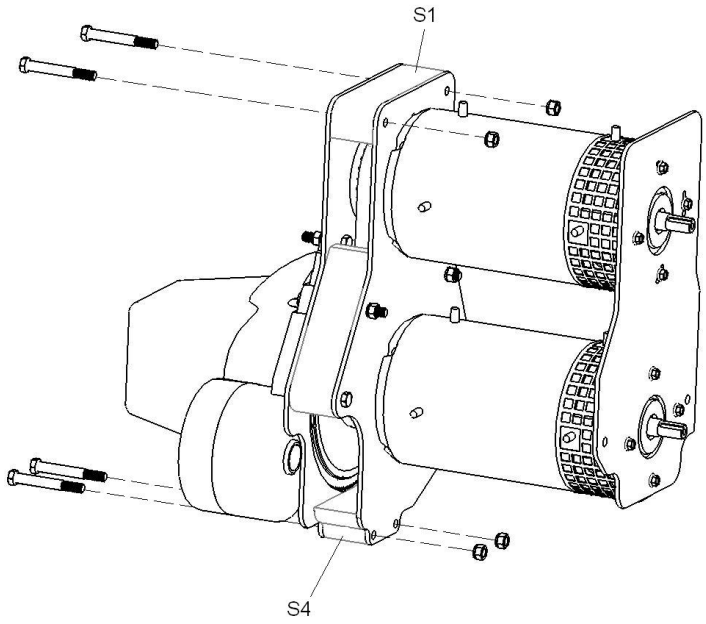
Step 12:

Insert the alignment pins through **P1** into their respective slots on the transmission as shown. Slide spacers **S2** and **S3** over the alignment pins. With the spacers in place, align **P2** over the alignment pins. The clutch should easily slide onto the transmission shaft. Inserting **B8** bolts from the transmission side, secure the plates and spacers with **M12 nuts and washers** on the **P2** side. Insert the **B7** bolt from the **P2** side and screw it into the transmission. DO NOT torque down the nuts and bolts yet.



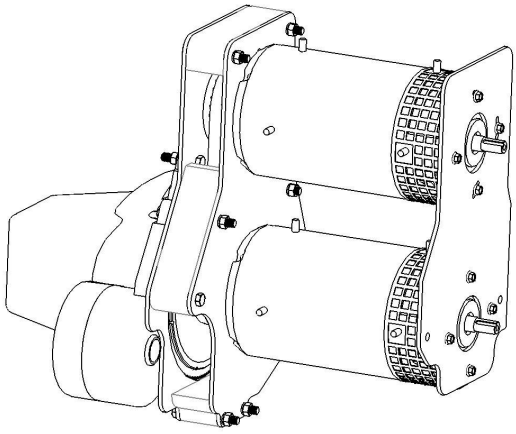
Step 13:

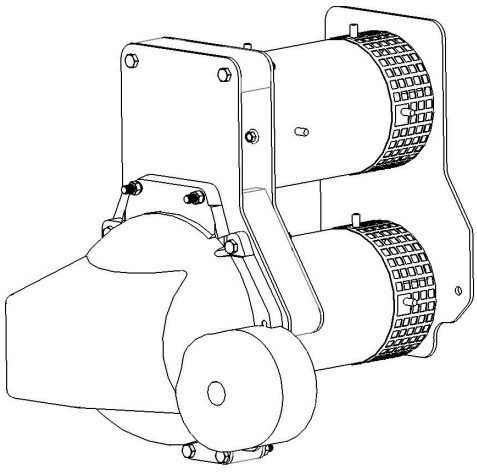
Slide spacers **S1** and **S4** between the plates as shown. Insert **B7** bolts from the transmission side, going through the spacers and secure them with **M12 Nuts and Washers** on the **P2** side. Torque all nuts and bolts from steps 12 and 13 in a standard torquing pattern.



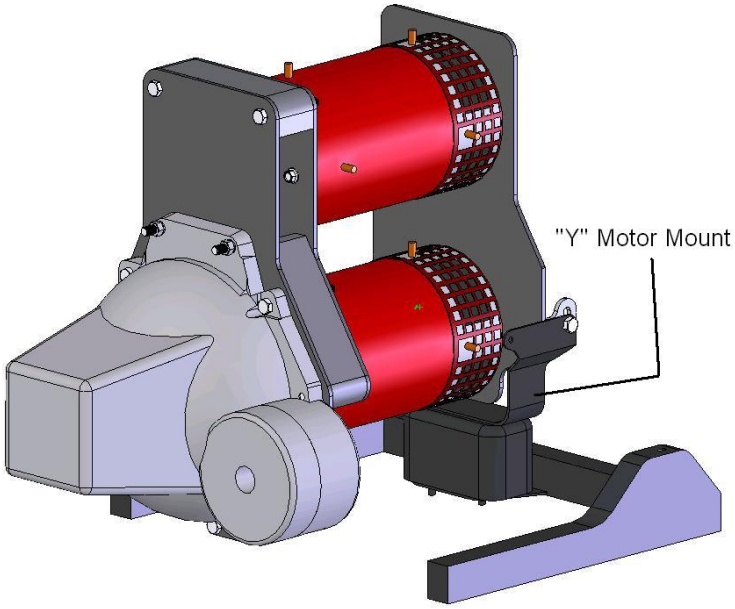
Completion:

Congratulations! The drive train is now fully assembled. Double check to make sure all bolts are firmly secured and there are no noticeable misalignments.



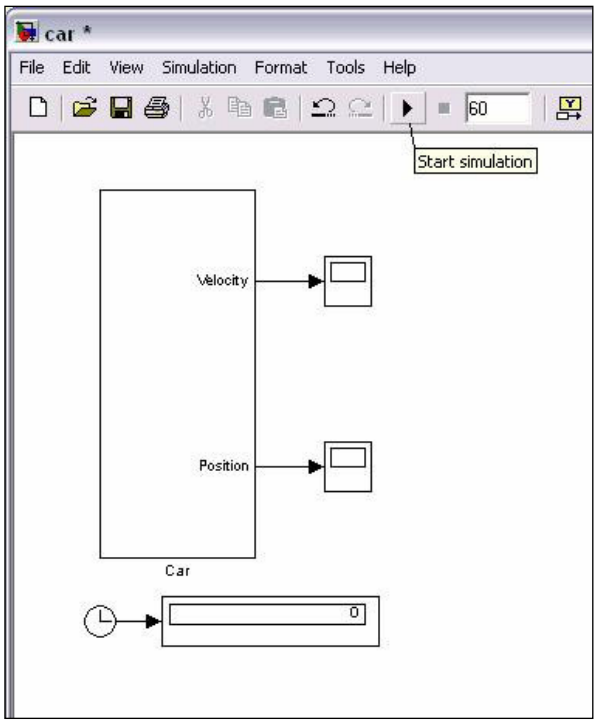


- Lower the Drive train into the motor compartment using an engine hoist.
- Align and mount the transmission to its original mounting brackets.
- Use pre-existing engine mounts to secure the drive train. Use brackets to attach the back plate (P3) to "Y" motor mount. The engine bay torsion bar should also be utilized.



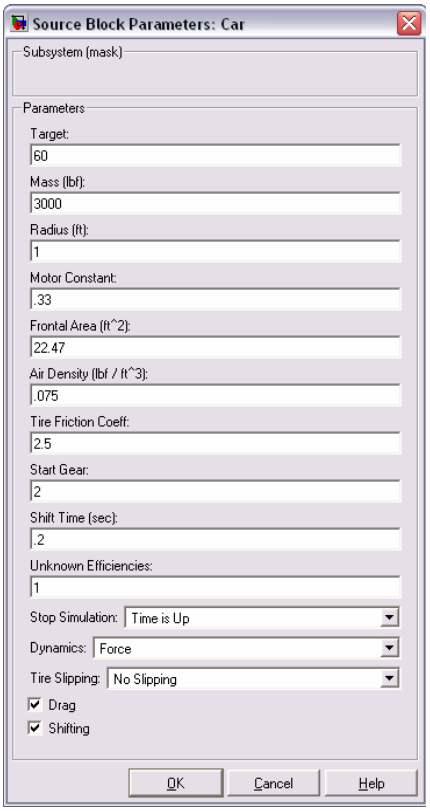
Run Simulation:

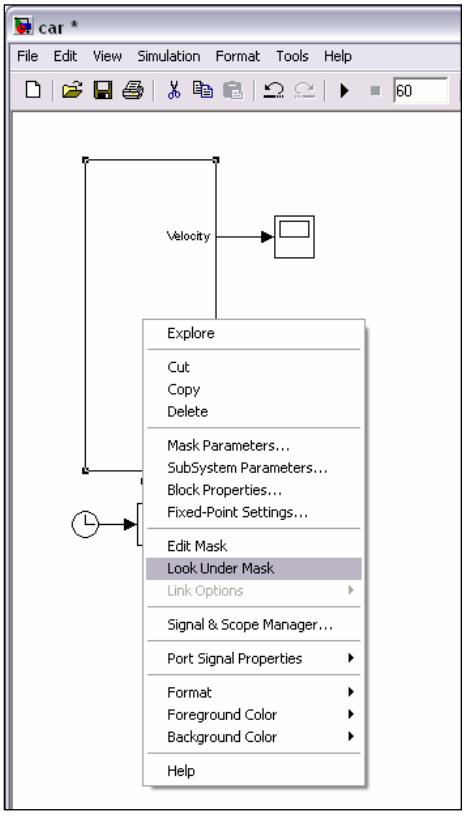
Click on the play symbol on the toolbar or select "Start" under the "Simulation" menu.



Changing Parameters:

Double click on the "Car" block. Change any values and click ok. To change values specific to car subcomponents, right click on the "Car" block and select "Look Under Mask." This will open a block diagram of all the subcomponents. Double click on any subcomponent block to change its parameters.





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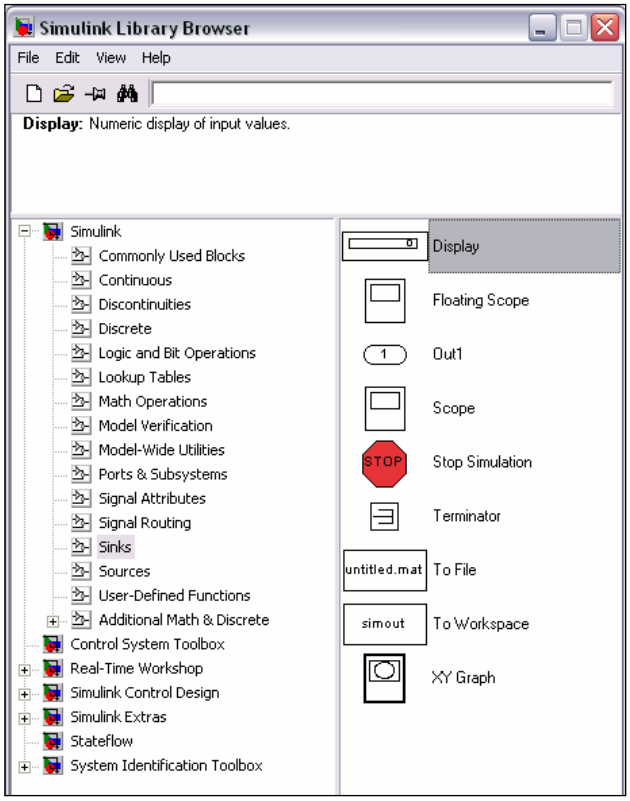
Signal Viewing:

To view the simulation signals double click on the "Scope" block associated with the signal. If there is no scope attached to the signal you wish to see or you would rather see the signal in a different manner, type "simulink" in the Matlab command line. This will open a new window titled "Simulink Library Browser." Double click on the "Sinks" button in the new window. A list of all signal sinks will appear. Drag the desired sink into the model and attach the signal to it. To split an already existing signal, hold the "Ctrl" button and drag from the signal to the sink.

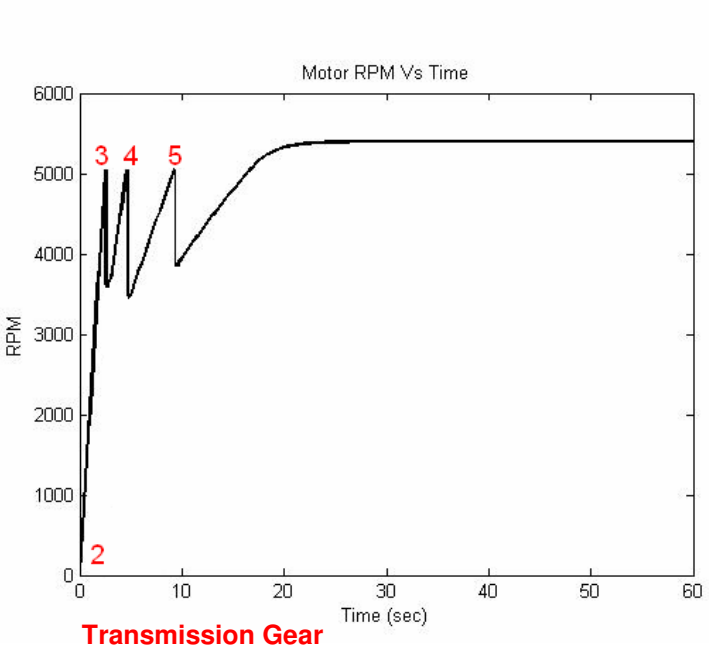


Before Initial Run:

- NEDRA compliant shielding is required.
- Water and Dust should be isolated from the drive train system.
- Break in the brushes of the motors by running them with no applied load at low voltage. i.e. one deep-cycle battery
- The first time the motors are run as part of the drive train system, make sure the clutch is depressed. This will ensure the clutch is aligned correctly. Make sure to use a low voltage.
- Never run the motors near max voltage (≈196 V) with the clutch depressed or no applied load.
- The drive train system will require instrumentation to monitor motor RPM, temperature, etc.
- Running motors at low RPM for extended periods of time may cause the motors to overheat. The addition of forced-air cooling is advised.
- For enhanced cold weather performance, use a light-weight oil for the transmission.

On the Road:

- Under normal driving conditions, start in second gear. First gear is only necessary for very low speeds and steep inclines.
- For maximum acceleration, start in second gear. Shifts should occur at 5000 RPM (see graph).
- In the case of drive train failure, immediately pull the emergency cut-off breaker and put the car in neutral.



Transmission Gear